

PREREQUISITE:

- Not required

COURSE OBJECTIVES (CO):

- To provide a basic understanding on the fundamental aspects of microbiology from historical development.
- To comprehend the various methods for identification of unknown microorganisms
- To understand physical and chemical means of sterilization and also learn techniques for isolation of pure cultures.

COURSE OUTCOME (COs):

Upon completion of this course students will be able to

COs	Course Outcomes	Blooms Level
CO1	Understand the basic microbial structure and functions of various physiological groups of prokaryotes and eukaryotes.	Understand
CO2	Learn the theory and practice skills in microscopy handling and staining techniques know various culture media and their applications.	Apply
CO3	Study microbial nutrition's - Autotrophy and heterotrophy modes of nutrition.	Understand
CO4	Identify the unknown organisms by using microbial tools.	Apply
CO5	Demonstrate electricity generation from the organic matter.	Apply

UNIT I Introduction and History of Microbiology**10 HOURS**

History of development of Microbiology, Contribution of Anton Van Leeuwenhoek, Louis Pasteur, Edward Jenner, Robert Koch, Alexander Fleming, Paul Ehrlich, Structure of prokaryotic and eukaryotic cell, General properties of microorganisms- Bacteria, Algae, Fungi and Protozoa. Bacterial Taxonomy- Principles- Modern approaches- Numerical, Serotaxonomy and chemotaxonomy.

UNIT II Classification of microorganisms**9 HOURS**

Systematics of bacteria - Microbial evolution and Diversity –Phenetic and Phylogenetic Haeckel's three-kingdom concept, Whittaker's Five- kingdom concept, Three-domain concept of Carl Woese. Bergey's manual and its importance. –Bacteria, Classification-Phenetic classification, Numerical Taxonomy, Phylogenetic Classification, Classification-Archaea-fungi-virus and algae.

UNIT III Microscopy and staining methods**10 HOURS**

Microscopy –Simple, Compound, Dark-field, Phase contrast, Fluorescent microscopes, Electron microscopes (SEM and TEM), Confocal microscopy, Stereo zoom microscope, differential interference contrast (DIC) – Principles and their applications. Stains and Staining techniques: Simple and Differential staining methods.

UNIT IV Systemic Biology**11 HOURS**

Scope of Microbiology. Microbial interactions- mutualism, symbiosis, commensalisms, predation, parasitism, amensalism, competition, bioluminescence, biodegradation, biofilms. Cleaning oil spills, microbes in composting, biopesticides, bioremediation, bioleaching, SCP, microbial enzymes and fermented foods. Microbial Biostimulants.

UNIT V Molecular taxonomy**8 HOURS**

Modern Microbiology: Molecular taxonomy, 16S/18S rRNAs sequencing and its importance in identification of microorganisms. Phylogenetic tree, recent trends in exploitation of microbial diversity, Community level physiological profile, fatty acid methyl esterase analysis, G+C ratio, nucleic acid reassociation and hybridization and DNA micro arrays.

TOTAL: 48 HOURS**TEXT BOOKS**

1. Dubey, R.C., and Maheswari, D.K., (2010). *A Text book of Microbiology*. (3rd Ed), S. Chand and Company, New Delhi.
2. Modi, H. A. (1996). *Elementary Microbiology*. Vol.2, AKTA Prakashan Nadiad, Gujarat
3. Powar, C.B., and Dagainawala, H.F., (2008). *General Microbiology*. Vol: 2. Himalaya Publishing House.
4. Singh, R.P. (2007). *General Microbiology*. Kalyani Publishers, New Delhi.
5. Pelczar Jr. M.J., Chan, E.C.S., and Kreig, N.R., (2004). *Microbiology*. (5thed.). TataMcGraw-Hill Publishing Company, New Delhi.
6. Powar. C.B and Dagainawala. H.F. 2010. *General Microbiology (Vol-II)*. Himalaya Publishing house.

REFERENCE BOOKS

1. Christopher, J.W., Linda, S., and Joanne, W., (2016). *Prescott's Microbiology*. (10th Ed), Mc Graw Hill Education, United States.
2. Noel, R.K., Wolfgang, L., William, B.W., Brian, P.H., Bruce, J.P., James, T.S., Naomi, W., and Daniel, B., (2011). *Bergey's Manual of Systematic Bacteriology: Volume 4*, Springer Science & Business Media, Germany.
3. Frobisher, H., Hinsdill, R.D., Crabtree, K.T., and Goodhert, D.R., (2005). *Fundamentals of Microbiology*, Saunders and Company, London.
4. Tortora, G.J., Funke, B.R., and Case, C.L., (2010). *Microbiology: An Introduction*. (10thed.). Pearson Education, Singapore.
5. Stanier, R.Y., Ingraham, J.L., Wheelis, M.L., & Painter, P. R., (2008). *General Microbiology*. (5thed.). Macmillan Press Ltd, London.
6. Salle, A.J. (2007). *Fundamental Principles of Bacteriology*. (7th ed.), Envins Press, New York.
7. Alcomo, I.E., (2006). *Fundamentals of Microbiology*. (8thed.). Jones and Bartlett Publishers, Sudbury, Massachusetts.

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
CO1	3	-	2	-	-	-	-	-	-	-	3	-	2	-	-	3	-
CO2	3	-	-	-	-	-	2	-	-	2	3	-	-	-	-	3	-
CO3	3	-	-	-	-	-	-	-	-	-	3	-	-	-	-	3	-
CO4	-	-	2	-	-	2	-	-	-	-	-	-	2	-	-	3	-
CO5	-	2	-	-	-	-	-	-	-	-	-	2	-	-	-	3	-
Average	3	2	2	-	-	2	2	-	-	2	3	2	2	-	-	3	-

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

PREREQUISITE:

- Principles and Systematics of Microbiology (24MBP101)

COURSE OBJECTIVES (CO):

- To provide information on sources of energy and its utilization by microorganisms and microbial transport systems in energy conservation.
- To impart knowledge on metabolic function and biochemical reaction going on inside the microbial cell.
- To teach metabolic pathways, their regulation and engineering, and methods used in their elucidation.

COURSE OUTCOME (COs):

Upon completion of this course students will be able to

COs	Course Outcomes	Blooms Level
CO1	Understand the basic microbial structure and functions of various physiological groups of prokaryotes and eukaryotes.	Understand
CO2	Learn the theory and practice skills in microscopy handling and staining techniques know various culture media and their applications.	Apply
CO3	Study microbial nutrition's - Autotrophy and heterotrophy modes of nutrition.	Understand
CO4	Identify the unknown organisms by using microbial tools.	Apply
CO5	Demonstrate electricity generation from the organic matter.	Apply

UNIT I Prokaryotic cell structure**11 HOURS**

Prokaryotic cell structure and organization - cell wall, plasma membrane, cytoplasmic matrix, inclusion bodies, ribosome, nucleoid, capsule, slime layers, S layers, pili, fimbriae, flagella and motility. Eukaryotic cell structure and its organelles. Lichens and microalgae: Structural organization and their properties. Mycoplasma. Basic structure of viruses.

UNIT II Bacterial spores**11 HOURS**

Definition of growth and generation time, Measurement of microbial growth and specific growth rate. Structure of bacterial endospore, Molecular architecture of spores, induction and stages of sporulation cycle. Influence of different factors on sporulation. Transport of Nutrients- Uptake of nutrients- Passive diffusion, Facilitated diffusion, active transport. Role of osmoregulatory protein.

UNIT III Metabolic pathway**11 HOURS**

Glycolysis, EMP and TCA cycle. Metabolism of lactic acid bacteria, propionic acid bacteria. Aerobic respiration and anaerobic respiration. Electron transport chain in prokaryotes and eukaryotes, inhibitors of electron transport chain. Substrate level and oxidative phosphorylation – ATP generation. Biosynthesis of fatty acids, nucleotides, amino acids, Cell wall biosynthesis of Gram positive and Gram negative bacteria. Toxins – characterization, mechanism of action.

UNIT IV Stress physiology**05 HOURS**

Effect of oxygen toxicity, Effect of pH on Microbial growth, Effect of osmotic pressure on bacteria, heat shock response on bacteria- Chaperons. Starvation stress and stringent response.

UNIT V Photosynthetic bacteria & Bioluminescence**10 HOURS**

Photosynthetic bacteria, photosynthetic pigments, generation of reducing power by cyclic and non- cyclic photophosphorylation, RUBISCO structure and molecular regulations of light and dark reaction. Photoperiodism and mechanism and action of Hydrogen oxidizing bacteria and Methanogenesis – assimilation of carbon dioxide. Bioluminescence and Quorum sensing – mechanism, importance and applications.

TOTAL: 48 HOURS**TEXT BOOKS:**

1. Joanne, M.W., Linda, S., and Christopher, J.W., (2008). *Prescott, Harley, and Klein's Microbiology*. (7th Ed). McGraw-Hill Higher Education, United States.
2. Berg, J.M., Tymoczko, J.L., Stryer, L., and Clarke, N.D., (2001). *Biochemistry*. (5thed.). WHFreeman &Co.

REFERENCE BOOKS:

1. Doelle, H.W. (2005). *Bacterial Metabolism*. Elsevier India Pvt. Ltd., New Delhi.
2. Moat, A, G., and Foster J.W., (2003). *Microbial Physiology*. John Wiley and Sons, New York.
3. Caldwell, D.R. (2008). *Microbial Physiology and Metabolism*. (2nded.). Wm C Brown Publishers, England.
4. Rose, A.H. (2008). *Chemical Microbiology – An Introduction to Microbial Physiology*. (International Ed.). Plenum Publishing Corporation.
5. Atlas, R.M., (1997). *Principles of Microbiology*. (2nded.). Wm. C. Brown Publishers, Iowa, US
6. Madigan, M.T., Martinko, J.M., and Parker, J., (2003). *Brock Biology of Microorganisms*. (10thed.). Prentice Hall, New Jersey.
7. White, D. (2003). *Physiology & Biochemistry of Prokaryotes*. (2nded.). Oxford University Press, NY.
8. Voet, D., and Voet J.G., (2003). *Biochemistry*. John Wiley and Sons, New York.
9. Satyanarayana, U. and Chakrapani, U. 2013. *Biochemistry*, Fourth Edition Book and Allied Pvt. Ltd., Kolkata.
10. Nelson, D.L. and Cox, M.M. 2012. *Lehingers's Principles of Biochemistry*, Sixth Edition, MacMillan worth Publishers, New Delhi.
11. Donald Voet and Judith G. Voet, 2011. *Biochemistry*. Third Edition, John Wiley and Sons, Inc. New York.
12. Michale G and Schomburg D (Ed)(2012) *Biochemical pathway: An Atlas of Biochemistry and Molecular biology*, p414.
13. Swanson, M., Regurea G, Schaechter M and Neidhardt FC (2016), *Microbe*, 2nd Edition, ASM press, P846.

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
CO1	3	-	2		-	-	-	-	-	-	-	-	-	-	-	3	-
CO2	2	-	2	3	-	-	-	2	-	-	-	-	-	-	-	3	-
CO3	2	-	2	2	-	-	-	-	-	-	-	-	-	-	-	3	-
CO4	3	-	-	2	-	-	-	2	-	-	-	-	-	-	-	3	-
CO5	3	-	-	2	-	-	-	2	-	-	-	-	-	-	-	3	-
Average	3	-	2	2.25	-	-	-	2	-	-	-	-	-	-	-	3	-

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

PREREQUISITE:

- Not required

COURSE OBJECTIVES (CO):

- To inculcate the basic application of metabolism in research.
- To deal with the genome structure, stability, organization, and its expression.
- To provide molecular mechanisms underlying mutations, detection of mutations and DNA damage and repair

COURSE OUTCOME (COs):

Upon completion of this course students will be able to

COs	Course Outcomes	Blooms Level
CO1	Understand the basic history of molecular genetics and apply cognitive thinking to the application-oriented sectors of genetics.	Understand
CO2	Comprehend the knowledge molecular mechanisms underlying mutations, detection of mutations and DNA damage and repair	Apply
CO3	Understand of the process of protein synthesis and operons along with of recombination DNA.	Understand
CO4	Analyse mutagenesis and genetic analysis with gene mapping.	Analyze
CO5	Understand and explore genetic engineering techniques.	Understand

Unit I Historical Preview of Genetics**10 HOURS**

Mendelian principles and classical genetics, Genetic concepts, use of microorganisms in genetic studies. Chemical basis of heredity – early concepts of genes – the discovery of the chemical basis of heredity - experimental evidence – contributions of Griffith, Avery, Hershey and Chase, Fraenkel – Conrat. Structure of nucleic acids – Structure of DNA and its elucidation, types and different models of DNA, extra-chromosomal DNA (Plasmids, Transposons). Structure of RNA. Organization of genetic material - Genome organization in viruses, bacteria and eukaryotes. DNA replication – prokaryotes and eukaryotes - theta and Plasmid DNA replication- rolling circle models of replication - Inhibitors of replication

UNIT II Transcription & Translation**10 HOURS**

Organization of transcriptional units and regulation of gene expression. Mechanism of transcription of prokaryotes-, Genetic code, Importance and properties of genetic code. Direction of protein synthesis, RNA template, direction with experimental proof, tRNA as adaptor SD sequence in bacteria, initiator tRNA, elongation, translocation and termination of protein synthesis. Post-translational modification. Gene Regulation - Operon models - lactose, tryptophan and arabinose operon.

UNIT III Mutation and repair mechanism**10 HOURS**

Mutagen, mutagenesis and mutation. Luria Delbruck experiment and its significance. Molecular basis of mutation. Spontaneous and induced mutations. Different types of mutation, mutant detection, mutant

selection and carcinogenicity testing. DNA damage – types of damage(deamination, oxidative damage, alkylation, Pyrimidine dimers) – DNA repair mechanism base excision, nucleotide excision, recombination repair, SOS repair.

UNIT IV Genetic Recombination

9 HOURS

Genetic Recombination in Bacteria: Conjugation. F+ v/s F-, Hfr+ v/s F-, F' v/s F-, Trans- formation, Transduction: generalized and specialized. Mobile elements in prokaryotes and eukaryotes – Insertion sequences, transposons – properties: Linkage and genetic maps. Genetics of T4 and λ phages – Genetic mapping of T4 phage.

UNIT V Vectors & Molecular markers

9 HOURS

Vectors: General characteristics of vectors, Plasmids, Ori site, selectable markers, multi-cloning sites, Phage vectors, Construction of genomic Library and cDNA library, Expression vectors and their importance. Transfer of recombinant DNA into host cells: Genetic transformation of bacteria, yeast, animal and plant cells. Principles and applications of DNA sequencing, DNA finger printing. Molecular Markers, RFLP, RAPD, AFLP and Isozyme Loci. CRISPR gene editing.

TOTAL: 48 HOURS

TEXT BOOKS

1. Snyder L. and Chapness W. (2007). Molecular Genetics of Bacteria. ASM Press.
2. Dale, J.W., Park, S.F. (2013). Molecular Genetics of Bacteria, 5th Edition, John Wiley & Sons.
3. Birge EA. (2006). Bacterial and Bacteriophage Genetics. 5th edition, Springer-Verlag New York.

REFERENCE BOOKS

1. Gardner JE, Simmons MJ & Snustad DP. (2006). Principles of Genetics. 8 Edition, John Wiley & Sons.
2. Jocelyn E. Krebs, Elliott S. Goldstein, Stephen T. Kilpatrick (2018). Lewin's GENES XII, 12 Edition, Jones & Bartlett Learning.
3. Cronan, J., Freifelder, D., Maloy, S. R. (2008). Microbial Genetics, 2 Edition, Narosa.

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	POS2
CO1	3	-	-	1	-	-	-	1	-	-	-	-	-	-	-	3	-
CO2	2	-	2	3	-	-	-	2	-	-	-	-	-	-	1	2	-
CO3	3	-	-	-	-	-	-	1	-	-	-	-	-	-	-	3	-
CO4	2	-	-	2	-	-	-	-	-	-	-	-	-	-	-	3	-
CO5	3	-	-	3	-	-	-	2	-	-	-	-	-	-	-	3	-
Average	3	-	2	2.25	-	-	-	1.5	-	-	-	-	-	-	1	3	-

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

PREREQUISITE:

- Not required

COURSE OBJECTIVES (CO):

- Introduce the basic concept of qualitative and quantitative analysis of a given sample.
- To study various spectroscopic techniques and its instrumentation.
- To know the concept of separation science and its applications.

COURSE OUTCOME (COs):

Upon completion of this course students will be able to

COs	Course Outcomes	Blooms Level
CO1	Explain bioinstrumentation techniques, design and application.	Understand
CO2	Understand the concepts and operation of various lab instruments and related terms.	Understand
CO3	Acquire knowledge and apply lab skills to perform experiments in laboratory.	Apply
CO4	Evaluate the concepts of physics, chemistry, and engineering principles in the instrumentation.	Evaluate
CO5	Learn and analyses laboratory skills that are essential for beginning-level employment in clinical, pharmaceutical, microbiology, biochemistry, and biotechnology laboratories.	Analyze

UNIT I Spectroscopy- Application and Interpretation**10 HOURS**

Properties of electromagnetic radiations. Instrumentation and applications of calorimetry, Visible spectrophotometer, UV-Visible spectrophotometer, Analysis of sample with Plastic, quartz and Glass Cuvette, spectrofluorometer, atomic spectroscopy, double beam spectroscopy, UV- Visible spectroscopy, FTIR, Raman Spectroscopy, Atomic Adsorption Spectroscopy, NMR spectroscopy and flow cytometer.

UNIT II Centrifugation**10 HOURS**

Principle and types of centrifuges. Principles and applications of analytical and preparative centrifuges. Relative molecular mass determination and sedimentation coefficient. Sub-cellular Fractionation of cellular components. Density gradient and ultra-centrifugation. Centrifuge rotor types and application. Calculation of centrifugal force and angular velocity.

UNIT III Chromatography**10 HOURS**

Principle, instrumentation and applications of ion exchange, affinity, gel filtration, Paper chromatography, thin layer chromatography, column chromatography, Gas chromatography, Low pressure liquid chromatography (LPLC) and high-performance liquid chromatography (HPLC) and fast protein liquid chromatography (FPLC), gas liquid chromatography-Mass spectroscopy, Radio frequency tunnelling microscopy, (GC-MS), LCMS, LCMS/MS, MALDI – TOF Nano-LC.

UNIT IV PCR and Electrophoresis**10 HOURS**

Polymerase chain reaction (PCR), Reverse transcription Polymerase chain reaction (RT-PCR), Quantitative Polymerase chain reaction (Q-PCR). Principle, instrumentation and applications of agarose gel electrophoresis, native PAGE, sodium dodecyl sulphate - polyacrylamide gel electrophoresis (SDS- PAGE), Isoelectric focusing, Immuno electrophoresis, pulse field gel electrophoresis, capillary electrophoresis, gel documentation

– applications. Zone and moving boundary electrophoresis

UNIT V Radio isotopic techniques

8 HOURS

Introduction, nature of radio activity, types and rate of radioactive decay, units of radio activity, detection, and measurement of radio activity. Principle, instrumentation, and applications of Geiger- Muller counter, solid and liquid scintillation counter and autoradiography. Biosafety methods in radioactive laboratory. Uses of Radio isotopic techniques and isolation.

