

## **PG DIPLOMA IN INDUSTRIAL MICROBIOLOGY**

**(Non-Semester)**

**(With effect from the academic year 2013-14)**

### **Eligibility for the Course**

Candidates for admission to PG Diploma In Industrial Microbiology could possess a Bachelors degree in Zoology, Botany, Chemistry, Biochemistry, Microbiology Biotechnology/Environmental/ Animal/plant Food sciences, Dietetics & Nutrition, Bioinformatics, BE in Chemical Engineering & Biotechnology; B.Tech in Biotechnology & Bioinformatics/Nanotechnology; BDS; MBBS; B.Sc in Agri/Agri Biotechnology;B.V.Sc., B.F.Sc., .Pharm and BPT.

### **Duration of the Course**

One year PG Diploma In PG Diploma In Industrial Microbiology course non-semester for One Year duration

### **Examination**

All the theory paper are of 3hours duration each for maximum of 100 marks with passing minimum of 50 marks Practical examinations are also for 3 hours duration for a maximum of 100 marks and passing minimum of 50 marks.

#### **Question Paper Pattern**

Maximum marks: 100

Time: 3 hours

Part A (5 x 3 = 15)

Five short answer questions (One question from each unit)

Part B (5 x 8 = 40)

Paragraph questions (Total questions 8, out of which answers are to be given for any five questions;

Part C (3x 15 = 45)

Total questions 5, out of which answers are to be given for any Three questions;

S.No	Theory & Practicals	Maximum Marks	Minimum Marks
1.	Fundamentals Of Microbiology	100	50
2.	Microbial Technology	100	50
3.	Microbial Fermentation Technology	100	50
4.	Industrial Microbiology	100	50
P1	Practical - I General Microbiology	100	50
P2	Practical – II Industrial Microbiology	100	50

## **Paper-1 Fundamentals of Microbiology**

### **UNIT- I:**

Definition and Scope of Microbiology - History and Development of Microbiology (contribution of pioneers) - Golden Era of Microbiology - sample-Poure plate-Streak plate-Spread plate and special methods- Safety procedure in microbiology-GLP.

**Unit 2:** Diversity of Microbial World - Prokaryotic cell - Structure of Bacterial cell- Archaeobacteria and Eubacteria - Structure and function of Plasma membrane - cell wall - capsule, flagella – nucleoid - plasmid - Gram positive and Gram negative bacteria.

**Unit 3:** Microbial Nutrition and Growth- Carbon requirements- Growth factors-Growth curve- Synchronous growth- Continuous culture – Measurement of Microbial growth - Mechanism of nutrients uptake- Bath culture- Influence of environmental factors on microbial growth.

**Unit 4:** Scope & Methods for studying microorganisms - pure culture techniques - methods of sterilization - physical and chemical types of media and preservation techniques.

**Unit 5:** Microbial metabolism- Generation of ATP- Enzymes- Metabolism rate- Stages of metabolism- Diversity of catabolic pathway- ATP Generating pathway- Fermentation pathway- Breakdown of Glucose to Pyruvate- Aerobic and an aerobic respiration.

### **Book.**

Prescott, L.M.; J.P. Harley and D.A.Klein. 1993. Microbiology. 2nd edition. Wm.c. Brown publishers

### **References**

1. M J Pelczar, E C S Chan and N R Krieg. Microbiology. Tata McGrawHill.1993
2. Schlegel.H.G. General Microbiology, Cambridge University press. Edinburgh, London.1991.
3. R C Dubey and D K Maheshwari. A Textbook of Microbiology. S.Chand.1998.

## **Paper-2. Microbial Technology**

Unit 1: Biochemistry of Microbes: Chemical composition of cell - molecules of living systems- Plasma membrane- Internal membrane system- Cytoplasmic matrix - Ribosome - Inclusion bodies- Bacterial endospore - Lipids- Proteins- Nucleic acids, pH and pK, Buffers.

Unit 2: Biosynthesis of bacterial cell wall - transport across membrane - effect of temperature - salinity and oxygen on growth - Anaerobic bacteria, adaptations in extreme conditions.

Unit 3: Microorganism in surface soil- Phyllosphere and rhizosphere microorganism - association with plants - Biogeochemical cycles- Carbon- Nitrogen - Sulphur.

Unit 4: Bacterial Genetics- Replication of chromosomes- Mutations-Spontaneous mutation-induced mutation - Transposable genetic elements- Overlapping genes- Transformation- Conjugation-Transduction- Genetic engineering- Modern applications.

Unit 5: Microbial Biofertilizers and Biopesticides: Types of Biofertilizer and Method of application - Birth and tactics of biological control - Microbial pesticides - Insecticides- Nematicides - Herbicides in Industrial level production - applications.

Book

1. P.D.Sharma. Microbiology.Third Edition-2010

### **References:**

1. Jones and Barlett. Fundamentals of Microbiology. New Edition-2013.
2. A G Moat, J W Foster and M P Spector. Microbial Physiology. Wiley.2007.

## **Paper-3. MICROBIAL FERMENTATION TECHNOLOGY**

**UNIT 1: Introduction to Fermentation Technology:** History of fermentation, Introduction to various fermentation processes, classification of fermentations, Introduction to fermentation technology, Microbial culture selection for fermentation processes, Media formulation and process optimization. Liquid and solid state fermentations- Pharmaceutical microbiology-Natural acquired active Immunity and Artificial acquired Immunity- Drug safety- Antimicrobial activity-Methods and applications.

