

**ST. ALOYSIUS AUTONOMOUS COLLEGE, JABALPUR (M.P.)**  
**SYLLABUS FOR THE DEGREE OF BACHELOR OF SCIENCE**  
**(SESSION: 2009-10 onwards)**  
**SUBJECT - INDUSTRIAL MICROBIOLOGY**  
**FIRST SEMESTER**  
**PAPER-I**

Time: 3 hours

MM: 35

**Developmental History of Industrial Microbiology & General Microbiology**

**No. of  
Lectures**

**UNIT- I**

**History of Industrial Microbiology:** History, scope and development of Industrial Microbiology; Applications of Industrial Microbiology in human welfare. **08**

**UNIT- II**

**Development of Microbiology in India & Abroad:** Antony van Leeuwenhoek, Alexander Fleming, Edward Jenner, Louis Pasteur, Robert Koch, Selman Waksman, Joseph Lister, M.S. Swaminathan, J.P.Talwar, T.S. Sadasivan, C.V.Subramaniyam & R.N.Singh. **10**

**UNIT- III**

**Diversity of Microbial World A:** Classification, general characteristics and structure of Bacteria- (eubacteria & archaeobacteria), Cyanobacteria, Actinomycetes, Mycoplasma, Rickettsia & Chlamydia. Bacterial & Algal Biotechnology. **9**

**UNIT- IV**

**Diversity of Microbial World B:** Classification, general characteristics, structure , reproduction & economic importance of Fungi .General concept of Fungal Biotechnology. **9**

**UNIT- V**

**Diversity of Microbial World C:** Classification, general characteristics and structure of Viruses (Prions, Virions ,Virusoids & Viroids) Virus host, General features of virus reproduction. DNA & RNA Viruses. **9**

**PRESCRIBED BOOKS:**

1. Powar C. B. and H. F. Dagainawala (2003).General Microbiology Vol.II; Himalaya Publishing House.
2. Dubey R. C. and D. K. Maheshwari (2004). A Text book of microbiology, 1<sup>st</sup> Edition; S. Chand and Company Ltd.
3. H.C. Dube (2005)A Textbook of Fungi, Vikas Publishing House.
4. A Textbook of Fungi- Vashistha (2003) S. Chand and Company Ltd.

**REFERENCE BOOKS:**

1. Davis and Harper, General Microbiology
2. Alexopoulos C. J. and C. W. Mims (1996). Introductory Mycology, 4<sup>th</sup> Edition; John Wiley and Sons, Inc. USA.
3. Stanier, R.Y., J.L. Ingraham, M.L. Wheelis and P.R. Painter (1987) Vth edition. General Microbiology, Macmillan Press Ltd.
4. Wiestrich G. A. and M. D. Lechtman (1988). Microbiology, 5<sup>th</sup> Edition; Macmillan Pulishing Company, New York.
5. Trivedi, P.C. (2004) 1<sup>st</sup> Edition. Microbial Biotechnology, Aavishkar Publisher.
6. Sharma, P.D. (2005) 2<sup>nd</sup> Edition. Microbiology, Rastogi Publications.
7. Pelczar M. J., E. C. S. Chan and N. R. Krieg (2003) Microbiology, 5<sup>th</sup> Edition; Tata McGraw Hill Publishing Company , New Delhi

**WEBSITES:**

[www.textbookofbacteriology.net](http://www.textbookofbacteriology.net)

[users.rcn.com/jkimball.ma.ultranet/BiologyPages/T/TOC.html](http://users.rcn.com/jkimball.ma.ultranet/BiologyPages/T/TOC.html)

# SYLLABUS FOR THE DEGREE OF BACHELOR OF SCIENCE

(SESSION: 2009-10 onwards)

## SUBJECT - INDUSTRIAL MICROBIOLOGY

FIRST SEMESTER

PAPER-II

### Tools and Techniques in Microbiology

Time: 3 hours

MM: 35

No. of  
Lectures

#### UNIT- I

**Basic Microscopy** : Invention of microscope, bright field, dark field, phase contrast microscopy  
Fluorescent microscopy, SEM, TEM and their applications, Use of software in microscopy

9

#### UNIT- II

**Instrumentation Techniques**: Basic principles, construction and applications of Autoclave, Oven, Incubator, B.O.D. Incubator, Laminar Air Flow, Colorimeter, Spectrophotometer, Densitometer, Fluorimeter, pH meter, Centrifugation and Electrophoresis.

9

#### UNIT- III

**Microbiological Methods**: Nutrient medium- characteristics of growth medium, types of media, preparation of media. Sterilization and disinfection techniques. Principles and methods of sterilization. Physical methods - autoclave, hot-air oven, pressure cooker, laminar air flow, filter sterilization. Radiation methods - UV rays, gamma rays, ultrasonic methods. Chemical methods - Use of alcohols, aldehydes, fumigants, phenols, halogens and hypochlorites. Phenol coefficient. Tyndallization & other aseptic techniques.

9

#### UNIT- IV

**Isolation & Identification of Microorganisms**: Pure, axenic, mixed culture, strain, isolate, clone. 8  
Pure culture techniques: dilution-plating (streak plate, pour plate and spread plate) . Enrichment culture, and micromanipulator. Slide culture technique. Maintenance and preservation of pure cultures: subculturing, overlaying cultures with mineral oils, lyophilization, sand cultures, storage at low temperature. Major microbial culture collection centers in India & Abroad.

#### UNIT- V

**Micrometry and Staining**: Occular and Stage micrometry, Cell count: haemocytometry, Use of Camera lucida. Stains and staining techniques. Simple staining, differential staining : flagella, cell wall, spore, acid fast and Gram staining, Negative staining. 10

#### PRESCRIBED BOOKS:

1. Powar C. B. and H. F. Dagainawala (2003). General Microbiology Vol.II; Himalaya Publishing House.
2. Tools and Techniques in Microbiology- Nath & Upadhyay
3. Singh, R.P. (2005) 1<sup>st</sup> Edition, Microbiology, Kalyani Publisher.

#### REFERENCE BOOKS:

1. Das, H.K. (2005) 2<sup>nd</sup> Edition. Textbook of Biotechnology, Wiley Dreamtech Pvt. Ltd.
2. Pelczar M. J., E. C. S. Chan and N. R. Krieg (2003) Microbiology, 5<sup>th</sup> Edition; Tata McGraw Hill Publishing Company, New Delhi
3. Microbiology: Essentials and Applications- Mckane and Kandel
4. Stanier, R.Y., J.L. Ingraham, M.L. Wheelis and P.R. Painter (1987) Vth edition. General Microbiology, Macmillan Press Ltd.
5. Wiestrich G. A. and M. D. Lechtman (1988). Microbiology, 5<sup>th</sup> Edition; Macmillan Publishing Company, New York.
6. A treatise on Media and Methods used in Bacteriological techniques- V. Iswarn
7. Biotechniques – Annie
8. Biotechniques – S.V, Rana

#### WEBSITES

[pathmicro.med.sc.edu/book/bact-sta.htm](http://pathmicro.med.sc.edu/book/bact-sta.htm), [www.en.wikipedia.org](http://www.en.wikipedia.org)

## LIST OF PRACTICALS

### FIRST SEMESTER

1. Isolation of Phytopathogens.
2. Isolation of Microorganisms from soil, air and water : Bacteria , Fungi and Algae.
3. Camera Lucida Drawing.
4. Determination of bacterial growth.
5. Study of fungal growth.
6. Preparation of media, slant, autoclaving and sterilization of glass wares.
7. Purification of Microbial Cultures.
8. Estimation of carbohydrates by colorimeter.
9. Measurement of pH of fruit juice.
10. Estimation of protein concentration by Spectrophotometry.
11. Standard plate count.
12. Bacterial Staining.

### **SCHEME OF PRACTICAL EXAMINATION FOR THE DEGREE OF B.Sc. WITH INDUSTRIAL MICROBIOLOGY (SEMESTER - I)**

<u>Time 4 Hours</u>	<u>MM: 50</u>
1. Bacterial staining / Camera Lucida drawing	08
2. pH meter / Spectrophotometer (UV-Visible) / Colorimetry	06
3. Demonstration of pure culture techniques	05
4. Determination of bacterial growth / Standard plate count	06
5. Spots (Five Spots)	10
6. Sessionals	10
7. Viva-voce	05
<hr/> <b>TOTAL</b>	<b>50</b>

**SYLLABUS FOR THE DEGREE OF BACHELOR OF SCIENCE**  
**(SESSION: 2009-10 onwards)**  
**SUBJECT - INDUSTRIAL MICROBIOLOGY**  
**SECOND SEMESTER**  
**PAPER-I**  
**Cell Biology & Microbial Genetics**

Time: 3 hours

MM: 35

No. of  
Lectures

**UNIT- I**

**Nucleic acids:** Chemical composition, structure and types of DNA & RNA (s). Replication of DNA .Genetic code, Concept of gene. **9**

**UNIT-II**

**Protein Synthesis:** Transcription, Translation, CAP/CRP, cAMP **8**

**UNIT-III**

**Concept of genes:** Operon concept, Gene expression in prokaryotes; *lac* Operon, Regulation of gene expression in eukaryotes (Britten-Davidson model). **10**

**UNIT-IV**

**Genetic recombination in bacteria:** Transformation, Transduction (Generalized & Specialized) and Conjugation. Genetic mapping .Extra chromosomal genetic material; Plasmids, Cosmids, Transposons **8**

**UNIT-V**

**Mutations:** Molecular mechanism of mutation. Structural aberrations: deletions, inversions, tandem duplications and insertions .Spontaneous and induced mutations. Frame shift mutations and base pair changes, Reversion & suppression .Chemical and physical mutagens. Repair of mutational damage .Overlapping genes, silent genes and their evolutionary significance. **10**

**PRESCRIBED BOOKS:**

1. Dubey R. C. and D. K. Maheshwari (2004). A Text book of microbiology, 1<sup>st</sup> Edition; S. Chand and Company Ltd.
2. Gupta, P.K. (2005) 3<sup>rd</sup> Edition. Genetics, Rastogi Publications.
3. Singh, B.D. Genetics

**REFERENCE BOOKS:**

1. Russell P. J.(2000). Fundamentals of Genetics, 2<sup>nd</sup> Edition; Addison Wesley Longman, Inc. San Francisco CA.
2. Nelson, D.L. and M.M. Cox (2001) 3<sup>rd</sup> Edition. Lehninger Principles of Biochemistry, Macmillan Worth Publisher.
3. Gardner E.J., M.J. Simmons and D.P. Snustad (2006) 8<sup>th</sup> Edition. Principles of Genetics. John Wiley and sons inc.
4. Malacinski G.M. (2003) 4<sup>th</sup> Edition. Essentials of Molecular Biology. Jones and Bartlett Publisher.
5. Karp G. (2005). Cell & Molecular Biology- Concepts and Experiments, 4th Edition; John Wiley and Sons, Inc. USA.
6. Singh, B.D. (2006) 1<sup>st</sup> Edition. Biotechnology, Kalyani Publisher.
7. Cappuccino J. G. and N. Sherman (1999). Microbiology a Laboratory Manual, 4<sup>th</sup> Edition; Addison Wesley Longman, Inc. San Francisco CA.

**Websites:**

[www.bgsu.edu](http://www.bgsu.edu)  
[www.cellbio.com](http://www.cellbio.com)

**(SESSION : 2009-10 onwards)**  
**SUBJECT - INDUSTRIAL MICROBIOLOGY**  
**SECOND SEMESTER**  
**PAPER-II**  
**Microbial Biochemistry**

Time: 3 hours

MM: 35

No. of  
Lectures

**UNIT-I**

**Carbohydrates:** Classification of carbohydrates. Chemical structure and properties of monosaccharides, disaccharides, oligosaccharides and polysaccharides - Starch, cellulose and glycogen.

9

**UNIT-II**

**Purines and Pyrimidines:** structure and properties of Purines and Pyrimidines. Biosynthesis of Purines and Pyrimidines.

9

**UNIT-III**

**Lipids:** Saturated and unsaturated fatty acids. Biosynthesis of fatty acids. Distribution and function of lipids in microorganisms. Degradation of lipids by  $\alpha$ ,  $\beta$  and  $\omega$  oxidation. Lipid peroxidation.

9

**UNIT-IV**

**Proteins:** Structure and Classification of amino acids. Acid –base properties and solubilities. Amino acid sequencing of proteins .Primary ,secondary and tertiary structure of proteins.

8

**UNIT-V**

**Enzymes:** Classification of enzymes, Co-enzymes and cofactors .Mechanism of enzyme action. Competitive and non competitive inhibition. Allosteric regulation of enzymes. Isoenzymes. Factors contributing to catalytic efficiency of enzymes.

10

**PRESCRIBED BOOKS:**

1. Powar C. B. and G. R. Chatwal(1994). Biochemistry, 3<sup>rd</sup> Edition; Himalaya Publishing House, New Delhi.
2. Powar C. B. and H. F. Dagainawala (2003).General Microbiology Vol.I; Himalaya Publishing House
3. Jain, J.L., S. Jain and N. Jain (2005) 6<sup>th</sup> Edition. Fundamental of Biochemistry. S. Chand and Co.

**REFERENCE BOOKS:**

1. Nelson, D.L. and M.M. Cox (2001) 3<sup>rd</sup> Edition. Lehninger Principles of Biochemistry, Macmillan worth Publisher.
2. Mott & Foster, Microbial Biochemistry
3. Cohn & Stumph, Outline of Biochemistry
4. Murray, R.K., D.K. Granner, P.A. Mayes and V.W. Rodwell (2003) 26<sup>th</sup> Edition. Harper's illustrated biochemistry. McGraw Hill Publisher.
5. Rama Rao, A.V.S.S. (2000) 8<sup>th</sup> Edition. Textbook of Biochemistry. UBS Publisher Ltd.
6. Berg J. M., J. L. Tymoczko and L. Stryer(2002). Biochemistry, 5<sup>th</sup> Edition, W. H. Freeman and Company, New York.

**WEBSITES**

<http://ghs.gresham.k12.or.us/science/ps/sci/ibbio/chem/notes/notes.htm>  
<http://www.sp.uconn.edu/~bi107vc/fa02/home107.html>

**LIST OF PRACTICALS**

## **SECOND SEMESTER**

1. Antibiotic sensitivity test
2. Effect of Ultraviolet on bacterial growth.
3. Effect of chemical mutagen on microbial growth
4. Dark and photorepair.
5. Isolation of DNA
6. Isolation of Auxotrophs.
7. Demonstration of bacterial transformation, transduction and conjugation.
8. Separation of amino acid by paper chromatography.
9. Separation of amino acid by thin layer chromatography.
10. Qualitative analysis of carbohydrates.
11. Qualitative analysis of proteins.
12. Qualitative analysis of fats.
13. Detection of Amylase activity.
14. Detection of Protease activity.
15. Detection of Lipase activity.

### **SCHEME OF PRACTICAL EXAMINATION FOR THE DEGREE OF B.Sc. WITH INDUSTRIAL MICROBIOLOGY (SEMESTER - II)**

#### **Time 4 Hours**

1. Qualitative analysis of carbohydrates / proteins/ fats	<b>MM: 50</b> 08
2. Detection of Amylase / Protease / Lipase activity	07
3. Isolation of DNA / Antibiotic sensitivity test	05
4. Chromatographic techniques	05
5. Spots (Five Spots)	10
6. Sessionals	10
7. Viva-voce	05

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**TOTAL**

**50**

# SYLLABUS FOR THE DEGREE OF BACHELOR OF SCIENCE

(SESSION: 2009-10 onwards)

SUBJECT - INDUSTRIAL MICROBIOLOGY

THIRD SEMESTER

PAPER-I

ENVIRONMENTAL MICROBIOLOGY

MM: 35

Time: 3 hours

	No. of Lectures
<b>UNIT- I</b>	
<b>Ecological groups of microorganisms I:</b> Based on O <sub>2</sub> requirement; Based on sources (autotrophs and Heterotrophs); Based on temperature (Psychrophiles, mesophiles, thermophiles, hyperthermophiles and super-hyperthermophiles); Based on habitat (soil microorganisms, aquatic microorganisms, air microorganisms); The extremophilic (acidophiles, alkalophilic, halophiles); On basis of nutrition (Saprophytes, parasitism, and symbiosis);	9
<b>UNIT- II</b>	
<b>Ecological groups of microorganisms II:</b> Acidophiles- Physiology, molecular adaptation, applications; Alkalophiles- Physiology, molecular adaptation, applications (bacteriorhodopsin, physiology, Polysaccharides, microbial enhanced oil recovery, cancer detection, drug screening liposomes, enzymes, bioremediation, gas vacuoles, other products); Psychrophiles- Physiology, molecular adaptation, applications (Sources of pharmaceuticals, bacterial ice nucleating agents, fermentation in industry, in microbial leaching, in bioremediation, denitrification of drinking water sources, anaerobic digestion of organic waters); Thermophiles and hyperthermophiles- Physiology, molecular adaptation, applications (enzyme, chaperons); Basophiles- Physiology, molecular adaptation, applications	9
<b>UNIT- III</b>	
<b>Aquatic microbiology:</b> Natural water, aquatic environment, Distribution of microorganisms in aquatic environment,Types of ecosystems- fresh water (ponds, lakes, streams), marine( estuaries, mangroves, deep sea),Assessment of water quality.Eutrophication,Water purification.	8
<b>UNIT- IV</b>	
<b>Aerobiology:</b> Definition, droplet nuclei, aerosol, assessment of air quality and microbial flora of air. Distribution of microbial flora in different layers of atmosphere. Air sampling,Types of air samplers-their construction and working, Efficiency of samplers.	10
<b>UNIT- V</b>	
<b>Waste water treatment:</b> Types of waste- characteristics of solid and liquid waste. Treatment of waste water- primary, secondary and tertiary treatment, aerobic and anaerobic digestion, Waste treatment and useful byproducts- solid saccharification, gasification. Composting- types of composts.	9

#### PRESCRIBED BOOKS:

1. Pelczar M. J., E. C. S. Chan and N. R. Krieg (2003) Microbiology, 5<sup>th</sup> Edition; Tata McGraw Hill Publishing Company , New Delhi.
2. Powar C. B. and H. F. Dagainawala (2003).General Microbiology Vol.II; Himalaya Publishing House.
3. Dubey R.C and D.K. Maheshwari. Textbook of Microbiology.
4. Martin Alexander. Introduction to soil Microbiology.

#### REFERENCE BOOKS:

1. Odum E.P. Fundamentals of Ecology. 3<sup>rd</sup> edition. Natraj Publishers.
2. Atlas and Bartha. Microbial Ecology.

**SYLLABUS FOR THE DEGREE OF BACHELOR OF SCIENCE**  
**(SESSION: 2008-09 onwards)**  
**SUBJECT - INDUSTRIAL MICROBIOLOGY**  
**THIRD SEMESTER**  
**PAPER-II**  
**BIOSTATISTICS**

<b>Time: 3 hours</b>	<b>MM: 35</b>	<b>No. of Lectures</b>
<b>Unit I</b> <b>Elementary Probability:</b> Basic idea of probability- Random experiment, Sample space and Event. Definitions and theorems of probability. Probability distributions-Normal, Binomial and Poisson.		<b>9</b>
<b>Unit II</b> <b>Measures of Central Values:</b> Characteristics of an ideal measure of central value. Means (Arithmetic, Geometric and Harmonic), Median and Mode.		<b>9</b>
<b>Unit III</b> <b>Measures of Dispersion:</b> Range, Interquartile range, Quartile deviation, Mean deviation, Standard deviation, Variance and Coefficient of variation.		<b>8</b>
<b>Unit IV</b> <b>Test of Significance:</b> Types of hypothesis, Types of Errors. Student's t-Test, Test of equality of two population means, Paired t-Test.		<b>10</b>
<b>Unit V</b> <b>Chi-Square Test:</b> Test of Goodness of Fit, Test in One-way Classification, Contingency table, Test of Independence of Factors, Yate's correction.		<b>10</b>

**PRESCRIBED BOOKS:**

1. Agrawal B. L. Basic Statistics.
2. Mishra and Mishra. Statistics.

**REFERENCE BOOKS:**

1. Glover and Mitchell. Biostatistics.
2. Freund E. J. Modern elementary Statistics, VI edition. Prentice Hall, New Jersey

**SYLLABUS FOR THE DEGREE OF BACHELOR OF SCIENCE  
(SESSION: 2008-09 onwards)  
SUBJECT - INDUSTRIAL MICROBIOLOGY  
LIST OF PRACTICALS**

**THIRD SEMESTER**

1. Isolation of micro organisms from air.
2. Isolation of micro organisms from water.
3. Isolation of micro organisms from soil.
4. Total count of bacteria from water.
5. Determination of MPN of faecal contaminants in water.
6. Measurement & confirmation of E.coli in water sample
7. Biochemical tests for identification of enteric bacteria.
8. Study of Rhizobium from root nodules.
9. Study of symbiotic & non symbiotic blue green algae.
10. Problems based on the determination of mean, median & mode.
11. Problems on Chi-Square test.
12. Experiments to demonstrate symbiotic, antagonistic activities & relations amongst microbes & their interactions with plants.

**SCHEME OF PRACTICAL EXAMINATION  
FOR THE  
DEGREE OF B.Sc. WITH INDUSTRIAL MICROBIOLOGY  
(SEMESTER - III)**

<b><u>Time 4 Hours</u></b>	<b><u>MM: 50</u></b>
1. IMViC test for bacterial identification/biostatistical problems	08
2. Biostatistical problem	06
3. Rhizobium root nodule studies/symbiotic/ antagonistic activities	05
4. Enumeration of bacteria from water	06
5. Spots (Five Spots)	10
6. Sessionals	10
7. Viva-voce	05
<hr/> <b>TOTAL</b>	<hr/> <b>50</b>

**SYLLABUS FOR THE DEGREE OF BACHELOR OF SCIENCE**  
**(SESSION: 2009-10 onwards)**  
**SUBJECT - INDUSTRIAL MICROBIOLOGY**  
**FOURTH SEMESTER**  
**PAPER-I**  
**MICROBIAL PHYSIOLOGY**

**Time: 3 hours**

**MM: 35**

**No. of  
Lectures**

**UNIT- I**

Diffusion, gaseous exchange, Osmosis, Plasmolysis, Biochemical properties of membrane. **9**

**UNIT- II**

Passive and active transport mechanism, Role of ionophores, Group translocation across the membrane. **8**

**UNIT- III**

Photosynthetic microbes, Oxygenic and Non oxygenic reaction centre, Electron transport, Photophosphorylation. **9**

**UNIT- IV**

Calvin cycle, Photorespiration and its significance, Effect of various factors on the rate of photosynthesis. **9**

**UNIT- V**

Respiration mechanism: Breakdown of carbohydrates through Glycolysis, Kreb's cycle. **10**

**PRESCRIBED BOOKS:**

1. Powar C. B. and H. F. Dagainawala (2003). General Microbiology Vol.II; Himalaya Publishing House
2. Tortora G.J., B.R. Funke and C.L. Case, 5<sup>th</sup> edition. Microbiology: An Introduction. The Benjamin/Cummings Publishing Co., Inc.
3. Powar C.B. Cell Biology.

**REFERENCE BOOKS:**

1. Madigan M. T., J.M. Martinko and J. Parker, 9<sup>th</sup> edition. Brock's Biology of Microorganisms. Prentice Hall
2. Talaro K. and A. Talaro Foundations in Microbiology. Wm. C. Brown Publishers.
3. Murray R. K., D. K. Granner, P.A. Mayes and V.W. Rodwell (2003) 26<sup>th</sup> edition. Harper's Illustrated Biochemistry.
4. Moat and Foster. Physiology and Metabolism.
5. Stanier, R.Y., J.L. Ingraham, M.L. Wheelis and P.R. Painter (1987) Vth edition. General Microbiology, Macmillan Press Ltd.

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**(SESSION: 2009-10 onwards)**  
**SUBJECT - INDUSTRIAL MICROBIOLOGY**  
**FOURTH SEMESTER**  
**PAPER-II**

**METABOLISM & IMMUNOIOGY**

**Time: 3 hours**

**MM: 35**

**No. of Lectures**

**UNIT- I**

Fermentation: Pentose phosphate pathway, Fermentation of alcohol, Citric acid & acetic acid.

**10**

**UNIT- II**

Methanogens & Methylootrophs, Economic importance of methylootrophs.

**8**

**UNIT- III**

Sulphur utilizing bacteria, Sulphate reduction pathway & Economic importance of sulphur bacteria.

**9**

**UNIT- IV**

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. Antigen- antibody reactions- precipitation, agglutination, neutralization, opsonisation. immunodiffusion, immunoelectrophoresis, ELISA

**10**

**UNIT- V**

Immunoglobulins –Structure, Functions & types, Production of vaccines & Monoclonal antibodies.

**10**

**PRESCRIBED BOOKS:**

1. Powar C. B. and H. F. Dagainawala (2003). General Microbiology Vol.II; Himalaya Publishing House
2. Stanier, R.Y., J.L. Ingraham, M.L. Wheelis and P.R. Painter (1987) Vth edition. General Microbiology, Macmillan Press Ltd.
3. Davis. Immunology
4. Talwar G.P. Immunology.

**REFERENCE BOOKS:**

1. Goldsby R.A., T.J. Kindt., B.A. Osborne and J. Kuby. 5<sup>th</sup> edition. Immunology. W.H. Freeman and company, New York.
2. Moat & Foster Physiology and Metabolism
3. Nelson, D.L. and M.M. Cox (2001) 3<sup>rd</sup> Edition. Lehninger Principles of Biochemistry, Macmillan worth Publisher.
4. Madigan M. T., J.M. Martinko and J. Parker, 9<sup>th</sup> edition. Brock's Biology of Microorganisms. Prentice Hall

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SUBJECT - INDUSTRIAL MICROBIOLOGY**

**LIST OF PRACTICALS**

**FOURTH SEMESTER**

1. Study of osmosis in bacterial cell.
2. Study of plasmolysis in bacterial cell.
3. To study nitrate uptake by given bacterial culture.
4. Determination of oxygen evolution during photosynthesis.
5. To study different parts of a fermenter and their working principle.
6. To study carbohydrate fermentation by bacteria.
7. Isolation of cyanobacteria in Pringsheim's broth from soil and water.
8. Titration of antigen & antibody.
9. To conduct a serological precipitation test.
10. Blood group test.
11. To isolate H<sub>2</sub>S producing bacteria.

**SCHEME OF PRACTICAL EXAMINATION  
FOR THE  
DEGREE OF B.SC. WITH INDUSTRIAL MICROBIOLOGY  
(SEMESTER - IV)**

**Time 4 Hours**

**MM: 50**

1. Nitrate uptake by bacteria	08
2. Carbohydrate fermentation by bacteria/ working of fermenter	06
3. Study of osmosis/ plasmolysis in bacterial cell	05
4. Serological test	06
5. Spots (Five Spots)	10
6. Sessionals	10
7. Viva-voce	05

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**TOTAL**

**50**

***Note: During the summer vacations student will visit some industries/lab and submit 3 – 4 weeks summer training report in B.Sc 6<sup>th</sup> semester for viva – voce exam.***

**SYLLABUS FOR THE DEGREE OF BACHELOR OF SCIENCE**  
**(SESSION : 2009-10 onwards)**  
**SUBJECT - INDUSTRIAL MICROBIOLOGY**  
**FIFTH SEMESTER**  
**PAPER-I**  
**AGRICULTURE MICROBIOLOGY**

**Time: 3 hours**

**MM: 35**

**No. of Lectures**

**UNIT-I**

**Soil microbiology** : Physical and chemical characteristics and microflora of various soil types. Rhizosphere & phyllosphere. Interaction amongst soil microorganisms – neutral association, positive associations and negative associations. Microbial interactions: Clay-humus-microbe interaction; Animal-microbe interactions: destructive association; Neutralism – normal microbiodata of human body; Symbiotic association (ectosymbiosis of protozoa, bacteria and fungi with birds and insects, ruminant symbiosis); Microbe-Microbe interactions (Symbiosis between algae and fungi: lichens); Antagonistic interaction : amensalism, competition and parasitism and predation (mycoparasitism, mycophagy, nematophagy: predaceous fungi/nematophagous fungi – nematode-trapping fungi, endoparasites, egg parasites)

**10**

**UNIT-II**

**Plant microbe interaction** ( Interaction of above ground parts destructive and beneficial association; Interaction of below ground parts 1. destructive association and 2.beneficial association; (i) cyanobacterial, (ii) bacterial ( associative symbionts, PGPR, Rhizobium) (iii) actinomycetes and (iv) fungal symbiosis (mycorrhiza, Types: ectomycorrhiza, ectendomycorrhiza, VAM, ericoid mycorrhiza arbutoid mycorrhiza, monotropoid mycorrhiza, orchid mycorrhiza), Effects of mycorrhizal fungi on their hosts, Works done on mycorrhiza in India.);

**10**

**UNIT-III**

**Biofertilizers** : Biological nitrogen fixation- nitrogenase enzyme, nif genes, symbiotic nitrogen fixation (Rhizobium, Frankia), non-symbiotic nitrogen fixation Azotobacter, Azospirillum, Cyanobacteria). Phosphate-solubilizing microorganisms.

**8**

**UNIT-IV**

**Biodegradation**: Biodegradation of xenobiotics, Bioaccumulation. Biopesticides, Biodeterioration. Biopesticides – *Bacillus thuringiensis*, Nuclear polyhedrosis virus (NPV), *Trichoderma*.

**8**

**UNIT-V**

**Plant pathology**: Concept of disease in plants. Symptoms of plant diseases caused by fungi, bacteria, and viruses., transmission of diseases. Bacterial diseases of plants- Citrus canker, Bacterial blight. Fungal diseases of plants-Late blight of potato, Powdery mildew of peas, Loose smut of wheat, Cereal rusts. Viral diseases of plants- Leaf curl of papaya, Tobacco mosaic disease, Bunchy top of banana.

**10**

**REFERENCE BOOKS:**

1. Subba Rao, N.S. (1993). **Biofertilizers in Agriculture and Forestry**, 3rd Edition Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
2. Rangaswami, G. and Bhagyaraj, D.J. (2001). **Agricultural Microbiology**, 2nd Edition, Prentice Hall of India, New Delhi.
3. Paul, E.A. and Clark, F.E. (1989). **Soil Microbiology and Biochemistry**, Academic Press, USA.
4. Alexander, M. (1985). **Introduction to Soil Microbiology**, 3rd Edition. Wiley Eastern Ltd., New Delhi.

**SYLLABUS FOR THE DEGREE OF BACHELOR OF SCIENCE**  
**(SESSION : 2009-10 onwards)**  
**SUBJECT - INDUSTRIAL MICROBIOLOGY**  
**FIFTH SEMESTER**  
**PAPER-II**  
**FOOD MICROBIOLOGY**

**Time: 3 hours**

**MM: 35**

**No. of  
Lecture**

**UNIT-I**

**Introduction to Food Microbiology:** Food as a substrate for microorganisms. Microbes in food microbiology- molds, yeasts and bacteria. Principles of food preservation- asepsis, removal of microorganisms.

**9**

**UNIT-II**

**Food spoilage:** mechanisms of food spoilage – Putrefaction souring, rancidity, soft rot, pigmentation and ropiness/ sliminess. Food borne diseasea Microbial spoilage of stored products, fruits and vegetables. Microbial spoilage of milk and meat.

**9**

**UNIT-III**

**Food preservation,I:** Methods of food preservation- Asepsis, Pasteurization, Canning, Dessication, Anaerobiosis, filtration. Food preservation by use of High Temperature, low temperature, (Freezing and refrigeration) Radiation.

**10**

**UNIT-IV**

**Food preservation,II:** Chemical preservation of food- Salt and sugar, organic acids. Use of SO<sub>2</sub>, ethylene and propylene oxides, wood smoke.

**8**

**UNIT-V**

**Food intoxication:** (botulism and staph poisoning), **food-borne diseases** (salmonellosis and shigellosis) and their detection.

**9**

**RECOMMENDED BOOKS :**

1. Modern plant pathology by Bilgrami and Dubey.
2. Food Microbiology by Frazier.
3. Microbiology by S.S. Purohit.
4. Microbiology by P.D. Sharma.
5. Agricultural Microbiology by R.S. Mehrotra.
6. Modern Food Microbiology by James M. Jay
7. Food Microbiology by Adam and Moss.

**SYLLABUS FOR THE DEGREE OF BACHELOR OF SCIENCE  
(SESSION: 2008-09 onwards)  
SUBJECT - INDUSTRIAL MICROBIOLOGY**

**LIST OF PRACTICALS**

**FIFTH SEMESTER**

1. Study of microbial diseases of crop plants.
2. Isolation of PSB from soil.
3. Study of effect of fungicides and insecticides on microorganisms.
4. Study of antagonistic activities amongst microorganisms.
5. Study of fungal contaminants from stored agricultural products.
6. Study of food spoilage microorganisms from sweets and bakery products.
7. Study of food spoilage microorganisms from meat.
8. Study of effect of the preservatives (Salt/ Sugar) on the growth of microorganisms.
9. Study of effect of the preservatives (Acids) on the growth of microorganisms.
10. Study of UV radiation on microorganisms.
11. Study of effect of agrochemicals on soil inhabiting microorganisms.
12. Detection of calcium & phosphorus in milk.

**SYLLABUS FOR THE DEGREE OF BACHELOR OF SCIENCE**

**(SESSION : 2009-10 onwards)**

**SUBJECT - INDUSTRIAL MICROBIOLOGY**

**SIXTH SEMESTER**

**PAPER-I**

**FERMENTATION TECHNOLOGY AND GOVERNMENT REGULATIONS**

**Time: 3 hours**

**Max. Marks : 35**

**No. of  
Lecture**

**Unit- I**

Fermentation equipments and production process. Principal types of fermenters- The batch fermenters, continuous and solid state fermenter.

**8**

**Unit- II**

Other fermentation equipments and industrial uses. The fluidized bed fermenter, stirred tank fermenters. Tubular fermenter. Computer control of fermentation process. Strain improvement process.

**9**

**Unit- III**

Industrial production of organic acids- Lactic acid, citric acid and acetic acid production and their applications.

**9**

**Unit- IV**

Role of international organisation in biotechnology. Government programmes for biotechnology development. Government regulations of recombinant DNA research.

**9**

**Unit- V**

Hazardous industrial wastes, Mycotoxin hazards in the production of fungal products. Regulations for disposal of biohazardous materials. Patenting of the products in industry.

**10**

**RECOMMENDED BOOKS :**

1. Fermentation technology by Whittakar.
2. General microbiology, vol. II ,by Powar and Dagainawala.
3. Molecular biology and Biotechnology by H.D. Kumar.

**SYLLABUS FOR THE DEGREE OF BACHELOR OF SCIENCE**  
**(SESSION : 2009-10 onwards)**  
**SUBJECT - INDUSTRIAL MICROBIOLOGY**  
**SIXTH SEMESTER**  
**PAPER-II**

**Time: 3 hours**

**Max. Marks : 35**

**No. of  
Lectures**

**INDUSTRIAL PRODUCTION**

**Unit- I**

Industrial production and applications of antibiotics – Penicillin and Streptomycine. Industrial production and applications of vitamins – vitamin B<sub>12</sub> and Riboflavin.

**9**

**Unit- II**

Importance of microorganisms in dairy industries. Production of Cheese and Buttermilk. In bakery industries – leavening of bread. Indian fermented foods.

**9**

**Unit- III**

Mass production of single cell proteins (SCP) and proteins from bacteria, Cyanobacteria, fungi and their significance.

**9**

**Unit- IV**

Industrial production of Enzymes – amylase and protease production and their applications.

**8**

**Unit- V**

Industrial production of alcohol, wine, beer and Production of amino acids – L-lysine and glutamic acid.

**10**

**RECOMMENDED BOOKS :**

4. Industrial microbiology by L.E. Casida.
5. Elements of Biotechnology by P.K. Gupta.
6. Industrial Microbiology by A.H. Patel.
7. Industrial Microbiology by Prescott and Dunn
8. Industrial Microbiology by Waites

**SYLLABUS FOR THE DEGREE OF BACHELOR OF SCIENCE  
(SESSION: 2009-10 onwards)  
SUBJECT - INDUSTRIAL MICROBIOLOGY**

**LIST OF PRACTICALS**

**SIXTH SEMESTER**

1. Study of a bioreactor.
2. Demonstration of fermentation by yeast.
3. Demonstration of IAA production by Microbes.
4. Screening of microorganisms for Amylase enzyme production by microorganisms.
5. Screening of microorganisms for Cellulase enzyme production.
6. Screening of microorganisms for Gelatinase enzyme production.
7. Screening of microorganisms for Lipase enzyme production.
8. Demonstration of mushroom cultivation.
9. Detection of milk quality by Resazurin dye test.
10. Demonstration of mass production of enzyme by using Bioreactor.