II SEMESTER

REVISED SYLLABUS

HCT 2.1 MICROBIAL PHYSIOLOGY AND METABOLISM		
CourseCode :HCT 2.1		Credit:4
Total ContactHours :60 T	InternalAssessment:20 M	Examination: 80 M

Course outcome:

After completion of course (Theory), students will be able to:

- Gain a fundamental understanding of cellular composition, membrane transport, energy metabolism, and the ways microorganisms grow, proliferate, and die in a given environment.
- Understand the regulation of biochemical pathways and possible process modifications for improved control over microorganisms for microbial product synthesis.
- Understand the microbial physiology and know the various Physical and Chemical growth requirements of bacteria and get equipped with various methods of bacterial growth measurement

UNIT-I	
Microbial Nutrition: Classification of organisms based on Carbon source, energy source and electron source, Macro and Micronutrients. **Microbial growth:** Phases of growth, factors influencing growth, Measurement ofgrowth, Continuous and Synchronous growth. **Microbial Photosynthesis:** Light Energy, Photolysis of Water, Photosynthetic Pigments, Cyclic and Non-Cyclic Photophosphorylation, Calvin's Cycle. Biological Oxidation: Electron Transport System, Oxidative Phosphorylation, Mechanism and Inhibitors of oxidative phosphorylation. Energetics of Oxidative Phosphorylation.	**15 hours**
UNIT-II	
Fermentation Reactions: Types of fermentation reactions, Homo and Hetero-fermentation pathways; Alcohol and Lactic acid fermentation pathways. Bioenergetics: Laws of thermodynamics, Free energy, Enthalpy, Entropy, High energy compounds, Oxidations and Reductions, Redox potential. **Carbohydrate metabolism:** Glycolysis-significance, energetics and regulation. Glycogenesis, glycogenolysis, gluconeogenesis-Significance, regulations; TCA cycle- significance, energetics and regulations. Glyoxylate cycle. Amphibolic nature of TCAcycle. HMP shunt.	**15 hours**
UNIT-III	
Lipid Metabolism: Fatty acid oxidation (β-oxidation), energetics of palmitic acid oxidation. Ketone bodies, ketogenesis, utilization of ketone bodies, overproduction of ketone bodies (Ketonemia, ketonuria, ketosis), extra mitochondrial biosynthesis of long fatty acids (palmitate), significance and regulation. Synthesis of	**15 hours**

triacylglycerols, metabolism of phospholipids and glycolipids. Biosynthesis and degradation ofcholesterol. **Metabolismofaminoacids:**Transamination,deamination,decarboxylation;Urea cycle - regulation. Metabolism of ammonia; Synthesis and degradation of Glycine, phenylanineandTyrosine,SynthesisanddegradationofSulfurcontainingamino acids. **Nucleotide metabolism:** Synthesis of IMP, AMP and GMP, Salvage pathway for purines, degradation of purine nucleotides, Biosynthesis and degradation of pyrimidine nucleotide.	
UNIT-IV	
Bioenergeticsand metabolites: Principlesofthermodynamics,activationenergy,freeenergy,enthalpy,entropy,highenergy compounds-ATP,NAD,FADandFMN;componentsandmechanismsofrespiratorychain, mechanism of substrate level phosphorylation; **Secondary metabolism:** Secondary metabolites from fungi and bacteria; regulation of secondarymetabolism;structure and outline of synthesis of antibiotics; bacterial toxins; fungal toxins-patulin, aflatoxin, fuminosin; fungal and bacterial pigments; fungal hormones- sirenin, sterols, trisporic acid; fungal alkaloids; bioluminescence in microorganisms – mechanisms and significance.	**15 hours**

REFERENCES

1. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2014). Molecular biology of the cell (6th ed.). Garland Science.
2. Berg JM,Tymoczko JL,StryerL.(2021) Biochemistry(9th ed.).W.H.Freeman and Company.
3. Caldwell DR.(1996). Microbial Physiology and Metabolism. Brown Publishers.
4. Dewey, I. W., & Sutherland, J. W. (2018). Microbial physiology (2nd ed.). Academic Press.
5. Doelle, S. W., & van der Werf, M. J. (2013). Microbial growth on C1 compounds (1st ed.). Springer Science & Business Media.
6. Harper, H. A., & Rodwell, V. W. (2018). Harper's illustrated biochemistry (31st ed.). McGraw-Hill Education.
7. Lehninger, A. L. (2017). Lehninger principles of biochemistry (7th ed.). W.H. Freeman and Company.
8. Moat, A. G., Foster, J. W., & Spector, M. P. (2016). Microbial physiology (5th ed.). Wiley-Blackwell.
9. Oren A., PapkeR.T.(2010) Molecular Physiology of Microorganisms.Caister Academic Press.
10. Powar, R., &Dhaginawala, A. (2019). Biochemistry (4th ed.). Himalaya Publishing House.
11. Rose, A. H., & Tempest, D. W. (1970). Advances in microbial physiology (Vol. 4). Academic Press.

