

Faculty of Science  
**B. Sc. INDUSTRIAL MICROBIOLOGY**  
**SEMESTER-WISE SYLLABUS IN CBCS PATTERN**

(Medium of Instruction and Examination shall be only in English)

Code	Course Title	Course Type	HPW	Credits
<b>FIRST YEAR SEMESTER -I</b>				
BS104	Fundamentals of Industrial Microbiology	DSC-1A	4T + 2P = 6	4+1 = 5
<b>SEMESTER -II</b>				
BS204	Biostatistics and Analytical Microbiology	DSC-1B	4T + 2P = 6	4+1 = 5
<b>SECOND YEAR SEMESTER -III</b>				
BS304	Microbial Physiology and Biochemistry	DSC-1C	4T + 2P = 6	4+1 = 5
<b>SEMESTER -IV</b>				
BS404	Microbial Genetics	DSC-1D	4T + 2P = 6	4+1 = 5
<b>THIRD YEAR SEMESTER -V</b>				
BS503	Immunology and Medical Microbiology	DSC-1E	3T + 2P	3+1 = 4
BS506	Instrumentation and Biotechniques	DSE-1E/A	3T + 2P	3+1 = 4
BS506	Biosafety and Intellectual property rights (IPR)	DSE-1E/B	3T + 2P	3+1 = 4
<b>SEMESTER -VI</b>				
BS603	Agricultural Microbiology	DSC-1F	3T + 2P	3+1 = 4
BS606	Food Microbiology and Fermentation Technology	DSE-1F/A	3T + 2P	3+1 = 4
BS606	Environmental Microbiology	DSE-1F/B	3T + 2P	3+1 = 4

**DSC: Discipline Specific Course (Core)**

**DSE: Discipline Specific Elective (Elective)**

**B. Sc (CBCS) Industrial Microbiology – I Year**  
**Semester-I – Paper-I**  
**BS104-DSC-1A: FUNDAMENTALS OF INDUSTRIAL MICROBIOLOGY**

**Theory syllabus**

**Credits – 4**

**UNIT – I**

1. Definition and Scope of Microbiology, History and Development of Microbiology (contribution of pioneers), Golden Era of Microbiology.
2. The era of the discovery of antibiotics, The discovery of the Anaerobic life, The physiological significance of fermentation
3. Diversity of Microbial World, Prokaryotic cell, Structure of Bacterial cell, Archaeobacteria and Eubacteria.

**UNIT - II**

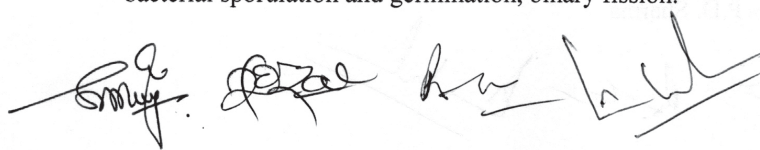
1. Structure and function of Plasma membrane, cell wall, capsule, flagella, nucleod, plasmid, Gram positive and Gram negative bacteria.
2. Definition of auxochrome; Chromophores; Acidic and Basic dyes; Classification of stains; Simple and differential staining; theories of staining, mordant and its function.
3. Gram staining; acid fast staining, endospore staining; negative staining; capsule staining, flagella staining; mechanism of gram staining.

**UNIT – III**

1. Sterilization and disinfection techniques - Principles and methods of sterilization. Physical methods - autoclave, hot-air oven, pressure cooker, laminar air flow, filter sterilization.
2. Radiation methods - UV rays, gamma rays, ultrasonic methods.
3. Chemical methods - Use of alcohols, aldehydes, fumigants, phenols, halogens and hypochlorites. Phenol coefficient.

**UNIT – IV**

1. Characteristics of Fungi, Algae, Protozoans, Viruses. Principles of classification of bacteria, algae, fungi, protozoa, viruses.
2. Methods for studying microorganisms, pure culture techniques, method, media – types, preservation techniques.
3. Microbial growth, phases of growth, conditions of growth, measurement of growth, bacterial sporulation and germination, binary fission.



**B. Sc (CBCS) Industrial Microbiology – I Year**  
**Semester-I – Paper-I**  
**BS104-DSC-1A: FUNDAMENTALS OF INDUSTRIAL MICROBIOLOGY**

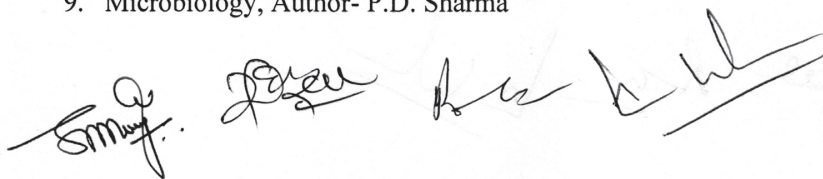
**Practical syllabus**

**Credits - 1**

1. Microbiology laboratory organization and safety precautions
2. To study the principle and applications of important instruments (biological safety cabinets, autoclave, incubator, BOD incubator, hot air oven, light microscope, pH meter) used in the microbiology laboratory.
3. Microscope and its handling
4. Micrometry - calibration of microscope and measurement of microorganisms (fungal spores).
5. Preparation of culture media – Czapek-Dox medium. PDA, Nutrient agar medium.
6. Demonstration of Motility by hanging drop method
7. Staining techniques :Simple staining, Gram's staining, staining of bacterial spores
8. Microscopic observation of bacteria (Gram +ve bacilli and cocci, Gram -ve bacilli), cyanobacteria (*Nostoc*, *Spirulina*), algae (*Scenedesmus* sp., diatoms), and fungi (*Saccharomyces*, *Rhizopus*, *Aspergillus*, *Penicillium*, *Fusarium*).

