

Semester – V							
Course Code	Course	Hrs- of Instructi ons/wk	Exam Durati on hrs	Marks allotted			Credits
				CIE	SEE	Total	
Part –II							
16UMBCC17	Core 13: Immunology	4	3	30	70	100	4
16UMBCC18	Core 14: Medical Microbiology	4	3	30	70	100	4
16UMBCC19	Core 15: Phycology - Self Study	1	-	30	70	100	4
16UMBCC20	Core 16: Computer Based Test (for Core Courses of Semesters I to V)	-	2	50	-	50	1
16UMBDC01/ 16UMBDC02/ 16UMBDC03	DSE-Core Elective 1 Pharmaceutical Microbiology/Quality Assurance and Quality control/ Bioethics and IPR	4	3	30	70	100	4
16UMBCC21	Core Practical- 5 Clinical Microbiology	9	6*	40	60	100	3
16UMBDC04/ 16UMBDC05/ 16UMBDC06	DSE-Core Elective 1 – Practical: Pharmaceutical Microbiology/Quality Assurance and Quality control/ Bioethics and IPR	3	3	20	30	50	1
16UMBCC22	Research Project/ Training/Internship	In the vacation after semester – IV		50	50	100	6
	Generic Elective-1 From Common UG Pool	2	3	100	-	100	2
TOTAL		27				850	29
*3 hrs on day 1 and 3 hrs on second day							

Semester – VI							
Course Code	Course	Hrs- of Instructi ons/wk	Exam Durati on hrs	Marks allotted			Credits
				CIE	SEE	Total	
Part –II							
16UMBCC23	Core 17: Molecular Biology	4	3	30	70	100	4
16UMBCC24	Core 18: Genetic Engineering	4	3	30	70	100	4
16UMBDC07/ 16UMBDC08/ 16UMBDC09	DSE-Core Elective 2 Advances in Microbiology / Microbiology and Health Care / Fundamentals of Research Methodology	4	3	30	70	100	4
16UMBCC25	Core Practical- 6 Molecular Biology	9	6*	40	60	100	3
16UMBDC10/ 16UMBDC11/ 16UMBDC12	DSE-Core Elective 2 Practical Advances in Microbiology / Microbiology and Health Care / Fundamentals of Research Methodology	3	3	20	30	50	1
16UMBCC26	Microbiology Outreach Activity	2	-	50		50	2
	Generic Elective-2 From Common UG Pool	2	3	100	-	100	2
		28				550	20
Total Marks: 4000							
Total Credit: 140+ 8 = 148							

*3 hrs on day 1 and 3 hrs on second day

SEMESTER - V

16UMBCC17	Core 13: Immunology	4hrs/week	4 Credits
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Course Objectives:

After successfully completing this course the student should be able to:

1. Demonstrate a comprehensive and practical understanding of basic immunological principles involved in protection mechanism.
2. Differentiate between innate and adaptive immunity, primary and secondary responses and identify the role of antigen presenting cells, lymphocytes, and phagocytic cells in immune responses.
3. Differentiate between humoral and cell mediated immunity.
4. Discuss Dysfunctional immunity and its consequences, Process of infection and vaccination
5. Principle and applications of various immune reactions in research and diagnosis

Unit 1: Immunity and Immunogen

(10hrs)

- Types of immunity: Natural, Acquired, herd, Innate, specific
- Cells and organs of immune system : An overview
- Primary response and generation of memory
- Antigen
 - a. Immunogenicity versus antigenicity
 - b. Factors influencing Immunogenicity
 - c. Adjuvant, Epitopes and Haptens
 - d. Antigen processing and presentation (Endogenous and Exogenous Antigens)

Unit 2: Antibody

(10hrs)

- Antibody
 - a. Basic structure of Antibody
 - b. Immunoglobulin classes and their Biological activities.
 - c. Epitopes and Receptors on immunoglobulin molecule
- Antibody Diversity and Clonal Selection Theory
- Overview of Monoclonal Antibody

Unit 3: Dysfunctional Immunity

(10hrs)

- Immunodeficiency Diseases
- Hypersensitivity
- Autoimmune diseases
- Overview of Tumor immunity
- Overview of Transplantation immunity

Unit 4: Infection and Prophylaxis

(10hrs)

- Introduction to the normal flora of healthy human host
- Host –microbe interactions
 - a. Process of Infection,
 - b. Pathogenicity
 - c. Virulence and infection
 - d. Microbial adherence
 - e. Penetration of epithelial cell layers,
 - f. Events in infection following penetration
 - g. Microbial virulence factors
- Vaccines: Conventional and Modern

Unit - 5: Haematology and Serology

(10hrs)

- Haematology – Study of Blood and Blood groups
 - a. Discovery of human blood group system
 - b. Blood coagulation
 - c. Principle, significance and procedure of blood transfusion
- Serology - In vitro antigen: antibody reaction
 - a. Strength of antigen – antibody reaction: Antibody affinity and avidity
 - b. Precipitation (in fluid and gel, immunoelectrophoresis)
 - c. Agglutination (Haemagglutination, Bacterial Agglutination, Passive Agglutination and agglutination inhibition)
 - d. Radioimmunoassay