12. Voet, D., Voet, J.G., & Pratt C.W.(2022). Fundamentals of Biochemistry: Life at the Molecular Level (6th ed.). Wiley.

HCT 2.2 MICROBIAL GENETICS AND MOLECULAR BIOLOGY		
CourseCode :HCT 2.2		Credit:4
Total ContactHours :60 T	InternalAssessment:20 M	Examination: 80 M

Course outcome:

After completion of course (Theory), students will be able to:

- Understand the genetic, epigenetic, and genomic mechanisms governing microbial physiology in a changing environment.
- Explain the principles and concepts of prokaryotic and eukaryotic genetics, viral genetics, and their application in research.
- Explain mutagenesis, mutation, and mutants and their significance in microbial evolution

UNIT-I	
Historical Preview of Genetics: Development of microbial genetics, contributions of various scientists, time line of the development of microbial genetics Chemical basis of heredity; early concepts of genes; discovery of the chemical basis of heredity - experimental evidences, Mendelian principles and classical genetics, Genetic concepts, use of microorganisms in genetic studies. **Genomic structure and organization:** Organization of genetic material – Genomeorganization in viruses, bacteria and eukaryotes. Interrupted genes, gene clusters. Structure of nucleosome, chromatin and chromosome.	**15 hours**
UNIT-II	
Genetic recombination: In bacteria; transformation, conjugation, competence, lysogeny, generalized and restricted transduction, sexduction, fine structure mapping, recombination in viruses, **Transposable elements:** Replicative transposition, Non-replicative transposition, Excision and transposase-mediated rearrangements, Insertion sequences, transposons, and integrons. Regulation of transposition, Use of transposons. Chromosomalrearrangements, Transposons and evolution.**Mutations:** Types of mutations, null, leaky, and conditional mutations, mutations as random or adaptive events; Mutagenic agents – physical, chemical and biological; molecular basis of mutations; Mutants – isolation, selections, screening and enrichments, Uses of mutants. Reversion and suppression - Reversion assays –Ames Test.	**15 hours**
UNIT-III	
Structure of nucleic acids: Structure of DNA and its elucidation, structural polymorphism in DNA, extra-chromosomal DNA. Structure of RNA, Systems that safeguard DNA: DNA repair mechanisms – photo reactivation, mismatch	**15 hours**

repair, recombination repair, SOS repair.Replication of DNA, evidence of semi-conservative replication. Mechanism andenzymology of DNA replication. Regulation of DNA replication. Replication of RNA.**Transcription:** Biosynthesis of RNA in prokaryotes and eukaryotes, DNA dependent RNA polymerase, initiation, elongation and termination of transcription. Post transcriptional processing - removal of intron transcripts, addition of 5' cap and 3 poly A tail, processing of mRNA, rRNA and tRNA. Reverse transcription.	
UNIT-IV	
Genetic code and translation: Elucidation and salient features of genetic code, wobble concept, Involvement of ribosome in translation, ribosome structure, initiation, elongation and termination of polypeptide chain synthesis in prokaryotes and eukaryotes, extraribosomal factors, post translation modifications of proteins, ribosome cycle.Regulation of gene expression: Enzyme induction and repression, constitutive expression and housekeeping genes, Operon concept, negative and positive regulation, catabolite repression, regulation of lac Operon, trp Operon, arabinose Operon, divergent Operon, attenuator regulation, translational regulation, feedback inhibition.**Gene silencing:**Transcriptional – genomic imprinting, paramutation, transposonsilencing, histone modifications, position effect; Post transcriptional – RNA interference, RNA silencing.	**15 hours**

REFERENCES

1. Hartwell, L.H., et al. (2023). Genetics – from Genes to Genomes. McGraw Hill Publ.
2. Hays, W. (2023). The genetics of bacteria and their viruses. CBS Publ. New Delhi.
3. Jenkins, J.B. (2022). Genetics. Houghton Mifflin Co., Boston
4. Lewin, B. (2023). Genes VIII. John Wiley & Sons, New York.
5. Maloy, S.R., Cronan, J.E., &Freifelder, D.M. (2023). Microbial Genetics. Jones & Bartlett Series.
6. Miller, G., et al. (2022). An introduction to Genetic Analyses. Freeman & Co., NY.
7. Stent, G.S., & Calendar, R. (2022). Molecular Genetics. Freeman & Co., San Francisco.
8. Streps, U.N., &Yasbin, R.E. (2022). Modern Microbial Genetics. Wiley Blackwell Publ.
9. Strickberger, M.W. (2023). Genetics. MacMillan Publ. Co. Inc. New York.
10. Watson, J.D., et al. (2022). Molecular biology of the Gene. Pearson Education India.