TOTAL: 48 HOURS

TEXT BOOKS:

1. John Enderle., (2006). *Bioinstrumentation*. (2006). Morgan and Claypool Publishers, NJ.
2. Richard Normann. (1988). *Principles of bioinstrumentation*. Wiley Publishers, US.
3. Keith Wilson and John Walker. (2010). *Principle and Techniques of Biochemistry and molecularbiology*. (7thed.). Cambridge university press, NY.
4. Boyer, R. (2000). *Modern Experimental Biochemistry*. (3rded.). Addison Wesley Longman, NewDelhi.
5. Chatwal, G.R., and Anand, S.K., (2003). *Instrumental Methods of Chemical Analysis*. (5thed.).Himalaya Publishing House, Mumbai

REFERENCE BOOKS:

1. Friedfelder, D. (2001). *Physical Biochemistry: Applications to biochemistry and molecular biology*. Oxford Publishers, New York.
2. Sharma, B.K. (2007). *Instrumental Methods of Chemical Analysis*, Krishna Prakashan Media (P) Ltd, India.
3. Wilson, k and walker. (2010). *Principles and Techniques of Biochemistry and Molecular Biology* (7th ed) Cambridge University Press, India.

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	POS2
CO1	3	-	-	1	-	-	-	-	-	-	-	-	-	-	-	2	3
CO2	3	-	1	1	-	-	-	2	-	-	-	-	-	-	-	2	3
CO3	2	-	2	1	-	-	-	2	-	-	2	-	-	-	-	2	3
CO4	-	-	2	2	-	-	-	2	-	-	1	-	-	-	-	2	3
CO5	3	-	2	1	-	-	-	1	-	-	2	-	-	-	-	2	3
Average	2.25	-	2	1.2	-	-	-	2	-	-	2	-	-	-	-	2	3

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

Instruction Hours/week: L:4 T:0 P:0

Marks: Internal:40 External:60 Total:100

End Semester Exam: 3 Hours

PREREQUISITE:

- Not required

COURSE OBJECTIVES (CO):

- To provide students with knowledge on the ecology of marine microorganisms, and their ecological role.
- To impart techniques for the characterization and study of marine microorganisms and microbial communities.
- To understand the ecological role of marine microorganisms and marine microbial communities.

COURSE OUTCOMES (COs):

Upon completion of this course students will be able to

COs	Course Outcomes	Blooms Level
CO1	Describe and explain both biological interaction processes and their impact to ecosystems.	Understand
CO2	Gain knowledge biology of marine microorganisms and their activities	Apply
CO3	Learn and apply modern techniques for the characterization and study of marine microorganisms and microbial communities.	Apply
CO4	Understand and analyse the architecture of the marine ecosystem and its essential role	Analyze
CO5	Analyse and isolate biomolecules from marine microbes.	Apply

UNIT I Marine microorganisms

10 HOURS

Introduction of coastal, shallow and deep sea. Marine microorganisms- important and their significance. Marine micro and macro-organisms-Collection, enumeration, and identification based on morphological, physiological and biochemical characteristics and preservation. Constructions of Winogradsky column International and national collection centres.

UNIT II Extremophiles and Marine bio-diversity

8 HOURS

Thermophiles, basophiles, halophiles, psychrophiles, alkaliphiles, oligotroph, toxitolerant, xerotolerant, endolith – Extremophiles and their environment. Coral reefs, Seagrass, Mangroves, Hydrothermal vents, and water currents.

UNIT III Marine food pathogens and microbial toxin

10 HOURS

Marine food pathogenic microorganisms, distribution, indicator organism's prevention and control. Microbiology of processed -finfish and shellfish products. Microbial diseases- diagnosis and control. Introduction, microbial toxin, algal blooms, types. Harmful effect- Human health, Economic impact and Environmental impact, Potential remedies.

UNIT IV Marine Pollution and its effect on marine ecology

10 HOURS

Effect of marine pollution to marine ecology: Pollution of ocean due to hydrocarbons, oil, surfactants, xenobiotics, pesticides, heavy metals, plastics, human activities and its impact on marine life. Microbial bioremediation in preserving marine life. Importance of microbes in marine nutrient cycles.

UNIT V Marine Microbes bioproducts**10 HOURS**

Marine plants and its uses. Microalgae and seaweeds – Food products- Human food and animal feed, Biomedical Products- Antimicrobial, antioxidant, antiviral and anticancer activity. Aquaculture feed inoculants -. Industrial Application- bioethanol production. Biopigment products - Phytoplanktons, Bioluminescence.

TOTAL: 48 HOURS**TEXT BOOKS:**

1. Colin Munn. (2011). *Marine Microbiology: Ecology & Applications*. (2nded.). Black Well Publishers.
2. David Sige. (2005). *Freshwater Microbiology: Biodiversity and Dynamic Interactions of Microorganisms in the Aquatic Environment*. (1sted.). Black well Publishers.
3. Joanne, M.W., Linda, S., and Christopher, J.W., (2008). *Prescott, Harley, and Klein's Microbiology*. (7th Ed). McGraw-Hill Higher Education, United States.

REFERENCE BOOKS:

1. Se-Kwon Kim. (2013). *Bioactive compounds and biotechnological applications*. CLS Publishers
2. Dube, H.C. (1994). *A text book of fungi, bacteria and viruses*. Vikas Publishing House, New Delhi.
3. Dale, J.W. (1994). *Molecular genetics of Bacteria*. John Wiley and Stones.

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	POS2
CO1	3	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	2
CO2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
CO3	-	-	-	2	2	-	-	-	-	-	-	-	-	-	-	-	2
CO4	2	-	2	3	-	-	-	2	-	-	-	-	-	-	-	-	2
CO5	-	-	-	3	-	-	-	2	-	-	-	-	-	-	-	-	2
Average	3	-	2	3	2	-	-	2	-	-	-	-	-	-	-	-	2

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

PREREQUISITE:

- Not required

COURSE OBJECTIVES (CO):

- To obtain a good understanding of the interpretation of biological database.
- To describe the history, scope and importance of Bioinformatics and the role of the internet in Bioinformatics
- Provide an overview of the application areas of bioinformatics
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COURSE OUTCOMES (COs):

Upon completion of this course students will be able to

COs	Course Outcomes	Blooms Level
CO1	Understand the history, scope and importance of Bioinformatics and the role of the internet in Bioinformatics	Understand
CO2	Acquire and analyse the information on the search engines and various software tools involved in bioinformatics.	Analyze
CO3	Learn and practice computational skills on search engines and various software tools involved in bioinformatics	Apply
CO4	Apply computational-based techniques which include genomics and proteomics in Bioinformatics.	Apply
CO5	Apply knowledge to retrieve information from available databases and use them for microbial identifications and drug designing, gain the ability to modify gene and protein structures in simulated systems	Apply

UNIT I Introduction of Bioinformatics**8 HOURS**

Basic introduction of Bioinformatics; An overview of major bioinformatics resources; NCBI, EBI, ExPASy, RCSB, Clustal-W, PDB, Open access bibliographic resources and literature databases, Sequence databases, Derived Databases.

UNIT II Biological Database**8 HOURS**

Bioinformatics tools - Global Vs local alignment – Similarity searching – Pair wise alignment and multiple alignments – Biological Databases – Literature, Sequence and Structure – identification and retrieving data from databases. DNA Barcoding.

UNIT III Protein Structure Prediction**11 HOURS**

Protein information resources – primary sequence database, Composite protein sequence database, secondary database, and Composite protein structure database. Protein structure prediction - Prediction of secondary and tertiary structure, Proteomic tools - ExPASy server.

UNIT IV Phylogenetic Analysis**11 HOURS**

Protein structure comparison and classification – RNA structure analysis – Plasmid mapping and Primer designing – Structure visualization softwares – Phylogenetics – Tree types and construction methods. Phylogenetic analysis algorithms such as maximum Parsimony, UPGMA, Transformed Distance, Neighbors-Relation, Neighbor-Joining, Bootstrapping methods, use of tools such as PHYLIP, MEGA.

UNIT V Drug Design and Analysis**10 HOURS**

DNA sequencing –Specialized genomic resources. DNA microarray – principles and databases – Genomics and Proteomics – genes prediction, splices sites and regulatory regions, SNP analysis, Modeling biological systems, Drug design - Structure-based drug design: Identification and Analysis of Binding sites and virtual screening, Vaccine design.

TOTAL: 48 HOURS**TEXT BOOKS:**

1. Rashidi, H., and Buehler, L.K., (2005). *Bioinformatics Basics: Applications in Biological Science and Medicine*. CRC Press/Taylor & Francis Group.
2. Bergeron, B. (2002). *Bioinformatics Computing*. Prentice Hall Publishres.
3. Mount D. W. (2001). *Bioinformatics. Sequence and Genome Analysis*, Cold Spring Harbor Laboratory Press.

REFERENCE BOOKS:

1. Higgins, D., and Taylor, W. (2000). *Bioinformatics. Sequence, Structure and databanks – A Practical Approach*, Oxford University Press.
2. Baxevanis, A.D., and Francis Ouellette, B.F. (2001) *Bioinformatics – A Practical Guide to the Analysis of Genes and Proteins*, Wiley –Interscience.
3. Gibson, G., and Muse, S.V. (2002). *A Primer of Genome Science*, Sinauer Associates, Inc. Publishers.
4. Misener, S., and Krawetz, S.A. (2000). *Methods in Molecular Biology – Bioinformatics. Methods and Protocols*, Humana Press.

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
CO1	3	-	-	-	2	-	-	-	-	-	-	-	-	-	-	3	-
CO2	3	-	2	2	-	-	-	-	-	3	-	-	-	-	-	-	3
CO3	-	-	2	2	2	-	-	-	-	3	-	-	-	-	-	-	3
CO4	-	-	-	2	-	-	-	-	-	3	-	-	-	-	-	-	3
CO5	-	-	2	2	-	-	-	-	-	3	1	-	-	-	-	-	3
Average	3	-	2	2	2	-	-	-	-	3	1	-	-	-	-	3	3

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

PREREQUISITE:

- Not required

COURSE OBJECTIVES (CO):

- To understand the basics of pharmaceutical microbiology and important microorganism playing roles pharmaceutically
- To understand different products of microbial origin playing a key role in pharmaceutical applications.
- To understand good practices and regulations involved in utilizing the microbial products for pharmaceutical application

COURSE OUTCOME (COs):

Upon completion of this course students will be able to

COs	Course Outcomes	Blooms Level
CO1	Understand pharmaceutical microbiology and well versed with the different microbial products used in pharmaceutical applications	Understand
CO2	Understand and apply of good laboratory practices and regulations for utilizing the microbial products in pharmaceutical applications	Apply
CO3	Learn and practice various drug discovery tools and appreciate the use of in silico methods in drug designing.	Apply
CO4	Analyze nucleic acids and their importance to combining and analyzing information	Analy
CO5	Understand and apply the process of production of various biopharmaceuticals from microbes	Apply

UNIT I Microorganisms affecting the pharmaceutical industry**10 HOURS**

The atmosphere, water, skin & respiratory flora of personnel, raw materials, packing, equipment's, building, utensils, etc. Types of microorganisms occurring in pharmaceutical products. Microbiological spoilage prevention of pharmaceutical products. Preservation of pharmaceutical products; antimicrobial agents used as preservatives, evaluation of the microbial stability of the formulation. Sterilization in the pharmaceutical industry Good manufacturing practices in the pharmaceutical industry. Physical, chemical & mechanical method of sterilization. Sterility indicators.

UNIT II Drug Metabolism**10 HOURS**

Absorption and distribution of drugs, importance of drug – protein interaction. Drug metabolism: chemical pathway of drug metabolism, phase I and phase II reactions, role of cytochrome P450, non- microsomal reactions of drug metabolism, drug metabolizing enzymes. Drug elimination of liver and kidney. Biotransformation of drugs. Enzymes responsible for bio transformations, microsomal & non-microsomal mechanism. Microbial products in pharmaceutical Industry.

UNIT III Drug Discovery and Development**10 HOURS**

Microbial, Recombinant, Biochemical and Molecular level screening systems and their construction/ design strategies. Conventional Process; Bio- prospecting. Search of database/data mining for Drug designing; Preclinical and Clinical trials; Estimation of toxicity: LD50 and ED50; Rational Drug Design – Principle (Structure activity relationship - SAR) and Tools (applications of High through Put Screening,

Combinatorial synthesis). Drug target, computer aided drug design, Preclinical and clinical testing.

UNIT IV The drug resistance

8 HOURS

The drug resistance – Drug sensitivity testing methods and their importance. Assay for antibiotics – Determination of MIC, the liquid tube assay, solid agar tube assay, agar plate assay (disc diffusion, agar well and cylinders cup method). Biochemical mechanism of resistant. Resistant bacteria by over use and misuse of antibiotics and uses of antibiotic combinations.

UNIT V Regulatory aspects in pharmaceuticals

10 HOURS

Good laboratory/manufacturing practices for pharmaceuticals production, validation and regulation; Government regulatory practices and policies for pharmaceutical industry: Food and Drug Administration (FDA), The Central Drugs Standard Control Organization (CDSCO), the Drug Controller General of India (DCGI); patenting of pharmaceutical products. Quality control and Quality assurance, GMP, Pharmacopeia, Good ~~manufacturing~~ practices in pharmaceutical industry.

TOTAL: 48 HOURS

TEXT BOOKS:

1. Geoff Hanlon & Norman A (2013). *Hodges Essential Microbiology for Pharmacy and Pharmaceutical Science*, Wiley-Blackwell
2. Prahlad Singh Mehra (2011). *A Textbook of Pharmaceutical Microbiology*, I K International Publishing House

REFERENCE BOOKS:

1. Madhu Raju Saghee , Tim Sandle , Edward C. Tidswell (2011). *Microbiology and Sterility Assurance in Pharmaceuticals and Medical Devices*, Business Horizons.
2. Geoff Hanlon, Norman A. Hodges (2013). *Essential Microbiology for Pharmacy and Pharmaceutical Science*, Wiley-Blackwell.
3. Stephen P. Denyer, Norman A. Hodges, Sean P. Gorman, Brendan F. Gilmore (2011). *Hugo and Russell's Pharmaceutical Microbiology*, Wiley-Blackwell.

WEB REFERENCE:

1. <https://pharmacy.sgtuniversity.ac.in/syllabus-pharmaceutical-microbiology-theory-b-pharmacy/>
2. <https://www.umu.se/en/education/syllabus/3fa015/>

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	POS2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
CO2	2	-	2	2	-	-	-	-	-	-	-	-	-	-	-	-	3
CO3	-	-	-	2	2	2	-	-	-	2	-	-	-	-	-	-	3
CO4	3	-	2	2	-	-	-	-	-	-	-	-	-	-	-	-	3
CO5	-	-	2	2	-	-	-	3	-	-	-	-	-	-	-	-	3
Average	3	-	2	2	2	2	-	3	-	2	-	-	-	-	-	-	3

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

PREREQUISITE:

- Microbial Physiology and Metabolism (24MBP102)

COURSE OBJECTIVES (CO):

- To equip the candidates on basic techniques in the isolation, characterization and identification of microorganism.
- To know various culture media and their applications and physical and chemical means of sterilization.
- To understand general bacteriology and microbial techniques for isolation of pure cultures.

COURSE OUTCOME (COs):

Upon completion of this course students will be able to

COs	Course Outcomes	Blooms Level
CO1	Practice sterilization, isolation and identification of the microorganisms using microbiological techniques	Apply
CO2	Demonstrate aseptic techniques and be able to perform routine culture handling tasks safely and effectively.	Apply
CO3	Learn the various methods for identification of unknown microorganisms	Analyze
CO4	Apply various Physical and Chemical growth requirements of bacteria and methods of bacterial growth measurement	Apply
CO5	Analyse the modes and mechanisms of energy conservation in microbial metabolism	Analyze

EXPERIMENTS**46 HOURS****Micrometry**

1. Staining techniques: Simple, Gram Staining, Capsule, Endospore and Acid fast staining (Demo)
2. Molecular Identification using 16S rRNA
3. Motility determination - Hanging drop and SIM inoculation.
4. Cultivation of anaerobic microorganisms – Wrights tube – McIntosh anaerobic jar-roll tube methods.
5. Lactophenol cotton blue mounting of fungi – *Aspergillus* sp, *Mucor* sp, *Rhizopus* sp, *Fusarium* sp, *Penicillium* sp
6. Measurement of microbial growth – Viable count – Direct count – Turbidity methods
7. Biochemical characterization
 - a) Indole Test
 - b) Methyl Red Test
 - c) Voges Proskauer Test
 - d) Citrate utilization Test
 - e) TSI Test
 - f) Catalase Test
 - g) Oxidase Test
 - h) Urease Test
 - i) Nitrate Test

- j) Carbohydrate fermentation Test
 - k) Amino acid utilization Test
8. Hydrolysis of polymers- Starch, Lipid, Casein, Gelatin.

Total: 46 HOURS

TEXT BOOKS:

1. Cappucino, J.G. and Sherman, N., (2001). *Microbiology A Laboratory Manual*, (6thed.). Benjamin Cummings, New York.
2. Gunasekaran, P. (1996). *Lab Manual in Microbiology*, (1sted.). New Age International (P)Ltd, Publishers, New Delhi.

REFERENCE BOOKS:

1. Dubey, R.C., and Maheshwari, D.K., (2002). *Practical Microbiology*, (1sted.). S. Chand and Company Ltd, New Delhi.
2. Brook, G.F., J., Butel, S., Stephen, A., and Morse, A., (2003). *Medical Microbiology*, (22nded.). McGraw Hill.
3. Chakraborty, P. (2003). *A Text book of Microbiology*. (2nded.). New Central Book Agency (P) Ltd., Calcutta.
4. Dismukes, W.E., Pappas, P.G., and Sobel, D., (2003). *Clinical Mycology*. Oxford University Press, UK.
5. Jawetz, E., Melnic, J.L., and Adelberg, E.A., (2019). *Medical Microbiology*. (28thed.). Lange Medical Publishers. NY

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	POS2
CO1	3	-	-	2	-	-	-	2	-	-	-	-	-	-	-	3	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO3	-	-	-	3	-	-	-	2	-	-	-	-	-	-	-	3	-
CO4	-	-	-	3	-	2	-	2	-	-	-	-	-	-	-	3	-
CO5	-	-	-	2	-	2	-	2	-	-	-	-	-	-	-	-	3
Average	3	-	-	2.5	-	2	-	2	-	-	-	-	-	-	-	3	3

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

PREREQUISITE:

- Microbial Genetics and Molecular Biology (24MBP103)
- Bioinstrumentation (24MBP104)

COURSE OBJECTIVES (CO):

- To acquire skills in the different molecular mechanisms of gene transfer, mutations and separation of nucleic acids.
- To equip the students with practical knowledge on basic techniques in Genetics.
- To learn and practice protein purification.