- e. ELISA
- f. Western Blot
- g. Immunofluorescence

Text Books:

- J.Kuby, R. A. Goldsby , T.J.Kindt , B.A. Osborne (2013). Immunology 7th edition. W.H. Freeman and Company , New York
- R. M. Atlas (2015). Principles of Microbiology. 2nd edition. Wm.C.Brown Publishers
- Prescott , Harley , Klein (2007). Microbiology 5th edition. McGraw-Hill Publishers
- P.M. Lyolyard , A. Whelan, M.W. Fanger. (2011) Instant Notes in Immunology. 3rd edition.
Garland Science Taylor and Francis Group, Newyork

Reference Books:

- C.A.Janeway, P.Travers, M. Walport, M.J. Shlomchick. (2005). Immunology – the immune system in health and Diseases. 6th edition. Garland Science Taylor and Francis Group, Newyork
- K.Murphy, P.Travers, M. Walport. (2008). Janeway’s Immunology. 7th edition. Garland Science Taylor and Francis Group, Newyork
- I.Roitt.(1977). Roitt’s Essential Immunology, 9th edition Blackwell Science
- J.M.Cruse, R.E.Lewis. (2009). Illustrated Dictionary of Immunology. 3rd edition. CRC Press Taylor and Francis Group, New York.
- A. K. Abbas, A. H.H.Lichtman, S.Pillai. (2017).Molecular and Cellular Immunity. 9th edition. Elsevier

16UMBCC18	Core 14: Medical Microbiology	4 hr/week	4 Credits
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Course Objectives:

By the end of the semester, a student should be able to:

1. Appreciate and understand the concept of medical microbiology.
2. Understand and explain epidemiology of the diseases caused by the various pathogens
3. Understand causes, treatment, pathogenicity of viruses, bacteria fungi and parasites

Unit 1: Epidemiology and host –parasite relationship

(09hrs)

- Definitions: Signs, symptoms and syndrome of disease, stages of infectious diseases- incubation period, prodromal phase, Invasive phase, decline phase
- Infection and their types
- Bacteraemia, septicaemia, pyamia, toxaemia and Viremia
- Epidemic, Endemic, Pandemic, Zoonotic and Exotic
- Dynamics of disease transmission: Causative or etiological agents, sources of reservoir of infection

Unit 2: Study of pathogenic organisms: Morphology, cultural characteristics,

biochemical characteristics, serolog, lab diagnosis and treatments (10hrs)

- Enteric pathogens (Shigella and Salmonella)
- Pyogenic organisms – Staphylococcus and Streptococcus
- Mycobacterium tuberculosis and Mycobacterium leprae
- Rickettsia

Unit 3: Study of pathogenic organisms: Morphology, cultural characteristics, serology & lab diagnosis (09hrs)

- Parasites : Plasmodium, Giardia and Entamoeba
- Fungus : Candida and Aspergillus
- Spirochetes – Treponema, Leptospira
- Metazoan diseases – Ascariasis and Filariasis

Unit 4: Viral diseases and their diagnosis with treatments (10hrs)

- Airborne viral diseases, symptoms diagnosis and treatments
- Hepatitis: Hepatitis A & B viruses
- Influenza and Measles
- AIDS and Ebola viruses

Unit 5: Advanced techniques (10hrs)

- Chemotherapeutic and antimicrobial agents
- Bioavailability of Drug
- Collection, transport and preliminary processing of Clinical pathogens
- Rapid methods of identification, Molecular methods of identification

Text Book

1. C. K. J. Paniker, Anathanarayan and Paniker's text book of Microbiology (2013) 8th Edition, Orient Longman

Reference Book

1. Tortora, G.J., Funke, B.R., Case, C.L, 1992. Microbiology: An introduction 5th Edition, Benjamin Pub. Co. NY
2. Chakraborty, P., 2003 A textbook of Microbiology, 2nd Edition New Central Book Agency, India.
3. Samuel Baron, Medical Microbiology. Fourth edition (1996) University of Texas Medical Branch of Galveston
4. K. Ryan and C. G. Ray, Sherris's Medical Microbiology: an Introduction to infectious diseases. (2004) McGraw hill Publication 4th edition

16UMBCC19	Core 15: Phycology (Self Study)	1hrs/week	4 Credits
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Course Objectives:

The course entitled as above is designed to

1. Enlighten the students about general features of algae ; their distribution;
2. Acquire a consolidated overview on different major groups of algae
3. Recognize the importance of algae from economic values
4. Understand the major differences among varied range of thallus organization and pigment system

Unit 1: General account (10hrs)

- General characteristics & distribution
- Classification & range of thallus organization
- Cell components & Pigment system
- Motility & Mode of reproduction
- Economic importance

