

INDUSTRIAL MICROBIOLOGY (Elective), 2020-21

- Note :** 1. A student who has passed the + 2 examination under 10+2+3 system of education of a recognized University/Board/Council or any other examination recognized by the Panjab University as equivalent thereto shall be eligible to offer the subject of Microbiology at the B.Sc. level, if he/she has passed the +2 examination with Physics, Chemistry, Mathematics, Biology as his/her subjects.
2. Only such colleges which have all necessary infrastructure or equipment and staff shall admit students to the subject of Microbiology. The infrastructure must be approved by the University as per usual practice.

Scheme of Examination	Duration	Marks
B.Sc. FIRST YEAR EXAMINATION, 2019-20		
Semester I		
THEORY	6 hrs.	75 (33+33+9*)
IMB 101: Fundamentals of Microbiology (I)	3 hrs.	37.5 (33+4.5*)
IMB 102: Microbial Genetics and Molecular Biology	3 hrs.	37.5 (33+4.5*)
PRACTICAL		
One Practical pertaining to the entire syllabus included in Theory Papers	3 hrs	25 (22+3*)
Semester II		
THEORY	6 hrs	75 (33+33+9*)
IMB 201: Fundamentals of Microbiology (II)	3 hrs.	37.5 (33+4.5*)
IMB 202: Fundamentals of Microbial Biochemistry	3 hrs.	37.5 (33+4.5*)
PRACTICAL		
One Practical pertaining to the entire syllabus included in Theory Papers	3 hrs	25 (22+3*)

Note : * Denotes marks for the Internal Assessment.

B.Sc. SECOND YEAR EXAMINATION

Semester III

THEORY	6 hrs.	75 (33+33+9*)
IMB 301: Environmental Microbiology	3 hrs.	37.5 (33+4.5*)
IMB 302: Agricultural Microbiology	3 hrs.	37.5 (33+4.5*)
PRACTICAL		
One Practical pertaining to the entire syllabus included in Theory Papers	6 hrs	25 (22+3*)

Semester IV

THEORY	6 hrs.	75 (33+33+9*)
IMB 401: Food Microbiology	3 hrs.	37.5 (33+4.5*)
IMB 402: Microbial Technology	3 hrs.	37.5 (33+4.5*)
PRACTICAL		
One Practical pertaining to the entire syllabus included in Theory Papers	6 hrs	25 (22+3*)

Note : * Denotes marks for the Internal Assessment.

THIRD YEAR EXAMINATION

Scheme of Examination	Duration	Marks
Semester V		
THEORY	6 hrs.	75 (33+33+9*)
IMB 501: Biodegradation of wastes and pullutants	3 hrs.	37.5 (33+4.5*)
IMB 502: Biofertilizers	3 hrs.	37.5 (33+4.5*)
PRACTICAL		
One Practical pertaining to the entire syllabus included in Theory Papers	6 hrs	25 (22+3*)
Semester IV		
THEORY	6 hrs	75 (33+33+9*)
IMB 601: Biostatistics, tools and techniques	3 hrs.	37.5 (33+4.5*)
IMB 602: Immunobiotechnology, tissue culture and Government regulations	3 hrs.	37.5 (33+4.5*)
PRACTICAL		
One Practical pertaining to the entire syllabus included in Theory Papers	6 hrs	25 (22+3*)

TOTAL MARKS: 200

Note : * Denotes marks for the Internal Assessment.

INDUSTRIAL MICROBIOLOGY
INDUSTRIAL MICROBIOLOGY (Elective)
B.Sc. 1st year Examination
Semester I
PAPER IMB 101: FUNDAMENTALS OF MICROBIOLOGY (I)

Max Marks: 37.5
Theory- 33 Marks
Internal Assessment: 4.5
Time-3 hours

Instructions for paper setters and candidates

1. The number of hours for theory and practical per week shall be 5 hours and 4 hours respectively.
2. There will be nine questions in all carrying equal marks. The first question will be compulsory and will be of short answer type
3. The remaining eight questions, two questions will be set from each Unit. The candidate will be required to attempt five questions in all including the first question and selecting one questions from each Unit in each paper.

Objective: To make the students aware with the history and basics of Microbiology along with the introduction of concept of various ongoing reactions within the microbial life

Unit-I

The History and scope of microbiology: Members of microbial world; discovery of microorganisms, developments of Industrial microbiology.