COURSE OUTCOME (COs):

Upon completion of this course students will be able to

COs	Course Outcomes	Blooms Level
CO1	Practice gene transfer, mutations and separation of nucleic acids techniques	Apply
CO2	Imparts knowledge in Bacterial transformation and conjugation	Apply
CO3	Learn and practice isolation of bacteriophages	Apply
CO4	Apply amino acids using various techniques	Apply
CO5	Learn and practice protein purification	Apply

EXPERIMENTS**48 HOURS**

1. Spontaneous Mutation – gradient plate technique
2. Induced Mutagenesis-chemical and physical -UV
3. Replica plating technique.
4. Competent cell preparation and Transformation in Bacteria
5. Bacterial Conjugation
6. Isolation of plasmid DNA from Bacteria
7. Isolation of chromosomal DNA from Bacteria
8. Estimation and purification of DNA.
9. Restriction digestion and electrophoresis.
10. Isolation and estimation of phages(T4)
11. Nuclear staining for nucleic acid identification.
12. Analysis of amino acid by Paper chromatography
13. Analysis of amino acid by Thin layer chromatography
14. Purification of proteins by column chromatography

TOTAL: 48 hours**TEXT BOOKS:**

1. Palanivelu, P. (2004). *Analytical Biochemistry and Separation Techniques*, (3rded.).

REFERENCE BOOKS:

1. Arora, B., and Arora, D.R., (2007). *Practical Microbiology*, 1st Ed. CBS Publishers and Distributors, Bangalore.
2. Alfred Brown and Heidi Smith. (2015). *Benson's Microbiological Applications, Laboratory Manual in General Microbiology*, 13th Edition, McGraw-Hill.

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
CO1	3	-	-	2	2	-	-	2	-	-	-	-	-	-	-	-	3
CO2	3	-	-	2	-	-	-	2	-	-	-	-	-	-	-	-	3
CO3	-	-	-	2	-	-	-	2	-	-	2	-	-	-	-	-	3
CO4	-	-	-	3	-	-	-	2	-	-	2	-	-	-	-	-	3
CO5	-	-	-	3	-	-	-	2	-	-	2	-	-	-	-	-	3
Average	3	-	-	2.4	2	-	-	2	-	-	2	-	-	-	-	-	3

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

JOURNAL PAPER ANALYSIS AND PRESENTATION

Instruction Hours/week: L:2 T:0 P:0

PREREQUISITE:

- Not required

COURSE OBJECTIVES (CO):

- To learn structure, classification, evolution and architecture of viruses
- To know how viruses are classified and interactions between viruses and the host immune system.
- To isolate and culture them and their potential use in research and therapy.

COURSE OUTCOME (COs):

Upon completion of this course students will be able to

COs	Course Outcomes	Blooms Level
CO1	Describe the structure and replication strategies of the viruses, the processes of entry into cells, control of gene transcription and where relevant translation and gene product stability.	Understand
CO2	Define and analyze the process of virus latency and describe in molecular terms control of the process and activation of viral genomes during reactivation and the interactions between viruses and the host immune system.	Analyze
CO3	Describe the growth behavior differences between normal cells and cells transformed by oncogenic DNA and RNA viruses.	Understand
CO4	Integrate experimental strategies learned in the context of viral systems into the design of experiments involving other systems.	Apply
CO5	Distinguish the replication strategies of representative viruses from the seven Baltimore classes	Create

Unit I Viral classification and properties**10 HOURS**

Historical perspective of virology - Scope of virology -Viral classification (Baltimore classification) and properties of viruses - Viral assay, cultivation of viruses (animal inoculation, Embryonated egg and tissue culture) - properties of viroids and Prions. Purification of virus: *in vivo* and *in vitro* methods.

Unit II Animal DNA viruses**10 HOURS**

Animal viruses- DNA viruses - morphology, replication, pathogenesis and laboratory diagnosis of Pox virus, Adeno virus, Hepatitis viruses - type B. Herpes simplex viruses, Oncogenic viruses- Papova virus - oncogenes and Oncogenesis.

Unit III Animal RNA viruses**10 HOURS**

Animal viruses - RNA viruses - morphology, replication, pathogenesis and laboratory diagnosis of Poliovirus. Rabies virus, Influenza virus, Mumps virus, Measles virus and Rubella virus, Retro virus - HIV virus. Dengue and Japanese Encephalitis, Swine Flu, Coronavirus-SARS and COVID-19.

Unit IV Plant viruses**10 HOURS**

Plant viruses - RNA viruses - TMV, Cowpea mosaic virus, Bunchy top virus: Brome mosaic viruses, Satellite viruses - Double stranded DNA viruses - CaMV - Single stranded DNA viruses - Gemini virus. Structure

and Replication of Bacteriophage (T4) - Filamentous phage (ΦX174). F2 phage, Fφ phage.

Unit V Immunization and Virology Techniques

8 HOURS

Nosocomial infections, Viral Vaccines-Interferons - Antiviral drugs Types of viral vaccine and their immunization schedule in children and adults.

TOTAL: 48 HOURS

TEXT BOOKS:

1. Ananthanarayanan, R., and Panicker, C.K.J., (2005). *Text book of Microbiology*. (7thed.). Orient Longman, New Delhi.
2. Cann, A.J. (2015). *Principles of Molecular Virology* (6th ed) Academic Press.
3. Prescott, M., Harley, J.P., and Klein, D.A., (2007). *Microbiology*. (7thed.). McGraw-Hill Inc. New York.
4. White, D. O., and Fenner, F.J., (2016). *Medical Virology*, (5thed.). Academic Press, New York.
5. Levy, J. A., Fraenkel-Conrat, H., and Owens, O. S., (1994). *Virology*. (3rded.). Benjamin Cummings.
6. Knipe D.M., Howley P.M., and Griffin D.E., (2006). *Fields Virology*. (5thed). Vols - I, II. Lippincott, Williams & Wilkins.

REFERENCE BOOKS:

1. Carter, J., and Saunders, V., (2013). *Virology: Principles and Applications*. (2nd ed). Wiley. Acheson, N.H. (2011). *Fundamentals of Molecular Virology*. (2nd ed), Wiley publication.
2. Dimmock, N.J., Easton, A.J., and Leppard, K.N., (2016). *Introduction to Modern Virology*, (7thed.). Blackwell Scientific Publications, Oxford, UK.
3. Flint, S.J., Racaniello, V.R., Enquist, L.W., Rancaniello, V. R., and Skalka, A. M., (2020). *Principles of Virology: Multi volume*. American Society Microbiology.
4. Jawetz, E., Melnic, J.L., and Adelberg, E.A., (2001). *Review of Medical Microbiology*. (22nded.). Lange Medical Publishers, NY.

WEBSITES:

1. <https://www.medicalnewstoday.com/articles/181418.php>
2. https://www.medicinenet.com/swine_flu/article.htm#swine_flu_h1n1_and_h3n2_influenza_

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO2	3	-	-	2	-	-	-	2	-	-	-	-	-	-	-	3	-
CO3	3	-	2	-	-	-	-	2	-	-	-	-	-	-	-	3	-
CO4	-	-	3	3	-	-	-	2	-	-	-	-	-	-	-	3	-
CO5	2	-	2	2	-	-	-	-	-	-	-	-	-	-	-	3	-
Average	2.75	-	2.33	2.33	-	-	-	2	-	-	-	-	-	-	-	3	-

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

Instruction Hours / week: L: 3 T: 1 P: 0

Marks: Internal: 40 External: 60 Total: 100

End Semester Exam: 3 Hours

PREREQUISITE:

- Not required

COURSE OBJECTIVES (CO):

- To introduces basic principles and then applies clinical relevance of manyetiological agents.
- To provide the basic principles of medical microbiologyand infectious disease, and mechanisms of infectious disease transmission, principles of aseptic practice
- To focus on pathogenic mechanisms in order to foster a student’s ability to solve problemsin their future clinical career

COURSE OUTCOME (COs):

Upon completion of this course students will be able to

COs	Course Outcomes	Blooms Level
CO1	Demonstrate an advanced level of microbial virulence mechanisms and host response to infection.	Understand
CO2	Apply molecular techniques to medical microbiology	Apply
CO3	Demonstrate skin and respiratory tract infections to identify a unknown organisms in clinical samples	Understand/ Apply
CO4	Apply diagnostic skills, and interpretation of laboratory tests in the diagnosis of infectious diseases.	Apply
CO5	Understand pathogenic bacteria in human disease with respect to infections of the respiratory tract, gastrointestinal tract, urinary tract, skin and soft tissue.	Understand

Unit I Isolation and identification of pathogens**11 HOURS**

Laboratory precaution and guidelines - Collection of clinical specimens - Blood, Urine, Sputum, Pus, CSF, Stool, Throat swab, Semen, Dental plaque - transport Media and its types - handling and examination of pathological specimens - Routine Laboratory diagnosis of bacterial pathogen -Antibiotic susceptibility testing. Quality control in microbiology lab, clean room maintenance and surveillance, face mask porosity testing- Bacterial Filtration Efficiency (BFE).

Unit II Infections**9 HOURS**

Infections - types of infections - methods of infections - Sources of infections - infectious disease cycle. Biomedical waste management. Definitions of Epidemics, Endemics Pandemics and investigation of epidemics and control. Definition of pathogens, Saprophytes and Commensal.

Unit III Gram positive organisms**9 HOURS**

Morphology, cultural characteristics, antigenic property, pathogenicity, laboratory diagnosis and treatment. *Staphylococcus* sp., *Streptococcus* sp., *Bacillus* sp., *Corynebacterium* sp., *Clostridium* sp. *Mycobacterium* sp.

Unit IV Gram negative organisms**9 HOURS**

Morphology, cultural characteristics, antigenic property, pathogenicity, laboratory diagnosis and treatment. *E.coli*, *Klebsiella* sp., *Proteus* sp., *Pseudomonas* sp., *Vibrio* sp., *Salmonella* sp., *Shigella* sp., *Treponema* sp., *Leptospira* sp; *Neisseria* sp. and *Haemophilus* sp.

Unit V Infection and Therapy**10 HOURS**

Nosocomial infection - Urinary tract infection, Respiratory tract infection, sexually transmitted disease - Monoprophylaxis - Antimicrobial chemotherapy and antibiotics. Antibacterial resistance- Inhibitors of nucleic acid synthesis, inhibitors of protein synthesis and inhibitors of cell membrane synthesis. Vaccines - Types - Vaccination schedule.

TOTAL: 48 HOURS**TEXT BOOKS:**

1. Ananthanarayanan, R., and Panicker, C.K.J. (2017). *Text Book of Microbiology* (10thed.). The Orient Blackswan.
2. Carl Fraenkel (2012). *Text book of bacteriology*. Printing company publishers, New York.

REFERENCE BOOKS:

1. Salle, A.J. (2008). *Fundamentals principles of bacteriology*. T.M.H. Ed.). McGraw Hill.
2. Brook, G.F., J., Butel, S., Stephen, A., and Morse, A., (2003). *Medical Microbiology*, (22nded.). McGraw Hill.
3. Jawetz, E., Melnic, J.L., and Adelberg, E.A., (2019). *Medical Microbiology*. (28thed.). Lange Medical Publishers. NY.

CO, PO, PSO Mapping

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PO1 3	PO1 4	PO1 5	PSO 1	POS 2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	3
CO2	2	-	2	3	-	-	-	2	-	-	-	-	-	-	-	2	3
CO3	3	-	-	2	-	-	-	-	-	-	-	-	-	-	-	3	2
CO4	-	-	-	3	-	-	-	-	-	2	-	-	-	-	-	3	-
CO5	3	-	3	2	-	-	-	2	-	-	-	-	-	-	-	-	3
Average	3	-	2.5	2.5	-	-	-	2	-	2	-	-	-	-	-	2.5	3

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

PREREQUISITE:

- Fundamental knowledge in algebra and probability and statistics.
- Basic understanding of research methodology and data collection techniques.

COURSE OBJECTIVES (CO):

- To introduce the fundamental concepts of biostatistics and correlation.
- To understand the principles and methods of tests of significance, ANOVA and sampling parameters.
- To gain knowledge about the scope, significance, and processes involved in research

COURSE OUTCOME (COs):

Upon completion of this course students will be able to

COs	Course Outcomes	Blooms Level
CO1	Apply the concepts of correlation and regression to analyze relationships between variables in bioscience.	Apply
CO2	Apply hypothesis testing methods, including t-tests, Z-tests, and F-tests, to bioscience data.	Apply
CO3	Understand the basic concepts of multivariate statistics and their significance in biostatistics.	Understand
CO4	Analyze the problems in research and characteristics of good research to enhance research quality.	Analyze
CO5	Learn and apply different types of sampling methods (random and non-random sampling) to collect data effectively.	Apply

UNIT I INTRODUCTION OF BIostatistics AND CORRELATION**10 HOURS**

Introduction to Biostatistics: Mean, Median, Mode, Basic Measures - Central Tendency and Dispersion, Variables in Bioscience, Correlation – Meaning and definition - Scatter diagram –Karl Pearson’s Correlation Coefficient. Rank Correlation. Regression: Regression in two variables – Properties of Regression, uses of Regression.

UNIT II TEST OF SIGNIFICANCE**10 HOURS**

Sampling parameters: sample and Population, Censoring, difference between parametric and non-parametric statistics. Sampling Distributions, Standard Error, Testing of Hypothesis, Level of Significance and Degree of Freedom, Confidence Interval; Small sample test based on t-test, Large Sample Test based on Normal Distribution: Z-test and F test.

UNIT III ANALYSIS OF VARIANCE**10 HOURS**

Basic Introduction to Multivariate statistics. Test of significance: Tests based on Means only-Both Large sample and small sample tests – Chi-square test – the goodness of fit. Analysis of Variance: one way and two-way classification, CRD, RBD Designs.

UNIT IV RESEARCH**9 HOURS**

Research: Scope and significance – Types of Research – Research Process – Characteristics of good research – Problems in Research – Identifying research problems.

UNIT V SAMPLING DESIGN**9 HOURS**

Research Designs – Features of good research designs. Sampling Design: Meaning – Concepts – Steps in sampling – Criteria for good sample design. Scaling measurements - Types of scale, Types of sampling – random sampling and non-random sampling. Sampling Errors.

TOTAL: 48 HOURS**TEXT BOOKS:**

1. Jerrold H. Zar. (2003). *Biostatistical Analysis*. (4thed.). Pearson Education(P) Ltd, Delhi.
2. Kothari. C.R. (2004). *Research Methodology – Methods and Techniques*. (2nded.). New Age International Pvt. Ltd, New Delhi.

REFERENCE BOOKS:

1. Daniel, Wayne W. (1999). *Biostatistics: A Foundation for Analysis in the Health Sciences* (7th ed.). John Wiley & Sons, Inc.
2. Sokal, Robert R., and Rohlf, F. James. (1995). *Biometry: The Principles and Practice of Statistics in Biological Research* (3rd ed.). W.H. Freeman and Company.
3. Altman, Douglas G. (1991). *Practical Statistics for Medical Research*. Chapman & Hall/CRC.

WEBSITES:

1. <https://www.coursera.org/courses?isNewUser=true&query=biostatistics>

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	POS2
CO1	-	-	-	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	3	-	3	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Average	-	-	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

PREREQUISITE:

- Not required

COURSE OBJECTIVES (CO):

- To study the biofertilizers, plant disease and increasing soil fertility.
- To impart a skilled knowledge on Microbes and environment and ecological importance.
- To understand the role of microbes in biogeochemical processes in different ecosystems.

COURSE OUTCOME (COs):

Upon completion of this course students will be able to

COs	Course Outcomes	Blooms Level
CO1	Understand the areas of Environmental microbiology and applications in environmental management.	Understand
CO2	Learn and practice bio fertilizer production	Apply
CO3	Apply the basic microbiological principles, the methods in microbial ecology and their theoretical and practical use	Apply
CO4	Analyze the microbial role in nutrient cycling and water quality	Analyze
CO5	Become Entrepreneurs after understanding the process and product development.	Create

Unit I Aquatic environment**9 HOURS**

Microbiology of water-water-borne diseases and their control measures. Microbes living around us. Major water pollutants. Microbiological analysis of water (total count, indicative organism), B.O.D. & C.O.D. - determination and implication. Methods of sewage treatment - physical screening, chemical, biological (sludge digestion; activated sludge, aerating filters, oxidation pond), solid waste microbial degradation.

Unit II Microbiology of air and Bioremediation**9 HOURS**

Microbial contaminants of air –Indoor air quality analysis- Micro flora in Hospitals, Houses and Library. Microbial indicators of air pollution. Air samplers and sampling techniques. Air sanitation. Bioremediation of air pollutants., Role of Microbiologist in pollution control.. Bioleaching – Biology of mineral leaching, recovery of metal from ores– oxidation of minerals – testing for biodegradability. Microbes and climate change or emission of green house

Unit III Microbes in agriculture and Biocontrol**10 HOURS**

Importance of microbes in agriculture, Current agriculture problems and solution. Bacterial diseases of agricultural crops - pathogens, symptoms and control measures with reference to Paddy, cotton, maize, tomato, citrus, mango and potato. Plant protection –phenolics – phytoalexins and related compounds. Biocontrol and its application: Biofungicides, bionematicides and Biopesticides- Microalgal species involved in bioremediation of pesticides

Unit IV Plant microbes interaction**10 HOURS**

Symbiotic and non-symbiotic microorganisms, root nodule formation, nitrogen fixers, Ureide metabolism in Plants, Enzymology (Hydrogenase, Nitrogenase), Genetics of symbiotic fixers- nif gene regulation.

Rhizosphere- R: S ratio, Interaction of microbes with plants. Bioconversion of agricultural wastes. Plant microbial interactions-Endophytic cycles. VAM and Pink-pigmented facultative methylophilic bacteria (PPFM).

Unit V Biofertilizers

10 HOURS

An Industrial Perspective of Plant Beneficial Microorganisms– A combination of biofertilizer and manure applications with reference to soil, seed and leaf sprays. Plant growth promoting microorganisms-*Mycorrhizae*, *Rhizobia*, *Azospirillum*, *Azotobacter*, *Azolla*, *Frankia*, Blue green algae, Phosphate- solubilizers fluorescent *Pseudomonas*. Entrepreneurship development in biofertilizer. Women scheme to initiate the start up and small scale business.

TOTAL: 48 HOURS

TEXT BOOKS:

1. Rangaswami, G., and Bhagyaraj, D.J., (2001). *Agricultural Microbiology*. (2nd ed.). Prentice Hall, New Delhi.
2. Saxena., and Sanjai., (2015). *Applied Microbiology*. Springer, Germany.
3. Bagyaraj D.J., and Rangaswami.G. (2009). *Agricultural Microbiology* (2nd edition). PHI Learning Pvt. Ltd.
4. Atlas, R.M., and Bartha, M., (2000). *Microbial Ecology - Fundamental and Applications*. (3rd ed.). Redwood City CA. Benjamin/Cumming Science Publishing Co., New Delhi.

REFERENCE BOOKS:

1. Denise., G.A., Sarah, S., and Deborah, A., (2015). *Nester's Microbiology*. McGraw-Hill Education.
2. Sen, K., and Ashbolt, N.J., (2010). *Environmental Microbiology: Current Technology and Water Applications*.
3. .K. R. Aneja. 2017. *Fundamental agricultural microbiology* (19th edition). New Age International Private Limited.