**References:**

1. Tortora GJ, Funke BR and Case CL. (2008). Microbiology: An Introduction. 9th edition. Pearson Education.
2. Madigan MT, Martinko JM, Dunlap PV and Clark DP. (2014). Brock Biology of Microorganisms. 14th edition. Pearson International Edition.
3. Wiley JM, Sherwood LM and Woolverton CJ. (2013) Prescott's Microbiology. 9th Edition. McGraw Hill International.
4. Atlas RM. (1997). Principles of Microbiology. 2nd edition. WM.T.BrownPublishers.
5. Pelczar MJ, Chan ECS and Krieg NR. (1993). Microbiology. 5th edition. McGrawHill Book Company.
6. Stanier RY, Ingraham JL, Wheelis ML, and Painter PR. (2005). General Microbiology. 5th edition. McMillan.
7. General Microbiology (1993) Authors- Powar and Dagainawala.
8. Microbiology, Author- S.S. Purohit.
9. Microbiology, Author- P.D. Sharma





**B. Sc (CBCS) Industrial Microbiology – I Year**  
**Semester-II – Paper-II**  
**BS204-DSC-1B: BIOSTATISTICS AND ANALYTICAL MICROBIOLOGY**

**Theory syllabus**

**Credits – 4**

**UNIT – I**

1. Introduction - Types of biological data, population and samples.
2. Descriptions of samples and populations - Frequency distributions, descriptive statistics (measures of Central tendency and measures of dispersion, Boxplot)
3. Probability - Introductory concepts, Binomial distribution, Random sampling. Distribution Theory - Normal distribution and sampling distributions.

**UNIT - II**

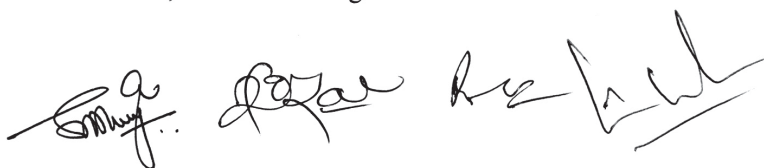
1. Statistical Inference - Statistical estimation, standard error of the mean, confidence interval and hypothesis testing of the population mean –  $t$  test. Brief discussions on the comparison of two independent population means.
2. The Chi square test and its applications.
3. Analysis of Variance - Multi sample Hypotheses, Linear Regression and Correlation.

**UNIT – III**

1. Colorimetry and Spectrophotometry - Lambert – Beer's Law. Ultraviolet, Visible, Infra red and Fluorescence spectroscopy.
2. Chromatography- Principle. Types of chromatography- Paper, Thin layer, Column, Ion exchange and Gas chromatography. Sedimentation and filtration.
3. Principle, working and applications of centrifuge.

**UNIT – IV**

1. Quality Control tests- Sterility testing, Microbial Limit Test (MLT).
2. Pyrogen testing (LAL test), Minimum Inhibitory Concentration(MIC).
3. FDA and Good Manufacturing Practices. Quantitative and qualitative analysis of food, milk, water and sewage.





**B. Sc (CBCS) Industrial Microbiology – I Year**  
**Semester-II – Paper-II**  
**BS204-DSC-1B: BIOSTATISTICS AND ANALYTICAL MICROBIOLOGY**

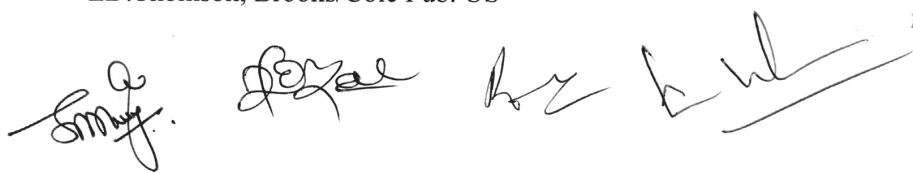
**Practical syllabus**

**Credits – 1**

1. Mean, Median, Mode from grouped and ungrouped Data set
2. Standard Deviation and Coefficient of Variation
3. Correlation and Regression
4. Testing of Hypothesis- Normal Distribution, t-test and Chi-Square-test
5. Separation of carbohydrates by Paper Chromatography
6. Separation of amino acids by Paper Chromatography
7. Separation of lipids by Thin Layer Chromatography
8. Determination of MIC of antibiotics
9. Determination of microbiological quality of milk

**References:**

1. S. Palanisamy and M. Manoharan, 2002. Statistical methods for Biologists. Palani Paramount Publication, Anna Nagar, Palani, T. N.
2. S.C. Gupta and K. Kapoor, 2002. Fundamentals of Applied Statistics. 3rd Edition. Sultan Sons Educational Publisher, N.D.
3. N. Gurumani, 2002. An introduction to Biostatistics. MJP Publishers, Chennai.
4. P.R. Vittal, and V. Malini, 2002. Statistical and Numerical Methods. Margham Publications, Chennai.
5. Keeler, J. 2002 Understanding NMR spectroscopy. John Wiley and Sons England.
6. Cavangh John et al 1995 Proton NMR, Spectroscopy principles and practice, Academic Press.
7. Holme. D.J. and H. Peck. Analytical Biochemistry.
8. A.Upadhyay, K.Upadhyay and N. Nath 2006 Biophysical Chemistry, Principles and Techniques Himalaya Pub. House.
9. Slater, R.J. 1991 Radioisotopes in Biology. A practical Approach, IRL Press, Oxford.
10. Holler, F.J., D.A. Skoog and S.R. Crouch, 2007 Principles of Instrumental Analysis IV ED. Thomson, Brooks/Cole Pub. US



**B. Sc (CBCS) Industrial Microbiology – II Year**  
**Semester-III – Paper-III**  
**BS304-DSC-1C: MICROBIAL PHYSIOLOGY AND BIOCHEMISTRY**

**Theory syllabus**

**Credits – 4**

**UNIT - I**

1. Physiological properties - Diffusion, gaseous exchange, osmosis, plasmolysis, biochemical properties of membrane, passive and active transport.
2. Photosynthesis - Photosynthetic microbes, oxygenic/anoxygenic reaction centres, electron transport, photophosphorylation, Calvin cycle (dark reaction) phosphoenol carboxylase, photorespiration and its significance.
3. Respiratory pathways - Respiratory pathways, breakdown of carbohydrates through Glycolysis, Krebs cycle, fermentation, pentose phosphate pathway, oxidative and substrate level phosphorylation, significance of Krebs cycle. Gluconeogenesis and its significance.