Study of Microbial structure: Light microscopy: Bright field, Dark field, Phase contrast, fluorescence. Preparation and staining of specimens, Electron microscopy: TEM, SEM. New techniques in microscopy: confocal, scanning probe (Principle and application only).

Unit-II

Microbial Growth: Prokaryotic cell cycle, phases of growth, generation time, growth rate, monoauxic, diauxic and synchronous growth, chemostat, measurement of microbial growth, growth curve

Microbial spores: Sporulation and germination process

Unit- III

Microbial control: Safety in microbiology laboratory, Pattern of microbial death, Sterilization and pasteurization process and their applications

Agents: Antimicrobial agents, Physical and chemical methods for control, Evaluation of antimicrobial agent effectiveness

Unit-IV

Microbial Physiology: Diffusion, Gaseous exchange, osmosis, Plasmolysis, Biochemical Properties of membranes, Passive and active transport, Donnan Equilibrium

Photosynthesis: Photosynthetic microbes, oxygenic/non-oxygenic reaction centres, electron transport, photophosphorylation, Calvin cycle (dark reaction), phos-phenol carboxylase, photo respiration and its significance

INDUSTRIAL MICROBIOLOGY (Elective)
B.Sc. 1st year Examination
Semester I
PAPER IMB 102: MICROBIAL GENETICS AND MOLECULAR BIOLOGY

Max Marks: 37.5
Theory- 33 Marks
Internal Assessment: 4.5
Time-3 hours

Instructions for paper setters and candidates

1. The number of hours for theory and practical per week shall be 5 hours and 4 hours respectively.
2. There will be nine questions in all carrying equal marks. The first question will be compulsory and will be of short answer type
3. The remaining eight questions, two questions will be set from each Unit. The candidate will be required to attempt five questions in all including the first question and selecting one questions from each Unit in each paper.

Objective: To provide the knowledge of inheritance material and applications of recombinant technology

Unit-I

Microbial Genetics: DNA as genetic material, structure of DNA, RNA, the genetic code, central dogma, reverse transcriptase, DNA replication in prokaryotes and eukaryotes (DNA polymerases, initiation, elongation and termination) , Gene transcription (RNA polymerase, initiation, elongation and termination, post transcriptional modifications), Translation (initiation, elongation and termination)

Unit-II

Microbial Mutations: concept of mutation, spontaneous and induced, Forward and reverse mutation. Methods for the selection of mutants, direct selection methods for resistant mutants, penicillin selection technique, replica plating technique, other technique for mutant selection, conditional lethality and its use in mutant selection.

Mutagenic agents: Detection and isolation of mutants, Methods for DNA repair

Unit-III

Genetic recombination in bacteria: Conjugation, Transformation, Transduction , isolation of auxotrophs

Recombinant Proteins: Production of recombinant proteins in bacteria and yeast (Applications and limitations)

Unit-IV

Extra chromosomal genetic material: Brief account of Plasmids, cosmids, transposons

Genomic library: Construction of genomic library, Amplified Genomic library, Subgenomics libraries, Identification of desired clone

RECOMMENDED BOOKS

1. Prescott, S.C. and C.G. Dunn (2012) Industrial microbiology (McGraw- Hill).
2. R. Y. Stanier, I.Ingraham, M.L.Wheller and P.R.Painter (2008). General microbiology (MacMillian Press London).
3. Pommerville and Jeffery C.(2011) Alcamo's Fundamentals of Microbiology (Jones & Bartlett London)
4. L.E.Casida (2010) Industrial Microbiology (New age Publication, New Delhi)
5. Gerald Karp (2009) Cell and molecular biology: Concepts and experiments (John Wiley & Sons International Edition)
6. H. F. Lodish, A. Berk and C.A. Kaiser (2007) Molecular cell biology (W.H. Freeman)

INDUSTRIAL MICROBIOLOGY (Elective) B.Sc. 1st year Semester I PRACTICALS

Max. Marks- 25 Marks
Practical-22 Marks
Internal assessment-3marks
Time-3 hours

1. Aseptic techniques and introduction to laboratory appliances.
2. Preparation of Media, autoclaving and sterilization of glassware, cotton plugging
3. Dilution and pour plating technique
4. Isolation of different groups-Bacteria, Fungi from soil, air and water
5. Haemocytometer
6. Isolation of bacteria and evaluation of its antibiogram
7. DNA isolation from E. Coli
8. Estimation of DNA Diphenylamine method
9. Estimation of RNA by orcinol method
10. Demonstration of PCR