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	2	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	3
CO3	2	-	-	-	-	-	-	3	-	-	-	-	-	-	-	2	-
CO4	2	-	-	2	-	-	-	3	-	-	-	-	-	-	-	1	3
CO5	2	-	-	2	-	-	-	3	-	-	-	-	-	-	2	2	-
Average	2.2	-	-	2	-	-	-	3	-	-	-	-	-	-	2	2.5	3

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

PREREQUISITE:

- Not required

COURSE OBJECTIVES (CO):

- To understand critical IT and national critical infrastructure.
- Understanding of the cyber- attacks that target computers, mobiles and persons
- Risk- based assessment, requirement of security controls and need for cyber security audit

COURSE OUTCOME (COs):

Upon completion of this course students will be able to

COs	Course Outcomes	Blooms Level
CO1	Understand the basic terminologies related to cyber security and current cyber security threat landscape.	Understand
CO2	Understanding of the cyber- attacks that target computers, mobiles and persons.	Understand
CO3	Understand the legal framework that exist in India for cybercrimes and penalties and punishments for such crimes	Understand
CO4	Understand the aspects related to personal data privacy and security.	Understand
CO5	Understand the main components of cyber security plan.	Understand

Unit I - Overview of Cyber security**7 HOURS**

Cyber security increasing threat landscape- Cyber Security Terminologies-Cyberspace, attack, attack vector, attack surface, threat, risk, vulnerability, exploit, exploitation, hacker., Non-state actors, Cyber Terrorism- Protection of end user machine- Critical IT and National Critical Infrastructure- Cyberwarfare-Case Studies.

Unit II - Cyber crimes**9 HOURS**

Cybercrimes targeting Computer systems and Mobiles- data diddling attacks, spyware, logic bombs, DoS, DDoS, APTs, virus, Trojans, ransomware, data breach- Online scams and frauds- email scams, Phishing, Vishing, Smishing, Online job fraud, Online sextortion, Debit/ credit card fraud, Online payment fraud, Cyberbullying, website defacement, Cyber- squatting, Pharming, Cyber espionage, Cryptojacking, Darknet- illegal trades, drugtrafficking, human trafficking-Social Media Scams & Frauds- impersonation, identity theft, job scams, misinformation, fake news cyber crime against persons - cyber grooming, child pornography, cyber stalking- Social Engineering attacks, Cyber Police stations, Crime reporting procedure- Case studies.

Unit III - Cyber Law**8 HOURS**

Cybercrime and legal landscape around the world- IT Act-2000 and its amendments. Limitations of IT Act-2000. Cybercrime and punishments- Cyber Laws and Legal and ethical aspects related to new technologies- AI/ML, IoT, Block chain, Dark net and Social media- Cyber Laws of other countries- Case Studies.

Unit IV - Data Privacy and Data Security**8 HOURS**

Defining data, meta-data, big data, non- personal data- Data protection, Data privacy and data security- Personal Data Protection Bill and its compliance- Data protection principles- Big data security issues and challenges- Data protection regulations of other countries- General Data Protection Regulations(GDPR)-2016 Personal Information Protection and

Electronic Documents Act (PIPEDA)-Social media- data privacy and security issues.

Unit V - Cyber Security Management, Compliance and Governance

8 HOURS

Cyber security Plan- cyber security policy, cyber crises management Plan-Business continuity- Risk Assessment-Types of security controls and their Goals-Cyber security audit and compliance- National cyber security policy and strategy.

TOTAL: 40 HOURS

TEXT BOOK:

1. Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Sumit Belapure and Nina Godbole, Wiley India Pvt. Ltd.
2. Information Warfare and Security by Dorothy F. Denning, Addison Wesley.

REFERENCE BOOK:

1. Security in the Digital Age: Social Media Security Threats and Vulnerabilities by Henry A. Oliver, Create Space Independent Publishing Platform.
2. Data Privacy Principles and Practice by Natraj Venkataramanan and Ashwin Shriram, CRC Press.
3. Information Security Governance, Guidance for Information Security Managers by W. KragBrothy, 1st Edition, Wiley Publication.
4. Auditing IT Infrastructures for Compliance by Martin Weiss, Michael G. Solomon, 2nd Edition, Jones Bartlett Learning.

WEBSITES:

1. www.Cybercrime.gov.in
2. <https://gac.gov.in/>
3. <https://www.india.gov.in/password-policy-ministry-electronics-and-information-technology?page=3>
4. <https://mahe.gov.in/mobile-app-policy/>
5. <https://www.dsci.in/>

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	POS2
CO1	2	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-
CO2	-	-	-	-	-	2	-	-	-	-	-	-	3	-	-	-	3
CO3	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	3
CO5	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	3
Average	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	3

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

PREREQUISITE:

- Not required

COURSE OBJECTIVES (CO):

- To deal with enzyme structure, stability, organization, and expression.
- To know the production and purification of microbial enzymes.
- To understand the role of enzymes in microbial metabolism.

COURSE OUTCOME (COs):

Upon completion of this course students will be able to

COs	Course Outcomes	Blooms Level
CO1	Understand the basics of enzymes with an emphasis on prokaryotes and eukaryotes	Understand
CO2	Analyze enzyme structure, stability, organization, and expression.	Analyze
CO3	Learn the role of enzymes in microbial metabolism	Understand
CO4	Learn and apply the production and purification of microbial enzymes	Apply
CO5	Analyze the enzymes behind complex diseases	Analyze

Unit I Bio energetics:**10 HOURS**

Enzyme nomenclature, classification, general properties of enzymes, factors affecting enzyme activity, activation energy, transition state, turnover number, enzyme co-factors. Enzyme kinetics; General kinetic principles; steady-state enzyme kinetics, Michelis-Menton equation, importance of Km and Vmax.

Unit II Enzyme inhibition and Enzyme regulation:**10 HOURS**

Enzyme inhibition and types- competitive, noncompetitive and uncompetitive inhibitors. Allosteric and cooperative effects, conquered model of Monod et al, and sequential model of Koshland et al, Principles of metabolic regulations; feedback regulations of multifunctional pathway.

Unit III Isolation and purification of enzymes:**10 HOURS**

Enzyme extraction –soluble enzymes, membrane bound enzymes, purification-precipitation methods, concentration of biomolecules: salting with ammonium sulphate precipitation, dialysis, lyophilization, chromatographic methods, total activity and specific activity.

Unit IV– Immobilization**8 HOURS**

Basic principles of cell and enzyme immobilization. Microencapsulation and Nanoencapsulation techniques. Protein Interaction , Inhibition kinetics.

Unit V –Uses of enzymes in analysis**10 HOURS**

Enzyme electrodes. Enzyme as biosensor, potentiometric biosensor, industrial applications of enzymes. Commercial value: steroidal conversions, penicillin and antibiotic conversion, immunosensor. Recent advances and future prospects of enzyme engineering; artificial enzymes and applications.

TOTAL: 48 HOURS

TEXT BOOKS:

1. Voet, D and Voet, J.G. (2011) *Biochemistry*. 4rd edition, John Wiley and Sons.
2. Berg, J.M., Tymoczko, J.L., and Stryer, L. (2011) *Biochemistry*, W. H. Freeman and Company.
3. Enzymes by P. Asokan, (2005). Chinna publications, 2nd edition.

REFERENCE BOOKS:

1. Nelson David I. and Cox, M.M. Macmillan. (2000). Principles of Biochemistry.
2. Robert K. Murray, Daryl K. Granner, Peter A. Mayes, Victor W. Rodwell, *Harpers Biochemistry* 24th edition, Prentice Hall International. Inc.
3. Hames & N.M. Hooper, *Instant Notes in Biochemistry*, 2nd Edition

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	POS2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	2
CO2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
CO3	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	3
CO4	2	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	3
CO5	2	-	-	-	-	-	-	3	-	2	-	-	-	-	-	-	3
Average	2.5	-	-	-	-	-	-	3	-	2	-	-	-	-	-	3	3

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

PREREQUISITE:

- Microbial Physiology and Metabolism (24MBP102)

COURSE OBJECTIVES (CO):

- To encompass the use of microorganisms in the manufacture of food or industrial products.
- To know the basics and concepts of fermentation techniques
- To elucidate the microbes in the production of microbial products.

COURSE OUTCOMES (COs):

Upon completion of this course students will be able to

COs	Course Outcomes	Blooms Level
CO1	Gain knowledge about basics in industrial biotechnology process	Understand
CO2	Demonstrate the Scale up methods for the production in large scale fermenter.	Apply
CO3	Elucidate the upstream processing for novel bioproducts	Apply
CO4	Learn and practice the process and protocol for the synthesis of bioproducts	Apply
CO5	Design various bioreactors for microbial fermentation and the production of bioproducts	Apply

Unit I Strain improvement & Preservation**10 HOURS**

Isolation, selection and improvement of important strains and pathways –Mutation, Protoplast fusion, parasexual cycle and genetic engineering for strain improvements, product formation and inhibition pathways and their regulations; applications in medicine, agriculture and industry. Role of plant and animal cells in bioprocess. Industrially important microorganisms, preservation, national and international culture collection centers.

Unit II Fermenter**10 HOURS**

Concepts and scope of Industrial microbiology, Primary and Secondary Screening of industrial microorganisms. Industrial fermentors: Basic functions, design and components. Different types of fermentors: Chemostat and turbidostat, tower fermentors, membrane bioreactors, scale up of fermentation process. Microbial growth kinetics: Batch cultures, continuous cultures, fed-batch cultures, industrial production of biomass and metabolites.

Unit III Fermentation media:**9 HOURS**

Desired qualities, sources of nutrition. Solid state and submerged fermentation. Industrial production of penicillin, alcohol, glutamic acid, and alcoholic beverages. Industrial enzymes: Production and applications of amylases, proteases, pectinases, cellulases and lipases- Industrial production.

Unit IV Physical factors and scale-up**9 HOURS**

Transport phenomena in fermentation: Gas- liquid exchange and mass transfer, oxygen transfer, critical oxygen concentration, heat transfer, aeration/agitation, its importance. Sterilization of Bioreactors, nutrients, air supply, products and effluents, process variables and control, scale-up of bioreactors, Upstream process.

Unit V Microbial Products and Downstream process**10 HOURS**

Enzymes- Introduction, large scale production, extraction and purification- Vitamins (Vitamin C), Amino acids, Enzymes, Antibiotics, Organic acids, Vaccines, Cheese, and Exopolysaccharides. Bio transformation product (steroid). Downstream processing: objectives and criteria Down streaming process of microbial products (Peptides, Biopolymers, surfactants, Enzymes) - separation, centrifugation, filtration, extraction, purification, crystallization, crystal washing, drying of crystals, freeze-drying, spray drying.

TOTAL: 48 HOURS**TEXT BOOKS:**

1. Peter Stanbury, Allan Whitaker., S, Stephen Hall. (2010). *Principles of Fermentation Technology*, 3rd Edition, 2016, Elsevier Science and technology.
2. Richard H. Baltz., Arnold L. Demain., Julian E. Davies. *Manual of Industrial Microbiology and Biotechnology*, 3rd edition, American Society for Microbiology.
3. Michael J. Waites., Neil L. Morgan. (2001). *Industrial Microbiology: An Introduction*, Wiley-Blackwell
4. El-Mansi, E. M. T., Bryce, C. F. A., Arnold L. Demain. Allman, A.R. (2011). *Fermentation Microbiology and Biotechnology*, 3rd Edition, CRC Press

REFERENCE BOOKS:

1. Shuler, M.L., Kargi F. and DeLisa, M. (2017). *Bioprocess Engineering: Basic concepts*, 3rd Edition, Prentice Hall, Engel wood Cliffs.
2. Casida, L.E.J.R. (2019). *Industrial Microbiology*, 2nd Edition, New Age International Private Ltd

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
CO2	2	-	-	2	-	-	-	3	-	-	2	-	-	-	-	-	3
CO3	-	-	-	2	-	-	-	3	-	-	-	-	-	-	-	-	3
CO4	-	-	-	2	-	-	-	2	-	-	-	-	-	-	-	-	3
CO5	-	-	-	2	-	-	-	3	-	-	2	-	-	-	2	-	3
Average	2.5	-	-	2	-	-	-	3	-	-	2	-	-	-	2	-	3

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

24MBP206 COMMUNITY ENGAGEMENT AND SOCIAL RESPONSIBILITY 2H-2C**Instruction Hours/week: L:2 T:0 P:0****Marks: Internal:40 External: 60 Total:100****End Semester Exam: 3 Hours****PREREQUISITE:**

- Not required

COURSE OBJECTIVES (CO):

- To gain insights into the structures, challenges, and opportunities within communities
- To explore ethical frameworks and dilemmas related to community engagement and social responsibility
- To develop skills in monitoring, evaluating, and reporting on the outcomes of community engagement efforts to ensure effectiveness and accountability.

COURSE OUTCOMES (COs):

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

COs	Course Outcomes	Blooms Level
CO1	Understand the concept, ethics, and spectrum of community engagement	Understand
CO2	Recognize the significance in local community development and rural culture.	Understand
CO3	Know the rural development programs, institutions	Understand
CO4	Comprehend methods for waste management	Understand
CO5	Implement policies for hygiene and sanitation among waste management workers	Apply

UNIT I INTRODUCTION AND PRINCIPLES**5 HOURS**

Concept, Ethics and Spectrum of Community engagement, Local community, Rural culture and Practice of community engagement - Stages, Components and Principles of community development, Utility of public resources. Contributions of self-help groups

UNIT II RURAL DEVELOPMENT**5 HOURS**

Rural Development Programs and Rural institutions Local Administration and Community Involvement- Social contribution of community networking, Various government schemes. Programmes of community engagement and their evaluation.

UNIT III COMMUNITY AND RESEARCH**5 HOURS**

Community Engaged Research and Ethics in Community Engaged Research Rural Distress, Rural Poverty, Impact of COVID-19 on Migrant Laborers, Mitigation of Disaster.

Unit IV Waste management**5 HOURS**

Waste management in rural and sub-urban areas; Government schemes on waste management; Types of waste. Collection, segregation, handling and dispersion of waste. Biomedical waste – Color code. The role of microorganisms in Waste management.

Unit V Personal care

4 HOURS

Personal care and hygiene for the waste management workers. Psychological wellbeing of the workers. Women folk health care and sanitary practices.

TOTAL: 24 HOURS

TEXT BOOK:

1. *Principles of Community Engagement*, (2011). 2nd Edition, NIH Publication No. 11-7782.
2. Tripathy, S.N., and Panda, S., (2011). *Fundamentals of Environmental Studies*; 3rd Edition, Vrianda Publications Private Ltd., New Delhi.
3. Kumar, A., (2004). *A Textbook of Environmental Science*; APH Publishing Corporation, New Delhi.

REFERENCE BOOKS:

1. Singh, M.P., Singh, B.S., and Dey, S.S., (2004). *Conservation of Biodiversity and Natural Resources*. Daya Publishing House, Delhi.
2. Uberoi, N.K., (2010). *Environmental Studies*, Excel Books Publications, New Delhi, India.
3. Maier RM, Pepper IL, Gerba CP (2019). *Environmental Microbiology*, Elsevier.
4. Bruce E Rittmann and Perry L McCarty. *Environmental Biotechnology. Principles and Applications*. McGraw-Hill International (2020) 2nd edition.

WEBSITES:

1. <https://youtu.be/-SQK9RGBt7o>
2. https://www.uvm.edu/sites/default/files/community_engagement_handout.pdf (Community Engagement)
3. https://www.atsdr.cdc.gov/communityengagement/pce_concepts.html (Perspectives of Community)
4. <https://egyankosh.ac.in/bitstream/123456789/59002/1/Unit1.pdf> (community concepts)
5. <https://sustainingcommunity.wordpress.com/2013/07/09/ethics-and-community-engagement/> (Ethics of community engagement)
6. <https://www.preservearticles.com/sociology/what-are-the-essential-elements-of-community/4558> (Elements of Community)
7. <https://www.yourarticlelibrary.com/sociology/rural-sociology/rural-community-top-10-characteristics-of-the-rural-community-explained/34968> (features of rural community)
8. <https://www.mapsofindia.com/my-india/government/schemes-for-rural-development-launched-by-government-of-india> (Government programmes for rural development)
9. <https://www.yourarticlelibrary.com/sociology/rural-sociology/rural-community-top-10-characteristics-of-the-rural-community-explained/34968> (rural lifestyle)
10. <https://www.insightsonindia.com/social-justice/issues-related-to-rural-development/government-schemes-for-rural-development-in-india/> (schemes for rural development)
11. <https://www.mpgkpdf.com/2021/09/community-development-plan-in-hindi.html?m=1>
12. <https://images.app.goo.gl/sNF2HMWCuCfkqYz56>
13. <https://images.app.goo.gl/VaMNNMEs77XyPMrP7>

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	3	2	-	-	-	-	-	-	-	-	-	2	2	-
CO5	-	-	-	3	2	-	-	-	-	-	-	-	2	-	-	2	-
Average	-	-	-	3	2	-	-	-	-	-	-	-	2	-	2	2-	-

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

PREREQUISITE:

- Environmental And Agricultural Microbiology (24MBP204)

COURSE OBJECTIVES (CO):

- To obtain practical skill in protein estimation, separation and purification
- To provide the basics of microbiology to build a foundation production of enzymes and antibiotics
- To study microbe enumeration from industry effluents.

COURSE OUTCOMES (COs):

Upon completion of this course students will be able to

COs	Course Outcomes	Blooms Level
CO1	Execute advanced techniques for protein estimation, separation and purification	Apply
CO2	Perform techniques for the production of enzymes and antibiotics	Apply
CO3	Practice production of microbial media from agricultural waste	Apply
CO4	Accomplish estimation of BOD and COD and enumeration of microbes from effluents	Apply
CO5	Achieve identification of VAM and estimation of lipase	Apply

EXPERIMENTS**48 HOURS**

1. Estimation of Protein by Lowry's Method.
2. Determination of molecular weight by SDS Polyacrylamide gel electrophoresis
3. Protein Purification using microfiltration.
4. Screening of (enzyme /antibiotic) production strain from soil samples
5. Formulation of cost effective alternative bacterial culture media from agricultural waste
6. Maintenance of culture on agar slants/glycerol stock
7. Isolation of symbiotic nitrogen fixers from root nodule –*Rhizobium*
8. Estimation of BOD and COD.
9. Identification of VAM fungi
10. Production and Estimation of Lipase enzyme.
11. Enumeration of microbes from industrial effluents.

TOTAL: 48 HOURS**TEXT BOOKS:**

1. Prakash S. Bisen. (2014). *Laboratory protocols in applied life sciences*. CRC Press, Taylor & Francis Group.
2. Alfred Brown and Heidi Smith. (2015). *Benson's Microbiological Applications, Laboratory Manual in General Microbiology*, 13th Edition, McGraw-Hill.

REFERENCE BOOKS:

1. Green and Sambrook. (2012). *Molecular Cloning: A Laboratory Manual*, 4th Edition, ColdSpring Harbor Laboratory Press, U.S.