Unit 2 : Blue Green algae (10hrs)

- General features & distribution
- Major groups upto class
- Range of vegetative structure
- Cell structure & special features (heterocyst, hormogone, akinete)
- Mode of reproduction & Economic importance

Unit 3 : Diatoms (09hrs)

General characteristics & distribution

- Cell structure and its components
- Motility and mode of reproduction
- Economic importance of diatoms

Unit 4: Green algae**(09hrs)**

- General characteristics & distribution
- Classification & cell structure
- Pigment system & motility
- Mode of reproduction
- Economic importance

Unit 5 : Brown & Red algae**(10hrs)**

Highlights on General features

- Major groups upto class
- Cell structure and Pigment system
- Mode of reproduction & Economic importance

Text Books:

- Pelczar, M.J., Chan, E.C.S., Kreig,N.R. (1993).Microbiology, 5th Edition, New Delhi; Tata Mc Graw Hill Publishing Co. Ltd.
- Sundara Rajan S (2003). College Microbiology. Volume 1 & 2. Revised Edition, Vardhana Publications, Bangalore
- Prescott, L.M., J.P. Harley and D.A .Klein (1993). Microbiology, 5th Edition,WM, C Brown Publishers.

Reference Book:

- Dubey RC and Maheswari DK (2005). A Text book of Microbiology. S.Chand &Company Ltd., New Delhi.
- O. P. Sharma (1996) . Textbook of Algae, 1st Edition, McGraw-Hill Education New Delhi

16UMBDC01	DSE-Core 1 -Pharmaceutical Microbiology	4hrs/week	4Credits
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Objectives:

1. For better perception in pharmaceutical microbiology standards
2. To understand industrial requirement of microbial technology
3. To get better opportunities in pharmaceutical industry/laboratories/ Research institutes
4. To be equipped with standard operating procedures as per regulatory authorities

Unit 1: Introduction to pharmaceutical industry (9hrs)

- Role of a Microbiology in a pharma industry
- Good Laboratory Practices (GLP) in pharmaceutical industry.
- Microbiology Laboratory and standards in industry
- Regulatory practices and policies: FDA and NGCMA.

Unit 2: Processes in Pharmaceutical Industry (10hrs)

- Good manufacturing practices and Good microbiology laboratory practices.
- QA and QC in industry
- Concepts of pharmaceuticals, biologics and biopharmaceuticals
- Types of pharmaceutical microbiology laboratories : Sterile & Nonsterile
- SOP, clean room, zones, microbial filters, media

Unit 3: Quality control: Microbiology Laboratory (10 hrs)

- Microscopic techniques for particulate matter
- Antimicrobial testing of pharmaceutical products
- Microbial Limit test, Water analysis
- Bacterial Endotoxin Testing (BET)
- Environmental Monitoring

Unit 4: Microbial control in pharmaceutical industries**(10hrs)**

- Disinfection: Classification, mode of action, factors influencing disinfectants
- Sterilization: Introduction, significance
- Microbiological assessment of various pharmaceutical products
- Fumigation, Growth Promotion test, Biological indicators, chemical Indicators

Unit 5: Role of microbes in pharmaceutical formulations**(9 hrs)**

- Drug formulations, Carriers and delivery systems, targeted drug delivery,
- Application of microbial enzymes in pharmaceutical industry
- Pharmaceuticals produced by microbial fermentations (streptokinase, streptodornase).
- Microbial production and spoilage of pharmaceutical products

Text Book

1. Vyas S. P., Dixit V. (2007) Pharmaceutical Biotechnology, CBS Publishers & Distributors
2. Quality Assurance in Microbiology by Rajesh Bhatia, Rattan Lal Ithpunjani. CBS publishers & distributors, New Delhi.
3. Good manufacturing practices for Pharmaceuticals By Sydney H. Willing, Murray M. Tuckerman, Willam S. Hitchings IV. Second edition Mercel Dekker NC New York

Reference Book

1. Stephen P. D., Norman A. H., Sean P. G., Brendan F. G. (2011) Hugo & Russell Pharmaceutical Microbiology 8th Ed. Wiley-Blackwell Publishing house
2. John S. Wolfson and David C. Hooper, (1989) Quinolone antimicrobial agents. American Society for Microbiology, Washington.
3. Cooper M. S. (1972) Quality control in the Pharmaceutical Industry Vol.2 Academic Press Inc.
4. Sidney H.W. Murray M. Tuckerman, W., S. Hitchings IV. Mercel D.,(2007) Good Manufacturing Practices for Pharmaceuticals, Second Edition, NC New York

16UMBDC02	DSE-Core 1 Quality Assurance and Quality Control	4hrs/week	4Credits
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Objectives:

1. For better perception in pharmaceutical microbiology standards
2. To understand industrial requirement of microbial technology
3. To get better opportunities in pharmaceutical industry/laboratories/ Research institutes
4. To be equipped with standard operating procedures as per regulatory authorities

Unit 1: Total Quality Management System (8hrs)