INDUSTRIAL MICROBIOLOGY (Elective)
B.Sc. 1st year Examination
Semester II
PAPER IMB 201: FUNDAMENTALS OF MICROBIOLOGY (II)

Max Marks: 37.5
Theory- 33 Marks
Internal Assessment: 4.5
Time-3 hours

Instructions for paper setters and candidates

1. The number of hours for theory and practical per week shall be 5 hours and 4 hours respectively.
2. There will be nine questions in all carrying equal marks. The first question will be compulsory and will be of short answer type
3. The remaining eight questions, two questions will be set from each Unit The candidate will be required to attempt five questions in all including the first question and selecting one questions from each Unit in each paper.

Objective: To make the students aware with the history and basics of Microbiology along with the introduction of concept of various ongoing reactions within the microbial life

Unit-I

Diversity of Microbial world: Microbial classification and taxonomy, Characteristics and Ultra-structure of Microbes: Bacteria, Algae, Fungi, Actinomycetes, Mycoplasma ,Viruses Techniques for determining microbial taxonomy

Fermentation technology: Types of fermentation: solid state, submerged, anaerobic and aerobic, Immobilized cell bioreactors, Immobilized enzyme bioreactors, Downstream processing

Unit-II

Microbial nutrition: Nutritional biodiversity: types of media, medium formulation. Microbial nutrition types: Autotrophs, hetrotrophs, organotrophs, chemotrophs

Microbial Diversity: Microbes in extreme environments: thermophiles, psychrophiles, halophiles, acidophiles, mesophiles

Unit- III

Preservation of industrial microorganisms: Cultural preservation and stability, Significance of preservation, methods for preservations, preservation by overlaying culture with mineral oil Ultra-freezing, lyophilization. Principles of storage at very low temperature or in liquid nitrogen Unit-IV

Respiratory pathway –Breakdown of carbohydrates through glycolysis, Kreb’s and substrate level photophosphorylation, significance of Kreb’s cycle, gluconeogenesis

Nitrogen metabolism –Nitrogen fixation in symbiotic and free living system, nitrification, Denitrification and ammonifying bacteria

INDUSTRIAL MICROBIOLOGY (Elective)
B.Sc. 1st year Examination
Semester II
PAPER IMB 202: FUNDAMENTALS OF MICROBIAL BIOCHEMISTRY

Max Marks: 37.5
Theory- 33 Marks
Internal Assessment: 4.5
Time-3 hours

Instructions for paper setters and candidates

1. The number of hours for theory and practical per week shall be 5 hours and 4 hours respectively.
2. There will be nine questions in all carrying equal marks. The first question will be compulsory and will be of short answer type
3. The remaining eight questions, two questions will be set from each Unit. The candidate will be required to attempt five questions in all including the first question and selecting one questions from each Unit in each paper.

Objective: To provide the in-depth knowledge of the nature and functions of various macromolecules including enzymes and their role in physiological reactions and their regulation.

Unit-I

Enzymes: Classification, thermodynamics of enzyme catalysis, competitive, uncompetitive and noncompetitive inhibition, Isozymes, factors contributing to catalytic efficiency of enzymes (mode of catalysis). First order and second order kinetics, covalent modifications

Unit-II

Carbohydrates: Classification and properties of carbohydrates. Chemical structure and properties of starch, cellulose, glycogen.

Lipids: Classification and properties of lipids, structure and functions of microbial Lipids. Degradation of lipids by alpha, beta and omega oxidation, lipid peroxidation

Unit-III

Metabolism: Metabolic pathways, biochemical reactions, energy metabolites, Carbohydrate metabolism: Biosynthesis and degradation of carbohydrates, glycolysis; Krebs cycle, enzymes of Krebs cycle, regulation of Krebs cycle

Unit-IV

Amino Acids: Structure & classification of amino acids. Amino Acids: Structure of amino acids, classification of essential amino acids based on polarity, zwitter ionic property, Synthesis of peptides. Biosynthesis and degradation of nucleic acids

