

SYLLABUS

M. Sc Industrial Microbiology

BABASAHEB
BHIMRAO
AMBEDKAR
UNIVERSITY



• LUCKNOW •

प्रज्ञा शील करुणा
ESTABLISHED 1996

Department of Environmental Microbiology

B. B. Ambedkar Central University,

Vidya Vihar, Raibareli Road

Lucknow- 226025

M.Sc. Industrial Microbiology
(Under Self Finance Scheme)
Department of Microbiology
School of Environmental Science
BBA University, Lucknow

Semester I

Paper Code	Title of Paper	Credits
IM 101	Concepts of Microbiology	06
IM 102	Microbial Biochemistry, Physiology & Genetics	06
IM 103	Genomics, Proteomics, Bioinformatics & Biostatistics#	06
IM 104	Practicals	06
IM 105	Applications of Microbiology for Sustainable Environment*#	06

* For Choice Based Credit System

#Students can opt for either IM 103 or IM 105

Semester II

Paper Code	Title of Paper	Credits
IM 201	Fermentation, Fermentors & Bioprocess Technology	06
IM 202	Microbial Products for Human Consumption	06
IM 203	Microbial Products for Agriculture*	06
IM 204	Practicals	06

* For Choice Based Credit System

Semester III

Paper Code	Title of Paper	Credits
IM 301	Microbial Products for Industrial Use & Applications	06
IM 302	Microbial Deterioration & Its Control	06
IM 303	Patents, IPR and Biosafety*	06
IM 304	Practicals	06

* For Choice Based Credit System

Semester IV

IM 401 Dissertation Work/ Industrial Training (24 Credits)

Ambedkar Studies* 01 Credit

Moral Studies* 01 Credit

* Papers are qualifying papers which the students can qualify in any of the first three semesters

M.Sc. Industrial microbiology

I Semester

IM 101 Concepts of Microbiology (06 Credit)

- **Unit I** History of Microbiology, Major contributions in the field of Industrial Microbiology, definition and scope of industrial microbiology
- **Unit II** Microbial diversity, classification, ultrastructure of prokaryotic cell, fungi, viruses, resting stages, adaptations in extreme conditions
- **Unit III** Microbial growth and nutrition, measurement of microbial growth, batch and continuous culture, effect of environmental factors on growth, types on the basis of nutrients.
- **Unit IV** Pure cultures and mixed cultures, cultivation of microorganisms, types of media. Control of microorganisms by physical and chemical methods, preservation of microbes by different techniques, culture collection centers

IM 102 Microbial Biochemistry, Physiology and Genetics (06 Credit)

- **Unit I** Biomolecules, structure and function of carbohydrates, amino acids, fatty acids, nucleic acids. Metabolism of carbohydrates glycolysis, citric acid cycle, gluconeogenesis, glyoxylate and pentose phosphate pathways, electron transport chain, phosphorylation, fermentation.
- **Unit II** Amino acid biosynthesis and degradation, urea cycle, structural organization of proteins, protein sequencing. Metabolism of fatty acids – biosynthesis, degradation and regulation. Biosynthesis and degradation of purines and pyrimidines.
- **Unit III** Metabolite and ion transport, transport of macromolecules across bacterial membranes, passive, facilitated, active transport systems, group translocation, iron uptake. Primary and secondary metabolites and their utilization by industrial processes.
- **Unit IV** Gene organization in microbes (bacteria, viruses and eukaryotes), structure of DNA and RNA. Replication of DNA, mutations – types, detection and isolation of mutants, DNA repair, DNA transcription, protein synthesis and regulation. Bacterial recombination, transposons, gene mapping.

IM 103 Genomics, Proteomics, Bioinformatics and Biostatistics (06 Credit) (Optional Paper)

- **Unit I** Structural and functional genomics, DNA sequencing, characteristics of bacterial genome, protein level gene expression, proteomics, concept of metagenome and its importance, techniques to evaluate metagenome, molecular markers, microarrays, DNA chip technology, biosensors.
- **Unit II** Definition, role and scope of bioinformatics, different branches of bioinformatics, terminologies – internet, software, hardware, databases, networking systems, infolibnet, EMB net, operating systems, algorithms. Applications of bioinformatics in scientific documentation.
- **Unit III** Biological information and databases, databanks, gene banks, accessing information, public domain databases for nucleic acid and protein sequences. Sequence analysis – computational methods, homology algorithms (BLAST) for proteins and nucleic acids, phylogenetic analysis, phylogenetic tree, methods.
- **Unit IV** Introduction to statistics, type of data, data collection – methods and tools, mean, mode median and standard deviation, test of significance – student t-test, f-test, chi square test, ANOVA, multiple range test, theory of probability, statistical analysis of biological assays.

IM 104 : Practicals

IM 105 Application of Microbiology for Sustainable Environment (Optional Paper for CBCS) (06 Credit)

- **Unit I** Microbes in environment – Role and diversity, technique to study them.
- **Unit II** Solid and Liquid waste Treatment of sewage and industrial effluents, Secondary waste treatment – aerobic, anaerobic and Composting.
- **Unit III** Role of Microbes in Agriculture – bioinoculants, biodegradation and bioremediation of xenobiotic compounds, technique of bioremediation using microbes.
- **Unit IV** Bioleaching of Metals, Biofuels, Microbes as food, bioplastics, GEMs – Application and hazards.