- Basic concept of Total quality management
- Importance of quality
- Components of TQM
- Advantages of quality

Unit 2: Quality Assurance (10hrs)

- Hazard and risk analysis in pharmaceutical products
- Personnel's in Quality assurance
- Functions of quality assurance
- Organizational setup in QA

Unit 3: Quality Control

- Definition : Quality Control and its types in various industries
- Principles of quality control
- Methods of quality control in food industry, Pharma industry
- Corrective and Preventive actions

Unit 4: Quality Audits and inspections**(10hrs)**

- Self inspections and internal assessments
- Audits : Purpose audits and its types
- Regulatory Compliance

Unit 5: Regulatory guidelines on Quality systems in industry**(10 hrs)**

- Regulatory bodies in industries
- FDA, USFDA, FSSAI and ISO
- Quality Standards in India : ISI, AGMARKS
- Commodity based standards

Text Book

1. Vyas S. P., Dixit V. (2007) Pharmaceutical Biotechnology, CBS Publishers & Distributors
2. Quality Assurance in Microbiology by Rajesh Bhatia, Rattan Lal Ithpunjani. CBS publishers & distributors, New Delhi.
3. Good manufacturing practices for Pharmaceuticals By Sydney H. Willing, Murray M. Tuckerman, Willam S. Hitchings IV. Second edition MerceL Dekker NC New York

Reference Book

1. Stephen P. D., Norman A. H., Sean P. G., Brendan F. G. (2011) Hugo & Russell Pharmaceutical Microbiology 8th Ed. Wiley-Blackwell Publishing house
2. John S. Wolfson and David C. Hooper, (1989) Quinolone antimicrobial agents. American Society for Microbiology, Washington.
3. Cooper M. S. (1972) Quality control in the Pharmaceutical Industry Vol.2 Academic Press Inc.
4. Sidney H.W. Murray M. Tuckerman, W., S. Hitchings IV. MerceL D.,(2007) Good Manufacturing Practices for Pharmaceuticals, Second Edition, NC New York

16UMBDC03	DSE-Core 1 Bioethics and IPR	4hrs/week	4Credits
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Objectives

- This part of the syllabus helps the students to understand the ethical, social, legal aspects in biology and bio containment

Unit 1: Bioethics

(8hrs)

- Bioethics - legal and socioeconomic impacts
- ethical concerns of biological research and innovation,
- Bioethics committees and guidelines for biosafety, stem cell research, RCGM

Unit 2: Intellectual Property Rights

(10hrs)

Intellectual property rights-Definition, Types

- Patent
- Copyright
- Trade mark
- Trade Related Aspects in Intellectual Property(TRIPS)
- General Agreement on Tariffs and Trades (GATT)
- Plant Breeders Rights (PBR)
- World Trade Organization (WTO)

Unit 3: Patents and Patent Laws

(10hrs)

- Patenting laws-Legal development
- Patentable subjects and protection in biology
- The patenting of living organisms

Unit 4: Biosafety

(10hrs)

- GLP - Containment facilities
- Biosafety levels - Genetically modified organisms and its release

- Genetically modified foods
- Biosafety guidelines in India
- International guidelines

Unit 5: Biodiversity

(9hrs)

- Elements of Biodiversity
- Ecosystem Diversity
- Genetic Diversity
- Species Abundance & Diversity

Text Books:

1. Sasson Albert, Biotechnologies and Development, UNESCO Publications, 1988.
2. Sasson Albert. Biotechnologies in developing countries present and future, UNESCO publishers, 1993.

Reference book

1. Singh K, Intellectual Property rights on Biotechnology 2010, BCIL, New Delhi,
2. Shaleesha A. Stanley, Bioethics, Wisdom educational service, 2008, Wisdom Educational Service
3. Beier, F.K., Crespi, R.S. and Straus, T. 1985 Biotechnology and Patent protection-Oxford and IBH Publishing Co. New Delhi,
4. Biotechnology by U. Sathyanarayana, 2009, Books and allied (p) Ltd
5. Biotechnology by B.D.Singh, 2009 Kalyani publishers,

16UMBCC21	Core Practical- 5 Clinical Microbiology	9hrs/week	3 Credits
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Objectives:

By the end of the semester, a student should be able to:

1. Perform basic test of clinical microbiology.
2. Screen and characterize some pathogens
3. Understand causes, treatment, pathogenicity of various parasites.