RECOMMENDED BOOKS

1. G.J. Tortora, B.R. Funke and C.L. Case (2009) Microbiology: An introduction (Benjamin/Cummings publishing company, Inc).
2. S.C. Prescott and C.G.Dunn (2012) Industrial microbiology (McGraw- Hill).
3. S.S. Purohit (2003) Microbiology: Fundamentals and applications (Agrobios, India)
4. A.L. Lehninger, D.L Nelson and M.M. Cox (2005) Principles of Biochemistry (W. H. Freeman, USA).
5. L. Stryer, J. M. Berg and J.L. Tymoczko (2001) Biochemistry (W.H. Freeman and Company, New York).
6. L.E.Casida (2010) Industrial Microbiology (New age Publication, New Delhi)
7. B. Simon ,G. Caroline and N. Jane (2008) Microbiology (Garland Science pub., London)

INDUSTRIAL MICROBIOLOGY B.Sc. 1st year Examination Semester II

Max. Marks- 25 Marks
Practical-22 Marks
Internal assessment- 3 marks
Time-3 hours

PRACTICALS

1. Enumeration of microorganisms total vs viable counts
2. Measurement of microbial growth – standard plate count.
3. Identification of isolated bacteria: Staining : simple, negative
4. Gram staining and spore staining
5. Metabolic characteristics: IMVIC Tests
6. Separation of amino acids by thin layer chromatography
7. Estimation of alkaline phosphatase activity
8. Measurement of celluloses by reducing sugar assay test
9. Estimation of Proteins by Lowry Method

B.Sc. 2nd YEAR EXAMINATION

SEMESTER-III

PAPER-IMB-301: ENVIRONMENTAL MICROBIOLOGY

Max Marks: 37.5

Theory- 33 Marks

Internal Assessment: 4.5

Time-3 hours

Instructions for paper setters and candidates

- 1. The number of hours for theory and practical per week shall be 5 hours and 4 hours respectively.**
- 2. There will be nine questions in all carrying equal marks. The first question will be compulsory and will be of short answer type**
- 3. The remaining eight questions, two questions will be set from each Unit. The candidate will be required to attempt five questions in all including the first question and selecting one question from each Unit in each paper.**

Objective: To make the students aware with the role of microbial interactions in environment, and recycling of nutrients in nature.

Unit-I

Environment: Soil, water and air environment, Microbes and concepts of environment, Environment Induced Genetic and Physiological adaptation in microbes, Microbial population of air, water and soil.

Unit-II

Biogeochemical cycling: The carbon cycle, Tropic relationship, Microbial mobilization and immobilization of carbon within the biosphere, The hydrogen and Oxygen Cycle, The nitrogen cycle, Nitrogen fixation, Ammonification, Denitrification, Nitrite ammonification. Sulphur cycle

Unit-III

Population Interaction: Neutralism, Commensalism, Synergism, Mutualism, Microbe- microbe interaction, Plant-microbe interaction, Animal-Microbe interaction, Competition, Amensalism, Parasitism, Predation.

Unit-IV

Biodegradation of xenobiotics in the environment-Ecological considerations, decay behavior, degradative plasmids. Degradation of pesticides. Bioremediation of contaminated soil.

**B.Sc. 2nd YEAR EXAMINATION
SEMESTER-III
Paper-IMB-302: AGRICULTURAL MICROBIOLOGY**

**Max Marks: 37.5
Theory- 33 Marks
Internal Assessment: 4.5
Time-3 hours**

Instructions for paper setters and candidates

1. The number of hours for theory and practical per week shall be 5 hours and 4 hours respectively.
2. There will be nine questions in all carrying equal marks. The first question will be compulsory and will be of short answer type
3. The remaining eight questions, two questions will be set from each Unit. The candidate will be required to attempt five questions in all including the first question and selecting one question from each Unit in each paper.

Objective: To provide the in-depth knowledge of role of microbes in agriculture and their role in diseases caused to animals and plants

Unit-I

Role of microbes in Agriculture: Introduction to Biocontrol Agents: Bioinsecticides, Bioherbicides, Rhizobium spp, Azotobacter and Azospirillum, Blue Green Algae and Azolla. Advantages and Limitations of Fertilizers.

Unit-II

Microbial diseases of crops – Symptoms of plant disease and mechanisms of microbial pathogenicity, Viral diseases TMV, Bhindi yellow Mosaic, Bacterial Diseases – Citrus Canker, Blight of Rice, Fungal Diseases-Rust & smuts of wheat. Control of Crop diseases.