REVISED SYLLABUS

HCT 2.3 BIOPHYSICS, BIOSTATISTICS, BIOINFORMATICS & RESEARCH METHODOLOGY		
CourseCode :HCT 2.3		Credit:4
Total ContactHours :60 T	InternalAssessment:20 M	Examination: 80 M

Course outcome:

After completion of course (Theory), students will be able to:

- Understand the chemical bonding concepts, biological polymersinsights.
- Understand the Databases and its types and tools and to understand the sequence alignment and database searches and phylogenetic constructions.
- Explore the fundamentals of biostatistics, analysis of statistical techniques and overview of the bioassays and the statistical software proficiency.
- Comprehend methods of research, tools and techniques literature survey and research paper.

UNIT-I	
Biophysics: **Chemical bonding; -** Quantum mechanics, Pauli's exclusion principle, Ionization energy, Electron affinity, Electronegativity and strong bonds, Secondary bonds. Energies, forces and bonds Interatomic potentials and spring constants, Free energy and internal energy.**Techniques and methods;** - X-Ray diffraction, NMR, Scanning tunneling microscope, Atomic force microscopy, patch clamping Molecular dynamics, potential energy and contour tracing Biological polymers: Nucleic acid Conformation DNA and RNA, Biological membranes chemistry and structure, Bacterial motion, chemical memory in primitive organisms, Excitable membranes, Diffusion and mobility of ions. Nerve Signals and Memory; Hebbian learning Neural networks.	**15 hours**
UNIT-II	
Bioinformatics **Biological Databases:** Introduction to Nucleic acid databases: NCBI, EMBL, DDBJ & GENBANK. Protein database: Swiss-prot, Prosite, Prints blocks &pfam. Genome database, Literature database (Pubmed and PMC). Protein Data Bank (PDB), Gene bank flat file, FASTA Format. OMIM, OMIA, Metabolic Pathway-KEGG. **Sequence Alignments and Phylogenetic Analysis:** Methods of sequence alignment: Pair wise (Global and Local Alignment) and Multiple Sequence Alignment (MSA). Progressive sequence alignment method, Internet based analysis tools- Clustal W and T-coffee. Database similarity searching: BLAST and FASTA, PSI-BLAST &PHI-BLAST. Phylogenetic tree: Introduction, types of trees phylogenetic trees and multiple alignments. Distance matrix method (MD), character-based methods, Steps in constructing alignments and	**15 hours**

phylogenesis. Phylogenetic software's (CLUSTAL-W, PHYLIP etc).	
UNIT-III	
Biostatistics: Introduction to Biostatistics, Sampling techniques, Data-Types, Data presentation styles. Measures of Central tendency, Skewness and Kurtosis. Scattered plots, Regression and Correlation methods. Multiple regression analysis Probabilities, Mean, median, mode, measure of dispersion, range, standard deviation, mean deviation, standard errors, confidence limits, simple significance tests based on the normal distribution; use of t-tests, regression analysis, ANOVA, LSD, Chi-square test, statistical basis of biological assays direct and indirect assays, probit, logit, LD50, ED50, slope ratio assay; Bioassay-their types, Dose response curves, Design and analysis of Epidemiological model studies. Statistical software- Excel, Python, SAS, R -Studio, MATAB.	**15 hours**
UNIT-IV	
Research Methodology: **Scientific research:** Essential steps in research; components of research, general laboratory organization, laboratory setup and equipment, laboratory note book-types, format and content.**Information retrieval:** Types of literature – books, reviews, research articles. Review process and analysis of information. Components of research article. Literature citation methods.**Scientific data presentation:** Design of experiments, units of measurement, collection, classification and tabulations of research data; preparation of tables, figures, diagrams, presentation of research data.	**15 hours**