**UNIT - II**

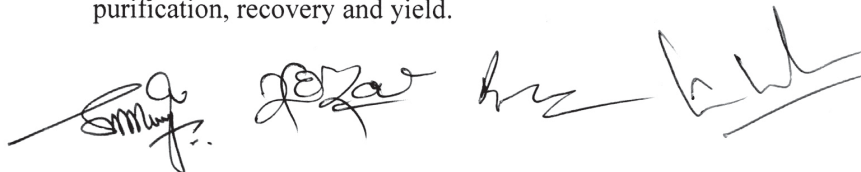
1. Nitrogen metabolism – Diversity of nitrogen fixers, symbiotic and non-symbiotic nitrogen fixation, regulation of nitrogen fixation, nitrification, denitrification and ammonifying bacteria.
2. Methylophiles - Methanogens and methylophiles, sulphur utilizing bacteria, sulphate reduction pathway, economic importance of methylophiles and sulphur utilizing bacteria.
3. Basic concepts of primary and secondary metabolism.

**UNIT - III**

1. Carbohydrates - classification of carbohydrates, chemical structure and properties of starch, cellulose, glycogen,
2. Lipids - saturated and unsaturated fatty acids, classification of lipids. Properties and functions of neutral lipids, phospholipids, glycolipids, steroids.
3. Amino acids - structure and classification of amino acids, essential and non essential amino acids.

**UNIT - IV**

1. Enzymes – Basics of enzymology, properties and classification of enzymes.
2. Biocatalysis - induced fit, and lock and key model, coenzymes, cofactors, factors affecting catalytic activity of enzymes.
3. Derivation of Michaelis-Menton equation, Inhibition of enzyme activity - competitive, noncompetitive, uncompetitive and allosteric mechanisms. Enzyme extraction, purification, recovery and yield.



**B. Sc (CBCS) Industrial Microbiology – II Year**  
**Semester-III – Paper-III**  
**BS304-DSC-1C: MICROBIAL PHYSIOLOGY AND BIOCHEMISTRY**

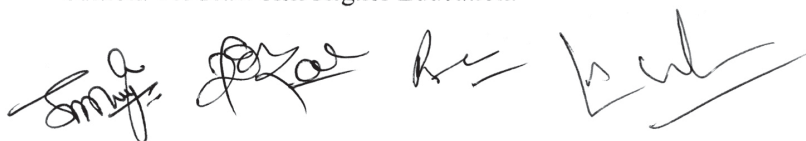
**Practical syllabus**

**Credits – 1**

1. Study and plot the growth curve of *E. coli* by turbidometric method.
2. Effect of temperature on growth of *E. coli*.
3. Effect of pH on growth of *E. coli*.
4. Effect of osmotic pressure (salt and sugar concentration) on bacterial growth.
5. Setting and observation of Winogradsky column.
6. The oligodynamic action of heavy metals on bacterial growth.
7. Quantitative estimation of protein by Lowry's method.
8. Quantitative estimation of glucose by Anthrone method.
9. Qualitative tests for carbohydrates.
10. Qualitative tests for amino acids.

**References:**

1. Campbell, MK (2012) Biochemistry, 7th ed., Published by Cengage Learning.
2. Campbell, PN and Smith AD (2011) Biochemistry Illustrated, 4th ed., Published by Churchill Livingstone.
3. Tymoczko JL, Berg JM and Stryer L (2012) Biochemistry: A short course, 2nd ed., W.H. Freeman.
4. Berg JM, Tymoczko JL and Stryer L (2011) Biochemistry, W.H. Freeman and Company.
5. Nelson DL and Cox MM (2008) Lehninger Principles of Biochemistry, 5th Edition., W.H. Freeman and Company.
6. Voet D. and Voet J.G (2004) Biochemistry 3rd edition, John Wiley and Sons.
7. Madigan MT, and Martinko JM (2014). Brock Biology of Microorganisms. 14th edition. Prentice Hall International Inc.
8. Moat AG and Foster JW. (2002). Microbial Physiology. 4th edition. John Wiley & Sons.
9. Reddy SR and Reddy SM. (2005). Microbial Physiology. Scientific Publishers India.
10. Gottschalk G. (1986). Bacterial Metabolism. 2nd edition. Springer Verlag.
11. Stanier RY, Ingraham JJ, Wheelis ML and Painter PR. (1987). General Microbiology. 5th edition, McMillan Press.
12. Willey JM, Sherwood LM, and Woolverton CJ. (2013). Prescott's Microbiology. 9th edition. McGraw Hill Higher Education.





**B. Sc (CBCS) Industrial Microbiology – II Year**  
**Semester-IV – Paper-IV**  
**BS404-DSC-1D: MICROBIAL GENETICS**

**Theory syllabus**

**Credits – 4**

**UNIT – I**

1. Overview of prokaryotic and eukaryotic cells, cell size and shape, Eukaryotic and prokaryotic Cell organelles, Cell division (mitosis and Meiosis)
2. Fundamentals of genetics - Mendelian laws, alleles, crossing over, and linkage. DNA and RNA as genetic materials.
3. Structure of DNA – Watson and Crick model. Extrachromosomal genetic elements – Plasmids and transposons. Replication of DNA – Semiconservative mechanism.

**UNIT – II**

1. Brief account on horizontal gene transfer among bacteria – transformation, transduction and conjugation.
2. Mutations – spontaneous and induced, base pair changes, frameshift mutations, deletions, inversions, tandem duplications, insertions. Various physical and chemical mutagens.
3. Outlines of DNA damage and repair mechanisms.