Unit-III

Pesticide Microbiology – Biomagnifications, Biodegradation. Reasons and spread of diseases in animals. Diseases of farm Animals – Rinderpest, Foot and mouth, Septicemia, Control of animal diseases.

Unit-IV

Methylotrophs – Methanogens and methylotrophs, sulphur utilizing bacteria, sulphate Reduction pathway, Economic importance of methylotrophs and sulphur utilizing bacteria, use of nucleotides as nitrogen source for growth of certain micro-organism's (pathway of nucleic acid breakdown).

RECOMMENDED BOOKS

1. Metcalf & Eddy, Inc., Tchobanoglous G., Burton F.L. and Stensel D.H. (2009) Wastewater engineering- Treatment, disposal and reuse. (Tata McGraw Hill, New Delhi).
2. Powar C.B., Dagainawala H.F. (2010). General Microbiology. (Himalaya Publishing House).
3. Marwaha S.S., Arora J.K. (2003). Biotechnological strategies in Agro-processing. (Asiatech Publishers Inc., New Delhi, India).
4. Singh R.S. (2009). Plant Diseases. (Oxford & IBH Publishing Company, New Delhi, India).
5. Van der Plank J.E. (2012). Principles of Plant Infection. (Academic Press).
6. Cappuccino J.G., Sherman N. (2007). Microbiology: A Laboratory Manual. (Pearson Benjamin Cummings).

INDUSTRIAL MICROBIOLOGY (Elective)
B.Sc. 2nd year Examination
Semester III

Max. Marks- 25 Marks
Practical-22 Marks
Internal assessment- 3 marks
Time-3 hours

PRACTICALS

1. Isolation of microorganisms from air.
2. Isolation of microorganisms from soil.
3. Isolation of microorganisms from water.
4. Total count of bacteria from water.
5. Isolation of thermophilic micro-organisms from soil.
6. IMVIC test for faecal bacteria.
7. Detection of chloride, phosphate and nitrate in water.
8. Estimation of pathogenic and non pathogenic bacteria from water sample.
9. Measurement of soil pH, temperature and moisture
10. Isolation of soil fungi associated with composting for cellulose degradation

INDUSTRIAL MICROBIOLOGY
B.Sc. 2nd YEAR EXAMINATION
SEMESTER-IV
PAPER-IMB-401: FOOD MICROBIOLOGY

Max Marks: 37.5
Theory- 33 Marks
Internal Assessment: 4.5
Time-3 hours

Instructions for paper setters and candidates

1. The number of hours for theory and practical per week shall be 5 hours and 4 hours respectively.
2. There will be nine questions in all carrying equal marks. The first question will be compulsory and will be of short answer type
3. The remaining eight questions, two questions will be set from each Unit. The candidate will be required to attempt five questions in all including the first question and selecting one question from each Unit in each paper.

Objective: To understand the role of microbes in food spoilage and role of useful microbes in production of various food varieties and their preservation to increase shelf-life.

Unit-I

Microbiological Production of Food: Fermented dairy products, Butter milk, Indian foods, Fermented meats, Leavening of breads, Alcoholic beverages, Beer, wines, Vinegar, Fermented vegetables, Pickles, Soya sauce, Single Cell Protein.

Unit-II

Food Preservation Methods: Asepsis, Filtration and Centrifugation, High Temperature, Pasteurization, Canning, Radiation, Low Temperature, Desiccation, Controlled atmosphere, Chemical preservation, Salt and Sugar, Organic acids, Nitrates and nitrites, Sulphur dioxide, ethylene oxide, Wood smoke, Anti-biotic.

Unit-III

Food Spoilage: Representative spoilage processes, Spoilage indicators of different foods and the factors: Spoilage of fruits and vegetables, Spoilage of meats, Spoilage of other foods, Indicators of human pathogens associated with foods.

Unit-IV

Detection of microbes in food: Qualitative methods to isolate pathogenic microorganisms, Quantitative methods for microbial enumeration: Direct enumeration, indirect estimations; Rapid methods and automation: Immunoassays, nucleic acid probe for detection of pathogens.