REFERENCES

1. ArthurLesk(2006)IntroductiontoBioinformatics–OxfordPress567pp.
2. Cotterill, R. (2002). *Biophysics:An Introduction*.JohnWiley&Sons. 416pp.
3. KraneDEandRaymerM L(2006) Fundamental ConceptsofBioinformatics–Pearson, 456 pp.
4. Motulsky, H.(2018).IntuitiveBiostatistics2nd edn.OxfordUniversityPress.320pp
5. Pappu,R.V.,&Sosnick,T.(2024).*Biophysics:AStudent'sGuidetothePhysicsofthe Life Sciences and Medicine*. Springer. 368 pp.
6. Parke,W.C.(2020).*Biophysics:AStudent'sGuidetothePhysicsoftheLifeSciencesand Medicine*. Springer. 368 pp.
7. Randles,R.H.(2019).Biostatistics: PrinciplesandApplications3rd edn.Pearson, 456pp.
8. Rastogi,V.B.(2015). Biostatistics3rd edn.MedTech,768pp.
9. StuartMB(2000)Bioinformatics–MedicalCenter,NYUSA.567pp.

REVISED SYLLABUS

SCT 2.1 MICROBIAL ENZYMOLOGY		
CourseCode :SCT 2.1		Credit:4
Total ContactHours :60 T	InternalAssessment:20 M	Examination: 80 M

Course outcome:

After completion of course (Theory), students will be able to:

- Acquire the knowledge of enzymes their properties and classification, Mechanism of action, Michaelis-Menten initial rate equation, methods for the determination of Km and Vmax.
- Analyses the mathematical derivations in understanding enzyme kinetics and different transformation and its application.
- Learn about enzyme kinetics, effect of enzymes concentration, pH and temperature on kinetics of enzyme reactions, enzyme inhibition and activation, and Multi substrate enzyme kinetics.
- Learn different immobilization techniques and Industrial and clinical scope of enzymes and preparation of various culture media, Purification techniques

UNIT-I	
Introduction to enzymes: Historical developments. Classification of enzymes into six major groups with suitable examples. Numerical classification of enzymes. Methods & structural conformations of enzymes. Properties of Enzymes, laws of thermodynamics, factors affecting the rate of chemical reactions. Arrhenius theory, collision theory, free energy. Enzymes as biocatalysts, catalytic power, activation energy, substrate specificity, active site.	**15 hours**
UNIT-II	
Enzyme kinetics: Lineweaver-Burke plot, Haldane-Briggs relationship. Concept and significance of Km and Vmax. Concept of enzyme inhibition; types of enzyme inhibitors-reversible, competitive, non- competitive, uncompetitive and irreversible; significance and applications of enzyme inhibitors. Basics of enzyme turnover- Kinetics, measurement and rates of enzyme turnover. **Mechanism of enzyme action:**Theories of mechanisms of enzyme action. Mechanism of action of lysozyme, chymotrypsin and ribonuclease. Monomeric, Oligomeric and multi-enzyme complex (PDH and fatty acid synthase), isozymes (Lactate dehydrogenase, creatine phosphokinase, alcohol dehydrogenase, alkaline phosphatase and isocitrate dehydrogenase) and Allosteric enzymes (Threonine dehydratase and aspartate transcarbomylase); covalently modulated enzymes (Glycogen phosphorylase) and Membrane bound enzymes (ATPase).	**15 hours**
UNIT-III	
Enzymes from microbial sources: Screening by plate assay methods,large scale production of enzymes, recovery of enzymes enzyme purification methods -	**15 hours**

enzyme precipitation, separation by chromatography, enzyme reactors. Immobilized enzymes: Physical and chemical methods of immobilization, immobilization supports, kinetics of immobilized enzymes. Enzyme electrodes, Enzyme catalysis in a pola medium, reverse micellar entrapment of enzymes and its applications.	
UNIT-IV	
Application of enzymes: Synthesis of chemicals using enzymes, food technology and medicine. Enzymes in diagnostic assays. Immune-enzyme techniques. Commercial products of microbes: Antibiotics, biopolymers, biosensors, biopesticides Production of biofuels. Microbial toxins: Types, biochemical and molecular basis of toxin production, implications. Genetically engineered microbes, anti-HIV anticancer, antifungal, anti-plasmodial, anti-inflammatory compounds.	**15 hours**

REFERENCES

1. Arora,N.K.,Mishra,J.,&Mishra,V.(Eds.).(2020). *Microbialenzymes:Rolesand applications in industries*. Springer Singapore
2. Bhatt,S.M.(2018). *EnzymologyandEnzymeTechnology* (2nded.). NewAgeInternational Publishers
3. Brahmachari,G.,Demain,A.L.,&Adrio,J.L.(Eds.).(2017). *Biotechnologyofmicrobial enzymes: Production, biocatalysis and industrial applications*. Elsevier
4. Palmer,T.,&Bonner,P.L.(2007). *Enzymes:Biochemistry,Biotechnology,ClinicalChemistry* (2nd ed.). Elsevier
5. Punekar,N.S.(2020).*Enzymes*(1sted.).SpringerNatureSwitzerlandAG.
6. Singh,S.,&Singh,R.(Eds.).(2020). *Microbialenzymesandbiotechniques*. Springer Singapore
7. West,T.S.,&Told,L.(2019).*TextbookofEnzymology*(4thed.).Wiley-Blackwell

