

B. Sc.
INDUSTRIAL
MICROBIOLOGY

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St. Aloysius College (Autonomous), Jabalpur, M.P.
Department of Botany and Microbiology
Department of Higher Education, Govt. of M.P.
Under Graduate Annual Pattern Syllabus
as recommended by Central Board of Studies and approved by the Governor of M.P.
Session 2019 onwards

Class: B. Sc.

Year: I

Subject: Industrial Microbiology

Paper: I – Fundamentals of Industrial Microbiology & Techniques

Max. Marks: 40(TH.)+10 (CCE) = 50

Course outcome: The students learn about the fundamentals of Microbiology, microbial diversity, scope and importance of Microbiology in various fields and will be equipped with practical skills of handling tools and instruments used in Microbiology laboratories for their future endeavour.

UNIT – I : HISTORY AND SCOPE :-

History:- Spontaneous generation and Biogenesis; scope and application of Microbiology in human welfare; Development of Microbiology:- Contribution of A. V. Leeuwenhoek, Alexander Fleming, Louis Pasteur, Robert Koch and Edward Jenner;

UNIT- II : DIVERSITY OF MICROBIAL WORLD A :-

Three kingdom and Whittaker's five kingdom system of classification.

General Characteristics and structure of Eubacteria- Morphology, structures external and internal to cell wall.

Bacteria with unusual Properties:- Archaeobacteria, Cyanobacteria, Mycoplasma and Actinomyces.

UNIT- III : DIVERSITY OF MICROBIAL WORLD B :-

Introduction to Fungi: Classification, general characteristics, reproduction and economic importance

Introduction to Virus, Classification, general characteristics, structure and reproduction: T4, TMV, Pox Virus, Prions, Virions, Virusoid and Virioids

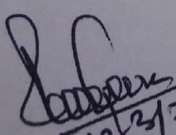
UNIT-IV: MICROBIAL TECHNIQUES :-

Microscopy: History, Principle, Construction and Application of Bright field Microscopy, Dark field Microscopy, Phase contrast, Fluorescent Microscopy and electron Microscopy, software in microscopy.

Instrumentation: Principle, construction and application of Autoclave, Hot air oven, incubator, B. O. D. incubator, laminar Air Flow, Colorimeter, Spectrophotometer, pH meter, centrifugation and chromatography(TLC)

UNIT-V : MICROBIOLOGICAL METHODS :-

Media Preparation; Concept of sterilization and disinfection, types of culture; Pure culture techniques; Nature of dyes, physical and chemical theories of staining, principle, procedure and


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UNIT-V: MICROBIOLOGICAL METHODS :-

Media Preparation; Concept of sterilization and disinfection; types of culture; Pure culture techniques; Nature of dyes, physical and chemical theories of staining, principle, procedure and

application of simple staining, negative staining, differential staining, enrichment culture and micromanipulator; Maintenance and preservation of pure cultures.

List of recommended books:

1. Microbiology- Pelezar, Chan and Kreig, Ingrahm
2. General Microbiology- Stainer, Ingraham, Wheelis and Painter.
3. Biology of Microorganisms Brook and Madigan.
4. Fundamental Principles of Bacteriology, - A.J. Salle.
5. Introduction to Microbiology, - Ingraham and Ingraham.
6. Tools and techniques In microbiology by Nath and Upadhyay
7. Power C. B. and H. F. Dagainawala (2003). General Microbiology Vol. 2; Himalaya Publishing House.
8. Dubey R. C. and D. K. Maheshwari (2004). A Text book of Microbiology, 1st Edition: S Chand and Company Ltd.
9. H. C. Dube (2005) A Textbook of Fungi, Vikas Publishing House.
10. Anuja, K. R. Experiments in Microbiology, Plant pathology, Tissue culture and Mushroom Cultivation: New Age International, New Delhi.
11. Atlas R. M. Microbiology Fundamentals and Applications, Mac Millan Publishing Company, New York.

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Year: I

Subject: Industrial Microbiology

Paper: II – Microbial Biochemistry & Immunology

Max. Marks: 40(TH.)+10 (CCE) = 50

Course outcome: Student develops fundamental knowledge of immunology and bio-molecules, acquire skills to analyse carbohydrates, proteins and lipids in various samples applicable in biochemical test.

UNIT – I: CARBOHYDRATES :-

Classification; Chemical structure and properties of monosaccharides, oligosaccharides and polysaccharides.

UNIT – II: LIPIDS AND NUCLEIC ACID :-

Saturated and unsaturated fatty acids; structure, classification, properties and functions of lipids.

Structure and properties of purines and pyrimidines, structure and types of nucleic acids.

UNIT – III: PROTEINS :-

Structure, classification and properties of amino acids, classification and properties of proteins, primary, secondary and tertiary structures of proteins.