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
CO1	3	-	-	-	-	-	-	3	-	-	-	-	-	-	-	3	2
CO2	-	-	-	2	-	-	-	3	-	-	-	-	-	-	-	3	2
CO3	-	-	-	2	-	-	-	3	-	-	-	-	-	-	-	2	3
CO4	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	2	3
CO5	2	-	-	-	-	-	-	3	-	-	-	-	-	-	-	3	3
Average	2.5	-	-	2	-	-	-	3	-	-	-	-	-	-	-	3	3

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

PREREQUISITE:

- Medical Microbiology (24MBP202)

COURSE OBJECTIVES (CO):

- To acquire practical knowledge in numerous diagnostic tests of clinical specimen
- To learn techniques for cultivation of virus
- To understand the techniques in biofilm formation

COURSE OUTCOME (COs):

Upon completion of this course students will be able to

COs	Course Outcomes	Blooms Level
CO1	Understand the clinical diagnosis of infection providing the combined treatment of bacteriology and virology.	Understand
CO2	Develop skills in biomedical waste Segregation and Disposal	Apply
CO3	Learn and practice antimicrobial sensitivity tests	Apply
CO4	Apply techniques for cultivation of virus	Apply
CO5	Practice and apply techniques in biofilm formation	Apply

EXPERIMENTS**48 HOURS**

1. Laboratory diagnosis of clinical specimen – Pus, Sputum, Urine, Blood, Stool.
2. Antibiotic sensitivity test disc preparation
3. Antibiotic sensitivity test – Kirby - Bauer, Stroke's method
4. MIC determination by Broth dilution technique, filter paper disc assay
5. Biomedical waste Segregation and Disposal (Color Coding)
6. Cultivation of Viruses-Egg inoculation and cell line (embryonated egg inoculation),
7. Isolation of coli phage from sewage using membrane filter technique.
8. ELISA.
9. Examination of plant viral diseases: Wilt of potato, Citrus canker, Rice dwarf virus.
10. MALDI TOF - Detection of bacterial hazards.
11. Antibiofilm formation.

TEXT BOOKS:**TOTAL HOURS: 48 HOURS**

1. Arora, B., and Arora, D.R., (2007). *Practical Microbiology*, (1sted.). CBS Publishers and Distributors, Bangalore
2. Cappucino, G.J., and Sherman, N., (2001). *Microbiology A Laboratory Manual*. (6thed.). Benjamin Cummings, New York.
3. Mukherjee, K.L. (2005). *Medical Laboratory Technology*, Vol. 3, Tata McGraw-Hill Publishing Company Ltd, New Delhi.
4. Sundararaj, T. (2005). *Microbiology laboratory manual*. Aswathy Sundararaj Publishers. Chennai.

REFERENCE BOOKS:

1. Baron, E.O., and Finegold, S., (1990). *Bailey and Scott's Diagnostic Microbiology*. (8thed.). C VMosby Company, StLouis.
2. Gaud, R.S., and Gupta, G.D., (1999). *Practical Microbiology*. (1sted.). Nirali Prakashan, Pune.
3. Reddy, S.M., and Reddy, S.R., (2004). *Microbiology A Laboratory Manual*. (3rded.). SriPadmavathi Publication, Hyderabad.
4. Vandepilte, J., Verhaegan, J., Engbaek, K., Rohner, P., Prot, P., and Heuck, C.C., (2004). *Basic Laboratory Procedures in Clinical Bacteriology*. (2nded.). A.I.T.B.S Publishers and Distributors, Delhi.

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	POS2
CO1	-	-	-	3	-	3	2	-	-	-	-	-	-	-	-	2	3
CO2	-	-	-	-	3	3	-	2	-	-	-	-	-	-	-	2	2
CO3	-	-	-	-	-	3	-	2	-	-	2	-	-	-	-	3	2
CO4	-	-	2	2	-	-	2	3	-	-	-	-	-	-	-	2	2
CO5	-	-	-	-	2	2	-	3	-	-	-	-	2	-	-	2	3
Average	-	-	2	2.5	2.5	3	2	3	-	-	2	-	2	-	-	2.2	2.4

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

JOURNAL PAPER ANALYSIS AND PRESENTATION

Instruction Hours/week: L:1 T:0 P:0

24MBP301

ADVANCED IMMUNOLOGY

Semester III

3H-2C

Instruction Hours/week: L:4 T:0 P:0

Marks: Internal:40 External:60 Total:100

End Semester Exam: 3 Hours

PREREQUISITE:

- Not required

COURSE OBJECTIVES (CO):

- To impart advanced knowledge through immune diagnosis, assessment of cell-mediated immunity and immunology of diseases.
- to identify the cellular and molecular basis of immune responsiveness.
- to describe immunological response and how it is triggered and regulated.

COURSE OUTCOMES (COs):

Upon completion of this course students will be able to

COs	Course Outcomes	Blooms Level
CO1	Strengthen the knowledge on the immune system, genetic control of antibody production, antigens and immunodiagnostics	Understand
CO2	Gain knowledge on the immune system, cells involved along with complement system and autoimmunity.	Understand
CO3	Develop an understanding of the immune system, antigen-antibody interactions.	Analyze
CO4	Analyze various diseased conditions generated due to the interplay of immune system components.	Analyze
CO5	Practice employment aspect of immunology and types of immune systems and mechanism of immune activation	Apply

UNIT I Immune system**8 HOURS**

Immunity – types. Cells of the immune system - lymphoid cells, mononuclear cells, granulocytic cells and mast cells. T & B – cell maturation, activation and differentiation. Organs of the immune system - primary and secondary lymphoid organs – cutaneous / mucosal - associated lymphoid tissues.

UNIT II Immunogenicity Functions**10 HOURS**

Antigens - factor influence immunogenicity - Epitopes - Haptens - study of antigenicity. Basis of antigen specificity. MHC – types and importance- distribution and function. Antigen processing and presentation to T-lymphocytes. Immunoglobulin- structure, types, distribution, biological and chemical properties - Antibody genes and antibody engineering –chimeric and hybrid monoclonal antibodies; Monoclonal and polyclonal antibodies. Complement system – mode of activation- Classical, Alternate and Lectin pathways, biological functions.

UNIT III Immune response**10 HOURS**

Antigen recognition – T-cell receptors (TCRs), B-cell receptor (BCR) MHC restriction, lymphocyte activation, clonal proliferation and differentiation. Physiology of acquired immune response – various phases of humoral immunity (HI), cell-mediated immunity (CMI), – cell mediated cytotoxicity, Autoimmunity, Hypersensitivity. Delayed-type Hypersensitivity (DTH) response- hypersensitivity types and Immunodeficiencies.

UNIT IV Vaccines**10 HOURS**

Active and passive immunization; Live, killed, attenuated, sub unit vaccines; vaccine technology –Role and properties of adjuvants, recombinant DNA and protein-based vaccines, plant-based vaccines, reverse

vaccinology; Peptide vaccines, conjugate vaccines; Catalytic antibodies and generation of immunoglobulin gene libraries.

UNIT V Immunological Techniques

10 HOURS

Antigen-antibody interactions: Precipitation, agglutination and complement-mediated immune reactions; Advanced immunological techniques –RIA, ELISA, Western blotting, ELISPOT assay, immunofluorescence, flow cytometry and immunoelectron microscopy; forensic serology, Immuno hematology – ABO, RH incompatibility Erythroblastosis fetalis and Immunological biosensor

TOTAL: 48 HOURS

TEXT BOOKS:

1. Ramesh, S.R. (2017). *Immunology*, 1st edition, McGraw Hill Education India Private Limited
2. Jenni Punt, Sharon Stranford, Patricia Jones, Judy Owen. (2019). *Kuby Immunology*, 8th Edition, W. H. Freeman
3. Ian Tizard. (2005). *Immunology: An Introduction*, 4th Edition, Cengage Learning.
4. Tanuja.S and Purohit, S.S. (2008). *Fermentation Technology*, Agrobios Publication, Jodhpur, India.

REFERENCE BOOKS:

1. Kuby. (2013). *Immunology*, 7th edition. W. H. Freeman and Company • New York.
2. Massoud Mahmoudi. (2009). *Immunology made ridiculously simple*. 1st edition. Med master.
3. Doan, Thao; Melvold, Roger; Viselli, Susan. (2012). *Lippincott's Illustrated Reviews, Immunology*, 2nd Edition, Lippincott Williams & Wilkins (LWW).
4. Peter J. Delves, Seamus J. Martin, Dennis R. Burton, Ivan M. Roitt. (2017). *Roitt's Essential Immunology*, 13th Edition, Wiley-Blackwell

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	POS2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	1
CO2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
CO3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
CO4	-	-	-	2	-	2	-	3	-	-	2	-	-	-	-	-	3
CO5	-	-	-	2	-	2	-	3	-	-	2	-	-	-	2	-	3
Average	3	-	-	2	-	2	-	3	-	-	2	-	-	-	2	3	3

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

PREREQUISITE:

- Principles and Systematics of Microbiology (24MBP101)
- Microbial Physiology and Metabolism (24MBP102)

COURSE OBJECTIVES (CO):

- To encompass the use of microorganisms in the manufacture of food or industrial products.
- To add information about the role of microorganisms in foods, beverage and pharma industries in production and spoilage processes.
- to discuss the role of microorganisms in industry, to carry out experiments to produce microbial metabolites

COURSE OUTCOME (COs):

Upon completion of this course students will be able to

COs	Course Outcomes	Blooms Level
CO1	Gain knowledge in the large-scale production of industrial products, providing the trends to cater to the needs of industry.	Understand
CO2	Gain theoretical and practical skills in food microbiology.	Understand
CO3	Analyze the role of microbes in food spoilage	Analyze
CO4	Analyze the importance of the role of microorganisms in food industries both in beneficial and harmful ways.	Analyze
CO5	Enhance their employment opportunities of microbiology-based food products.	Create

UNIT I Food Microbes**10 HOURS**

Food and microorganisms –Morphological Characteristics-Industrial Importance-Fungi, Bacteria; Intrinsic and extrinsic factors affecting microbial growth – sources of contamination of food. Food plant sanitation – Indicator microorganisms and Microbiological criteria – Coliform bacteria. Lactic antagonism and hurdle concept.

UNIT II Preservation**9 HOURS**

Food preservation – principles – factors affecting preservation – food preservation using temperature – low temperature food preservation, lyophilization high temperature food preservation — preservation of foods by drying chemicals and radiation – limitations – commercial applications.

UNIT III Food Toxins and Control**9 HOURS**

Spoilage of food and fermented food products - Sources, contamination, spoilage, preservation and control - cereals and cereals products, vegetables and fruits, meat and meat products, egg and poultry, fish and sea foods, canned foods. Fermented food – bread, sauerkraut and soy sauce.

UNIT IV Methods for detection**10 HOURS**

Applications of microorganisms in food and microbial fermentation. Methods for detection discusses the fermentation, pre and probiotics. Genetically modified foods. Phage based biosensor for the detection of pathogenic bacteria. Sample and enumeration of bacteria from food, chemicals, biological and physical methods for determining microorganisms and their products in food.

UNIT V Food Control Agencies**10 HOURS**

Relevance of microbial standards for food safety- Hazard Analysis Critical Control Point (HACCP). Food Safety and Standards Authority of India (FSSAI), Food Agricultural Organization (FAO), World Health Organization (WHO), The International Children's Emergency Fund (UNICEF) Codex Alimentarius Commission, The International Commission on Microbiological Specifications for Foods (ICMSF), The Food and Drug Administration (FDA), United States Department of Agriculture (USDA). Good Manufacturing in Food Industry (GMP).

TOTAL: 48 HOURS**TEXT BOOKS:**

1. Sridhar, S. (2010). *Industrial Microbiology*, Dominant Publishers, New Delhi.
2. Tanuja. S and Purohit, S.S. (2008). *Fermentation Technology*, Agrobios Publication, Jodhpur, India.
3. Harider, S.I. and Ashok, A. (2009). *Biotechnology, A Comprehensive Training Guide for the Biotechnology Industry*, CRC Press, New York.

REFERENCE BOOKS:

1. Casida, L.E. (2007). *Industrial microbiology*, New age international (P) Ltd., New Delhi.
2. Clark, D.P and Pazdernik, N.J. (2009). *Biotechnology applying the genetic revolution*, Elsevier Academic Press, UK.
3. Glazer, A and Nikaido. (1995). *Microbial biotechnology fundamentals of applied microbiology*, W. H. Freeman and company, USA.
4. Glick, B.R and Pasternak, J.J. (2003). *Molecular Biotechnology Principles and Applications of Recombinant DNA*, 3rd edition, ASM Press, USA.

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	POS2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	3
CO2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
CO3	2	-	-	2	-	-	-	3	-	-	-	-	-	-	-	-	3
CO4	1	-	-	3	-	2	-	3	-	-	2	-	-	-	2	-	3
CO5	-	-	-	2	-	2	-	3	-	-	2	-	-	-	2	-	3
Average	2.25	-	-	2	-	2	-	3	-	-	2	-	-	-	2	2	3

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

PREREQUISITE:

- Principles and Systematics of Microbiology (24MBP101)

COURSE OBJECTIVES (CO):

- To introduce principles and clinical relevance of many etiological agents responsible for infectious diseases.
- To explain mycotic poisoning caused by fungi and covers classification of parasites and lab techniques
- To cover mechanisms of parasite disease transmission

COURSE OUTCOME (COs):

Upon completion of this course students will be able to

COs	Course Outcomes	Blooms Level
CO1	Identify the different types of fungi, classify the structure and life cycles.	Analyze
CO2	Assess the reasons of infection with parasites and investigate ways by which the parasites damage their hosts and the response of the host.	Understand
CO3	Conduct procedures related to isolation and identification of parasites.	Analyze
CO4	Function in multi-disciplinary teams to advise the population on scientific basis to prevent infections with parasites.	Apply
CO5	Report the identification method for parasites	Apply

UNIT I Mycology**8 HOURS**

General characteristics of Fungi – Classification of fungi – morphological and systemic classification. Mycotoxicoses. Medically important fungi – routine mycological techniques - Antifungal agents and its mode of action.

UNIT II Fungal infections**10 HOURS**

Mycosis – Types of mycosis. Superficial mycosis. Cutaneous mycosis – Dermatophytoses – Trichophyton, Microsporum and Epidermophyton. Deep mycosis – Opportunistic mycosis, Mycotic Poisoning.

UNIT III Parasitology**10 HOURS**

Introduction to Parasitology – Classification of Parasites - protozoa-amoebae – flagellates - Laboratory techniques in parasitology - Ova, cyst analysis direct and concentration methods. Blood smear examination - antiprotozoan therapy.

UNIT IV Protozoan Life cycle**10 HOURS**

Protozoan infections – Sources of infection. *Entamoeba histolytica*, *Plasmodium falciparum*, *Leishmania donovani* - *Giardia intestinalis* *Trichomonas vaginalis*, *Toxoplasma gondii*, *Pneumocystis carinii*, *Balantidium coli*.

UNIT V Helminthic Life cycle**10 HOURS**

Helminthic infections – *Taenia solium*, *Trematodes* - *Schistosoma haematobium*, *Nematodes* - *Trichuris trichiura* - *Ascaris lumbricoides*, *Ancylostoma duodenale*, *Wuchereria bancrofti*.

TOTAL: 48 HOURS

TEXT BOOKS:

1. Ananthanarayanan, R., and Panicker, C.K.J., (2005). *Text Book of Microbiology* (7th ed.). Orient Longman, New Delhi..
2. Chakraborty, P. (2003). *A Text book of Microbiology*. (2nded.). New Central Book Agency (P) Ltd., Calcutta.
3. Ananthanarayanan, R. and C.K.J. Panicker, (2009). *Text Book of Parasitology*. 6th Edition. Jaypee brothers medical publishers (p) Ltd, New Delhi.
4. Mehrotra, R.S., and Aneja, K.R., (2007). *Introduction to Mycology*. New Age International Ltd, New Delhi.
5. Panjarathinam, R. (2007). *Text book of Medical Parasitology*, (2nd ed.). Orient Longman Publishers.
6. Parija, S.C. (2008). *A Text book of Medical Parasitology*. (3rd ed.). All India Publishers and Distributors, New Delhi.

REFERENCE BOOKS:

1. Casida, L.E. (2007). *Industrial microbiology*, New age international (P) Ltd., New Delhi.
2. Carl Fraenkel. (2012). *Text book of bacteriology*. Printing company publishers, New York.
3. Dismukes, W.E., Pappas, P.G., and Sobel, D., (2003). *Clinical Mycology*. Oxford University Press. UK.
4. Jawetz, E., Melnic, J.L., and Adelberg, E.A., (2001). *Review of Medical Microbiology*. (22nd ed.). Lange Medical Publishers, New York.

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	POS2
CO1	3	-	-	2	-	-	-	2	-	-	-	-	-	-	-	-	3
CO2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
CO3	2	-	-	3	-	-	-	3	-	-	-	-	-	-	-	-	3
CO4	-	-	-	2	-	2	-	3	-	-	2	-	-	-	-	-	3
CO5	-	-	-	2	-	2	-	3	-	-	2	-	-	-	-	-	3
Average	3	-	-	3	-	2	-	3	-	-	2	-	-	-	-	-	3

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

24MBP304

**MICROBIAL TECHNOLOGY AND INTELLECTUAL
PROPERTY RIGHTS**

4H-4C

Instruction Hours/week: L:4 T:0 P:0

Marks: Internal:40 External:60 Total:100

End Semester Exam: 3 Hours

PREREQUISITE:

- Principles and Systematics of Microbiology (24MBP101)

COURSE OBJECTIVES (CO):

- To deal rDNA technology using microorganisms
- To create awareness on the Intellectual property rights and patenting of biotechnological processes.
- To discuss recent developments in IPR laws in India and types of IPR

COURSE OUTCOME (COs):

Upon completion of this course students will be able to

COs	Course Outcomes	Blooms Level
CO1	Understand and apply rDNA technology with emphasis on plasmid Biology and blotting techniques.	Apply
CO2	Understand and apply the use of various concepts of cloning vectors.	Understand/ Apply
CO3	Analyze importance of transgenic plants.	Analyze
CO4	Familiarize with the principles of bioethical concepts.	Evaluate
CO5	Analyse the IPR issues in patents in biotechnology innovations and patenting methods for various products and processes	Apply

UNIT I Microbial technology**9 HOURS**

Introduction to microbial technology, restriction enzymes – nomenclature – types – and its properties, isolation of DNA, plasmids and RNA. Handling and quantification of nucleic acids, radiolabelling and non-radiolabelling of nucleic acids, gel electrophoresis - Blotting techniques – Southern, Northern and Western blotting techniques.

UNIT II Cloning**9 HOURS**

Cloning vectors: Plasmid as cloning vectors - pBR322, Bacteriophage - lamda, M13; Cosmid, phagemids. Yeast vector. Expression vectors. Prokaryotic hosts: *E. coli*, Eukaryotic hosts: Yeast cell. Gene cloning - basic steps, cloning construction of cDNA, selection and screening method of recombinants. biolabeling of genes and proteins.

UNIT III Transgenic plant and Animal**10 HOURS**

Transgenic plants: Methodology, development of herbicide resistance plants, delayed fruit ripening, Biocontrol agents - Insecticidal toxin of BT, cry gene and baculovirus. Transgenic animals. Methodology, development of transgenic mice – its application. DNA diagnostic in medical forensics. Biosafety and Bioethics. GMO, GMO Crops and Animals

UNIT IV Patenting**10 HOURS**

Discrepancies in biotechnology / chemical patenting. IPR – historical perspective – recent developments in IPR laws in India, IPR and the rights of farmers in developing countries. Types of IPR- Governing bodies-National and International. Prior art, novelty, non-obviousness, inventive step, copyright,

trademark, trade secret and GI

UNIT V Fundamental research

10 HOURS

Patenting – fundamental requirements – patenting multicellular organisms – patenting and fundamental research. Patenting of biological materials, Product patents, conditions for patenting, Patenting of liveforms, regulating recombinant technology, Food and food ingredients. Trade secrets. Writing a patent document.