IInd Semester

IM 201: Fermentation, Fermentors and Bioprocess Technology

(06 Credit)

- **Unit I** Fermentation: an overview, isolation, screening and selection of industrially important microorganisms, strain improvement for industrial purposes, use of recombinant DNA technology, cloning vectors, role and applications of genetic engineering in development of industrial strains
- **Unit II** Bioreactors, design and components of basic fermentor, specialized fermentors for specific purposes – continuous, anaerobic, for gaseous nutrients, for treatment of wastes, trickle flow reactors, cyclone reactors, submerged types, tube reactors, packed bed reactors, lab scale to pilot to industrial – scale up process, online monitoring.
- **Unit III** Bioprocessing – downstream processing of industrial fermentation processes, product purification and recovery, physico-chemical basis of bio-separation processes, techniques for purification of end products – chromatography, electrophoresis, distillation, crystallization, filtration.
- **Unit IV** Economics of a fermentation process, determination of cost and its recovery, cost cutting strategies, cell and enzyme immobilization, biological waste treatment, hygiene and safety in fermentation industries.

IM 202: Microbial Products for Human Consumption

(06 Credit)

- **Unit I** Antibiotic fermentations – production of β lactams (penicillins), semi-synthetic penicillins and cephalosporins, amino-glycosides (streptomycin), macrolids (erythromycin), quinines.
- **Unit II** Production of vitamins (B₁₂, riboflavin, A), enzymes for pharmaceutical industries, vaccines, recombinant proteins (insulin, interleukins and interferons), biotransformations - hormones
- **Unit III** Microbes in food industry, fermented foods (breads, sauerkraut, pickles, tofu), dairy products from microbes (cheese, curd, yoghurt), microbes as food - single cell protein, mushrooms, probiotics.
- **Unit IV** Alcoholic beverages – brief history of development of industrial process, production of beer (brewing) – media (raw materials used), process, maturation, carbonation. Types of beer (lager, pilsner, bock, ale, stout, porter). Whiskeys – types and production, Production of wine – media and raw material used, different types (sparkling wine, burned wine, cider, wine vinegar), vinegar.

IM 203 :Microbial Products for Agriculture

(06 Credit) (Optional Paper for CBCS)

- **Unit I** Biofertilizers – history of, production of biofertilizers, from symbiotic and asymbiotic nitrogen fixers, phosphate solubilizing microbes, phytohormones from microbes. Applications of microbes in fields.
- **Unit II** Biopesticides – history of development, production of biopesticides from bacteria, fungi and viruses and their applications against different types of pathogens.
- **Unit III** *Bacillus thuringiensis* (Bt) as a major biopesticide, role of Bt in pest control, transgenic crops from Bt, their development and applications. Other transgenic crops – role of *Agrobacterium*, issues related to GM crops.

- **Unit IV** Composting – static pile, aerated pile, bioreactor process, biofuels – ethanol, methane, hydrogen and biogas, recovery of metals – bioleaching of copper, gold and uranium

IM 204 : Practicals

IIIrd Semester

IM 301: Microbial Products for Industrial Use & Applications

(06 Credit)

- **Unit I** Enzymes – production and applications of amylase, proteases, invertase, pectinase, cellulase, glucose oxidase, catalase, lipase, lactase, polymerase, glucose isomerase
- **Unit II** Organic acids – production and applications of citric acid, fumaric acid, lactic acid, benzoic acid, gluconic acid, kojic acid, itaconic acid, acetic acid.
- **Unit III** Production of industrial alcohol, acetone-butanol fermentation, glycerol from yeasts and bacteria
- **Unit IV** Microbial polysaccharides (xanthane, dextrane, alginate, gellan, cellulose, curdlan, pullulan, scleroglucan) and polyesters - bioplastics (polyhydroxyalkanoates)

IM 302: Microbial Deterioration & Its Control (06 Credit)

- **Unit I** Microbial deterioration of food – factors (intrinsic and extrinsic), sources of contamination, spoilage of cereals, vegetables and fruits, egg, milk, meat, seafood and their products.
- **Unit II** Microbial degradation of leather, jute, cotton, paper, paint, wood, metals, buildings – process of degradation, bio-chemical reactions involved
- **Unit III** Control of deterioration, preservation techniques, testing methods for presence of contamination in food, water and other products related to human consumption
- **Unit IV** Bioremediation of contaminated sites due to industrial pollution, oil spills, pesticides, explosives. In situ and ex situ bioremediation techniques, role of genetically engineered microbes in bioremediation

IM 303: Patents, IPR and Biosafety

(06 Credit) (Optional Paper for CBCS)

- **Unit I** Patent laws, patent application procedure, copyright laws, ownership and enforcement of copyrights, patents and copyrights, transfer of copyrights, infringements, trademarks – objectives, rights and protection
- **Unit II** Intellectual property rights, biotechnology and IPR, commercial potential of biotechnology inventions, issues in patenting biotechnological inventions, patenting of life forms (GEMs) – objectives, rationale, international treaties, Indian perspectives
- **Unit III** Biosafety regulation of products, microbial products and biosafety concerns – individual, society, national and international, biosafety regulations in laboratories, handling of recombinant products.
- **Unit IV** Assessment of impact of transgenic crops, GM foods, drugs, vaccines, assessment of recombinant products viz a viz environment, international biosafety protocols, biological weapons and how to combat

IM 304: Practicals

IVth Semester

- **IM 401** Dissertation work (24 Credits)
- **IM 501** Ambedkar Studies* (01 Credit)
- **IM 502** Moral Studies* (01 Credit)

Papers IM 501 and IM 502 are qualifying papers which the students can qualify in any of the first three semesters.