REVISED SYLLABUS

SCT 2.2 ENVIRONMENTAL MICROBIOLOGY		
CourseCode :SCT 2.2		Credit:4
Total ContactHours :60 T	InternalAssessment:20 M	Examination: 80 M

Course outcome:

After completion of course (Theory), students will be able to:

- Understandthe microbial diversity and microbial communities inhabiting a multitude of ecological habitats.
- Thorough knowledge of the occurrence, abundance and distribution of microorganism in the soil, water and air.
- Competency in various aspects of environmental microbiology and appreciate trends in microbial ecology.
- Understandthevariouscellular,molecularandbiochemicaladaptationsrelatedto extremophiles.

UNIT-I	
Ecosystem and Soil microbiology **Ecosystem:** Origin, Concept and Development of Environmental Microbiology. Microbial Community: Ecosystem, habitat and niche. Concept and dynamics of microbial population and community. Structure and functions of microbial communities. Ecological succession. Biogeochemical cycles – carbon, nitrogen, phosphorus and Sulphur. **Soil Microbiology:** Historical development of soil microbiology; Physical characteristics and nutrient status of soil. Distribution of microorganisms in soil, their importance in maintaining soil fertility, organic matter and composting. Influence of environmental factors on soil microorganisms. Role of microorganisms in formation of different soils. Enumeration of soil microorganisms. Microbial interactions among soil microorganisms-mutualism, commensalism, antagonism, competition, synergism, parasitism and predation. Rumen microbiology; Significance of coprophilous microorganisms.	**15 hours**

UNIT-II	
Aquatic microbiology: **Aquatic environment:** Physical, chemical and biological parameters: temperature, hydrostatic pressure, light, salinity, turbidity, pH, nutrients. Fresh, brackish, estuarine, marine and subterranean water environment and distribution of microorganisms in the aquatic environment, planktons, lentic, lotic, benthic, euphotic, neustons, microbial mats, biofilms. Methods in the study of fresh and marine water microorganisms. **Water Pollution:** Sources, Characteristics of water pollutants, health hazards due	**15 hours**

to water pollution. Standard water quality criteria, Water quality testing (MPN technique). Eutrophication - causes, consequences and prevention. Waste water treatment: Primary-physical processes; Secondary-biological treatment by fixed biofilm systems (trickling filters, RBC, fluidized bed reactors), suspended systems (activated sludge process, oxidation lagoons, anaerobic digesters, septic tank, ETP, current technologies); Tertiary- Filtration (sand beds & membrane filters) chlorination, ozonization, radiation and reverse osmosis.	
UNIT-III	
Microbiology of the atmosphere: **Microorganisms in air:** sources of air-borne microorganisms, aerosols microbial survival in air: pH, temperature, radiation, oxygen, and other factors. Aerobiology – biological components air, aeroallergens, air-sampling devices and techniques, Air pollution and Radiation hazards: Sources and characteristics of air pollutants; Health hazards due to air pollution; Greenhouse effect. Ozone depletion and acid rain. Radiation hazards and safety measures. **Geomicrobiology:** Rock and Mineral Weathering, Mineral Transformations, Microbial Metal Binding, Microbiota of Subsurface Crystals, Stromatolite - studies.	**15 hours**
UNIT-IV	
Extremophiles, Bioremediation and bioterrorism: **Extreme environments:** Physical environment- temperature, salinity, pressure, pH, magnetic force, starvation strategies. Extreme thermophiles, psychrophiles, halophiles, barophiles and othermicroorganisms in extreme environments; Biotic and abiotic factors influencing survival and adaptations of extremophiles, mechanisms of survival. **Biodeterioration and Bioremediation:** Biodegradation of xenobiotics: Microbial degradation of pesticides, polycyclic aromatic hydrocarbons, natural and synthetic polymers (cellulose, pectin, lignin, detergents). Microbial remediation: Concept and scope of bioremediation. **Bioterrorism:** Microbial agents as weapons of bioterrorism. Bioterrorism and potable water, contaminant transport mechanisms; Bioterrorism in agriculture, contamination through airborne microbial agents, formites. Case study (anthrax, SARS, foot and mouth diseases and others).	**15 hours**