**UNIT – III**

1. Concept of gene – Muton, recon and cistron. One gene-one enzyme, one gene-one polypeptide, one gene-one product hypotheses.
2. Types of RNA and their functions. Outlines of RNA biosynthesis in prokaryotes.
3. Genetic code. Structure of ribosomes and a brief account of protein synthesis.

**UNIT – IV**

1. Types of genes – structural, constitutive, regulatory. Operon concept. Regulation of gene expression in bacteria – *lac* operon.
2. Basic principles of genetic engineering - restriction endonucleases, DNA polymerases and ligases, vectors. Outlines of gene cloning methods. Genomic and cDNA libraries.
3. General account on application of genetic engineering in industry, agriculture and medicine.



**B. Sc (CBCS) Industrial Microbiology – II Year**  
**Semester-IV – Paper-IV**  
**BS404-DSC-1D: MICROBIAL GENETICS**

**Practical syllabus**

**Credits – 1**

1. Estimation DNA by diphenylamine (DPA) method.
2. Estimation of RNA by orcinol method
3. Study of cell division in onion root tip (mitotic divisions)
4. Isolation of DNA from bacteria.
5. Isolation of mutants of bacteria by UV exposure.
6. Problems related to Mendilian laws mono and dihybrid cross (problems)
7. Problems related to gene interactions
8. Problems related to DNA and RNA characteristics, Transcription and Translation.

**References:**

1. Genes XI, Author- B. Lewin.
2. Principles of Genetics, Authors- Gardner, Simmons and Snustad.
3. Concepts of Genetics, Authors- Klug and Cummings.
4. Microbial Genetics, Authors- Freifelder.
5. Genetics, Authors- Arora and Sandhu.
6. Text of Microbiology, Authors- Ananthanarayanan and Paniker.
7. S R Maloy, D Freifelder and J E Cronan. Microbial Genetics. Jones and Barlett Publishers.



**B. Sc (CBCS) Industrial Microbiology – III Year**  
**Semester-V – Paper-V (Discipline Specific Course)**  
**BS503-DSC-1E: IMMUNOLOGY AND MEDICAL MICROBIOLOGY**

**Theory syllabus**

**Credits – 3**

**UNIT-I**

1. History and scope of Immunology: Contributions of Edward Jenner, Louis Pasteur, Early theories of Immunity.
2. Types of Immunity – Innate immunity, acquired immunity, immune response – humoral immune response, cell mediated immune response
3. Antigen antibody interactions: Agglutinations: Hemagglutinations, bacterial agglutinations, passive agglutinations, precipitation: precipitation reactions in fluids, precipitation reactions in gels Radial immuno diffusion, Double immuno diffusion (Ouchterlony method) and complement fixation

**UNIT-II**

1. Structure and functions of Immunoglobulins (IgG, IgM, IgA, IgE, IgD)
2. Hybridoma technology for synthesis of Monoclonal antibodies Medical and diagnostic applications of monoclonal antibodies.
3. History of medically important microorganisms involved in industry. Normal flora of human body, their importance and quality checking of industrial products.

**UNIT – III**

1. Definition of infection, non-specific defense mechanisms, mechanical barriers, antagonism of indigenous flora.
2. Collection, transport and processing of clinical samples, General methods of laboratory diagnosis – cultural, biochemical, serological and molecular methods
3. Air-borne diseases - Tuberculosis, Influenza, Food and water-borne diseases - Typhoid, Hepatitis- A, Zoonotic diseases - Rabies, Anthrax, Insect-borne diseases - Malaria, Filariasis, Dengue fever, Contact diseases - Syphilis, Gonorrhoea, Blood-borne diseases - Serum hepatitis, AIDS





**B. Sc (CBCS) Industrial Microbiology – III Year**  
**Semester-V – Paper-V (Discipline Specific Course)**  
**BS503-DSC-1E: IMMUNOLOGY AND MEDICAL MICROBIOLOGY**

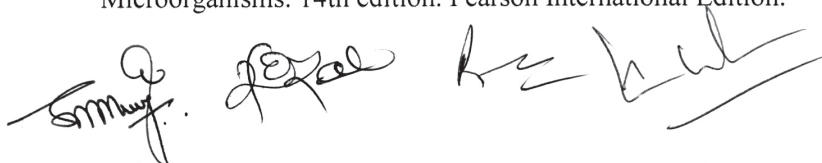
**Practical syllabus**

**Credits – 1**

1. Determination of blood groups and Rh typing.
2. Estimation of hemoglobin content of human blood
3. Preparation of blood smear and different blood cell count
  - i) RBC count
  - ii) WBC count
4. Differential staining of WBC by Leishman's stain
5. Widal-slide agglutination test
6. RPR card test for syphilis
7. Tridot test
8. Antibiotic sensitivity testing – disc diffusion method.
9. Parasites – Malarial parasite, *Entamoeba* (study of permanent slides).

**References:**

1. Abbas AK, Lichtman AH, Pillai S. (2007). Cellular and Molecular Immunology. 6th edition Saunders Publication, Philadelphia.
2. Delves P, Martin S, Burton D, Roitt IM. (2006). Roitt's Essential Immunology. 11th edition Wiley-Blackwell Scientific Publication, Oxford.
3. Goldsby RA, Kindt TJ, Osborne BA. (2007). Kuby's Immunology. 6th edition W.H. Freeman and Company, New York.
4. Murphy K, Travers P, Walport M. (2008). Janeway's Immunobiology. 7th edition Garland Science Publishers, New York.
5. Peakman M, and Vergani D. (2009). Basic and Clinical Immunology. 2nd edition Churchill Livingstone Publishers, Edinburgh.
6. Ananthanarayan R. and Paniker C.K.J. (2009) Textbook of Microbiology. 8th edition, University Press Publication
7. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013) Jawetz, Melnick and Adelberg's Medical Microbiology. 26th edition. McGraw-Hill Publication
8. Goering R., Dockrell H., Zuckerman M. and Wakelin D. (2007) Mims' Medical Microbiology. 4th edition. Elsevier
9. Willey JM, Sherwood LM, and Woolverton CJ. (2013) Prescott, Harley and Klein's Microbiology. 9th edition. McGraw Hill Higher Education
10. Madigan MT, Martinko JM, Dunlap PV and Clark DP. (2014). Brock Biology of Microorganisms. 14th edition. Pearson International Edition.



**B. Sc (CBCS) Industrial Microbiology – III Year**  
**Semester-V – Paper-VI/A (Discipline Specific Elective)**  
**BS506-DSE-1E/A: INSTRUMENTATION AND BIOTECHNIQUES**

**Theory syllabus**

**Credits – 3**

**UNIT – I**

1. Microscopy: Brightfield and darkfield microscopy, Fluorescence Microscopy, Phase contrast Microscopy.
2. Electron Microscopy (Scanning and Transmission Electron Microscopy).
3. Biophysical Principles: Osmosis, osmotic pressure, Donan equilibrium, diffusion potential, diffusion coefficient, endocytosis & exocytosis, gradient of chemical potential as driving force in transport, membrane potential & ionophores.

**UNIT – II**

1. Chromatography: Principles and applications of paper chromatography (including Descending and 2-D), Thin layer chromatography. Column packing and fraction collection.
2. Gel filtration chromatography, ion-exchange chromatography and affinity chromatography, GLC, HPLC.
3. Electrophoresis: Principle and applications of native polyacrylamide gel electrophoresis. SDS- polyacrylamide gel electrophoresis, 2D gel electrophoresis. Isoelectric focusing, Zymogram preparation and Agarose gel electrophoresis.

**UNIT – III**

1. Spectrophotometry: Principle and use of study of absorption spectra of biomolecules. Analysis of biomolecules using UV and visible range. Colorimetry and turbidometry.
2. Centrifugation: Principle, working and applications of centrifuge. Preparative and analytical centrifugation, fixed angle and swinging bucket rotors.
3. Differential centrifugation, density gradient centrifugation and ultracentrifugation.



**B. Sc (CBCS) Industrial Microbiology – III Year**  
**Semester-V – Paper-VI/A (Discipline Specific Elective)**  
**BS506-DSE-1E/A: INSTRUMENTATION AND BIOTECHNIQUES**

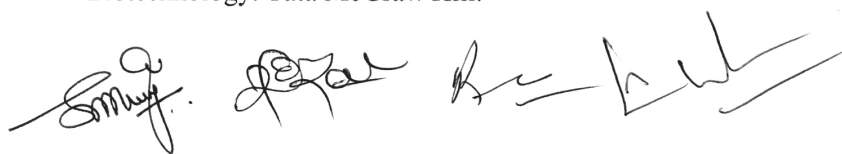
**Practical syllabus**

**Credits – 1**

1. Study of fluorescent micrographs to visualize bacterial cells.
2. Ray diagrams of phase contrast microscopy and Electron microscopy.
3. Separation of mixtures by paper / thin layer chromatography.
4. To demonstrate column packing in any form of column chromatography.
5. Separation of protein mixtures by Polyacrylamide Gel Electrophoresis (PAGE).
6. Determination of  $\lambda_{\text{max}}$  for an unknown sample and calculation of extinction coefficient.
7. Separation of components of a given mixture using a laboratory scale centrifuge.
8. Understanding density gradient centrifugation with the help of pictures.

**References:**

1. A.Upadhyay, K.Upadhyay and N. Nath 2006 Biophysical Chemistry, Principles and Techniques Himalaya Pub. House.
2. Wilson K and Walker J. (2010). Principles and Techniques of Biochemistry and Molecular Biology. 7th Ed., Cambridge University Press.
3. Nelson DL and Cox MM. (2008). Lehninger Principles of Biochemistry, 5th Ed., W.H. Freeman and Company.
4. Willey MJ, Sherwood LM & Woolverton C J. (2013). Prescott, Harley and Klein's Microbiology. 9thEd., McGraw Hill.
5. Karp G. (2010) Cell and Molecular Biology: Concepts and Experiments. 6th edition. John Wiley & Sons. Inc.
6. De Robertis EDP and De Robertis EMF. (2006). Cell and Molecular Biology. 8th edition. Lipincott Williams and Wilkins, Philadelphia.
7. Cooper G.M. and Hausman R.E. (2009). The Cell: A Molecular Approach. 5th Edition. ASM Press & Sunderland, Washington D.C., Sinauer Associates, MA.
8. Nigam A and Ayyagari A. 2007. Lab Manual in Biochemistry, Immunology and Biotechnology. Tata McGraw Hill.





**B. Sc (CBCS) Industrial Microbiology – III Year**  
**Semester-V – Paper-VI/B (Discipline Specific Elective)**  
**BS506-DSE-1E/B: BIOSAFETY AND INTELLECTUAL PROPERTY RIGHTS (IPR)**

**Theory syllabus**

**Credits – 3**

**UNIT – I**

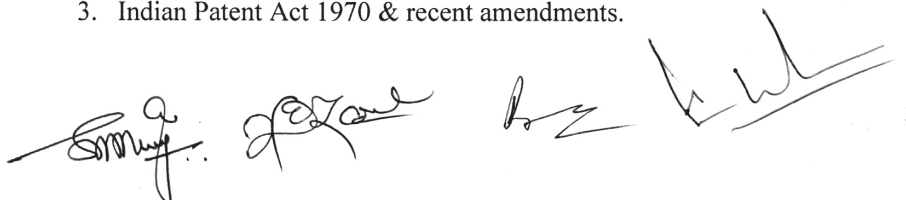
1. Biosafety: Introduction; biosafety issues in biotechnology; Biological Safety Cabinets & their types. Primary Containment for Biohazards; Biosafety Levels of Specific Microorganisms.
2. Biosafety Guidelines: Biosafety guidelines and regulations (National and International); GMOs/LMOs- Concerns and Challenges.
3. Role of Institutional Biosafety Committees (IBSC), RCGM, GEAC etc. for GMO applications in food and agriculture. Environmental release of GMOs; Risk Analysis; Risk Assessment; Risk management and communication; Overview of International Agreements - Cartagena Protocol.

**UNIT – II**

1. Introduction to Intellectual Property: Patents, Types, Trademarks, Copyright & Related Rights, Industrial Design and Rights, Traditional Knowledge.
2. Geographical Indications- importance of IPR – patentable and non patentables – patenting life – legal protection of biotechnological inventions – World Intellectual Property Rights Organization (WIPO).
3. Grant of Patent and Patenting Authorities: Types of patent applications: Ordinary, PCT, Conventional, Divisional and Patent of Addition; An introduction to Patent Filing Procedures.

**UNIT - III**

1. Patent licensing and agreement; Patent infringement- meaning, scope, litigation, case studies, Rights and Duties of patent owner.
2. Agreements and Treaties: GATT, TRIPS Agreements; Role of Madrid Agreement; Hague Agreement; WIPO Treaties.
3. Indian Patent Act 1970 & recent amendments.



**B. Sc (CBCS) Industrial Microbiology – III Year**  
**Semester-V – Paper-VI/B (Discipline Specific Elective)**  
**BS506-DSE-1E/B: BIOSAFETY AND INTELLECTUAL PROPERTY RIGHTS (IPR)**

**Practical syllabus**

**Credits – 1**

1. Study of components and design of a BSL-III laboratory.
2. Filing applications for approval from biosafety committee (IBSC).
3. Filing primary applications for patents.
4. Study of steps of a patenting process.
5. A case study.

**References:**

1. Bare Act, 2007. Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt. Ltd., New Delhi.
2. Kankanala C (2007). Genetic Patent Law & Strategy, 1st Edition, Manupatra Information Solution Pvt. Ltd. New Delhi
3. Mittal, D.P. (1999). Indian Patents Law, Taxmann, Allied Services (p) Ltd.
4. Singh K K (2015). Biotechnology and Intellectual Property Rights: Legal and Social Implications, Springer India.
5. Goel D & Prashar S (2013). IPR, Biosafety and Bioethics. Pearson.
6. Senthil Kumar Sadhasivam and Mohammed Jaabir, M. S. 2008. IPR, Biosafety and biotechnology Management. Jasen Publications, Tiruchirappalli, India.



**B. Sc (CBCS) Industrial Microbiology – III Year**  
**Semester-VI – Paper-VII (Discipline Specific Course)**  
**BS603-DSC-1F: AGRICULTURAL MICROBIALOLOGY**

**Theory syllabus**

**Credits – 3**

**UNIT - I**

1. Physical and chemical characteristics of soil. suitability of soil for agriculture, soil chemistry, humus formation, soil fertility, micro/macronutrients,
2. Rhizosphere and phyllosphere, frequency/density and abundance of soil microbes, biological significance of soil enzymes. Microbe–Microbe Interactions: Mutualism, Synergism, Commensalism, Competition, Amensalism, Parasitism, and Predation.
3. Plant growth-promoting microorganisms - mycorrhizae, rhizobia, Azospirillum, Azotobacter, cyanobacteria, Frankia and phosphate solubilizing microorganisms

**UNIT - II**

1. Outlines of biological nitrogen fixation (symbiotic, non-symbiotic).
2. Biofertilizers: Different types, benefits and applications. Production and quality control in biofertilizers
3. Concept of plant disease: definitions of disease, disease cycle & pathogenicity

**UNIT - III**

1. Symptoms of plant diseases caused by fungi (groundnut rust and white rust of crucifers). Symptoms of plant diseases caused by bacteria (angular leaf spot of cotton) and viruses (tomato leaf curl).
2. Biopesticides – Bacillus thuringiensis, Nuclear polyhedrosis virus (NPV), Trichoderma.
3. Principles of plant disease control. Chemical and Biological control of plant diseases. Post harvest diseases and their control – microbial spoilage of fruits and vegetables





**B. Sc (CBCS) Industrial Microbiology – III Year  
Semester-VI – Paper-VII (Discipline Specific Course)  
BS603-DSC-1F: AGRICULTURAL MICROBIALOLOGY**

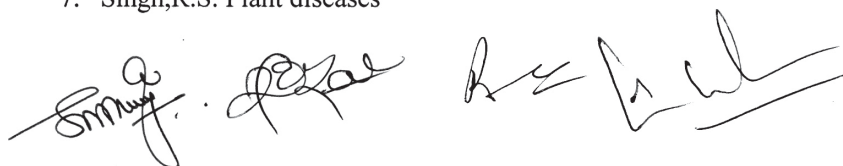
**Practical syllabus**

**Credits – 1**

1. Analysis of soil - pH, moisture content, water holding capacity, percolation, capillary action
2. Isolation of microbes (bacteria & fungi) from rhizosphere and rhizoplane.
3. Isolation of *Rhizobium* from root nodules of legumes
4. Isolation of *Azotobacter*/*Azospirillum* from soil
5. Isolation of phosphate solubilizers from soil
6. Demonstration of Koch's postulates in fungal, bacterial and viral plant pathogens.
7. Study of important diseases of crop plants by cutting sections of infected plant material – *Cercospora* (Ground nut rust) and *Albugo* (White rust of crucifers)

**References:**

1. Subba Rao, N.S. (1995) Soil Microorganisms and plant growth, Oxford and IBH publishing Co. Pvt. Ltd.
2. Paul, E.A. and Clark. F.E. (1989). Soil Microbiology and Biochemistry. Academic press New York.
3. Subba Rao, N.S. (1995). Biofertilizers in Agriculture and Forestry. 3rd Edition. Oxford and IBH publication Co. Pvt. Ltd., New Delhi.
4. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4th edition. Benjamin/Cummings Science Publishing, USA.
5. Madigan MT, Martinko JM and Parker J. (2014). Brock Biology of Microorganisms. 14th edition. Pearson/ Benjamin Cummings.
6. Mehrotra, R.S. Plant Pathology
7. Singh, R.S. Plant diseases



**B. Sc (CBCS) Industrial Microbiology – III Year**  
**Semester-VI – Paper-VIII/A (Discipline Specific Elective)**  
**BS606-DSE-1F/A: FOOD MICROBIOLOGY AND FERMENTATION TECHNOLOGY**

**Theory syllabus**

**Credits - 3.**

**UNIT – I**

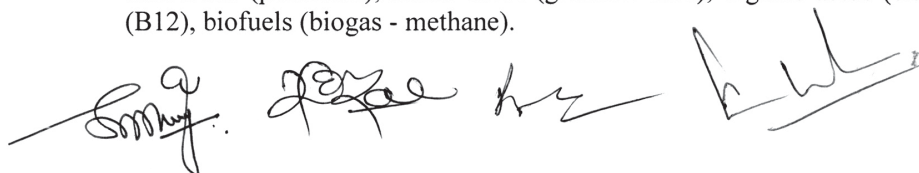
1. Microorganisms of food spoilage and their sources. Intrinsic and extrinsic factors that affect growth and survival of microbes in foods, natural flora and source of contamination of foods in general. Spoilage of different food materials - fruits, vegetables, meat, fish.
2. Canned foods. Food intoxication (botulism and staph poisoning), foodborne diseases (salmonellosis and shigellosis) and their detection.
3. Microbiological production of fermented foods – bread, cheese, yogurt.

**UNIT - II**

1. Principles, physical methods of food preservation: temperature (low, high, canning, drying), irradiation, hydrostatic pressure, high voltage pulse, microwave processing and aseptic packaging, chemical methods of food preservation: salt, sugar, organic acids, SO<sub>2</sub>, nitrite and nitrates, ethylene oxide, antibiotics and bacteriocins.
2. Microorganisms as food – SCP, edible mushrooms (white button, oyster and paddy straw). Concept of probiotics.
3. Microorganisms of industrial importance – yeasts, moulds, bacteria, actinomycetes. Screening and isolation of industrially-important microorganisms. Outlines of strain improvement.

**UNIT - III**

1. Types of fermentation – aerobic, anaerobic, batch, continuous, submerged, surface, solid state.
2. Design of typical batch fermentor. Factors affecting fermentor design, Types of fermentors, Fermentation media. Control of agitation, aeration, pH, temperature and dissolved oxygen.
3. Industrial production of alcohols (ethyl alcohol), beverages (beer), enzymes (amylases), antibiotics (penicillin), amino acids (glutamic acid), organic acids (citric acid), vitamins (B12), biofuels (biogas - methane).



**B. Sc (CBCS) Industrial Microbiology – III Year**  
**Semester-VI – Paper-VIII/A (Discipline Specific Elective)**  
**BS606-DSE-1F/A: FOOD MICROBIALOLOGY AND FERMENTATION TECHNOLOGY**

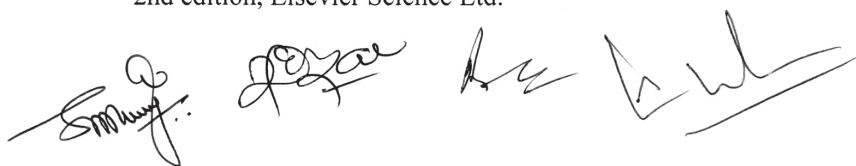
**Practical syllabus**

**Credits – 1**

1. Measurement and production of citric acid by *A. niger*.
2. Measurement and production of ethanol by *Saccharomyces*.
3. Measurement of in vitro production of IAA by soil fungi.
4. Demonstration for the production of amino acids by soil fungi.
5. Demonstration for the cultivation of mushroom.
6. Estimation of streptomycin.
7. Isolation and identification of microorganisms of spoiled food.
8. In vitro production of aflatoxin by *A. flavus*

**References:**

1. Adams MR and Moss MO. (1995). Food Microbiology. 4th edition, New Age International (P) Limited Publishers, New Delhi, India.
2. Banwart JM. (1987). Basic Food Microbiology. 1st edition. CBS Publishers and Distributors, Delhi, India.
3. Dillion VM and Board RG. (1996). Natural Antimicrobial Systems and Food Preservation. CAB International, Wallingford, Oxon.
4. Frazier WC and Westhoff DC. (1992). Food Microbiology. 3rd edition. Tata McGraw-Hill Publishing Company Ltd, New Delhi, India.
5. Jay JM, Loessner MJ and Golden DA. (2005). Modern Food Microbiology. 7th edition, CBS Publishers and Distributors, Delhi, India.
6. Tortora GJ, Funke BR, and Case CL. (2008). Microbiology: An Introduction. 9th edition. Pearson Education.
7. Patel A.H. (1996). Industrial Microbiology. 1st edition, Macmillan India Limited.
8. Okafor N. (2007). Modern Industrial Microbiology and Biotechnology. 1st edition. Bios Scientific Publishers Limited. USA.
9. Waites M.J., Morgan N.L., Rockey J.S. and Higon G. (2001). Industrial Microbiology: An Introduction. 1st edition, Wiley – Blackwell.
10. Casida LE. (1991). Industrial Microbiology. 1st edition. Wiley Eastern Limited.
11. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology. 2nd edition. Panima Publishing Co. New Delhi.
12. Stanbury PF, Whitaker A and Hall SJ. (2006). Principles of Fermentation Technology. 2nd edition, Elsevier Science Ltd.



**B. Sc (CBCS) Industrial Microbiology – III Year**  
**Semester-VI – Paper-VIII/B (Discipline Specific Elective)**  
**BS606-DSE-1F/B: ENVIRONMENTAL MICROBIALOLOGY**

**Theory syllabus**

**Credits – 3**

**UNIT - I**

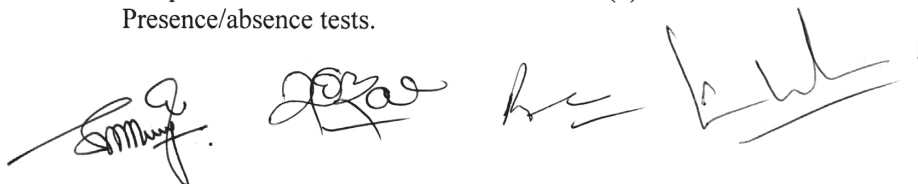
1. Structure and function of ecosystems. Terrestrial Environment: Soil profile and soil microflora. Aquatic Environment: Microflora of fresh water and marine habitats. Atmosphere: Aeromicroflora and dispersal of microbes.
2. Extreme Habitats: Extremophiles: Microbes thriving at high & low temperatures, pH, high hydrostatic & osmotic pressures, salinity, & low nutrient levels. Microbial succession in decomposition of plant organic matter.
3. Carbon cycle: Microbial degradation of cellulose, hemicelluloses, li Nitrogen cycle: ammonification, nitrification, denitrification and nitrate reduction. Phosphorus cycle: Phosphate immobilization and solubilisation.

**UNIT - II**

1. Solid Waste management: Sources and types of solid waste, Methods of solid waste disposal (composting and sanitary landfill).
2. Liquid waste management: Composition and strength of sewage (BOD and COD), Primary, secondary (oxidation ponds, trickling filter, activated sludge process and septic tank) and tertiary sewage treatment.
3. Bioremediation or Biodegradation: Microbial tolerance to heavy metals (Pb, Hg), Mechanisms of resistance, remediation of soil by microbes. Microbial plastics & biodegradation of petroleum. Brief idea about bio-magnification.

**UNIT - III**

1. Eutrophication - food chain, potability of water - microbial assessment of water quality - water purification.
2. Brief account of water borne diseases and preventive measures
3. Treatment and safety of drinking (potable) water, methods to detect potability of water samples: (a) standard qualitative procedure: presumptive test/MPN test, confirmed and completed tests for faecal coliforms (b) Membrane filter technique and (c) Presence/absence tests.





**B. Sc (CBCS) Industrial Microbiology – III Year**  
**Semester-VI – Paper-VIII/B (Discipline Specific Elective)**  
**BS606-DSE-1F/B: ENVIRONMENTAL MICROBIALOLOGY**

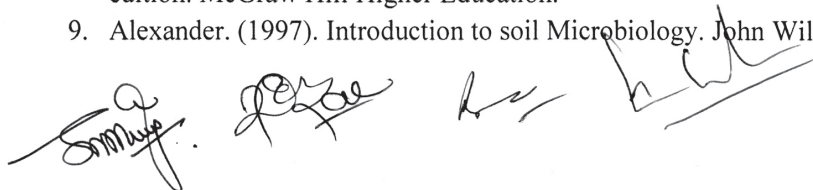
**Practical syllabus**

**Credits – 1**

1. Isolation of microorganisms from air
2. Isolation of microorganisms from water/sewage
3. Isolation of microorganisms from soil
4. Estimation of organic matter
5. Determination of BOD of waste water sample.
6. Determination of COD of waste water sample.
7. Bacteriological examination of water using multiple tube fermentation test: presumptive test, confirmed test and completed test
8. Study the presence of microbial activity by detecting (qualitatively) enzymes (dehydrogenase, amylase, urease) in soil.
9. Estimation of phosphates, sulphates and nitrates in polluted and unpolluted water bodies.
10. Isolation of phosphorous solubilizing bacteria/fungus from soil sample.
11. Demonstration of ammonification, nitrification and denitrification.

**References:**

1. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4th edition. Benjamin/Cummings Science Publishing, USA.
2. Madigan MT, Martinko JM and Parker J. (2014). Brock Biology of Microorganisms. 14th edition. Pearson/ Benjamin Cummings.
3. Singh A, Kuhad, RC & Ward OP (2009). Advances in Applied Bioremediation. Volume 17, Springer-Verlag, Berlin Hedeilberg.
4. Campbell RE. (1983). Microbial Ecology. Blackwell Scientific Publication, Oxford, England.
5. Coyne MS. (2001). Soil Microbiology: An Exploratory Approach. Delmar Thomson Learning.
6. Stolp H. (1988). Microbial Ecology: Organisms Habitats Activities. Cambridge University Press, Cambridge, England.
7. Subba Rao NS. (1999). Soil Microbiology. 4th edition. Oxford & IBH Publishing Co. New Delhi.
8. Willey JM, Sherwood LM, and Woolverton CJ. (2013). Prescott's Microbiology. 9th edition. McGraw Hill Higher Education.
9. Alexander. (1997). Introduction to soil Microbiology. John Wiley and Sons. N.Y.



### Minutes of the meeting of Board of Studies in Microbiology

The meeting of board of studies in Microbiology was held on 28 /05/2016 at 11.00am in the chambers of Head, Department of Microbiology to discuss the following agenda

The following members were present

1. Dr. Srinivas Munjam : Chairman, BOS
2. Dr. P. Venkataiah : Head, Department of Microbiology
3. Prof. S. Girisham : Member
4. Dr. E. Sujatha : Member & In-charge, Dept of MB, UASC, KU
5. Dr. T. Rajakomuraiah : Member
6. Dr. G. Renuka : Member  
Dept. of Microbiology  
Govt. Pingle College for Women  
Hanamkonda, Warangal
7. Dr. T. Sujatha : Member  
Dept. of Microbiology  
SR&BGNR College  
Khammam

After through discussion the following resolution was made

1. Resolved to approve of B. Sc Microbiology and B. Sc Industrial Microbiology Semester wise CBCS pattern syllabus (Theory and Practicals) with effect from the academic year 2016-2017 in all colleges under the jurisdiction of Kakatiya University.

Dr. Srinivas Munjam

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Dr. P. Venkataiah

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Prof. S. Girisham

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Dr. E. Sujatha

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Dr. T. Rajakomuraiah

: 

Dr. G. Renuka

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Dr. T. Sujatha

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