**B.Sc. 2nd YEAR EXAMINATION
SEMESTER-IV
Paper-IMB-402: MICROBIAL TECHNOLOGY**

**Max Marks: 37.5
Theory- 33 Marks
Internal Assessment: 4.5
Time-3 hours**

Instructions for paper setters and candidates

1. The number of hours for theory and practical per week shall be 5 hours and 4 hours respectively.
2. There will be nine questions in all carrying equal marks. The first question will be compulsory and will be of short answer type
3. The remaining eight questions, two questions will be set from each Unit. The candidate will be required to attempt five questions in all including the first question and selecting one question from each Unit in each paper.

Objective: To understand the type of microbes involved in the fermentation processes and the varieties of products produced and their downstream processing

Unit-I

Microbial processes in Industrial Biotechnology: Industrially important microbes, its screening, selection and identification. Methods: Maintenance and preservation of industrially important microbial cultures

Unit-II

Fermentation Industry and role of microbes: Production Process, Fermentation media, Aeration, pH, Temperature, Batch versus Continuous culture, Downstream processing and product recovery.

Unit-III

**Quality control of industrial products: Production of Pharmaceuticals: Antibiotics, Vitamins (B12)
Production of Organic Acids: Acetic Acid, Citric Acid, Production of Amino Acid: Glutamic Acid.**

Unit-IV

**Microbiology enhanced recovery of mineral resources, Bioleaching of metals, Oil recovery.
Biodeterioration: Paper, Wood, Paint, Textiles, Metal Corrosion.**

RECOMMENDED BOOKS

1. Stanbury P.F., Whitaker A., Hall S.J. (1984). Principles of Fermentation Technology. (Pergamon Press, Oxford).
2. Stanier R.Y., Ingraham J.L., Wheelis M.L. and Painter R.R. (2008). General Microbiology. (Macmillan Press London).
3. Pommerville J.C. (2011). Alcamo's Laboratory Fundamentals of Microbiology. (Jones & Bartlett Publishers, London).
4. Casida L.E. (2010). Industrial Microbiology. (New Age Publication, New Delhi, India).
5. Marwaha S.S., Arora J.K. (2003). Biotechnological strategies in Agro-processing. (Asiatech Publishers Inc., New Delhi, India).
6. Singh B.D. (2008). Biotechnology: Expanding Horizons. (Kalyani Publishers, India).
7. Patel A.H. (2007). Industrial microbiology. (New Age International Publishers).

INDUSTRIAL MICROBIOLOGY (Elective)
B.Sc. 2nd year Examination
Semester IV

Max. Marks- 25 Marks
Practical-22 Marks
Internal assessment- 3 marks
Time-3 hours

PRACTICALS

1. Isolation and identification of micro-organisms of spoiled food, Fungi and bacteria.
2. Isolation of *Aspergillus flavus* from spoiled food.
3. Litmus milk reaction.
4. Methylene Blue test for microbial contamination of Milk.
5. Isolation of Lactobacilli from curd..
6. Production and Estimation of Ethanol.
7. Isolation and screening of bacteria from soil for amylase and cellulose production
8. Preservation of microbial culture by making glycerol stocks
9. Study of laboratory fermenter.

INDUSTRIAL MICROBIOLOGY (Elective)
B.Sc. 3rd year Semester V

PAPER IMB-501: BIODEGRADATION OF WASTES AND POLLUTANTS

Max Marks: 37.5
Theory- 33 Marks
Internal Assessment: 4.5
Time-3 hours

Instructions for paper setters and candidates

1. The number of hours for theory and practical per week shall be 5 hours and 4 hours respectively.
2. There will be nine questions in all carrying equal marks. The first question will be compulsory and will be of short answer type
3. The remaining eight questions, two questions will be set from each Unit The candidate will be required to attempt five questions in all including the first question and selecting one questions from each Unit in each paper.

Objective: To make the students understand the problems of generated waste and development of techniques to manage solid waste using microorganisms.

Unit-I

Solid waste disposal: Sanitary land fills, Composting, Incineration.

Unit -II

Treatment of Liquid Waste: Sewage Treatment, Primary treatment, Secondary treatment, Tertiary treatment, Disinfection.

Unit - III

Treatment and safety of water supplies: Disinfection of potable water supplies, Bacterial indicators of water safety, Standards for tolerable levels of faecal contamination.

Unit-IV

Biodegradation of environmental pollutants: Alkyl-Benzyl Sulphonates, Oil pollution.