REFERENCES:

1. APHA,(1994),Standard Methods,17th Ed.,AmericanPublicHealthAssociation
2. Atlas&Bertha.(1998). MicrobialEcology.3rdEd.
3. BrockT.D.(1971),PrinciplesofMicrobialEcology.PrenticeHallPubl.Co.Philadelphia.
4. CristonJ.Hurst,(2007), ManualofEnvironmentalMicrobiology, ASMPubl.,New York.
5. Feltcher,M. &GreyTRG,(1987), Ecologyof MicrobialCommunities, CambridgeUniv. Press.
6. GabrielBritton,(1994),WastewaterMicrobiology,JohnWilley&Sons,NewYork.
7. MartinAlexander.(1971) MicrobialEcology.John Willey&Sons.NewYork.
8. MetcalfandEddy. (1991).WasteWaterEngineering.McGrawHill Int. Publ.
9. RalphMitchell,(1995),EnvironmentalMicrobiology,WileyLiss,NewYork.
10. RoseR.D.(1972),AirPollution&Industry.ReinholdCo.,New York.

REVISED SYLLABUS

OET 2.1 MICROBES IN HUMAN WELFARE		
CourseCode :OET 2.1		Credit:2
Total ContactHours :60 T	InternalAssessment:10 M	Examination: 40 M

Course outcome:

After completion of course (Theory), students will be able to:

- Understand the history and scope of microbiology
- Learn about viruses, mycoplasma, rickettsia, bacteria, fungi, actinomycetes, algae, and protozoa. They will also study the general characteristics, structure, and reproduction of microorganisms.
- Understand the distribution and appearance of microorganisms
- Understand microbes in food: Students will learn about fermented food products such as nutritive and medicinal value of fermented foods; probiotics; nutraceuticals.

UNIT-I	
Introduction to microorganisms; Definition, Discovery of microorganisms, Spontaneous generation vs. biogenesis. Contributions of Antonie von Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister and Alexander Fleming. Types – viruses, mycoplasma, rickettsia, bacteria, fungi, actinomycetes, algae and protozoa; General characteristics, structure and reproduction of microorganisms. Distribution of microorganisms: In air, water and soil; On and in the bodies of plants and animals.**Appearance of microorganisms:**Microscopic observations-Cell size, shape and arrangement, glycocalyx, capsule, flagella, endoflagella, fimbriae and pilli. Cell wall: Composition and detailed structure of Gram-positive and Gram-negative cell walls. Different types of microscopes, different shapes and sizes of microorganisms, staining properties, staining of cells organelles and inclusion bodies.	**15 hours**

UNIT-II	
Isolation and cultivation of microorganisms: Sterilization methods (physical andchemical); Media – preparation, ingredients and types; Pure culture techniques.**Microorganisms and human Health –** Role of microorganisms in human health; Action of antibiotics to combat microbial diseases; Microbial vaccines as prophylactic measures; Concepts and principals of immunity to microbial infections; Major human diseases caused by important microbial pathogens.**Microorganisms and Industry:** Microbial fermentations; Bioprocess engineering; Raw materials; Types of fermenters and fermentations; Production of antibiotics, enzymes,organic acids and pigments.	**15 hours**

REFERENCES

1. Atlas,R.M.,&Bartha,R.(2013).Microbialecology:Fundamentalsandapplications(5th ed.).Benjamin Cummings.
2. Atlas,R.M.,&Bartha,R.(1998).Microbialecology:Fundamentalsandapplications(3rded.).BenjaminCummings.
3. Doyle,M.P.,Beuchat,L.R.,&Montville,T.J. (1997).Foodmicrobiology:Fundamentalsandfrontiers(1sted.).ASM Press.
4. Frazier,W.C.,&Westhoff,D.C.(2008).Foodmicrobiology(5thed.).TataMcGraw-HillEducation.
5. Lammert,J.M.(2011).Techniquesinmicrobiology:Astudenthandbook(1sted.).W.H. Freeman.
6. Madigan,M.T.,Martinko,J.M.,Bender,K.S.,Buckley,D.H.,&Stahl,D.A.(2014).Brock biologyof microorganisms (14th ed.). Pearson.
7. Mitchell,R.(2004).Environmentalmicrobiology(2nded.).Wiley-Liss.
8. PelczarJr.,M. J.,Chan, E. C., &Krieg, N. R. (1988). Microbiology: Conceptsandapplications (2nded.). McGraw- Hill.
9. Stanier,R. Y.(1977).Generalmicrobiology(3rded.).CambridgeUniversityPress.
10. SubbaRao, N.S. (2002).Soilmicrobiology(4thed.).Oxford&IBHPublishingCo.