UNIT – IV: ENZYMES :-

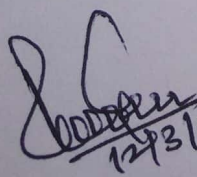
Classification of enzymes, coenzymes and cofactors, mechanism of enzyme action, competitive and non-competitive inhibitions, allosteric regulation of enzymes, isoenzymes, factors affecting enzyme action.

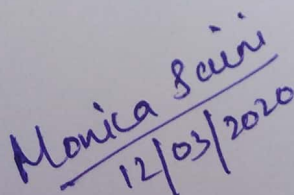
UNIT – V: IMMUNOLOGY

History & Scope of immunology, antigens- types of antigens, antigenic determination, determinants of antigenicity. Antibodies- nature, function, structure of immunoglobulin, types of Ig and abnormal immunoglobulins. Production of vaccines & Monoclonal antibodies. Antigen-antibody reactions-precipitation, agglutination, neutralization, opsonisation, immunodiffusion, immunoelectrophoresis, ELISA.

List of recommended books:

1. Principles of Biochemistry - A.L. Lehninger.
2. Fundamentals of Biochemistry - J.L. Jain
3. Biochemistry- Voet and Voet.
4. Microbial Genetics – Freifelder.
5. Text book of Microbiology – Dubey and Maheshwari.


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Class: B. Sc.

Year: II

Subject: Industrial Microbiology

Paper: I – Microbial Physiology & Metabolism

Max. Marks: 40 (TH.) + 10 (CCE) = 50

Course outcome: Completion of course imparts skill regarding Isolation and identification of microbes from various samples, techniques to estimate size and shape of microbes, culture of photosynthetic bacteria and its application for farmers and various section of sustainable agriculture.

UNIT – I : MICROBIAL GROWTH:-

Definition of growth. Mathematical nature and expression of growth. Generation time. Growth curve in Bacteria. Measurement of Growth (cell number, cell mass and cell constituent). Effect of environment on the microbial growth, (temperature, pH and Oxygen). Continuous culture Synchronous culture and Batch culture.

UNIT – II : MEMBRANE TRANSPORT PROCESS:-

Different models of cell membrane. Biochemical properties of cell membrane. function of cell membrane. Types of cellular transport (diffusion, gaseous exchange, osmosis, plasmolysis, active & passive transport, group translocation).

UNIT – III : BACTERIAL PHOTOSYNTHESIS AND FUELING REACTIONS:-

Classification of photosynthetic bacteria (Oxygenic & anoxygenic photosynthetic bacteria). Photosynthetic structure. Photosynthetic pigments. Photosynthetic electron transport system. Mechanism of Photosynthesis (Cyclic & Non cyclic).

UNIT – IV : METABOLIC PATHWAYS:-

Respiratory Pathways (Glycolysis, Entner Doudoroff pathway, Pentose phosphate pathway, Krebs cycle). Calvin Cycle, substrate level & oxidative phosphorylation. Fermentation process & products.

UNIT – V : MICROBIAL ASSIMILATION AND BIOENERGETICS:-

Assimilation of Ammonia, Nitrogen and sulphate. Methanogens and methylotrophs. Principles of Bioenergetics. ΔG , endergonic and exergonic reaction, oxidation reduction reaction, Redox potential

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Year: II

Subject: Industrial Microbiology

Paper: II – Microbial Genetics & Molecular Biology

Max. Marks: 40(TH.)+10 (CCE) = 50

Course outcome: Scholars develop basic concepts and techniques regarding Microbial physiology and metabolism. It develops understanding of various application of microbial techniques in the field of molecular biology.

UNIT – I- DNA REPLICATION AND PROTEIN SYNTHESIS:

Types and mechanism of DNA Replication; DNA topology; DNA Replication in prokaryotes and eukaryotes, Protein synthesis.

UNIT-II- GENE REGULATION IN PROKARYOTES AND EUKARYOTES:

Operon concept- Lac and trp; Britten Davidson model of gene expression.

UNIT-III- MUTATION:

Types of mutation: Molecular basis; Mutagenic agents DNA damage and repair mechanism; Auxotrophs; Prototrophs and ame's test

UNIT-IV- GENETIC RECOMBINATION IN BACTERIA

Transformation, Transduction and Conjugation, Genetic mapping, extrachromosomal genetic material; Plasmid, cosmid, transposon, overlapping gens, silent genes.

UNIT-V- RECOMBINANT DNA TECHNOLOGY:-

Isolation of DNA; Enzymes used in recombinant DNA Technology; Use of vectors:- PBR322, PUC 8 phage vectors-M.13.λ, Cosmid, phagemid, Ti plasmid, SV40; Gene cloning in prokaryotes; Southern and western blotting.

rDNA products; Insulin, Interferons and Immunotoxins.

Class: B. Sc.