INDUSTRIAL MICROBIOLOGY (Elective)
B.Sc. 3rd year Semester V
PAPER IMB-502: BIOFERTILIZERS

Max Marks: 37.5
Theory- 33 Marks
Internal Assessment: 4.5
Time-3 hours

Instructions for paper setters and candidates

1. The number of hours for theory and practical per week shall be 5 hours and 4 hours respectively.
2. There will be nine questions in all carrying equal marks. The first question will be compulsory and will be of short answer type
3. The remaining eight questions, two questions will be set from each Unit The candidate will be required to attempt five questions in all including the first question and selecting one questions from each Unit in each paper.

Objective: To make the students aware about the means to replace harmful chemicals used as fertilizers with biological ones which are harmless and biodegradable.

Unit-I

Symbiotic association: General account about the microbes used as bio-fertilizers, Rhizobium – taxonomy, physiology, host Rhizobium interaction, mass cultivation, carrier base inoculants and serology, Rhizobium – Woodland and Actinorrhizal nitrogen fixing plants – the endophytes, host plant.

Unit-II

Associative and non-symbiotic association: Azospirillum rhizosphere competence and host plant specificity, taxonomy and physiology, carrier base inoculant, associative effect of different micro-organisms.

Azotobacter – Classification, characteristics, ecology, physiology, crop response, Azotobacter inoculum, maintenance and mass cultivation, Cyanobacteria (blue green algae), Azolla and Anabaena-azolli association.

Unit-III

Nitrogen fixation factors affecting growth of plants: Blue green algae and Azolla in rice cultivation. VAM mycorrhizal association, types of mycorrhizal association, taxonomy occurrence and distribution, phosphorous nutrition growth and yield, collection of VAM, isolation, stock plants and inoculum production of VAM.

Unit-IV

Production and quality control in Bio-fertilizers: Isolation and identification of different nitrogen fixing microbes, assessment of nitrogen fixing ability of different strains under controlled and field conditions, direct and indirect methods, culture production, fermenter, storage culture, carrier packing, quality control, ISI standards, inoculum requirements, packing marketing and storage, inoculum requirements, methods of application.

RECOMMENDED BOOKS

1. General Microbiology by R.Y. Stanier.
2. Microbiology by Pelczar and Reid.
3. Comprehensive Biotechnology, Vol. I, II, III and IV.
4. Standard methods of water analysis.
5. Methods in Microbiology, Vol. XXIV by J.R. Norris, D.J. Road, A.K. Verma.
6. Nitrogen fixation by Sprent and Sprent.

INDUSTRIAL MICROBIOLOGY (Elective)
B.Sc. 3rd year Semester V

PRACTICALS

Max. Marks- 25 Marks
Practical-22 Marks
Internal assessment- 3 marks
Time-3 hours

1. Estimation of BOD and COD from water sample.
2. Standard methods of water analysis
3. IMVIC test for water analysis.
4. Nodulation by Rhizobium.
5. Counting of viable number of nodules from legume plants.
6. Isolation of VAM spores from soil samples.
7. Demonstration for the germination and identification of VAM spores.
8. Demonstration of cyanobacterial growth for nitrogen fixation and measurement of heterocyst frequency.
9. Preparation of Bio-fertilizers and testing.

INDUSTRIAL MICROBIOLOGY (Elective)
B.Sc. 3rd year Semester VI
PAPER IMB-601: BIostatISTICS, TOOLS AND TECHNIQUES

Max Marks: 37.5
Theory- 33 Marks
Internal Assessment: 4.5
Time-3 hours

Instructions for paper setters and candidates

1. The number of hours for theory and practical per week shall be 5 hours and 4 hours respectively.
2. There will be nine questions in all carrying equal marks. The first question will be compulsory and will be of short answer type
3. The remaining eight questions, two questions will be set from each Unit The candidate will be required to attempt five questions in all including the first question and selecting one questions from each Unit in each paper.

Objective: To introduce the importance of statistics of life science, role of various useful techniques of Biotechnology and the basic knowledge of computers in data analysis.

Unit-I

Biostatistics: Basic idea of probability, distribution patterns, normal binomial and Poisson distribution, sampling methods, mean, mode and median, chi-square statistics, Analysis of variance transformation, Exponential and logarithmic functions.

Unit-II

Techniques used in Microbiology: Microscopy – Simple microscopy, phase contrast microscopy, fluorescence microscopy. Chromatography techniques – Paper chromatography, thin layer chromatography, affinity chromatography, gel filtration, Electrophoresis moving boundary zone (paper, gel), Immuno-electrophoresis, Isoelectric focusing.