List of Practicals:

1. Study of serological and hematological reactions
 - a. Agglutination (blood grouping, Serodiagnosis of enteric fever by Widal test)
 - b. Serodiagnosis of syphilis by RPR Test
 - c. Total count of RBC and WBC
 - d. Differential count of WBC
 - e. Haemoglobin estimation by Sahli's method
 - f. Bleeding time by filter paper technique and clotting time by capillary method
 - g. Erythrocyte Sedimentation Rate (ESR-demonstration)
2. Blood Chemistry
 - a. Blood sugar estimation by GOD / POD method
 - b. Blood urea by DAM method
 - c. Serum bilirubin estimation
 - d. Cholesterol estimation
 - e. Ouchterlony Double Diffusion (Demonstration)
3. Physical, Chemical and Microscopic examination of Clinical samples – urine, stool, pus, Sputum
4. Isolation, identification of following pathogens from clinical Samples: E. coli, Salmonella spp., Pseudomonas spp., Proteus spp., Shigella spp., Staphylococcus spp,
5. Streptococcus spp. (for identification use of keys as well as Bergey's Manual is recommended)

6. Study of growth characters of isolated pathogens on following media: Mannitol Salt Agar, Wilson Blair agar, Salmonella Shigella agar, Glucose azide medium, Cetrimide agar, TSI agar

Reference book

1. Broude AI: Medical Microbiology and Infectious Diseases, WB Saunders Co.
2. Jawetz, Melnick & Adelberg's: Medical Microbiology, 26th Edition, Mc Graw Hill Companies, a LANGE medical book.
3. Chapel and Haeney: Essentials of Clinical Immunology, Blackwell Scientific Publications.
4. Forbes BA, Sahm DF and Weissfeld AS: Bailey & Scott's Diagnostic Microbiology, Mosby

16UMBDC04	DSE-Core 1 –Practical: -Pharmaceutical Microbiology	3hrs/week	1Credits
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Course Objectives:

The student shall be able to:

1. Acquire skills to examine microbial load of pharmaceutical products
2. Understand the role of microbes in drugs
3. Identify different microbes associated with products, enumerate them and understand their role
4. Evaluate different parameters affecting pharmaceutical product quality.

List of Practicals

1. Sterility testing by using *B. sterothermophilus* / *B. subtilis*.
2. Testing for microbial contamination. Microbial loads from syrups and suspensions
3. Determination of antimicrobial activity of chemical compounds (like phenol, resorcinol and formaldehydes) Comparison with standard products.
4. Microscopic analysis of sterile injectables and tablets
5. Quality assessment of pharmaceutical products with special reference to regulatory affairs

Reference Books

1. Quality Assurance in Microbiology by Rajesh Bhatia, Rattan Lal Ithpunjani. CBS publishers & distributors, New Delhi.
2. Good manufacturing practices for Pharmaceuticals By Sydney H. Willing, Murray M. Tuckerman, Willam S. Hitchings IV. Second edition MerceL Dekker NC New York

16UMBDC05	DSE-Core 1 –Practical: -Quality Assurance and Quality Control	3hrs/week	1Credits
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Course Objectives:

The student shall be able to:

1. Acquire skills Quality management system
2. Understand the role of quality in human life and its role in betterment of society
3. Identify different domains of industry in quality systems like food, pharma etc.

List of Practicals:

1. To check the quality of packed food products as per standard protocol of microbiology.
2. Testing for microbial contamination and sterility of the food products in packed food and packaged drinking water
3. Check regulatory guidelines on packaging materials and codes for assurance in quality
4. Study of various pharmaceutical packaged products

Reference Books :

1. Quality Assurance in Microbiology by Rajesh Bhatia, Rattan Lal Ihhpunjani. CBS publishers & distributors, New Delhi.

16UMBDC06	DSE-Core 1 –Practical: - Bioethics and IPR	3hrs/week	1Credits
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Course Objectives:

The student shall be able to:

1. Acquire knowledge about patent laws.
2. Understand the role of different government bodies
3. Identify different domains of biodiversity

List of Practical

1. Case study of Patenting (Bt-Cotton).
2. To study various biodiversity hot spots.
3. Patent prior art search.
4. Patent drafting / claim drafting.

Reference books:

1. K.C. Kankanala, Indian Patent Law and Practice, Oxford India Publication, 2012
2. M. B. Rao & Manjula Guru, Patent Law in India, Wolters Kluver Publication, 2010
3. Ademola A. Adenle, E. Jane Morris, Denis J. Murphy, Genetically Modified Organisms in Developing Countries, Cambridge University Press
4. K. D. Raju, Genetically Modified Organisms: emerging law and policy in India, Tata Energy Research Institute Publication, 2007

SEMESTER - VI

16UMBCC23	Core 17: Molecular Biology	4hrs/week	4 Credits
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Objectives

After completion of this course, student will be able to:

- Understand the basic concept and scope of recombinant DNA technology
- Understand the function of various Enzymes and Vectors used in Gene manipulation
- Describe the methods used in selection, screening & analysis of recombinants
- Develop knowledge of the genomic and cDNA cloning strategies
- Understand the application and ethical aspects of using RDT in developing products.