**UNITII: Bioreactors:** Basic concepts of bioreactors/fermenters, design and operation of Fermenters, different types of bioreactors: Packed bed reactor, Fluidized bed reactor, Trickle bed reactor, Bubble column reactor etc. Scale up of fermentation processes

**UNIT III: Microbial kinetics and downstream processing:** Basic concepts in microbial kinetics, growth curve, growth pattern of microbes in bioreactors: Batch, fed batch and synchronous growth; Introduction to down Stream processing. Principles, methodology and applications of techniques for isolation, purification, characterization, formualation, packing and preservation of fermentation products; Bioprocess economics.

**Unit IV: Industrial Fermentation Technology:** Substrates for fermentation industry, inoculum development; fermentation types- Single cell proteins for food and feed, Alcoholic beverages and vinegar, Biopesticides, Biofertilizers, Organic acids, Food additives, Vitamins, Microbial polysaccharides etc. Biotransformation; Pharmaceutical products; Vaccines; By-product utilization in fermentation industry; Genetic Engineering in fermentation Technology

**UNIT V: Commercialization of fermentation technology:** Concepts of Total Quality Management, ISO standards; Biosafety guidelines, Good Laboratory Practices, Good Manufacturing Practices, Intellectual property rights, Patents and patenting systems in India and other countries, entrepreneurship opportunities in fermentation technology, Governments initiatives in supporting bioprocess industries: Technology Business Incubators, Small Business Innovation Research Initiative (SBIRI) Scheme etc.

### **Book**

1. Prescott, L.M.; J.P. Harley and D.A.Klein. 1993. Microbiology. 2nd edition. Wm.c. Brown publishers.

### **Referances**

1. Frazier, W.C. and Westhoff, D.C. 1988. Food Microbiology. 4th Ed. McGraw Hill, NY.
2. Atlas, R.M. and Bartha R. 1992. Microbial Ecology: Fundamentals and Applications. 2nd Ed. Redwood city. CA. Benjamin / Cummings.
3. Winnackr, E.L. 1987. From Genes to clones. Introduction to Gene Technology. VCH, Weinheim.

## **Paper-4 Industrial Microbiology**

Unit 1. Exploitation of microorganisms and their products, screening, strain development strategies, immobilization methods, fermentation media, raw material used in media production, antifoaming agents, buffers, downstream processing.

Unit 2. Fermentation equipment and its uses - fermentor design - Types of fermentors and fermentations- single, batch, continuous, multiple, surface, submerged and solid state.

Unit 3. Industrial products from microorganisms- antibiotics: production of penicillin – streptomycin - Interferons - vaccines, hormones - vitamins. Enzymes from microbes - amylase – protease - Organic acids - citric acid - acetic acid - amino acids - glutamic acid - lysine.

Unit 4. Production of alcoholic beverages – Production petroleum from Bacteria and Yeast – Production of beer and wine, biofuels: ethanol, methane, biogas- Recombinant DNA Technology and Immobilization of enzymes in industrial microbiology.

UNIT- 5: Introduction of food Microbiology - Food spoilage – Food preservation methods – Microbiology of Milk and Dairy products – Microbiology of Fermented foods- Fermentation of meats – Bread – Vegetables - Single cell protein.

### **References:**

1.

Book

1. P.D.Sharma. Microbiology. 2010.
2. N S Subba Rao. Soil Microbiology. Oxford and IBH.1999

### **References:**

1. Alcamo: Fundamentals of Microbiology. 8<sup>th</sup> Edition . Jones and Bartlett Publishers. ISBN 0-7637-1067-9. 2011.
2. Whitaker and Stanbury. Principles of Fermentation Technology.1999
3. Casida. Industrial Microbiology. Tata McGraw Hill.1991.

## **Practical-I: General Microbiology**

1. Preparation of culture media (agar/ broth).
2. Learning the techniques of sterilization.
3. Isolation of E. coli plasmid.
4. Transformation in E. coli.
5. Isolation of DNA from bacteria.
6. Electrophoretic analysis of proteins and nucleic acids.
7. Isolation of root nodulating bacteria.
8. Enumeration of microorganisms from air.
9. Isolation of bacteria from rhizosphere and RFLP and RAPD
10. Coliform test.

### **Referance**

James G. Cappuccino and Natalie Sherman. 2004 (6<sup>th</sup> edition), Microbiology A laboratory Manual- Pearson Education.

Beister, L.1996. Microbiology in Praticce (6<sup>th</sup> edition) Adeland Wesley, Langman, New York.

## **Practicals- II. Industrial Microbiology**

1. Isolation of pure culture.
2. Enumeration of microbial population.
3. Estimation of proteins.
4. Production protein by Upstream and downstream Demonstration
5. Estimation of glucose.
6. Thin Layer Chromatography
7. Demonstration of Secondary metabolites Production
8. Paper chromatography.
9. Production Bio-Fertilizer in Industrial level
10. Enzyme assays – amylase, gelatinase, catalase etc.

### **Reference**

Sambrook, J., E.F. Fritsch and T. Maniatis (1989). Molecular cloning, A lab manual second Edition. Cold Spring Harbor Laboratory press, USA