Unit-III

Instruments used in Microbiology: Electron Microscopes, Spectrophotometers, Centrifuges, Membrane filters, Distillation systems, Flow cytometers, PCR Machines, Water Purification systems, Fermenters - basic principles, functioning and usage.

Unit-IV

Fermenters used in Microbiology: Principal types of Fermentation – Introduction, Factors involved in fermenter design, differences between biochemical and chemical process, classification of biochemical reactions, rate process, operational consideration, local conditions within a fermenter, Fermenter configurations, the batch fermenter, continuous stirred tank fermenter, the tubular fermenter, the fluidized bed fermenter, solid state fermenter, Principal operating characteristics of fermenters, Computer control of fermentation process., Introduction - Computer hardware and software, Harward Graphics, LOTUS and DOS, Computer application in fermentation technology, Justification and planning.

INDUSTRIAL MICROBIOLOGY (Elective)

B.Sc. 3rd year Semester VI

PAPER IMB-602: IMMUNOBIOTECHNOLOGY, TISSUE CULTURE AND GOVERNMENT REGULATIONS

Max Marks: 37.5

Theory- 33 Marks

Internal Assessment: 4.5

Time-3 hours

Instructions for paper setters and candidates

1. The number of hours for theory and practical per week shall be 5 hours and 4 hours respectively.
2. There will be nine questions in all carrying equal marks. The first question will be compulsory and will be of short answer type
3. The remaining eight questions, two questions will be set from each Unit The candidate will be required to attempt five questions in all including the first question and selecting one questions from each Unit in each paper.

Objective: To understand the basics of defense system working against microbial diseases, development of vaccines and latest developments in immunology, medical science like gene therapy and stem cell culturing. Further how to apply Biotechnology for tackling the modern biohazardous in the world with the help of Government programmes at national and international level.

Unit –I

History and scope of immunology: Types of Immunity, Physiology of immune response, Antigen – antibody reaction, Immunoglobulins –structure, distribution and function.

Unit-II

Vaccines and Monoclonal antibodies: Types of vaccines, antibodies. Production of vaccines, monoclonal antibodies (hybridoma technology, siderospores).

Unit-III

Process and products of animal and plant cell culture: Nature of cell culture, Cell growth systems, Products from cell culture, Genetically engineered animal cells and bacteria, Metabolites from recombinant DNA modified plants.

Unit –IV

Bitechnology programmes and regulation: Role of International organizations in biotechnology, Government programmes for biotechnology development, governmental regulations of recombinant DNA research. Regulation for disposal of biohazardous materials, patenting. biotechnological processes and products, Mycotoxins, hazards in the production of fungal products. Health hazards during microbial spoilage, carcinogenic, mutagenic, teratogenic biologicals.

RECOMMENDED BOOKS

1. Statistics by D.N. Elhance.
2. Statistics by Mishra and Mishra.
3. Tools and techniques in biology by Swaroop, Pathak and Arora.
4. Fermentation technology by Whittaker.
5. Immunology by Davis.
6. Immunology by G.P. Talwar.

INDUSTRIAL MICROBIOLOGY (Elective) B.Sc. 3rd year Semester VI

PRACTICALS

Max. Marks- 25 Marks
Practical-22 Marks
Internal assessment- 3 marks
Time-3 hours

1. Biostatistics: Manual and by computer.
2. Problems on Chi-square test.
3. Problems on mean, mode and median.
4. Study and use of spectrophotometer.
5. Protein/Carbohydrate/Organic acid estimation by colorimeter.
6. Paper chromatographic separation of amino acid by one way descending.
7. Measurement of PH, acidity and total soluble solids of fruit juice.
8. Detection of blood groups.
9. Co-relation of optical density to transmission.
10. Study of antigen and antibodies.
11. Detail study of laboratory appliances.

ENTERPRENEURSHIP

The students will be delivered lectures on how to select for product line, design and development process, economics on materials and energy requirement, stock the product and release the same for marketing etc. The basic regulations of excise should be apprised to the candidates. In parallel the students will be asked to serve the demand for a given product, feasibility of its production under the given constraints of raw material, energy input, financial situations, export potentials etc. Procedural details on how to select, process, how to move for loans, how to operate and how to repay the loans in a phasic manner should also be highlighted during the lectures.

The students are required to submit a draft project during the session.