Unit: 1 Molecular genetics and organization of genetic materials (10hrs)

- Concept of central dogma
- DNA as genetic material: experimental evidences
- Different forms of DNA
- Genomic organization of Eubacteria and Archaeobacteria
- Mendelian Laws

Unit: 2 Replication and Recombination (10 hrs)

- Experimental evidences of Replication and enzymes involved in DNA Replication
- Process of Replication in Prokaryotes
- Regulation of Replication
- Process of Recombination- mechanism of gene transfer- Transformation, Conjugation, transduction and transposable elements

Unit: 3 Transcription (10 hrs)

- Enzymes involved in Transcription of Prokaryotes
- Process of Transcription in Prokaryotes and its inhibitors
- Types of RNA molecules and Post transcriptional modification
- Regulation of gene expression at transcriptional level in prokaryotes

Unit: 4 Translations**(8 hrs)**

- The machinery of Protein synthesis-Genetic code, role of t-RNA and Ribosome
- Process of Translation in Prokaryotes and its inhibitors
- Post translational modification
- Distinguishing features of prokaryotic translation

Unit: 5 Mutations and Repair**(10 hrs)**

- Occurrence, kinds of Mutation, spontaneous & induced Mutation
- Mutagens, detection of Mutation Lethal Mutations, Biochemical Mutations
- Phenotypic effects of Mutation and Molecular basis of Mutation
- Significance & Practical applications of Mutation
- DNA Repair-Types and mechanism

Text Books

1. 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
2. Becker WM, Kleinsmith LJ, Hardin J and Bertoni GP (2009) The World of the Cell, 7th edition, Pearson Benjamin Cummings Publishing, San Francisco
3. De Robertis EDP and De Robertis EMF (2006) Cell and Molecular Biology, 8th edition. Lippincott Williams and Wilkins, Philadelphia

Reference books

1. Karp G (2010) Cell and Molecular Biology: Concepts and Experiments, 6th edition, John Wiley & Sons. Inc.
2. Sambrook J and Russell DW. (2001). Molecular Cloning: A Laboratory Manual. 4th Edition, Cold Spring Harbour Laboratory press.
3. Krebs J, Goldstein E, Kilpatrick S (2013). Lewin's Essential Genes, 3rd Ed., Jones and Bartlett Learning
4. Gardner EJ, Simmons MJ, Snustad DP (2008). Principles of Genetics. 8th Ed. Wiley-India

16UMBCC24	Core 18: Genetic Engineering	4hrs/week	4 Credits
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Objectives

After completion of this course, student will be able to:

- Understand the basic concept and scope of recombinant DNA technology
- Understand the function of various Enzymes and Vectors used in Gene manipulation
- Describe the methods used in selection, screening & analysis of recombinants
- Develop knowledge of the genomic and cDNA cloning strategies
- Understand the application and ethical aspects of using RDT in developing products.

Unit 1: Introduction to Recombinant DNA Technology (8 hrs)

- Introduction to RDT
- History and relevant landmarks in the development of RDT
- Scope of RDT in biotechnology and human welfare
- Terminologies associated with RDT: Overview of cDNA, Clone, Gene, Genome, Vector, Recombinant, Genemap, Transgenics

Unit 2: Tools for RDT: Enzymes, Vector and Host (12 hrs)

- Enzymes:
 - a) Restriction Endonuclease: Definition, nomenclature, mechanism, types and application
 - b) Ligase: Definition, mechanism, application
 - c) Other essential enzymes: DNA and RNA polymerase, Reverse Transcriptase.
- Vectors: Definition, properties, types.
 - a) Plasmid vector
 - b) Bacteriophage vector
 - c) Shuttle Vector
 - d) Cosmid Vector
 - e) Yeast Vector: YAC
 - f) Vector for Plant: Agrobacterium
 - g) Vector for animal: SV40
- Selection of suitable host

Unit 3: Isolation of target DNA and Cloning Strategies (10 hrs)

- Isolation of DNA and selection of target gene.
- Construction of genomic Library
- Construction of cDNA Library
- Methods of Cloning
- PCR: As alternative to genomic DNA/ cDNA cloning

Unit 4: Expression, Screening and Selection of recombinants (10 hrs)

- Transformation of r-DNA to suitable host
- Expression of recombinant in suitable host: prokaryotic and eukaryotic.
- Basic techniques for screening and selection of the clones
- Sequence-dependent screening of recombinants: Hybridization and PCR
- Identification of DNA marker: RAPD, AFLP

Unit 5: Application and Ecosocial impact of RDT (10 hrs)

- Development of Transgenic plants: BT cotton
- Genetically modified Food
- Genetically Modified Organism
- Gene Therapy
- Scientific and ethical issues regarding GM food/organism

Reference book

1. S.B. Primrose, R.M. Twyman and R.W.Old.(2001) *Principles of Gene Manipulation. 6th Edition*, S.B.University Press,.
2. B.D. Singh (2010) *Biotechnology Expanding Horizons*. Kalyani Publishers.
3. J. Sambrook and D.W. Russel.(2001) *Molecular Cloning: A Laboratory Manual*

16UMBDC07	DSE-Core 2 Advances in Microbiology	4hrs/week	4 Credits
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Course Objectives:

- After successfully completing this course the student should be able to:
- Understand the Principles of evolution of Microbial genome
- Understand the concept of non cultivable microbes and Metagenomics as a tool to study such living forms
- Explain the molecular basis of Host – Microbe interactionship
- Acknowledge the Networking in biological systems and Synthetic biology

Unit 1: Unit 1 Evolution of Microbial Genomes (10hrs)

- Salient features of sequenced microbial genomes, core genome pool, flexible genome pool and concept of pangenome,
- Horizontal gene transfer (HGT),
- Evolution of bacterial virulence - Genomic islands, Pathogenicity islands (PAI) and their characteristics

Unit 2: Metagenomics (10hrs)

- Brief history and development of metagenomics,
- Understanding bacterial diversity using metagenomics approach,
- Prospecting genes of biotechnological importance using metagenomics
- Basic knowledge of viral metagenome, metatranscriptomics, metaproteomics and metabolomics.

Unit 3: Molecular Basis of Host-Microbe Interactions (10hrs)

- Epiphytic fitness and its mechanism in plant pathogens,
- Hypersensitive response (HR) to plant pathogens and its mechanism,
- Type three secretion systems (TTSS) of plant and animal pathogens,
- Biofilms: types of microorganisms, molecular aspects and significance in environment, health care, virulence and antimicrobial resistance

Unit 4: Systems and Synthetic Biology (10hrs)

- Networking in biological systems,
- Quorum sensing in bacteria,
- Co-ordinated regulation of bacterial virulence factors,
- Basics of synthesis of poliovirus in laboratory,
- Future implications of synthetic biology with respect to bacteria and viruses

Unit - 5: Overview of Omics Technology

(10hrs)

- Genomics
- Transcriptomics
- Proteomics
- Metaboliomics

Text Books:

- 1 Fraser CM, Read TD and Nelson KE. (2004,). Microbial Genomes, Humana Press
- 2 Miller RV and Day MJ. (2004). Microbial Evolution- Gene establishment, survival and exchange, ASM Press
- 3 Bull AT. (2004). Microbial Diversity and Bioprospecting, , ASM Press
- 4 Sangdun C.(2007). Introduction to Systems Biology, Humana Press
- 5 Klipp E, Liebermeister W. (2009). Systems Biology – A Textbook, Wiley –VCH Verlag

Reference Books:

- 1 Caetano-Anolles G. (2010). Evolutionary Genomics and Systems Biology, John Wiley and Sons
- 2 Madigan MT, Martink JM, Dunlap PV and Clark DP (2014). Brook’s Biology of Microorganisms, 14th edition, Pearson-Bejamin Cummings
- 3 Wilson BA, Salyers AA Whitt DD and Winkler ME (2011)Bacterial Pathogenesis- A molecular Approach, 3rd edition, ASM Press,
- 4 Bouarab K, Brisson and Daayf F (2009) Molecular Plant-Microbe interaction CAB International
- 5 Voit EO (2012) A First Course in Systems Biology, 1st edition, Garland Science

16UMBDC08	DSE-Core 2 Microbiology and Health Care	4hrs/week	4 Credits
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Course objective

This course is designed to provide instruction about,

1. Microorganisms are beneficial for Human health care
2. Role of Microorganisms in different fields
3. Role of Microbes in day to day life

Unit: 1 History of Microbiology (10 hrs)

- History of microbiology and Health care
- Spontaneous generation verses Bio-generation
- Germ theory of disease
- Koch Postulate

Unit: 2 Microorganisms as probiotics (10 hrs)

- Probiotics
- Characteristics of probiotics
- Commercially available probiotic products
- Benefits of probiotic products

Unit: 3 Microorganisms as food (10 hrs)

- Microorganisms as a food source-Mushroom, Single cell protein, Functional Food
- Mushroom as a complete food and Nutritional level of mushroom
- Microorganisms in Dairy (Cheese, Yogurt, Buttermilk, Kefir)
- Microorganisms in fermented food (Pickles, Sauerkraut, Silage, Sausage, Bread)

Unit: 4 Microorganisms as Bio-fertilizer and Bio-pesticides (10 hrs)

- Microorganisms as a Bio-fertilizer and Bio-pesticides
- Types of Bio-fertilizer and Bio-pesticides
- Benefits of bio-fertilizer and Bio-pesticides

Unit: 5 Microorganisms as Vaccines (10 hrs)

- Vaccines
- Microorganisms as Vaccines
- Types of Vaccines: Live, attenuates vaccines, inactivated vaccines, Toxoid vaccines, Recombinant Vaccines, DNA Vaccines
- Production of Vaccines

Text book:

- Frazier .W.C Westhoff, D.C., (1978). Food Microbiology. Tata McGraw-Hill Publication Company
- Subba Rao, N.S., (1999). Bio-fertilizers in Agriculture and Agro forestry. New Delhi:Oxford IBH
- Pelczar, M.J., Chan, E.C.S., Kreig, N.R. (1993). Microbiology 5th Edition, Tata McGraw-Hill Publication Company