REVISED SYLLABUS

OET 2.2 FUNDAMENTALS & APPLICATIONS OF MICROBIOLOGY		
CourseCode :OET 2.2		Credit:2
Total ContactHours :60 T	InternalAssessment:10 M	Examination: 40 M

Course outcome:

After completion of course (Theory), students will be able to:

- have broad and balanced knowledge on theintroduction and history of microbiology.
- Understand the scope and concept of industrial microbiology and also industrialproduction of microbial based commercial products
- Acquire the knowledge on the microbial disease pathogenesis, clinical conditions,epidemiology and diagnosis.
- Understand the clinical sample types and its handling, collection and processing.

UNIT-I	
Microbiology and industrial microbiology Introduction to Microbiology: Historical development of microbiology, General characteristics of different groups of microorganisms: Outline Classification of bacteria. Methods of classification of bacteria, Prokaryotic and Eukaryotic cells: Structural organization of Prokaryotic and Eukaryotic cell, Major groups of Microorganisms– Viruses, Bacteria, Algae, Fungi and Protozoa. **Industrial Microbiology**: Introduction, scope, microorganisms, properties and industrial products Screening for microbes of industrial importance. Primary screening, screening for amylase, organic acid, antibiotic, amino acid and vitamin producing microorganisms. Secondary screening.	**15 hours**
UNIT-II	
Industrial microbiology: Industrial production of Alcohol (Ethanol), Wine, Beer, Organic acids (Citric, acetic, Lactic and Gluconic acid) Solvent (Glycerol Acetone, Butanol), Antibiotics (Penicillin, streptomycin, tetracycline) Amino acids (lysine, glutamic acid) Single cell proteins (SCP) Vitamins (Riboflavin) Enzymes (Amylase, lactase, protease), Hydrocarbons – Biodegradable plastic – Polyhydroxyalkanoates (butyrate, propionate etc), recombinant protein (hepatitis – B vaccine).	**15 hours**

REFERENCES:

1. Alcamo's Fundamentals of Microbiology by Jeffrey C. Pommerville(2013)-12th Edn.
2. AtlasR.M.(1998) Microbiology, Fundamentals and Application 2nd Edition MacMillan Publishing Company.
3. Bruijinetal.,(1998),Bacterial Genomes,ChapmanandHill.
4. DaleJ.W.Molecular Genetics and Bacteria,(1994),JohnWileyandSons.
5. HayesW.(1970)Genetics of Bacteria and their viruses. The English Book Society of Black well Scientific publication, Oxford.
6. Hundersonetal.,(1999),Cellular Microbiology WileyPublications.
7. Lewin.B. (2002)GenesVIII,OxfordPress.
8. Microbiology Fundamentals and Applications by SS. Purohit.
9. PrescottL.M.,J.P.HanleyandD.A.Klein.(1999)MicrobiologyWCBMcGraw-Hill,Con .NY.
10. RogerL.P.JohnT.,KnowlerandD.A.Violp.Leadr.(1992).TheBiochemistryofNucleicAcids 11th Edition Chapman and Hall.
11. SamuelSinger.(2001) Experiments on Applied Microbiology, AcademicPress. New-York.
12. StanleyR.,Maloy,JohnE.,Cronan,Junior.DavidFrieifelour(1994).Microbial Genetics Jones and Barlett Publications. Bosten.
13. SulliaS.B.andS.Shantaram.(1998),General Microbiology, Oxford IBH Publishing Con, New Delhi.

HCP 2.1 MICROBIAL PHYSIOLOGY AND METABOLISM

CourseCode :HCP2.1	Credit:2
InternalAssessment:10 M	Examination: 40 M

Practicals:

1. Determinationofgrowthcurveandgenerationtime.
2. DeterminationofoptimumpH,temperatureforgrowthofbacteriaandfungi.
3. Lipidsaponificationvalueoffats,Iodinenumberoffattyacids.
4. Qualitativeanalysisoflipids.
5. Estimationofmicrobialenzymes– amylase,protease,invertase,cellulase,lipase,catalase and phosphatase.
6. Determination of K_m and V_{max} .and KI
7. Extractionandseparationofaflatoxinbypaperchromatography.
8. EffectofpH,temperature,enzymeconcentration,substrateconcentrationand inhibitors on enzyme activity.
9. Qualitativeandquantitativeestimationofcarbohydrates.
10. Effectofdifferentsubstrate(Primary,secondary&tertiary)onmicrobialgrowth
11. De-aminationofAminoacids.
12. De-carboxylationofAminoacids.