TOTAL: 48 HOURS

TEXT BOOKS:

1. Ananthanarayanan, R., and Panicker, C.K.J., (2005). *Text Book of Microbiology* (7th ed.). Orient Longman, New Delhi..
2. Chakraborty, P. (2003). *A Text book of Microbiology*. (2nd ed.). New Central Book Agency (P) Ltd., Calcutta.
3. Ananthanarayanan, R. and C.K.J. Panicker, 2009. *Text Book of Parasitology*. 6th Edition. Jaypee brothers medical publishers (p) Ltd, New Delhi.
4. Mehrotra, R.S., and Aneja, K.R., (2007). *Introduction to Mycology*. New Age International Ltd, New Delhi.

REFERENCE BOOKS:

1. Casida, L.E.2007. *Industrial microbiology*, New age international (P) Ltd., New Delhi.
2. Carl Fraenkel. (2012). *Text book of bacteriology*. Printing company publishers, NewYork.
3. Dismukes, W.E., Pappas, P.G., and Sobel, D., (2003). *Clinical Mycology*. Oxford University Press. UK.
4. Jawetz, E., Melnic, J.L., and Adelberg, E.A., (2001). *Review of Medical Microbiology*. (22nd ed.). Lange Medical Publishers, New York.

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	POS2
CO1	3	-	-	-	-	2	-	3	-	-	-	-	-	-	-	-	3
CO2	3	-	-	-	-	3	-	3	-	-	-	-	-	-	-	-	3
CO3	2	-	-	-	-	2	-	3	-	-	-	-	2	-	-	-	3
CO4	3	-	-	2	-	2	-	1	-	-	-	-	-	-	-	-	3
CO5	2	-	-	2	-	2	-	3	-	-	2	-	-	-	-	-	3
Average	3	-	-	2	-	2.2	-	3	-	-	2	-	2	-	-	-	3

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

PREREQUISITE:

- Not required

COURSE OBJECTIVES (CO):

- To appraise the students to basic and high throughput techniques in Genomics and Proteomics
- To get introduced to chemical synthesis of DNA and sequencing of DNA and its applications in human health.
- To present methods and experimental tools in forensic science.

COURSE OUTCOME (COs):

Upon completion of this course students will be able to

COs	Course Outcomes	Blooms Level
CO1	Understand the basic concepts of genomics, transcriptomics and proteomics.	Understand
CO2	Discuss the use of genomics and proteomics in human health.	Analyze
CO3	Suggest and outline solution to theoretical and experimental problems in metagenomics and forensic Microbiology	Apply
CO4	Explain Forensic Science, Forensic law, Ethical issue.	Understand
CO5	Comprehend types and Identification of Microbial Diatoms, fecal bacteria and their forensic significance	Apply

UNIT I Introduction about metagenomics**8 HOURS**

Need of Metagenomics, Omics: Stream of omics- Proteomics, Genomics, Metabolomics, Lipidomic and Epigenomics. Role of omics in Microbiology, Application of Metagenomics.

UNIT II Metagenomic Techniques**10 HOURS**

Introduction – Shot gun sequencing Vs 16S sequencing. Metagenomics Technique: Sample processing, Metagenomic DNA extraction, NGS (Next generation sequencing), Binning, Annotation, Data analysis.

UNIT III Genomics**10 HOURS**

Genome projects: The Human genome project, Structural genomics: Assembly of a contiguous DNA sequence- shotgun method, clone contig method, and whole –genome shotgun sequencing. Determining the functions of individual genes and by studying the activity of a protein coded of an unknown gene. Synthetic genomes and their applications.

UNIT IV Scope of Forensic Microbiology**10 HOURS**

Historical Aspects, Scope, Basic principal of forensic science with its significance Branches of Forensic Science. Forensic law, Ethical issue. Organizational structure of Forensic science Laboratory. Frye case and Dauber standard.

UNIT V Development of Forensic Microbiology**10 HOURS**

Development of Forensic Microbiology, Types and Identification of Microbial Diatoms, fecal bacteria and their

forensic significance. Parentage testing. Bio terrorism, Food poisoning, Criminal act –HIV transmission.

TOTAL: 48 HOURS

TEXT BOOKS:

1. Ananthanarayanan, R., and Panicker, C.K.J., (2005). *Text Book of Microbiology* (7th ed.). Orient Longman, New Delhi.
2. Chakraborty, P. (2003). *A Text book of Microbiology*. (2nd ed.). New Central Book Agency (P) Ltd., Calcutta.
3. Ananthanarayanan, R. and C.K.J. Panicker, 2009. *Text Book of Parasitology*. 6th Edition. Jaypee brothers medical publishers (p) Ltd, New Delhi.
4. Mehrotra, R.S., and Aneja, K.R., (2007). *Introduction to Mycology*. New Age International Ltd, New Delhi.

REFERENCE BOOKS:

1. Casida, L.E. (2007). *Industrial microbiology*, New age international (P) Ltd., New Delhi.
2. Carl Fraenkel. (2012). *Text book of bacteriology*. Printing company publishers, New York.
3. Dismukes, W.E., Pappas, P.G., and Sobel, D., (2003). *Clinical Mycology*. Oxford University Press. UK.
4. Jawetz, E., Melnic, J.L., and Adelberg, E.A., (2001). *Review of Medical Microbiology*. (22nd ed.). Lange Medical Publishers, New York.

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	POS2
CO1	3	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	3
CO2	2	-	-	-	2	-	-	2	-	3	-	-	-	-	-	-	3
CO3	2	-	-	-	-	-	-	3	-	3	-	-	-	-	-	-	3
CO4	2	-	-	2	-	2	-	3	-	-	-	-	-	-	-	-	3
CO5	2	-	-	2	-	2	-	3	-	-	-	-	-	-	-	-	3
Average	2.2	-	-	2	2	2	-	3	-	3	-	-	-	-	-	-	3

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

PREREQUISITE:

- Not required

COURSE OBJECTIVES (CO):

- To detail the entrepreneurship in field of life sciences.
- To obtain good understanding about the interpretation of biological products.
- To uptake metabolic pathways and control mechanisms of commercially important metabolites.

COURSE OUTCOMES (COs):

Upon completion of this course students will be able to

COs	Course Outcomes	Blooms Level
CO1	Describe and apply entrepreneurial ideas and business theories in practical framework	Understand
CO2	Clarify the metabolic pathways and control mechanisms of commercially important metabolites	Analyze
CO3	Commentate single cell proteins and express the importance of mushroom cultivation and probiotics	Understand
CO4	Express the mass production of microbial inoculants used as Biofertilizers and Bioinsecticides	Analyze
CO5	Analyze production of Monoclonal antibodies, Cytokines. TPH and teaching kits, Biofuels, Bioplastics and Bio pigments	Analyze

Unit I Entrepreneurship:**8 HOURS**

Notions and theories of Entrepreneurship, Entrepreneurial traits and motivation- Nature and importance of Entrepreneurs, - Financial analysis Investment process, Break even analysis, Profitability analysis, Budget and planning process. Government schemes for commercialization of technology-Funding and support mechanisms for entrepreneurship. Professional ethics in entrepreneurship.

Unit II Production of microbial metabolites and Single cell proteins:**10 HOURS**

Metabolic pathways and control mechanisms of primary and secondary metabolites; Commercially important metabolites: Primary – ethanol, citric acid; Secondary – β exotoxin; Single Cell Protein: Algae (*Spirulina maxima*, *Chlorella pyrenoides*) and Yeast (*Candida tropicalis*) as SCP, Mushroom Cultivation and Probiotics.

Unit III Biofertilizers and Biopesticides:**10 HOURS**

Production of *Rhizobium*, *Azotobacter*, *Azospirillum*, *Phosphobacterium*, BGA (*Anabena*, *Nostoc*); Packing, Quality assurance, Field Application and Crop Response. Bioinsecticide: Mass Production, field Application, and Crop Response of Bacteria (*Bacillus thuringiensis*, *Bacillus papillae*, *Pseudomonas fluorescens*), Fungi (*Verticillium lecanii*, *Coelomyces*) and Viruses (Baculo viruses, NPV, Granulosis virus).

Unit IV Commercial Products:**10 HOURS**

Production and Application of TPA, HGH, Cytokines and Monoclonal Antibodies; Production of enzymes – Cellulase, Protease, Amylase and lipase Production of teaching kits-DNA isolation, widal. Biochemistry, Industrial Production and Application of biogas, bio-diesel, hydrogen fuel, gasoline; Bioplastics - PHB, PHA; Biopigments – Lycopene, Betacarotene, and its applications.

Unit V Government regulatory practices and policies:**10 HOURS**

Regulatory aspects of quality control. Sterilization control and sterility testing- Chemical and biological indicators. Regulatory authorities for introduction of medicines in market – Role of Food and Drug Administration, FDA guidelines for drugs / biologicals, Validation (GMP, GLP, GCP, etc.). Clinical studies: Phase I, phase II, phase III and phase IV of clinical trials – Objectives, Conduct of trials, Outcome of trials.

TOTAL: 48 HOURS

TEXT BOOKS:

1. Ashton Acton, Q., (2012). *Biological Pigments– Advances in Research and Application*. Scholarly Editions: Atlanta, Georgia.
2. Crueger, W, and Crueger. A. (2000), *Biotechnology: A Text Book of Industrial microbiology*, 2nd Edition, Sinauer Associates: Sunderland.Mass..
3. Hugo, W.B. and Russel, A.D. (2003), *Pharmaceutical Microbiology*, 6th Edition. Blackwell Scientific Publications: U K.

REFERENCE BOOKS:

1. Stanbury, P.F, and Whitekar. A. (1999), *Principles of Fermentation Technology*, 2nd Edition. Butterworth-Heinemann: Oxford.
2. Stockholm, K.T.H., Sven-Olof Enfors, and Lena Haggstrom. (2000), *Bioprocess Technology: Fundamentals and Applications*, Royal Institute of Technology: Sweden.

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	POS2
CO1	3	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	3
CO2	3	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	3
CO3	2	-	-	-	-	2	-	3	-	-	2	-	-	-	-	-	3
CO4	2	-	-	-	-	2	-	3	-	-	2	-	-	-	-	-	3
CO5	3	-	-	2	-	2	-	3	-	-	2	-	-	-	2	-	3
Average	2	-	-	2	2	2	-	3	-	-	2	-	-	-	2	-	3

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

PREREQUISITE:

- Not required

COURSE OBJECTIVES (CO):

- To provide knowledge about the Bio nanomaterials synthesis and its advancement.
- To give knowledge of the Nanoscience and Applications
- To understand the synthesis of nanomaterials and their application

COURSE OUTCOME (COs):

Upon completion of this course students will be able to

COs	Course Outcomes	Blooms Level
CO1	Understand the basics in nanotechnology	Understand
CO2	Understand fundamentals of nanomaterials and their properties	Understand
CO3	Learn and practice biosynthesis of nanoparticles	Apply
CO4	Apply knowledge in characterizing the synthesized nanoparticles	Apply
CO5	Interpret the data on the characterized particles	Analyze

Unit 1 Introduction to nano**8 HOURS**

History and scope of nanotechnology, Introduction to nanoparticles, nano definitions nanoscale, unique properties of nanoparticles with bulk materials, physical and chemical properties of Gold, silver, and copper nanoparticles.

Unit II Synthesis of nanoparticles**10 HOURS**

Synthesis of nanoparticles by top down, bottom approach. synthesis of nanoparticles by physical method-homogenizer, Sonication, chemical and. Synthesis of nanoparticles by biological methods-plants, microorganisms and its importance.

Unit III Characterization of nanoparticles**11 HOURS**

Nanoparticles characterization by atomic force microscope (AFM), scanning electron microscope (SEM), Transmission Electron Microscope (TEM), Dynamic Light Scattering Method, Characterization of particles by FTIR, X-ray diffraction (XRD), Nuclear Magnetic Resonance (NMR), UV-Visible spectrophotometer.

UNIT IV Drug delivery**10 HOURS**

Nanoparticles in cancer therapy, Biosensors - DNA Microarrays - Cell Biochips- Nanoparticles for Bioimaging - Military applications of Nanotechnology - Nanomaterials for food Applications - Toxicity of Nanoparticles - Future Perspectives.

UNIT V Nanoparticles application**9 HOURS**

Application of nanoparticles in medicine, and in various industries (cosmetics, paints etc) nanotoxicity, hazards of nanoparticles, environmental issue; biosafety and ethical issue in application of nanoparticles.

Total Hours: 48 HOURS

TEXT BOOKS:

1. David, S. (2004). Goodsell. *Bionanotechnology*. Wiley-Blackwell.
2. Gonsalves, K., Halberstadt, C., Laurencin, C.T. (2007). *Biomedical Nanostructures*. Wiley-Blackwell.
3. Sabliov, C., Hongda, A., Yada, R., (2015). *Nanotechnology and Functional Foods*. Wiley-Blackwell Publishers
4. Rakesh Kumar, and Tiwari, K., (2013). *A Textbook of Nanoscience*. Publisher: S.K. Kataria & Sons.
5. Ausubel, F.M., Brent, R., Kingston, R.E., Moore, D.D., Siedman, J.G., Smith, J.A., and Struhl K., (1999). *Short protocols in Molecular Biology*. (4th ed.). Wiley, New York

REFERENCE BOOKS:

1. Goosell, D.S. (2004). *Bionanotechnology: Lessons from nature*. John Wiley & Sons Inc. publication.
2. Goodsell, D.S. (1996). *Biomolecules and Nanotechnology*. *Ancient Scientist*, 88, 230 –237.
3. Blundell, T.L., and Johnson, L.N., (1976). *Protein crystallography*. New York.
4. Eisenberg, D., and Crothers, D., (1979). *Physical Chemistry with Applications to the LifeSciences*. Benjamin Cummings, Menlo Park, California.

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	POS2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
CO2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
CO3	2	-	-	-	-	2	-	3	-	-	-	-	-	-	-	-	3
CO4	2	-	-	2	-	2	-	3	-	-	-	-	-	-	-	-	3
CO5	1	-	-	2	-	2	-	3	-	-	-	-	-	-	-	-	3
Average	2.2	-	-	2	-	2	-	3	-	-	-	-	-	-	-	-	3

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

PREREQUISITE:

- Advance Immunology (24MBP301)

COURSE OBJECTIVES (CO):

- To Identify and enumerate immune cells and also perform agglutination reactions.
- To Realize the role of immune cells in developing immunity against microbial diseases
- To develop the technical skill of immunology.

COURSE OUTCOME (COs):

Upon completion of this course students will be able to

COs	Course Outcomes	Blooms Level
CO1	Gain knowledge of advanced techniques involved in Immunology	Understand
CO2	Understand and perform Immunology techniques which forms an integral part of Microbiology.	Apply
CO3	Learn and practice advanced techniques involved in Serology and Immunology	Apply
CO4	Analyze the antigen antibody interactions for diagnosis	Analyze
CO5	Generate an Immunological kit for the assays	Create

EXPERIMENTS**HOURS: 36 HOURS**

1. Identification of various immune cells by morphology – Leishman staining, Giemsa staining.
2. Separation of serum / plasma
3. ABO Blood grouping - Rh typing and cross matching.
4. Estimation of hemoglobin content of human blood.
5. Agglutination tests.
6. WIDAL - slide and tube test
7. RA test.
8. RPR test.
9. ASO test.
10. CRP test.
11. β -HCG test
12. ELISA- thyroid hormone analysis
13. Ouchterlony's Double Immunodiffusion test (ODD)
14. Counter immunoelectrophoresis (CIE)

TEXT BOOKS:**TOTAL: 36 HOURS**

1. Wilmore Webley, (2017). *Immunology Lab Manual*, 12th Edition, LAD Custom Publishing.
2. Patricia Tille. (2018). *Bailey & Scott's Diagnostic Microbiology*, 14th Edition, Elsevier eBook on Vital Source.

REFERENCE BOOKS:

1. Alfred Brown and Heidi Smith. (2015). *Benson's Microbiological Applications, Laboratory Manual in General Microbiology*, 13th Edition, McGraw-Hill
2. Ian Freshney, R. (2010). *Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications*, 6th Edition, John Wiley & Sons, Inc.

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
CO1	3	-	-	-	2	-	-	2	-	-	-	-	-	-	-	-	3
CO2	3	-	-	-	2	-	-	3	-	-	-	-	-	-	-	-	3
CO3	2	-	-	-	-	2	-	3	-	-	-	-	-	-	-	-	3
CO4	1	-	-	2	-	2	-	3	-	-	2	-	-	-	-	-	3
CO5	1	-	-	2	-	2	-	3	-	-	3	-	-	-	3	-	3
Average	2	-	-	2	2	2	-	3	-	-	2.5	-	-	-	3	-	3

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

PREREQUISITE:

- Food Microbiology and Quality Control (24MBP302)

COURSE OBJECTIVES (CO):

- To provide information on fermented food product production in food industries.
- To develop the skill in Isolation of pathogen and disease mechanisms
- To give employment opportunities to meet the current food demands and understand food spoilage and the role of microorganisms.

COURSE OUTCOME (COs):

Upon completion of this course students will be able to

COs	Course Outcomes	Blooms Level
CO1	Understand contamination of food products which may include bacteria and fungi	Understanding
CO2	Identify ways to control microorganisms in foods and thus know the principles involving various methods of food preservation.	Applying
CO3	Analyze the importance in the prevention of contamination that might be caused by the microorganisms.	Analyzing
CO4	Apply techniques for mushroom cultivation, milk quality analysis and immobilization techniques.	Applying
CO5	Develop the skills of an efficient microbiologist in the food and beverage industries.	Evaluating

EXPERIMENTS**HOURS: 48 HOURS**

1. Production of enzymes – solid and submerged fermentation.
2. Production of sauerkraut, yoghurt, wine and cheese
3. Isolation and Enumeration of Bacterial and Fungal Food spoilers
4. Detection and enumeration of Microorganisms present in lab surfaces- settle plate method.
5. Analysis of Milk quality by Methylene Blue and Resazurin Dye Reduction Test
6. Detection of coliforms from water - MPN test
7. Mushroom Cultivation.
8. Immobilization technique (Sodium alginate method).
9. Isolation and identification of *Candida albicans*
10. Wet mount preparation of parasites- Saline, iodine

TEXT BOOKS:**TOTAL: 48 HOURS**

1. Adams, M.R., and Moss, M.O., (2000). *Food Microbiology*. Royal Society of Chemistry. Cambridge, U.K.
2. Ahmed, E.Y., and Carlstrom, C., (2003). *Food Microbiology: A Laboratory Manual*, John Wiley and Sons, Inc. New Jersey.
3. Arora, B., and Arora, D.R., (2007). *Practical Microbiology*. (1st ed.). CBS Publishers and Distributors, Bangalore.