Reference book:

- Tortora, G.J., Funke, B.R., Case, C.L., (2004). Microbiology Introduction .Singapore: Pearson Education.
- Prescott, M.J., Harley, J.P., Klein, D.A. (2002). Microbiology 5th edition, New York: WCB Mc GrawHill publication

16UMBDC09	DSE-Core 2 Fundamentals of Research Methodology	4 hrs/week	4 Credits
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Objectives

- After completion of this course, student will be able to:
- Understand the concept of research and importance of studying research methodology
- Gain knowledge regarding various components of research
- Distinguish between various scientific documents
- Understand the concept of thesis writing
- Gain elementary knowledge regarding application of statistics in research

Unit 1: Introduction to Research Methodology (10 hrs)

- Introduction to Research and Research Methodology
- Objective of Research
- Types of research
- Significance of research
- Process of Research

Unit 2: Components of Research (10 hrs)

- Defining research problem
- Designing research
- Sample and sampling
- Data Collection
- Data Analysis

Unit 3: Scientific documents and standards (10 hrs)

- Scientific Documents: Types
- Journals: types and properties.
- Publication: Types, Ethics and standards
- Quality of Journal: Impact Factor, Citation.

Unit 4: Dissertation/Thesis Writing and Presentation

(10 hrs)

- Modes of presenting scientific data
- Basics of Poster Presentation
- Thesis/Dissertation writing: overview, components and order of presentation.
- Ethics of Publication and Thesis writing

Unit 5: Elementary statistics for Research

(10 hrs)

- Hypothesis
- Hypothesis testing
- Measures of central tendency: Mean, Mode, Median
- ANOVA , Chi Square test

Reference book:

1. C.R. Kothari.(2004) Research Methodology. *2nd Edition*, New Age International Publisher.

16UMBCC25	Core Practical- 6 Molecular Biology	9hrs/week	3 Credits
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Objectives:

At the end of the course, the students will be able to:

- 1 Use the techniques used in biotechnology that are based on DNA-Protein and Protein-Protein interactions.
- 2 Students can perform protein engineering and drug designing.

List of Practicals

- 1 Isolation of genomic DNA from bacteria
- 2 Isolation of plasmid DNA from bacteria
- 3 Agarose gel electrophoresis of isolated DNA
- 4 Isolation of RNA from yeast cells
- 5 Quantitation of DNA by spectrophotometry
- 6 Determination of T_m value of DNA
- 7 Bacterial Transformation
- 8 Bacterial Conjugation
- 9 U.V induced mutagenesis
- 10 Plasmid curing by Acridine orange

Reference books

- 1 T.A.Brown, Molecular Biology Lab Fax
- 2 Sambrook and Russel, Molecular Cloning.
- 3 Frederick M. Ausubel Current Protocols in Molecular Biology

16UMBDC10	DSE-Core 2 Practical Advances in Microbiology	3hrs/week	1 Credits
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Objectives:

After successfully completing this course the student should be able to:

1. Understand the concept of non cultivable microbes and Metagenomics as a tool to study such living forms
2. Explain the molecular basis of Host – Microbe interactionship
3. Acknowledge the Networking in biological systems and Synthetic biology

List of Practicals:

1. Extraction of metagenomic DNA from soil
2. Understand the impediments in extracting metagenomic DNA from soil
3. PCR amplification of metagenomic DNA using universal 16s ribosomal gene primers
4. Case study to understand how the poliovirus genome was synthesized in the laboratory
5. Case study to understand how networking of metabolic pathways in bacteria takes place

Reference books

1. R. J. Slater (1986). Experiments in Molecular Biology. Humana Press

16UMBDC1 1	DSE-Core 2 Practical : Microbiology and Health Care	3hrs/week	1 Credits
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Objectives:

At the end of the course, the students will be able to:

1. Isolate microbes from food samples
2. Isolate microbes from soil/plant samples
3. identification of fungus from bread.

List of Practicals

- 1 Isolation and identification of microorganisms from butter milk
- 2 Isolation and identification of Probiotics from commercially available probiotic food
- 3 Isolation of Nitrogen fixing bacteria from root nodules
- 4 Isolation of non- symbiotic bacteria from Rhizospheric soil
- 5 Isolation and identification of fungus from fermented food (Bread)

Reference book:

1. Tortora, G.J., Funke, B.R., Case, C.L., (2004). Microbiology Introduction .Singapore: Pearson Education.
2. Prescottt, M.J., Harley, J.P., Klein, D.A. (2002). Microbiology 5th edition, New York: WCB Mc GrawHill publication

16UMBDC12	DSE-Core 2 Practical : Fundamentals of Research Methodology	3hrs/week	1 Credits
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Objectives:

At the end of the course, the students will be able to:

- Draft research proposal
- Prepare experimental protocol
- Statistically analyze experimental data.

List of Practicals:

1. Writing research proposal
2. Protocol filling and submission
3. Making data analysis using statistics