HCP 2.2 MICROBIAL GENETICS AND MOLECULAR BIOLOGY

CourseCode :HCP2.2	Credit:2
InternalAssessment:10 M	Examination: 40 M

Practicals:

1. IsolationofGenomicDNAfrom*E.coli.*
2. AgarosegelelectrophoresisforseparationofNucleicacids
3. Estimation of DNA, RNA and plasmids, and determination of purity and concentration of isolated DNA using spectrophotometer.
4. SeparationofproteinsbySDSPAGE,saltfractionationofYeastproteinand quantification, estimation of protein by Lowry's method, RFLP and RAPD analysis, and restriction digestion of DNA.
5. Isolationofplasmidsfrombacteriabyagarosegelelectrophoresis,digestionofthegene of interest withsuitable restriction enzymes, and ligationof the digested gene in a vector.
6. Preparation of competent *E. coli* cells for Bacterial transformation, transformation of the vector into the host cell and selection of the desired clones.
7. Induction of gene expressionand purification of the induced protein from the host, and amplification, purification and separation of PCR product.
8. Inductionandstudyofphysicalandchemicalmutagensinbacteria/fungi.
9. Studyof mutagenic effect and Induction of mutation in yeast / bacteria by chemical /

radiation method.

10. Plasmidcuringinbacteria
11. Transformationandselectionoftransformants
12. Conjugationandgenemappingin*E. coli*
13. Isolationofbacteriophagesandphagetitration,andstudyofreplicaplatingtechnique.

HCT 2.3 BIOPHYSICS, BIOSTATISTICS, BIOINFORMATICS & RESEARCH METHODOLOGY	
CourseCode :HCP2.3	Credit:2
InternalAssessment:10 M	Examination: 40 M

Practicals:

1. Determination of Melting temperature of DNA
2. Determination of Lambert's Beers Law
3. Measurement of central tendency for arithmetic mean
4. Problems related to median value
5. Measurement of Dispersion
6. Analysis of variances (ANOVA)
7. NCBI, EMBO DDBJ and OMIM
8. Designing of oligonucleotieds
9. Sequence similarity searching using BLAST analysis
10. Sequence comparison using Multiple sequence alignment
11. Construction of Phylogenetic tree methods
12. Prediction of gene in an DNA sequence using gene prediction algorithm
13. Study of Protein sequence databases
14. Prediction of amino acid sequence of a protein

SCP 2.1 MICROBIAL ENZYMOLOGY

CourseCode :SCP2.1	Credit:2
InternalAssessment:10 M	Examination: 40 M

Practicals:

1. Populationgrowthofbacteria(*E.coli*)andyeast(*S.cerevisiae)*
2. Sugarfermentationtests,Catalaseactivity,Hydrolyticrancidity,Caseinhydrolysis
3. StudyofTemperature(Heatstress)andacidandpHstresstolerancebymicrobes
4. Studyofoxidativestress
5. IsolationofThermophiles,acidophiles,alkalophilesandhalophiles
6. Isolationofaerobic,facultativeaerobic,anaerobicandmicroaerophilicmicrobes.
7. Screeningofmicroorganismforinvertases,amylase,proteases,lipases
8. DeterminationofoptimumpH,temperature,enzymeandspecificactivityofmicrob ialenzyme (invertase, amylase)
9. Effectofinhibitoronmicrobialamylaseactivity
10. DeterminationofKmandVmaxofmicrobialamylase
11. Isolationofstreptomycinresistantstrainof*E.coli*bygradientplatemethod.
12. Amestest

SCP 2.2ENVIRONMENTAL MICROBIOLOGY

CourseCode :SCP2.2	Credit:2
InternalAssessment:10 M	Examination: 40 M

Practicals:

1. Estimation of total organic matter/soil moisture in soil
2. Estimation of total alkalinity of soil
3. Isolation and Enumeration of soilmicroorganisms by directplateserial dilution method
4. Isolation and enumeration of rhizosphere and non-rhizospheresoil microorganisms .
5. Winogradsky column
6. Estimation of dissolved oxygen/ free carbon-di-oxide of water
7. Estimation of total solid/total acidity/total alkalinity content of water.
8. Estimation of biological oxygen demand of water
9. Determination of chemical oxygen demand of water
10. Estimation of chlorine in water samples
11. Estimation of biomass in water by wet weight and dry weight method
12. Bacteriological examination of water-MPN test
13. Enumeration of air borne microorganisms by gravity slide / gravity plate/ vertical cylinder trap method