REFERENCE BOOKS:

1. Cappucino, G.J., and Sherman, N., (2001). *Microbiology A Laboratory Manual*. (6th ed.). Benjamin Cummings, New York.
2. Demain, A.L., and Davies, J.E., (1999). *Manual of Industrial Microbiology and Biotechnology* (2nd ed.). ASM Press, Washington.
3. Garg, N., Garg, K.L., and Mukerji, K.G., (2010). *Laboratory Manual of Food Microbiology*. I.K. International Publishing House, New Delhi.
4. Harry, W., Seeley, Jr., and Denmark, P.N., (1984). *Microbes in Actions: A lab Manual of Microbiology*. D. B. Taraporwalla and Sons.
5. Jay, J.M., Loessner, M.J., Golden, D.A., (2005). *Modern Food Microbiology*. Springer Science, USA.
6. Davies, J.E., and Demain, A.L., (2009). *Manual of Industrial Microbiology and Biotechnology* ASM Publisher, USA Demain,

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	POS2
CO1	3	-	2	2	-	-	-	2	-	-	-	-	-	-	-	-	3
CO2	2	-	-	2	-	-	-	3	-	-	-	-	-	-	-	-	3
CO3	2	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	3
CO4	1	-	-	2	-	2	-	3	-	-	3	-	-	-	-	-	3
CO5	-	-	-	2	-	2	-	3	-	-	2	-	-	-	-	-	3
Average	2	-	2	2	-	2	-	3	-	-	2.5	-	-	-	-	-	3

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

PREREQUISITE:

- Not required

COURSE OBJECTIVES (CO):

- To study the use of microorganisms in the manufacture of food or industrial products on the basis of employment.
- To gain knowledge on design of bioreactors, factors affecting growth and production, heat transfer and oxygen transfer
- To understand the rationale in medium formulation; design for microbial fermentation, and sterilization of medium and air.

COURSE OUTCOMES (COs):

Upon completion of this course students will be able to

COs	Course Outcomes	Blooms Level
CO1	Acquire knowledge in the production of industrial product, fermentation components and types	Understand
CO2	Isolate, preserve the microbes for fermentation upstream processes	Apply
CO3	Apply techniques for microbial production of various enzymes	Apply
CO4	Experiment with production of organic acids and beverages	Apply
CO5	Practice the techniques for the production of amino acids, vitamins and single cell proteins	Apply

Unit I Basics of fermentation processes**7 HOURS**

Definition, scope, history, and chronological development of the fermentation industry. Component parts of the fermentation process. Component parts of fermentation process. Microbial growth kinetics, batch and continuous, direct, dual or multiple fermentations; scale up of fermentation, comparison of batch and continuous culture as investigative tools, examples of the use of fed batch culture.

Unit II Isolation and Preservation**7 HOURS**

Isolation, preservation, and strain improvement of industrially important microorganisms. Use of recombination system (Parasexual cycle, protoplast fusion techniques), application of recombinant strains, and the development of new fermentation products.

Unit III Screening and Inoculum development**7 HOURS**

Screening (primary and secondary screening); detection and assay of fermentation products (Physico-chemical assay, biological assays). Inoculum development, criteria for transfer of inoculum, development of inoculum: Bacteria, Fungi and Yeast.

Unit IV Microbial Production**7 HOURS**

Fermentation type reactions (Alcoholic, bacterial, mixed acid, propionic acid, butanediol and acetone-butanol).

Microbial production of enzymes (amylases, Proteases, cellulases) primary screening for producers, large scale production. Immobilization methods.

Unit V Alcohols and Beverages

8 HOURS

Fermentative production of industrial alcohol, production of beverages. Production of organic acids: citric acid, amino acids: glutamic acid, production of vitamins. fungal enzymes and Single cell protein.

TOTAL: 36 HOURS

TEXT BOOKS:

1. Sridhar, S. (2010). *Industrial Microbiology*, Dominant Publishers, New Delhi.
2. Tanuja. S and Purohit, S.S. (2008). *Fermentation Technology*, Agrobios Publication, Jodhpur, India.
3. Harider, S.I. and Ashok, A. (2009). *Biotechnology, A Comprehensive Training Guide for the Biotechnology Industry*, CRC Press, New York.

REFERENCE BOOKS:

1. Casida, L.E. (2007). *Industrial microbiology*, New age international (P) Ltd., New Delhi.
2. Clark, D.P and Pazdernik, N.J. (2009). *Biotechnology applying the genetic revolution*, Elsevier Academic Press, UK.
3. Glazer, A and Nikaido. (1995). *Microbial biotechnology fundamentals of applied microbiology*, W. H. Freeman and company, USA.
4. Glick, B.R and Pasternak, J.J. (2003). *Molecular Biotechnology Principles and Applications of Recombinant DNA*, 3rd edition, ASM Press, USA.

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	POS2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
CO2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
CO3	2	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	3
CO4	-	-	-	2	-	2	-	3	-	-	2	-	-	-	-	-	3
CO5	-	-	-	2	-	2	-	3	-	-	2	-	-	-	2	-	3
Average	2.66	-	-	2	-	2	-	3	-	-	2	-	-	-	2	-	3

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

24MBP391

INTERNSHIP PROGRAMME

2C

Instruction Hours/week: L:0 T:0 P:0

Marks: Internal:100 External: - Total:100

24BTPOE301

NUTRITION AND DIETETICS

Semester - III
3H-2C

Instruction Hours/week: L:3 T:0 P:0

Marks: Internal: 40 External: 60 Total: 100

End Semester Exam: 3 Hours

PREREQUISITE:

Student should know about basics of food, its nutrients and their relationship to health

COURSE OBJECTIVES (CO)

The main objectives of the course are

- To understand the fundamentals of food, nutrients and their relationship to health
- To develop knowledge on nutrition deficiency diseases and their consequences
- To know about food adulteration and prevention of food adulteration

COURSE OUTCOMES (COs)

On completion of the course, students are able to

COs	Course Outcomes	Blooms Level
CO1	Name the fundamentals of nutrition and their relationship to health	Remember
CO2	Learn to derive maximum benefits from available food resources	Understand
CO3	Identify the consequences of vitamin and mineral deficiency/excess of vitamin	Apply
CO4	Analyze the importance of nutrition in adult age	Analyze
CO5	Assess about nutrition deficiency diseases and their consequences	Evaluate

UNIT I BASIC CONCEPTS IN FOOD AND NUTRITION**5 HOURS**

Understanding relationship between food, nutrition and health, Functions of food-Physiological, psychological and social. Dietary guidelines for Indians and food pyramid

UNIT II NUTRIENTS**5 HOURS**

Functions, dietary sources and clinical manifestations of deficiency/ excess of the following nutrients: Carbohydrates, lipids and proteins, Fat soluble vitamins-A, D, E and K, Water soluble vitamins – thiamin, riboflavin, niacin, pyridoxine, folate, vitamin B12 and vitamin C, Minerals – calcium, iron and iodine

UNIT III NUTRITION DURING THE ADULT YEARS**10 HOURS**

Physiological changes, RDA, nutritional guidelines, nutritional concerns and healthy food choices - Adult, Pregnant woman, Lactating mother, Elderly. Nutrition during childhood -Growth and development, nutritional guidelines, nutritional concerns and healthy food choices -Infants, Preschool children, School children, Adolescents. Nutritional needs of nursing mothers and infants, determinants of birth weight and consequences of low birth weight, Breast feeding, Assessment and management of moderate and severe malnutrition among children, Child health and morbidity, neonatal, infant and child mortality

UNIT IV INTRODUCTION TO NUTRITIONAL DEFICIENCY DISEASES**6 HOURS**

Causes, symptoms, treatment, prevention of the following: Protein Energy Malnutrition (PEM), Vitamin A Deficiency (VAD), Iron Deficiency Anemia (IDA), Iodine Deficiency Disorders (IDD), Zinc Deficiency, Flurosis Nutritional needs during pregnancy, common disorders of pregnancy (Anemia, HIV infection, Pregnancy induced hypertension), relationship

between maternal diet and birth. Maternal health and nutritional status, maternal mortality and issues relating to maternal health.

UNIT V DIETETICS

10 HOURS

Dietary and stress management. Dietary recommendations of WHO. Diet for diabetes mellitus-Nutrition recommendations for patient with diabetes, Meal planning, Diet for Cardiovascular Diseases -Dietary management and general guidelines for coronary heart disease, Diet for cancers at various sites in the human body, diet therapy, managing eating problems during treatment. Hormonal imbalance - Poly cystic ovarian syndrome, causes of hormonal imbalance. Diet management.

Total : 36 Hours

TEXT BOOKS:

1. Srilakshmi.B. (2015) Food Science:. New Age International (P) Ltd. Publishers. 6nd Edition., New Delhi
2. Swaminathan.M. (2008). Essential of Food and Nutrition Vol II The Bangalore Printing and Publishing Co. Ltd., Bangalore.

REFERENCE BOOKS:

1. Garrow,J.S., and James, W.P.T.,(2000). *Human Nutrition & Dietetics*, Longman Group, UK.
2. Gordon M, Wardlaw and Paul M. (2012). *Perspectives in Nutrition*: U.S.A. McGraw Hill Publishers. 9rd Edition. New Delhi
3. Sharma, R (2004). *Diet Management*,3rdEdition, Reed Elsevier India Private Limited, Chennai.
4. Srilakshmi.B. (2014). *Nutrition Science*, 4th Edition, New Age International (P) Ltd. Publishers. New Delhi.

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
CO1	3	-	-	-	-	-	-	2	2	-	2	2	2	-	2	2	2
CO2	3	-	-	-	-	-	-	2	2	-	2	2	2	-	2	2	2
CO3	3	-	-	-	-	-	-	2	2	-	2	2	2	-	2	2	2
CO4	3	-	-	-	-	-	-	2	2	-	2	2	2	-	2	2	2
CO5	3	-	-	-	-	-	-	2	2	-	2	2	2	-	2	2	2
Avg	3	-	-	-	-	-	-	2	2	-	2	2	2	-	2	2	2

1-Low; 2-Medium; 3-Strong; '-' No correlation

PREREQUISITE:

Not Required

COURSE OBJECTIVES (CO):

- To enable the understanding of RPA and the types of variables.
- To create expertism in handling the User Events and various types of Exceptions and strategies.
- To demonstrate the Deployment of the Robot and to maintain the connection.

COURSE OUTCOMES (COs):

Upon completion of this course, the student will be able to:

COs	Course Outcomes	Blooms Level
CO1	Explain the RPA and the ability to differentiate it from other types of automation.	Understand
CO2	Analyze the different types of variables, Control Flow and data manipulation techniques.	Analyze
CO3	Summarize Image, Text and Data Tables Automation.	Understand
CO4	Evaluate the User Events and its types of Exceptions and strategies.	Evaluate
CO5	Illustrate the deployment of the robot and to maintain the connection.	Apply

UNIT I INTRODUCTION TO ROBOTIC PROCESS AUTOMATION**8 HOURS**

Scope and techniques of automation, Robotic process automation - What can RPA do?, Benefits of RPA, Components of RPA, RPA platforms, The future of automation.

RPA Basics: History of Automation - What is RPA - RPA vs Automation - Processes & Flowcharts - Programming Constructs in RPA - What Processes can be Automated - Types of Bots - Workloads which can be automated - RPA Advanced Concepts - Standardization of processes - RPA Development methodologies - Difference from SDLC - Robotic control flow architecture - RPA business case - RPA Team - Process Design Document/Solution Design Document – Industries best suited for RPA - Risks & Challenges with RPA - RPA and emerging ecosystem.

UNIT II RPA TOOL INTRODUCTION AND BASICS

7 HOURS

Introduction -The User Interface - Variables - Managing Variables - Naming Best Practices - The Variables Panel - Generic Value Variables - Text Variables True or False Variables - Number Variables - Array Variables - Date and Time Variables Data Table Variables - Managing Arguments - Naming Best Practices - The Arguments Panel - Using Arguments - About Imported Namespaces - Importing New Namespaces- Control Flow - Control Flow Introduction - If Else Statements - Loops - Advanced Control Flow - Sequences - Flowcharts - About Control Flow - Control Flow Activities - The Assign Activity - The Delay Activity - The Do While Activity - The If Activity - The Switch Activity - The While Activity - The For Each Activity - The Break Activity - Data Manipulation- Data Manipulation Introduction - Scalar variables, collections and Tables -Text Manipulation - Data Manipulation - Gathering and Assembling Data

UNIT III ADVANCED AUTOMATION CONCEPTS & TECHNIQUES

7 HOURS

Recording Introduction - Basic and Desktop Recording - Web Recording - Input/Output Methods - Screen Scraping - Data Scraping - Scraping advanced techniques - Selectors - Defining and Assessing Selectors - Customization - Debugging - Dynamic Selectors - Partial Selectors - RPA Challenge - Image, Text & Advanced Citrix Automation - Introduction to Image & Text Automation - Image based automation - Keyboard based automation - Information Retrieval - Advanced Citrix Automation challenges - Best Practices - Using tab for Images - Starting Apps - Excel Data Tables & PDF - Data Tables in RPA - Excel and Data Table basics - Data Manipulation in excel – Extracting Data from PDF - Extracting a single piece of data - Anchors - Using anchors in PDF.

UNIT IV HANDLING USER EVENTS & ASSISTANT BOTS, EXCEPTION HANDLING

7 HOURS

What are assistant bots? - Monitoring system event triggers - Hotkey trigger - Mouse trigger - System trigger - Monitoring image and element triggers - An example of monitoring email - Example of monitoring a copying event and blocking it - Launching an assistant bot on a keyboard event.

Exception Handling -Debugging and Exception Handling - Debugging Tools - Strategies for solving issues - Catching errors.

UNIT V - DEPLOYING AND MAINTAINING THE BOT

7 HOURS

Publishing using publish utility - Creation of Server - Using Server to control the bots - Creating a provision Robot from the Server - Connecting a Robot to Server - Deploy the Robot to Server - Publishing and managing updates - Managing packages - Uploading packages - Deleting packages.

TOTAL: 36 HOURS

TEXT BOOKS:

1. Alok Mani Tripathi. (2018). *Learning Robotic Process Automation*, Packt Publishing.
2. Frank Casale , Rebecca Dilla, Heidi Jaynes , Lauren Livingston.(2015). *Introduction to Robotic Process Automation:a Primer*, Institute of Robotic Process Automation,1st Edition.
3. Richard Murdoch. (2018). *Robotic Process Automation: Guide to Building Software Robots, Automate Repetitive Tasks & Become an RPA Consultant*, Independently Published, 1st Edition.

REFERENCE BOOKS:

1. Srikanth Merinda. (2018). *Robotic Process Automation Tools, Process Automation and their benefits: Understanding RPA and Intelligent Automation*, Consulting Opportunity Holdings LLC, 1st Edition.
2. Lim Mei Ying. (2018). *Robotic Process Automation with Blue Prism Quick Start Guide: Create software robots and automate business processes*, Packt Publishing, 1st Edition.

WEBSITE LINKS:

1. <https://www.uipath.com/rpa/robotic-process-automation>
2. <https://www.academy.uipath.com>

CO, PO, PSO Mapping

CO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PSO	PSO
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	1	2
CO1	3	-	-	-		2	-	-	2	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	3	-	-	3	-	-	-	-	-	-	-	-
CO3	-	-	-	3	-	-	2	-	3	-	-	-	-	-	-	-	-
CO4	2	2	-	-	-	-	2	1	2	-	-	-	-	-	-	-	-
CO5	-	2	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-
Average	2.5	2	1	2.5	-	2.5	2	1	2.5	-	-	-	-	-	-	-	-

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

24CHPOE301

INDUSTRIAL CHEMISTRY

Semester III

3H-2C

Instruction Hours/week:L: 3 T: 0 P: 0 Marks: Internal: 40 External: 60 Total:100
External Semester Exam: 3 Hours

PREREQUISITE:

- Not Required

COURSE OBJECTIVES:

- To gain the comprehensive process of cane sugar and paint production.
- To understand the physical and chemical properties, characteristics, and the manufacturing processes of glass and cement.
- To acquire the knowledge of rubber fabrication.

COURSE OUTCOMES (CO's):

Upon completion of this course, the student will be able to:

COs	Course Outcomes	Blooms Level
CO1	Illustrate comprehensive process of cane sugar production.	Understand
CO2	Apply the knowledge of paint classification, constituents and diverse applications.	Apply
CO3	Examine the physical and chemical properties of glass.	Analyze
CO4	Analyze the manufacturing processes of cement, including the wet and dry processes,	Analyze
CO5	Explain the rubber fabrication, including refining processes, fabrication methods, and vulcanization techniques.	Evaluate

UNIT I SUGAR**8 HOURS**

Introduction, Manufacture of Cane Sugar - Extraction of juice, Purification of Juice, Defecation, Sulphitation, Carbonation, Concentration or Evaporation. Crystallization -Separation of crystals, drying, refining, recovery of sugar from Molasses, Bagasse. Manufacture of sucrose from beet root. Estimation of sugar, double sulphitation process, double carbonation.

UNIT II PAINTS**8 HOURS**

Classification, constituents, setting of paints, requirements of a good paint. Emulsion, Latex, Luminescent, Fire retardant and Heat resistant paints. Methods of applying paints. Special applications and failures of paint. Varnishes - Introduction – Raw materials – Manufacture of varnishes.

UNIT III GLASS**8 HOURS**

Introduction, Physical/Chemical properties, Characteristics of glass. Raw materials, methods of manufacture - formation of batch material, melting, shaping, annealing and finishing of glass.

UNIT IV CEMENT**6 HOURS**

Introduction, raw materials, manufacture – Wet process, Dry process, reactions in kiln, setting of cement, properties and uses of cement. Plaster of Paris, Gypsum, Lime.

UNIT V RUBBER**6 HOURS**

Introduction, Importance, types and properties of rubber. Refining of crude rubber, drawbacks of raw rubber. Rubber fabrication, vulcanization techniques.

TOTAL: 36 HOURS

TEXT BOOKS:

1. Sharma, B.K. (2014). *Industrial Chemistry*, 14th Edition, Meerut: Goel Publishing House.
2. Vermani, O.P and Narula, A.K. (2016). *Industrial Chemistry*. Delhi: [Galgotia Publications Pvt Ltd](#).

REFERENCE BOOK:

1. Jain, P.C. and Monika Jain. (2016). *Engineering Chemistry*, 16th Edition, New Delhi: Dhanpat Rai Publishing Co. (Pvt) Ltd.

CO, PO, PSO Mapping

CO	P O1	P O2	P O3	P O4	P O5	P O6	P O7	P O8	P O9	PO 10	PO 11	PO 12	PO 13	PO 14	PO 15	PS O1	PS O2
CO1	3	-	-	2	-	-	-	-	2	-	1	-	-	2	-	2	-
CO2	3	-	-	2	-	-	-	-	2	-	1	-	-	-	-	2	-
CO3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO4	-	-	-	2	-	-	-	-	2	-	1	-	-	1	-	3	-
CO5	2	-	-	2	-	-	-	-	2	-	1	-	-	1	-	2	-
Average	2.5	-	-	2	-	-	-	-	2	-	1	-	-	1.3	-	2.4	-

1-Low, 2-Medium, 3-High, '-' - No Correlation

PREREQUISITE:

- Basic understanding of financial management principles.

COURSE OBJECTIVES(CO):

- To familiarize students with the concept of Investment Planning and its methods.
- To examine the scope and methods of Personal Tax Planning.
- To analyze Insurance Planning and its relevance.

COURSE OUTCOMES(COs):**Learners should be able to**

COs	Course Outcomes	Blooms Level
CO1	Familiarize with regard to the concept of Investment Planning and its methods	Understand
CO2	Examine the scope and ways of Personal Tax Planning;	Analyze
CO3	Analyze Insurance Planning and its relevance	Analyze
CO4	Develop an insight in to retirement planning and its relevance.	Create
CO5	Construct an optimal portfolio in real life situations	Create

UNIT I INTRODUCTION TO FINANCIAL PLANNING**7 HOURS**

Financial goals, Time value of money, steps in financial planning, personal finance/loans, education loan, car loan & home loan schemes. Introduction to savings, benefits of savings, management of spending & financial discipline, Net banking and UPI, digital wallets, security and precautions against Ponzi schemes and online frauds such as phishing, credit card cloning, skimming.