Year: III

Subject: Industrial Microbiology

Paper: I – Fermentation Technology & Biostatistics

Max. Marks: 40(TH.)+10 (CCE) = 50

Course outcome: Learners are equipped to become an entrepreneur in the field of Industrial production of various microbial products like antibiotics, vitamins and enzymes. Awareness regarding bio safety measures enables the student to serve the microbial industry in future. Students get acquainted with techniques of agriculture and food microbiology, production of biofertilizer and quality testing of edibles.

UNIT – I :- PRINCIPLE OF FERMENTATION :-

Primary and secondary screening of industrially important microorganisms ; Strain improvement mutation, recombination and protoplasmic fusion; development of inoculum for industrial fermentation; types of fermentation media – saccharine materials, starchy materials, cellulosic materials, nitrogenous materials, enhancers and precursors.

UNIT – II :- DESIGN AND TYPES OF FERMENTOR :-

Structure of a batch fermentor ; Types of fermentor ; Batch ; Continuous ; Stirred tank ; Fluidized bed and Solid State fermenter ; computer control of fermentation process.

UNIT – III :- RECOVERY PROCESS :-

Downstream Processing – intracellular and extracellular product recovery (Physical and Chemical methods) ; Cell disruption method ; solvent extraction and purification ; Product recovery by whole broth processing.

UNIT – IV :- BIOSAFETY MEASURES :-

Government regulations of recombinant DNA Research ; Quality control regulations ; Hazardous industrial waste ; mycotoxin hazards ; Regulation for disposal of bio-hazardous materials ; Biopatents in industries; Biosafety in laboratories and industries (Dairy and Food, Pharmaceutical, Agricultural and Beverages).

UNIT – V :- BIostatISTICS AND BIOINFORMATICS :-

A. Biostatistics : Principle of Biostatistics; Classification of Data; Tabulation and Graphical representation; Measures of Central Tendency- Mean, Mode, Median- merits and demerits; Measure of Dispersion Range; Mean Deviation variance and Standard Deviation.

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B. Bioinformatics: Basic Organization of computer; Computer Hardware; Software. Bit, Byte, Computer Memory, Binary Code, Binary System; Introduction to Bioinformatics, Database and application of Bioinformatics.

Text & Reference Books:

1. Whitaker, A, Stanbury, P.F. and Hall, S.J. 2009. Principles of fermentation techniques, Elsevier.
2. Prescott, S.C., Dunn, C.G., and Reed, G. 1982. Prescott and Dunn's Industrial Microbiology, 4th Edition, AVI Publ. Co., Westport, Conn.
3. Hui, Y. H., Meunier-goddik, L., Hansen, A.L., Josephsen, J., Nip, W.K., Stanfield, P.S. and Toldra, F. 2004. Handbook of Food and Beverage Fermentation Technology, New York; Marcel Dekker Incorporated.
4. Casida L. E., 1968. Industrial Microbiology, Wiley New York.
5. Shrivastava M, 2008, Fermentation Technology, Alpha science International.
6. Agrawal B.L., Basic Statistics.
7. Mishra and Mishra Statistics.
8. Glover and Mitchell: Biostatistics.

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Class: B. Sc.

Subject: Industrial Microbiology

Paper: II – Agricultural, Environmental and Industrial Microbiology

Max. Marks: 40(TH.)+10 (CCE) = 50

Course outcome: Student will learn techniques regarding microbial analysis of food samples and dairy products.

Information regarding microbial food poisoning, Industrial and municipal waste water treatment, production of single cell protein makes the student efficient to start enterprise at pilot scale level.

UNIT I :- BIOFERTILIZERS AND BIOPESTICIDES :-

Biofertilizer :- Industrial production of *Rhizobium*, *Azotobacter*, Cyanobacteria, Mycorrhizae
VAM and phosphate solubilizing bacteria

Biopesticides :- Production of bacterial, viral and fungal biopesticides, microbial warfare on plants.

UNIT II :- BIOREMEDIATION AND BIOLEACHING :-

Management of Industrial waste- textile, pharmaceutical and dairy industry.

Management of agricultural waste.

Management of Municipal waste- Primary, Secondary and Tertiary treatment Microorganisms in Composting.. Bioremediation of copper and gold.

UNIT III :- METABOLITES PRODUCTION :-

Industrial production of organic acids, enzymes (amylase and protease), solvents (acetone, ethanol and glycerol) Vitamins (B12 and riboflavin), Antibiotics (Penicillin and Streptomycin)

UNIT IV :- FOOD AND DAIRY MICROBIOLOGY :-

Microbial role in production of bread, cheese, butter, yoghurt, cultured buttermilk, condensed and dry milk products, Indian fermented foods.

UNIT V :- BIOFUEL AND MICROBIAL FOODS :-

Biofuel :- Microorganism used, fermentation condition, recovery, production and uses of hydrogen, ethanol and biogas.

SCP :- Production of SCP (Algae and Bacteria); Product quality, merits and demerits.

Mushroom :- Production (long and short method) and harvesting.

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