# Faculty of Science

**B. Sc. INDUSTRIAL MICROBIOLOGY**

**SEMESTER-WISE SYLLABUS IN CBCS PATTERN**

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

<table>
<thead>
<tr>
<th>Code</th>
<th>Course Title</th>
<th>Course Type</th>
<th>HPW</th>
<th>Credits</th>
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<tbody>
<tr>
<td>BS104</td>
<td>Fundamentals of Industrial Microbiology</td>
<td>DSC-1A</td>
<td>4T + 2P = 6</td>
<td>4+1 = 5</td>
</tr>
<tr>
<td>BS204</td>
<td>Biostatistics and Analytical Microbiology</td>
<td>DSC-1B</td>
<td>4T + 2P = 6</td>
<td>4+1 = 5</td>
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<tr>
<td>BS304</td>
<td>Microbial Physiology and Biochemistry</td>
<td>DSC-1C</td>
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<tr>
<td>BS404</td>
<td>Microbial Genetics</td>
<td>DSC-1D</td>
<td>4T + 2P = 6</td>
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<tr>
<td>BS503</td>
<td>Immunology and Medical Microbiology</td>
<td>DSC-1E</td>
<td>3T + 2P</td>
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<tr>
<td>BS506</td>
<td>Instrumentation and Biotechniques</td>
<td>DSE-1E/A</td>
<td>3T + 2P</td>
<td>3+1 = 4</td>
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<tr>
<td>BS506</td>
<td>Biosafety and Intellectual property rights (IPR)</td>
<td>DSE-1E/B</td>
<td>3T + 2P</td>
<td>3+1 = 4</td>
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<tr>
<td>BS603</td>
<td>Agricultural Microbiology</td>
<td>DSC-1F</td>
<td>3T + 2P</td>
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<tr>
<td>BS606</td>
<td>Food Microbiology and Fermentation Technology</td>
<td>DSE-1F/A</td>
<td>3T + 2P</td>
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<tr>
<td>BS606</td>
<td>Environmental Microbiology</td>
<td>DSE-1F/B</td>
<td>3T + 2P</td>
<td>3+1 = 4</td>
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**DSC:** Discipline Specific Course (Core)

**DSE:** Discipline Specific Elective (Elective)
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, Archaeabacteria 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
2. Radiation methods - UV rays, gamma rays, ultrasonic methods.

UNIT – IV
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

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:

8. Microbiology, Author- S.S. Purohit.
9. Microbiology, Author- P.D. Sharma
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)

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.

UNIT – III
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

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:

UNIT - I
1. Physiological properties - Diffusion, gaseous exchange, osmosis, plasmolysis, biochemical properties of membrane, passive and active transport.
2. Photosynthesis - Photosynthetic microbes, oxygenic/anoxogenic reaction centres, electron transport, photophosphorylation, Calvin cycle (dark reaction) phosphoenol carboxylase, photorespiration and its significance.

UNIT - II
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.
Practical syllabus

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.
9. Qualitative tests for carbohydrates.
10. Qualitative tests for amino acids.

References:

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.

UNIT – II
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.

UNIT – IV
3. General account on application of genetic engineering in industry, agriculture and medicine.

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Practical syllabus

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 Mendelian 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- Ananthnarayanan and Paniker.
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
Practical syllabus

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

References:

UNIT – I

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.

UNIT – III
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

1. Study of fluorescent micrographs to visualize bacterial cells.
2. Ray diagrams of phase contrast microscopy and Electron microscopy.
4. To demonstrate column packing in any form of column chromatography.
5. Separation of protein mixtures by Polyacrylamide Gel Electrophoresis (PAGE).
6. Determination of λmax 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:

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.

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.
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:

UNIT - I
1. Physical and chemical characteristics of soil. suitability of soil for agriculture, soil chemistry, humus formation, soil fertility, micro/macronutrients,
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 MICROBIOLOGY

Practical syllabus

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 (Grout rust) and *Albugo* (White rust of crucifers)

References:

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

2. Canned foods. Food intoxication (botulism and staph poisoning), foodborne diseases (salmonellosis and shigellosis) and their detection.

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, organicacids, SO₂, nitrite and nitrates, ethylene oxide, antibiotics and bacteriocins.
2. Microorganisms as food – SCP, edible mushrooms (white button, oyster and paddy straw). Concept of probiotics.

UNIT – III

1. Types of fermentation – aerobic, anaerobic, batch, continuous, submerged, surface, solid state.
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).
Practical syllabus

1. Measurement and production of citric acid by A. niger.
4. Demonstration for the production of amino acids by soil fungi.
5. Demonstration for the cultivation of mushroom.
7. Isolation and identification of microorganisms of spoiled food.
8. In vitro production of aflatoxin by A. flavus

References:

UNIT - I

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
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 MICROBIOLOGY

Practical syllabus

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:

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
   Dept. of Microbiology
   Govt. Pingle College for Women
   Hanamkonda, Warangal
   Member
7. Dr. T. Sujatha
   Dept. of Microbiology
   SR&BGNNR College
   Khammam
   Member

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  
Dr. P. Venkataiah  
Prof. S. Girisham  
Dr. E. Sujatha  
Dr. T. Rajakomuraiah  
Dr. G. Renuka  
Dr. T. Sujatha