UNIT II INVESTMENT PLANNING**7 HOURS**

Process and objectives of investment, Concept and measurement of return & risk for various assets class, Measurement of portfolio risk and return, Diversification & Portfolio formation. Gold Bond; Real estate; Investment in Greenfield and brownfield Projects; Investment in fixed income instruments- financial derivatives & Commodity market in India. Mutual fund schemes including SIP; International investment avenues.

UNIT III PERSONAL TAX PLANNING**7 HOURS**

Tax Structure in India for personal taxation, Scope of Personal tax planning, Exemptions and deductions available to individuals under different heads of income and gross total income, Special provision u/s 115BAC vis-à-vis General provisions of the Income-tax Act, 1961. Tax avoidance versus tax evasion.

UNIT IV INSURANCE PLANNING**7 HOURS**

Need for Protection planning. Risk of mortality, health, disability and property. Importance of Insurance: life and non-life insurance schemes. Deductions available under the Income-tax Act for premium paid for different policies.

UNIT V RETIREMENT BENEFITS PLANNING**8 HOURS**

Retirement Planning Goals, Process of retirement planning, Pension plans available in India, Reverse mortgage, New Pension Scheme. Exemption available under the Income-tax Act, 1961 for retirement benefits.

TOTAL: 36 HOURS

TEXT BOOKS:

1. Indian Institute of Banking & Finance. (2017). *Introduction to Financial Planning*, Taxmann Publication., New Delhi.
2. Pandit, A. (2014). *The Only Financial Planning Book that You Will Ever Need*, Network Publications Ltd., Mumbai.

REFERENCE BOOKS:

1. Sinha, M. (2008). *Financial Planning: A Ready Reckoner*, McGraw Hill Education, New York.
2. Halan, M. (2018). *Let's Talk Money: You've Worked Hard for It, Now Make It Work for You*, Harper Collins Publishers, New York.
3. Tripathi, V. (2017). *Fundamentals of Investment*, Taxmann Publication, New Delhi.

CO, PO, PSO Mapping

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	P01 1	P01 2	P01 3	P01 4	P01 5	PSO 1	PSO 2
CO1	3	-	-	-	3	-	-	-	-	-	3	-	-	-	3	3	3
CO2	3	-	-	-	3	-	-	-	-	-	3	-	-	-	3	-	-
CO3	3	-	-	-	3	-	-	-	2	-	3	-	-	-	3	3	3
CO4	3	-	-	-	3	-	-	-	2	-	3	-	-	-	3	3	3
CO5	3	-	1	-		-	-	-	2	-	3	-	-	-	3	-	-
Average	3	-	1	-	3	-	-	-	2	-	3	-	-	-	3	3	3

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

PREREQUISITE:

- Basics of Cyber Security.

COURSE OBJECTIVES (CO):

- To understand about computer forensics and investigations.
- To know about digital evidence, e-mail investigation, and Mobile device forensics.
- To analyse and validate forensics data.

COURSE OUTCOMES (COs):

Upon the completion of this course, the students will be able to

COs	Course Outcomes	Blooms Level
CO1	Explain various investigation procedures and summarize duplication of digital evidence.	Evaluate
CO2	Apply the knowledge of digital evidences.	Apply
CO3	Design and develop various forensics tools and analyse the network forensics.	Analyze
CO4	Determine the systematic study of high-tech forensics	Evaluate
CO5	Analyze and validate digital evidence data	Analyze

UNIT I COMPUTER FORENSICS AND INVESTIGATIONS**7 HOURS**

Computer forensics and investigations as a profession – Preparing for computer investigations – Taking a systematic approach–Procedures for corporate high-tech investigations–Data recovery work stations and software– Conducting an investigation.

UNIT II DATA ACQUISITION**7 HOURS**

Data acquisition – Storage formats for digital evidence – Validating data acquisitions – Processing crime and incident scenes–Identifying digital evidence–Collecting evidence in private sector incident scenes – Preparing for search-seizing digital evidence at the scene-storing digital evidence –Reviewing a case.

UNIT III COMPUTER FORENSICS TOOLS**7 HOURS**

Current computer forensics tools–Software tools–Hardware tools–The Macintosh file structure and boot process – Computer forensics analysis and validation – Addressing data –Hiding techniques.

UNIT IV NETWORK FORENSICS**7 HOURS**

Virtual machines – Network forensics – Developing standard procedures – Live acquisitions – email investigations – Investigating e-mail crimes and violations – Understanding e-mail servers – Cell phone and mobile device forensics.

UNIT V MOBILE DEVICE FORENSICS**8 HOURS**

Understanding mobile device forensics – Acquisition procedures –Report writing for high-tech investigations – Importance of reports – Guidelines for writing reports –Expert testimony in high-tech investigations.

TOTAL:36 HOURS

TEXT BOOKS:

1. Bill Nelson, Amelia Phillips and Christopher Steuart,(2018). *Computer Forensics and Investigations*, Cengage Learning, 5th Edition.
2. Eoghan Casey. (2017). *Handbook of Digital Forensics and Investigation*, 1st Edition, Academic Press.
3. John R Vacca, (2016). *Computer Forensics*, 2nd Edition, Cengage Learning.

REFERENCE BOOKS:

1. John R. Vacca, (2005), *Computer Forensics: Computer Crime Scene Investigation*, 2nd Edition Cengage Learning.
2. Marjie T Britz, (2008), *Computer Forensics and Cyber Crime: An Introduction*, 2nd Edition, Pearson Education.
3. Mari E-Helen Maras, (2014). *Computer Forensics: Cybercriminals, Laws, and Evidence*, 2nd Edition Jones & Bartlett Learning.

WEBSITES:

1. www.cps.brockport.edu/~shen/cps301/figures/figure1.pdf
2. www.forensicsguru.com/devicedataextractionsimcell.php
3. www.nptel.ac.in/courses/106101060
4. www.samsclass.info/121/ppt/ch11.ppt
5. www.garykessler.net/library/role_of_computer_forensics.html
6. www.ukessays.com/essays/information-technology/computer-forensics-and-crime-investigations-information-technology-essay.php.

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
CO1	-	-	3	-	-	-	-	-	-	-	2	-	-	-	-	2	-
CO2	-	-	3	-	1	-	-	-	-	-	-	-	-	-	-	-	2
CO3	3	-	-	-	-	1	2	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-
CO5	3	-	3	-	-	-	-	-	-	-	2	-	-	-	-	-	-
Average	3	-	3	-	1	1	2	-	-	-	2	-	-	-	-	2	2

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

Instruction Hours/week: L:3 T:0 P:0 Marks: Internal:40 External:60 Total:100

End Semester Exam:3Hours

PREREQUISITE

Course Objectives (CO):

- To train learners to crack competitive exams
- To enhance their ability to speak in English and face an interview.
- To make the student apply, prepare and clear the competitive exams.
- To prepare the student to concentrate, stay positive and confident.
- To take even failure at ease and continue the target of clearing competitive exams.

Course Outcomes (COs):

Upon the completion of this course, students will be able to

COs	Course Outcomes	Blooms Level
CO1	execute the grammatical elements in competitive exams	Apply
CO2	identify the various skills to build a strong outer relationship	Understand
CO3	analyse logical reasoning questions	Analyse
CO4	execute the process of sharing the general knowledge with use of proper communication	Apply
CO5	translate the correct structure of sentence from one language to other	Understand

UNIT I Grammar

8 HOURS

Number-Subject, Verb and Agreement-Articles-Sequences of Tenses-Common Errors

UNIT II Word Power

7 HOURS

Idioms and Phrases-One word substitution-Synonyms-Antonyms-Words often confused

UNIT III Paragraph

7 HOURS

Expansion of an idea

UNIT IV Writing

7 HOURS

Essay- Letters-Memos-Agenda-Resume writing

UNIT V Speaking

7 HOURS

Public Speaking-Group Discussion-Interview-Spoken English

TOTAL:36 HOURS

TEXT BOOK

Saraswathi, V. and Maya K. Mudbhatkal (2014). *English for Competitive Examinations*, Emerald: Chennai.

WEBSITES

1. <https://www.ef.com/wwen/english-resources/english-idioms/>

2. <https://www.talkenglish.com/speaking/listbasics.aspx>

CO, PO, PSO Mapping

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14	PO 15	PSO 1	PSO 2
CO1	-	-	3	-	-	3	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-
CO3	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Average		2.5	3	3	3	3	-	3	-	-	-	-	-	-	-	-	-

3-Strong; 2-Medium; 1-Low ‘-’ – No Corrections

PREREQUISITE:

- Not Required

COURSE OBJECTIVES (CO):

- To understand the basic concepts of organizational behavior.
- To analyze the individual behavior traits required for performing as an individual or group.
- To obtain the perceiving skills to judge the situation and communicate the thoughts and ideas.
- To evaluate how to perform in group and team and how to manage the power, politics and conflict.
- To recognize the importance of organizational culture and organizational change, group and team work to managing the conflict between members of the organization

COURSE OUTCOMES (COs):

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

COs	Course Outcomes	Blooms Level
CO1	Connect organizational behavior issues in the context of the organizational behavior theories and concepts.	Understand
CO2	Assess the behavior of the individuals and groups in organization and manage the stress.	Apply
CO3	Categorize team, power, politics and conflict arising between the members.	Analyze
CO4	Explain how organizational change and culture affect the working relationship within organizations.	Evaluate
CO5	Plan and exhibit the communications skills to convey the thoughts and ideas of case analysis to the individuals and group.	Analyze

UNIT I ORGANIZATION BEHAVIOR : INTRODUCTION**7 HOURS**

Organization Behavior: Meaning and definition - Fundamental concepts of Organization Behavior - Contributing disciplines to the Organization Behavior field – Organization Behavior Model - Significance of Organization Behavior in the organization success - Challenges and Opportunities for Organization Behavior.

UNIT II BEHAVIOUR AND PERSONALITY**7 HOURS**

Attitudes – Sources - Types - Functions of Attitudes – Attitude and Job satisfaction, Emotions and Moods – Emotional Intelligence – Organization Behavior Applications of Emotions and Moods, Learning – Theories of Learning. Personality – Determinants of personality- Theories of Personality - psycho-analytical, social learning, job-fit, and trait theories.

UNIT III PERCEPTION**7 HOURS**

Perception – factors influencing perception - Person Perception – Attribution Theory – Frequently Used Shortcuts in Judging Others- Perceptual Process- Perceptual Selectivity - Organization Errors of perception – Linkage between perception and Decision making.

UNIT IV GROUP AND STRESS MANAGEMENT**7 HOURS**

Foundation of Group Behavior - Concept of Group - Types of Groups - Stages of Group Development - Group Norms - Group Cohesiveness – Stress- Causes of Stress- Effects of Occupational stress- Coping strategies for stress.

UNIT V ORGANIZATION CULTURE AND CHANGE AND STRESS MANAGEMENT**8 HOURS**

Organizational culture- Definitions and Characteristics of Culture- Types of Culture – Creating and Maintaining an Organizational Culture. Organizational change –Meaning- Forces for Change- Managing Planned Change - Factors in Organizational Change - Resistance to change- Overcoming resistance to change.

TOTAL: 36 HOURS**TEXT BOOKS:**

1. Fred Luthans. (2017). *Organizational Behavior: An Evidence - Based Approach*, 12th Edition, Mcgraw Hill Education, New Delhi.
2. Steven Mcshane and Mary Ann Von Glinow (2017), *Organizational Behavior*, 6th Edition, McGraw Hill Education, New Delhi
3. Robbins,S.P, and Judge,T.A.(2016). *Organizational Behaviour*, 16th edition, Prentice Hall of India, New Delhi

REFERENCE BOOKS:

- 1.Laurie J. Mullins (2016). *Management and Organisational behaviour*, 10th Edition, Pearson Education, New Delhi
- 2.Robbins,S. P, and Judge,T.A.(2016). *Essentials of Organizational Behavior*,13th Edition, Pearson Education

WEB SITES:

<https://nptel.ac.in/courses/110/105/110105033/>

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
CO1	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO3	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	2	-
Average	-	-	2	3	2	-	3	-	-	-	-	-	-	-	-	2.5	-

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

PREREQUISITE:

- Algebra, Probability and Statistics, Digital Communication, Programming Skills.

COURSE OBJECTIVES (CO):

- To understand the communication channels and the importance of error correction.
- To explore the linear codes, self-orthogonal codes, and self-dual codes.
- To learn about the cyclic codes, their properties, and decoding methods.

COURSE OUTCOMES (COs):

Upon completion of this course, the student will be able to:

COs	Course Outcomes	Blooms Level
CO1	Understand the fundamental concepts of error detection, correction, and decoding in communication channels.	Understand
CO2	Apply the concepts of generator matrix and parity check matrix in encoding and decoding linear codes.	Apply
CO3	Analyze different types of codes, including Binary and q-ary Hamming codes, Golay codes, and MDS codes, for their error-correcting capabilities.	Analyze
CO4	Understand the definitions and properties of cyclic codes.	Understand
CO5	Apply BCH codes and Reed Solomon codes to various coding problems.	Apply

UNIT I ERROR DETECTION, CORRECTION AND DECODING**7 HOURS**

Communication channels – Maximum likelihood decoding – Hamming distance – Nearest neighbour hood minimum distance decoding – Distance of a code.

UNIT II LINEAR CODES**7 HOURS**

Linear codes – Self orthogonal codes – Self dual codes – Bases for linear codes – Generator matrix and parity check matrix – Encoding with a linear code – Decoding of linear codes – Syndrome decoding.

UNIT III BOUNDS IN CODING THEORY**8 HOURS**

The main coding theory problem – lower bounds - Sphere covering bound – Gilbert Varshamov bound – Binary Hamming codes – q-ary Hamming codes – Golay codes – Singleton bound and MDS codes – Plotkin bound.

UNIT IV CYCLIC CODES**7 HOURS**

Definitions – Generator polynomials – Generator matrix and parity check matrix – Decoding of Cyclic codes.

UNIT V SPECIAL CYCLIC CODES**7 HOURS**

BCH codes – Parameters of BCH codes – Decoding of BCH codes – Reed Solomon codes.

TOTAL: 36 HOURS

TEXT BOOKS:

1. Hill, H. (1986). *A first course in Coding theory*, OUP.
2. San Ling and Chaping Xing, (2004). *Coding Theory: A first course*, Cambridge University Press.

REFERENCE BOOKS:

1. Berlekamp, E.R. (1968). *Algebraic Coding Theory*, Mc Graw – Hill.
2. Lin, S. and Costello, D. J. (1983). *Error control Coding: Fundamentals and Applications*, Prentice – Hall, Inc., New Jersey.
3. Vera Pless, (1982). *Introduction to the Theory of Error Correcting Codes*, Wiley, New York.

WEBSITES:

1. <https://nptel.ac.in/courses/108104092>
2. <https://nptel.ac.in/courses/117106031>

CO, PO, PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14	PO 15	PSO 1	PSO 2
CO1	2	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1
CO2	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1
CO3	2	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1
CO4	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
CO5	3	2	1	-	-	-	1	-	-	-	-	-	-	-	-	-	1
Average	2.4	1.4	1	-	-	-	1	-	-	-	-	-	-	-	-	-	1

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

Instruction Hours/week: L: 3 T: 0 P: 0

Marks: Internal: 40 External: 60 Total: 100

End Semester Exam: 3 Hours

PREREQUISITE:

- Not Required

COURSE OBJECTIVES (CO):

- To create awareness about types and handling of domestic appliances
- To acquire knowledge about principle of operation, working and application of various domestic appliances.
- To gain the skills in assembly, repair, installation, testing and maintenance of domestic appliances.
- To acquire skills in entrepreneurship

COURSE OUTCOMES (COs):

Upon the completion of this course, the students will be able to

COs	Course Outcomes	Blooms Level
CO1	Repair maintenance of the basic electrical and electronics appliances	Apply
CO2	Identification to protective devices	Understand
CO3	Repair and maintenance of the split Vacuum Cleaner and washing machine	Analysis
CO4	Repair and maintenance of the electric fan & hair drier	Apply
CO5	Acquire knowledge about tools, equipment and Instruments	Understand

UNIT I INSTRUMENTS AND TESTING

8 HOURS

Introduction – voltage tester screwdriver – continuing test – insulation test – measurement of power for dc & ac circuits. **Electrical Cooking Appliances** introduction – types – construction – electric toaster – types – automatic and non-automatic. **Electric Iron Box** types – non-automatic – automatic – construction and working – comparison – trouble shooting – Steam iron box.

UNIT II WATER HEATERS & COFFEE MAKERS

7 HOURS

Water heater – function – types – electric kettle – immersion water heater – construction and working – storage water heaters – non pressure type – pressure type – construction and working – repairs & remedies – coffee maker – types – construction and working of percolator type.

UNIT III ELECTRIC MIXER & EGG BEATERS

7 HOURS

Electric maker – function and its construction – general operating instruction – caution – cleaning – repairs and remedies – egg beaters – hand operated crank type – electric type and its construction.

UNIT IV VACUUM CLEANER AND WASHING MACHINE

7 HOURS

Vacuum cleaner – function – principle – main components – features – types - working – accessories - filters – repairing. washing machine – function – types – semi and fully automatic – top and front loading – washing technique – working cycle – construction and working of washing machine – comparison of top and front-loading machines – problems and remedies.

UNIT V ELECTRIC FAN & HAIR DRIER

7 HOURS

Fan – function – terminology – construction and working of ceiling & table fans –exhaust fan – general fault and remedy. hair drier – function – types – construction and working – safety features – repairs & remedies.

TOTAL: 36 HOURS

TEXT BOOKS:

1. *Electrical Practical, Directorate General of employment & training (DGET),(2018) .Arihant Publisher.*
2. *Handbook of Repair and Maintenance of Domestic Electronics Appliances handbook* By Shashi Bhushan Sinha, BPB Publications.

REFERENCE BOOKS:

1. Dixon and Graham, *Electrical Appliance Manual–Hardcover*, ISBN 13: 9781859608005.
2. Graham and Dixon, (1995). *Electrical Appliances: The Complete Guide to the Maintenance and Repair of Domestic Electrical Appliances* (Haynes for Home DIY S.).
3. Shashi Bhushan Sinha, *Handbook of Repair and Maintenance of Domestic Electronics Appliances*.

WEBSITES:

1. <https://alison.com/courses?query=Electrical%20Appliance%20and%20Servicings#>.
2. <https://www.scribd.com/document/269725441/Electrical-Appliances-PDF>.
3. <https://www.unitec.ac.nz/career-and-study-options/electrical-and-electronics-engineering/electrical-appliance-serviceperson-eas>.

CO, PO, PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PSO1	PSO2
CO1	-	-	3	-	-	-	-	-	1	-	2	-	2	-	-	2	-
CO2	-	-	3	-	1	-	-	-	1	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	1	2	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	2	-	-	-	-	-	2	-	-	-	2
CO5	3	-	3	-	-	-	-	-	-	-	2	-	-	-	-	-	-
Average	3	-	3	-	1	1	2	-	1	-	2	-	2	-	-	2	2

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation