KURUKSHETRA UNIVERSITY, KURUKSHETRA

(Established by the State Legislature Act XII of 1956)

("A" Grade NAAC Accredited)

B.Sc. INDUSTRIAL MICROBIOLOGY
Revised Scheme of Examination (w.e.f. 2015-2016)

B.Sc.-I

Paper No.	Nomenclature	Max. (Ext. + Int.) Marks	Hours
Semester-I			
IMB Paper - 101	Fundamentals of Industrial Microbiology	50 (40+10)	3 hrs
IMB Paper - 102	Microbial Biochemistry	50 (40+10)	3 hrs
Paper-III	Practical (Continued)		
Semester-II			
IMB Paper-201	Basic Microbial Techniques	50 (40+10)	3 hrs
IMB Paper-202	Microbial Physiology	50 (40+10)	3 hrs
IMB Paper-203	Practical (based on theory papers of I & IInd Semesters)	90	6 hrs
	Total	**290**	

B.Sc.-II

Semester-III			
IMB Paper-301	Microbial Genetics	50 (40+10)	3 hrs
IMB Paper-302	Environmental Microbiology-I	50 (40+10)	3 hrs
Paper-III	Practical (Continued)		
Semester-IV			
IMB Paper-401	Food Microbiology	50 (40+10)	3 hrs
IMB Paper-402	Environmental Microbiology-II	50 (40+10)	3 hrs
IMB Paper-403	Practical (based on theory papers of IIIrd & IVth semesters)	90	6hrs
	Total	**290**	

Job Summer Training (One Month) in an Institute/Industry (Summer Vacations)

B.Sc.-III

Semester-V			
IMB Paper-501	Agricultural Microbiology	50 (40+10)	3 hrs
IMB Paper-502	Fermentation Technology & IPR	50 (40+10)	3 hrs
Paper-III	Practical (Continued)		
Semester-VI			
IMB Paper-601	Microbial Biofertilizer	50 (40+10)	3 hrs
IMB Paper-602	Microbial Biotechnology	50 (40+10)	3 hrs
IMB Paper-603	Practical (based on theory papers of Vth & VIth semester)	90	6 hrs
IMB Paper-604	Evaluation & Viva-voce of 'job summer training' report	30	
	Total	**320**	
	Grand Total	**900**	

Practical Examinations will be held at the end of Semesters II, IV& VI

B.Sc.-IST SEMESTER (INDUSTRIAL MICROBIOLOGY)

IMB-101 FUNDAMENTALS OF INDUSTRIAL MICROBIOLOGY

Max. Marks: 50
(Ext.40+Int.10)
Time: 3 Hours

INSTRUCTIONS FOR THE PAPER- SETTERS

- Nine questions of equal marks should be set.
- Question No.1 consisting of number of short answer type questions (having no internal choice) spread over the whole syllabus should be compulsory.
- Eight questions, two questions from each unit (I, II, III, IV) should be set.

INSTRUCTIONS FOR THE CANDIDATES

- Candidates will be required to attempt five questions in all, selecting one question from each unit (I, II, III, IV) and the compulsory question 1.
- All questions will carry equal marks.

UNIT- I

Introduction, scope and development of industrial microbiology: Introduction, scope and historical development (discovery era, transition period, golden age and microbiology in the twenty first century) of microbiology. Applied branches of Microbiology and industrial importance of microorganisms in various industries.

UNIT- II

Biology of microorganisms: Morphology and characteristics of various groups of microorganisms (Bacteria, Archaea, Viruses, Protozoa, Algae and Fungi). Brief account of cell structure of bacteria. Carl Woese three Domain system of classification. Taxonomy: classification, nomenclature and identification: Binomial system of nomenclatures. Taxonomic ranks. Various methods of staining of bacteria (simple, Gram) and fungus (mold and yeast).

UNIT- III

Fundamentals of nutrition and culture techniques: Nutritional requirements and nutritional types of bacteria. Pure culture techniques –pour plate, spread plate, streak plate and serial dilution agar plate method. Advantages and disadvantages of various techniques.

UNIT- IV

Culture medium and preservation of cultures: Methods of Sterilization used in industrial microbiology- Physical: Heat (Autoclave, hot air oven); filtration (membrane filtration and HEPA filters); Chemicals (Alcohol, halogens, ethylene); Radiation (UV rays, gamma rays).

Culture medium (natural and synthetic) - Preparation and types. Preservation of microbial culture-serial subculture, at very low temperature, overlaying culture with mineral oil, lyophilization or freeze drying, in liquid nitrogen.

Reference Books:

- Powar,C.B. & Daginawala, H.F.: General Microbiology Vol.1, Himalaya Publishing House, Bombay
- Prescott, L.M. et al. (2005 & 2007).Microbiology, McGraw Hill International Edition, USA.
- Patel, A.H.: Industrial Microbiology, McMillan India.
- Pelczar, M.J., Chan, E.C.S. & Krieg, N.R.: Microbiology, Tata Mc Graw-Hill Publishing Company Limited, New Delhi.

IMB-102 MICROBIAL BIOCHEMISTRY

Max. Marks: 50
(Ext.40+Int.10)
Time: 3 Hours

INSTRUCTIONS FOR THE PAPER- SETTERS

● Nine questions of equal marks should be set.

● Question 1 consisting of number of short answer type questions (having no internal choice) spread over the whole syllabus should be compulsory.

● Eight questions, two questions from each unit (I, II, III, IV) should be set.

INSTRUCTIONS FOR THE CANDIDATES

● Candidates will be required to attempt five questions in all, selecting one question from each unit (I, II, III, IV) and the compulsory question 1.

● All questions will carry equal marks

UNIT- I

Basic aspects of bioenergetics:- Entropy, enthalpy, e-carriers, e-donors, inhibitors, uncouplers, energy bond. Ist and IInd law of thermodynamics.

Cell and its macromolecules: Difference between cellular organization of procaryotes & eukaryotes and their macromolecules

Water: Structure, hydrogen bonding, solvent properties, ionization and fitness of the aqueous environment for living organisms.

UNIT- II

Carbohydrates: Classification, physical and Chemical Properties of Carbohydrates, Structure and properties of Starch, Cellulose, Glycogen.

Lipids: Classification, structure and functions. Physical and chemical properties of lipids.

Nucleic acids: Structure of nucleotide. Structure, types and functions of DNA & RNA.

UNIT-III

Amino acids and proteins: Classification, Structure and properties of amino acids. Henderson and Hesselbalch Equation for Ionization of amino acids and Zwitter Ionic Property. Classification, structure and properties of proteins.

UNIT- IV

Enzymes: Classification, coenzymes, cofactor, isozymes. Thermodynamics explanation of enzyme catalysis, reaction orders. Derivation of Michaelis Menton kinetic equation. Competitive, uncompetitive and noncompetitive inhibition.

Reference Books:

- Jain, J.L.: General Biochemistry- S. Chand & Co.
- Nelson, David L. & Cox, Michael M.: Lehninger : Principles of Biochemistry, Freeman, W.H. and company.
- Powar,C.B. & Daginawala,H.F.: General Microbiology vol.-I, Himalaya Publishing House, Bombay.
- Satyanarayan, U.: Biochemistry- Books & allied Pvt.Ltd.

B.Sc.-IIND SEMESTER (INDUSTRIAL MICROBIOLOGY)

IMB-201 BASIC MICROBIAL TECHNIQUES

Max. Marks: 50
(Ext.40+Int.10)
Time: 3 Hours

INSTRUCTIONS FOR THE PAPER- SETTERS

● Nine questions of equal marks should be set.
● Question 1 consisting of number of short answer type questions (having no internal choice) spread over the whole syllabus should be compulsory.
● Eight questions, two questions from each unit (I, II, III, IV) should be set.

INSTRUCTIONS FOR THE CANDIDATES

● Candidates will be required to attempt five questions in all, selecting one question from each unit (I, II, III, IV) and the compulsory question 1.
● All questions will carry equal marks.

UNIT -I

Microscopy & Micrometry: Simple Microscopy, dark field microscopy, Phase Contrast Microscopy, Fluorescence and Electron Microscopy (TEM and SEM). Calibration of ocular micrometer. Microscopic enumeration of microorganisms.

UNIT- II

Chromatography Techniques: Paper Chromatography, Thin Layer Chromatography, Column Chromatography. Types of Chromatography- Adsorption, Partition, Gas liquid Chromatography, Gel permeation, Ion exchange and Affinity Chromatography. Gel-electrophoresis.

UNIT- III

Instruments -Basic Principles and Usage: pH-Meter- Basic Principle, working and application.
Colorimetry, Spectrophotometry- Basic Principle, laws of absorption and absorption spectrum. The chromophore concept. The instrumentation of UV, visible and infrared spectrophotometry and its application.
Centrifugation- relative Centrifugation force, instrumentation and its application.

UNIT- I

Fermentation and fermentor: Concept of fermentation and discovery of fermentation. Fermentor- its parts & function. Types of fermentor-batch, continuous, chemostat and fed batch. Immobilized cell reactor system, solid state fermentation reactors.

Reference Books:

- Kathleen P.T& Arthur T. Foundations in Microbiology. Basic Principles. McGraw Hill.
- Wilson K & Walker J(2005). Principles and Techniques of Biochemistry and Molecular Biology, 6th ed.,Cambridge University Press.
- Sawhney, S.K. & Singh Randhir : Introductory Practical Biochemistry, Narosa Publishing House, New Delhi
- Mahajan R, Sharma J & Mahajan RK(2010). Practical Manual of Biotechnology. Vayu Education of India
- Welson and Goulding: Tools and techniques in Biology.

IMB-202 MICROBIAL PHYSIOLOGY

Max. Marks: 50
(Ext.40+Int.10)
Time: 3 Hours

INSTRUCTIONS FOR THE PAPER- SETTERS

● Nine questions of equal marks should be set.
● Question 1 consisting of number of short answer type questions (having no internal choice) spread over the whole syllabus should be compulsory.
● Eight questions, two questions from each unit (I, II, III, IV) should be set.

INSTRUCTIONS FOR THE CANDIDATES

● Candidates will be required to attempt five questions in all, selecting one question from each unit (I, II, III, IV) and the compulsory question 1.
● All questions will carry equal marks

UNIT- I

Microbial Growth:

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

UNIT-II

Membrane Transport Process:

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

UNIT-III

Bacterial Photosynthesis:

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

UNIT-IV

Metabolic Pathways:-

Respiratory Pathways (Glycolysis, Entner Daudoroff pathway, Pentose phosphate pathway, Krebs cycle), Calvin cycle, Substrate level & oxidative phosphorylation, β Ketoadipate pathway. Fermentation process & products.

Reference Books :

Geeta Sumbali: Principles of Microbiology
Pelczar, Reid & Chan.: Microbiology
Lehninger: Principles of Biochemistry
Moat & Foster: Microbial physiology & Metabolism
Dubey & Maheshwari: A text book of Microbiology

IMB-203 PRACTICAL **M. M 90**
Time 6 hrs

List of practicals based on theory papers (IMB 101,102, 201, 202) of Semesters Ist and IInd

SEMESTER-I

1. Laboratory rules, washing and cleaning of glassware. Distillation of water.
2. Principle, Construction and working of Microscope Autoclave, Oven, Incubator (Ordinary and B.O.D), Laminar air flow Hood. Water bath. Quebec colony counter.
3. Preparation of culture media: Nutrient agar, Potatodextrose agar, Czapek-Dox agar.
4. Preparation of agar plates, agar slants and deep tubes.
5. Study of
(a) Pour plate.
(b) Spread plate.
(c) Streak plate.
6. Standard plate count.
7. Demonstration of common molds and yeasts of industrial significance.
8. Demonstration of Cyanobacteria or algae
9. Demonstration of a protozoan.

SEMESTER –II

1 Separation of amino acids by paper chromatography
2 Separation of amino acids and lipids by thin layer chromatography
3. Carbohydrate estimation by colorimeter.
4. Protein estimation by colorimeter by Folin-ciocalteu reagent.
5. Staining techniques: -
(a) Preparation of bacterial smear
(b) Simple staining
(c) Gram staining
(d) Negative staining
(e) Endospore staining.
6. Effects of temperature on the growth of bacteria.
7. Effect of pH on growth of bacteria.

B.Sc.-IIIRD SEMESTER (INDUSTRIAL MICROBIOLOGY)

IMB-301 MICROBIAL GENETICS

Max. Marks: 50
(Ext.40+Int.10)
Time: 3 Hours

INSTRUCTIONS FOR THE PAPER- SETTERS

● Nine questions of equal marks should be set.

● Question 1 consisting of number of short answer type questions (having no internal choice) spread over the whole syllabus should be compulsory.

● Eight questions, two questions from each unit (I, II, III, IV) should be set.

INSTRUCTIONS FOR THE CANDIDATES

● Candidates will be required to attempt five questions in all, selecting one question from each unit (I, II, III, IV) and the compulsory question 1.

● All questions will carry equal marks

UNIT-I

Nucleic acids: DNA as genetic material, structure of DNA.Watson & Crick model of DNA. Conformational flexibility of DNA, DNA replication (conservative and semi conservative).

UNIT- II

Gene expression and regulation in procaryotes: The genetic code and its characteristics. Central dogma, transcription, translation and protein synthesis. Inhibitors of protein synthesis. Operon concept, inducible and repressible system.Lac operon, its positive and negative regulation.

UNIT- III

Mutation: Molecular mechanism of mutation, forward and reverse mutation, transition, transversion, chemical induced, radiations and base analogues. Mutation frequency. Application of mutation, Auxotroph, Prototroph, AMES test & replica plating technique.

UNIT- IV

Genetic Recombination and extra-chromosomal inheritance

Concept of genetic recombination: Transformation, Transduction and Conjugation. Plasmids and Transposons. Homologous recombination. Introduction to yeast genetics: Overlapping genes, split genes, exon and introns in brief.

Reference Books:

- Dubey, R.C. & Maheshwari: A Text book of Microbiology.
- Dale JW, (2002). Microbial Genetics of bacteria, Jones& Bartlett publishers.
- Gardner E.J., Simmons, M.J. & Snustard, D.P.: Principles of Genetics, John Wiley & Sons. Inc
- Freifelder D, (2008). Molecular Biology Jones and Bartlett Publishers USA
- Klug, W.S. & Cummings, M.R.: Concepts of Genetics, Prentice Hall International Inc.
- Powar,C.B.& Daginawala, H.F.: General Microbiology Vol.1, Himalaya Publishing House, Bombay

IMB-302 ENVIRONMENTAL MICROBIOLOGY-I

Max. Marks: 50
(Ext.40+Int.10)
Time: 3 Hours

INSTRUCTIONS FOR THE PAPER- SETTERS

● Nine questions of equal marks should be set.
● Question 1 consisting of number of short answer type questions (having no internal choice) spread over the whole syllabus should be compulsory.
● Eight questions, two questions from each unit (I, II, III, IV) should be set.

INSTRUCTIONS FOR THE CANDIDATES

● Candidates will be required to attempt five questions in all, selecting one question from each unit (I, II, III, IV) and the compulsory question 1.
● All questions will carry equal marks

UNIT-I

Soil Microbiology:

Soil as dynamic ecosystem, Physical characteristics of soil, Microbial flora of soil, Interaction among soil microorganism (Neutralism, commensalism, mutualism, antagonism, competition, parasitism and predation).

UNIT-II

Biogeochemical cycles:

Factors affecting soil microflora (moisture content, oxygen content, pH, temperature). Biogeochemical cycles (carbon, nitrogen, sulphur, phosphorus, magnesium and iron cycle)

UNIT-III

Air Microbiology:

Distribution of microorganism in Air, Out door and indoor microflora, Allergic disorders by air microflora, Collection and enumeration of microflora of air (Liquid and solid impingement devices)

UNIT-IV

Water Microbiology:

Type of water (atmospheric, surface and stored), the aquatic environment (temperature, light, pressure, pH, turbidity & inorganic and organic constituents), Microflora of aquatic environment (freshwater & marine microbiology)

Reference Books:

Rana S.V.S.: Environmental Biotechnology
P.D. Sharma: Microbiology
Dubey & Maheshwari: A text book of Microbiology
Atlas & Bartha: Microbial ecology- Fundaments & applications
Coyne, MS: Soil Microbiology: An Exploratory Approach, Delimer

B.Sc.-IVTH SEMESTER (INDUSTRIAL MICROBIOLOGY)

IMB-401 FOOD MICROBIOLOGY

Max. Marks: 50
(Ext.40+Int.10)
Time: 3 Hours

INSTRUCTIONS FOR THE PAPER- SETTERS

● Nine questions of equal marks should be set.
● Question 1 consisting of number of short answer type questions (having no internal choice) spread over the whole syllabus should be compulsory.
● Eight questions, two questions from each unit (I, II, III, IV) should be set.

INSTRUCTIONS FOR THE CANDIDATES

● Candidates will be required to attempt five questions in all, selecting one question from each unit (I, II, III, IV) and the compulsory question 1.
● All questions will carry equal marks

UNIT-I

Food Spoilage:

Microbes in food, Extrinsic and intrinsic factors affecting microbial growth in foods, Microbial spoilage of foods (General account).Microbial spoilage of specific food- Milk & milk products, Fruits & vegetables, Cereals & cereal products, Meat & meat products, Canned foods

UNIT-II

Food Preservation Methods:

Aseptic handling, Use of temperature, Dehydration, Lyophilization, Osmotic pressure, Radiations Canning , Chemical preservatives (salt and sugars, organic acids, propylene oxide, wood smoke and antibiotics)

UNIT-III

Food Borne Diseases:

Food poisoning (Food intoxication & food infections), Bacterial food poisonings (botulism & *Staphylococcus*), Fungal food poisoning (*Aspergillus* & *Penicillium*)

UNIT-IV

Microbiological Production of Food:

Fermented food, Fermented dairy products (yoghurt, butter milk & cheese), Fermented bakery products (bread), Fermented beverages (beer and wine), Single cell proteins, Probiotics & Prebiotics

Reference Books:

Frazier: Food Microbiology
Adams & Moss: Food Microbiology
James M Jay: Food Microbiology
Pelczar, Reid & Chan: Microbiology

IMB-402 ENVIRONMENTAL MICROBIOLOGY-II

Max. Marks: 50
(Ext.40+Int.10)
Time: 3 Hours

INSTRUCTIONS FOR THE PAPER- SETTERS

● Nine questions of equal marks should be set.
● Question 1 consisting of number of short answer type questions (having no internal choice) spread over the whole syllabus should be compulsory.
● Eight questions, two questions from each unit (I, II, III, IV) should be set.

INSTRUCTIONS FOR THE CANDIDATES

● Candidates will be required to attempt five questions in all, selecting one question from each unit (I, II, III, IV) and the compulsory question 1.
● All questions will carry equal marks

UNIT-I

Microbiology of Domestic & Waste water:

Sewage/ waste water (physical, chemical & microbiological characteristics) BOD and COD, Water treatment (primary treatment, secondary treatment, tertiary treatment, water disinfection by chlorination.

UNIT-II

Water and disease transmission

Water pollution, Brief account of water borne diseases, Water quality assays and public health (Standard plate count, most probable number procedure, membrane filter method), Coliforms as indicator organisms.

UNIT-III

Solid waste disposal:

Solid processing (landfills, composting & anaerobic sludge digestion), effect on public health and microbial pathogens in municipal solid waste, Green house gases.

UNIT-IV

Biodegradation of Environmental pollutants:

Alkyl benzyl sulphonates, degradation of Oil spills. Role of methanotrophic bacteria, methanogens in bio-degradation of toxic chemicals.

Reference Books:

P.D. Sharma: Microbiology
R.C Dubey: A text book of Biotechnology
Atlas & Bartha: Microbial ecology Fundaments & applications
Tortora & Funke: Microbiology
Coyne, MS: Soil Microbiology: An Exploratory Approach, Delimer

IMB-403 PRACTICAL M.M.90

Time 6 hrs

List of practicals based on theory papers (IMB 301, 302, 401, 402) of Semesters IIIrd and IVth

SEMESTER-III

1. Estimation of DNA.
2. Estimation of RNA.
3. Effect of atmospheric oxygen (air) on growth of bacteria.
4. Isolation and Identification of Microorganisms from spoiled food (Breads, fruits, vegetable & cake).
5. Demonstration of mushroom production (White button mushroom).
6. Study of indoor and outdoor microflora.
7. Isolation of microorganisms from sewage water.

SEMESTER-IVth

1. To study Litmus milk reactions.
2. Methylene blue reductase test.
3. Isolation of *Lactobacilli* and *Streptococci* from Curd.
4. Production of sauerkraut.
5. Detection of coliforms in water by multiple tubes fermentation test- Presumptive, confirmed and completed test.
6. IMVIC test for coliform bacteria.
7. Determination of BOD of water.
8. Determination of COD of water.

B.Sc.-VTH SEMESTER (INDUSTRIAL MICROBIOLOGY)

IMB-501 AGRICULTURAL MICROBIOLOGY

Max. Marks: 50
(Ext.40+Int.10)
Time: 3 Hours

INSTRUCTIONS FOR THE PAPER- SETTERS

● Nine questions of equal marks should be set.

● Question 1 consisting of number of short answer type questions (having no internal choice) spread over the whole syllabus should be compulsory.

● Eight questions, two questions from each unit (I, II, III, IV) should be set.

INSTRUCTIONS FOR THE CANDIDATES

● Candidates will be required to attempt five questions in all, selecting one question from each unit (I, II, III, IV) and the compulsory question 1.

● All questions will carry equal marks

UNIT-I

Diversity of soil microorganisms. Microbe: microbe interactions, Microbe: plant/animal interactions. Soil enzymes properties.

Major soil borne diseases of plants and their transmission.

Fungi as saprotrophs and Substrate succession (Hudson, Garrett & Deacon concepts).

UNIT-II

Biodegradation of cellulose, hemicellulose, lignin and pectin.

Biodegradation of pesticides and biodeterioration of useful products.

UNIT-III

Major types of symptoms, Koch's postulates, mode of infection, classification of plant diseases.

Disease cycle and control of following diseases caused by viruses, bacteria and fungi (White rust of crucifers, red rot of sugarcane, potato blights, citrus canker, bacterial blight of paddy and tobacco mosaic virus).

UNIT-IV

Principle of biological control, mechanism of action of biocontrol agents.

Classification and advantages of biopesticides

Major commercial biopesticides based on fungi, bacteria and viruses (in brief).

Text and Reference Books:

Mehrotra, R.S.and Aggarwal, A. Plant Pathology, Tata McGrawHill,`New Delhi

Coyne, M.Soil Microbiology; An Exploratory Approach, Delmar.

Whipps, J.M and Lumsden, R.D. Biotechnology of Fungi for Improving Plant Growth. Cambridge University Press.

IMB-502 FERMENTATION TECHNOLOGY & IPR

Max. Marks: 50
(Ext.40+Int.10)
Time: 3 Hours

INSTRUCTIONS FOR THE PAPER- SETTERS

● Nine questions of equal marks should be set.
● Question 1 consisting of number of short answer type questions (having no internal choice) spread over the whole syllabus should be compulsory.
● Eight questions, two questions from each unit (I, II, III, IV) should be set.

INSTRUCTIONS FOR THE CANDIDATES

● Candidates will be required to attempt five questions in all, selecting one question from each unit (I, II, III, IV) and the compulsory question 1.
● All questions will carry equal marks

UNIT-I

History and Scope of fermentation technology.
Industrial Microorganisms: Desirable characteristics and selection of industrial Microorganism, Isolation of suitable industrial microorganisms from natural habitat, Culture Collection Centres, Strain improvement and maintenance.

UNIT-II

Biology of industrial Microorganisms: Cell growth, Microbial growth kinetics, factors affecting growth, Basic nutrition, Primary metabolism, Secondary Metabolism, Regulation of Metabolism.
Fermentation Media: Media composition, Media sterilization, Contamination, Inoculum media, Media economics, Screening for fermentation media

UNIT-III

Fermentor design: Basic design of Fermentor, Construction of bioreactors,, Requirements of aseptic operation,
Aeration and mixing, Type of Fermentors stirrer tank bubble column and airlift, Instrumentation and control.
Scale up study: Product recovery, scale up of fermentation, Down-stream processing, Product development, Regulation and safety.

UNIT-IV

Introduction to Intellectual Property: Intellectual property and IPR, patent, copyrights, geographical indications, trademarks, trade secret, Industrial designs. Patent law, Legislations covering IPR's in India. Patentable and non-patentable items.

Text and Reference Books:

Waites M.J. et al.: Industrial Microbiology, Blackwell Science Ltd.
Stanburry et al. (2011). Principle of fermentation technology Pergamon Press.
Singh I. and Kaur B, Patent law and Entrepreneurship, Kalyani Publishers (2006)
Glazer A.N and Nikaido, H.: Microbial Biotechnology, W.N. Freeman and Co.

B.Sc.-VITH SEMESTER (INDUSTRIAL MICROBIOLOGY)

IMB-601 MICROBIAL BIOFERTILIZERS

Max. Marks: 50
(Ext.40+Int.10)
Time: 3 Hours

INSTRUCTIONS FOR THE PAPER- SETTERS

● Nine questions of equal marks should be set.
● Question 1 consisting of number of short answer type questions (having no internal choice) spread over the whole syllabus should be compulsory.
● Eight questions, two questions from each unit (I, II, III, IV) should be set.

INSTRUCTIONS FOR THE CANDIDATES

● Candidates will be required to attempt five questions in all, selecting one question from each unit (I, II, III, IV) and the compulsory question 1.
● All questions will carry equal marks

UNIT-I

Rhizosphere: Rhizosphere concept, R:S values, Mycorhizosphere, Actinorhizae, Significance of rhizosphere microflora, Isolation of rhizosphere microflora.

UNIT-II

Biofertilizers: -General account about the microorganisms used as biofertilizers.
Basic concept of nitrogen fixation process: Site of nitogen fixaion, heterocyst, nitrogenase and biochemistry of nitrogen fixation, physiology of nitrogen fixation in blue green algae.
Mycorrhizal Biofertilizer: - Types of mycorrhizal association, taxonomy, occurrence and distribution, collection of VAM, inoculum production of VAM, phosphorus nutrition.

UNIT-III

Bacterial Biofertilizers: Taxonomy, physiology and mass cultivation of Rhizobium
Frankia, Azospirlluim, Azotobacter and Cyanobacteria.

UNIT-IV

Production and Quality Control in Biofertilizers: 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, storage,culture, carrier, packing, quality control, ISI standards, inoculum requirements, packing, marketing and storage and methods of application.

Text and Reference Books: -

Sperut and Spemt.: Nitrogen Fixation
Alexander, M: Introduction to Soil Microbiology, Wiley, New York.
Atlas & Bartha: Microbial Ecology, Fundamentals and applications. Benjamin/Cummins

IMB-602 MICROBIAL BIOTECHNOLOGY

Max. Marks: 50
(Ext.40+Int.10)
Time: 3 Hours

INSTRUCTIONS FOR THE PAPER- SETTERS

● Nine questions of equal marks should be set.
● Question 1 consisting of number of short answer type questions (having no internal choice) spread over the whole syllabus should be compulsory.
● Eight questions, two questions from each unit (I, II, III, IV) should be set.

INSTRUCTIONS FOR THE CANDIDATES

● Candidates will be required to attempt five questions in all, selecting one question from each unit (I, II, III, IV) and the compulsory question 1.
● All questions will carry equal marks

UNIT-I

Microbial Products: - Application of microbial biotechnology, production of primary and secondary metabolites of industrial significance, A brief discussion about production of industrial products such as
Biofuels: Ethanol, Methane
Alcoholic beverages: Beer, Wine.

UNIT-II

Organic acids: Citric acid, Lactic acid
Antibiotics: Penicillin, Streptomycin
Amino acids: Glutamic acid, Lysine
Enzymes: Protease, Amylase and Lipases

UNIT-III

Bioconversions: A brief account of steroid biotransformation.
Microbial Foods: Single cell proteins.
Biotechnology of mushroom cultivation.
Biogas production

UNIT-IV

Introduction to genetic engineering: Various hosts for molecular cloning, restriction endonucleases and other commonly used enzymes & their applications. Selection and screening of the recombinant clones (Southern and northern Blotting).

Text and Reference Books:

Waites M.J. et al.: Industrial Microbiology, Blackwell Science Ltd.
Casida L.E: Industrial Microbiology, New Age International Publishers, New Delhi
Prescott and Dunn's.: Industrial Microbiology, AVI Publishing Co. USA
Glazer A.N and Nikaido H.: Microbial Biotechnology,W.N. Freeman and Co.
Primrose SB and Twyman RM, Principles of Gene Manipulation and Genomics , Blackwell Publishing (2006).

IMB-603 PRACTICAL **MM. 90**
Time 6 hrs

List of practicals based on theory papers (IMB 501, 502, 601, 602) of Semesters Vth & VIth

VTH SEMESTER

1. Isolation of antibiotic producing microorganisms from soil.
2. Study and identification of bacterial and fungal diseases of plants such as:
   Citrus canker; red rot of sugarcane; white rust of crucifers; tobacco mosaic virus.
3. Isolation of a plant pathogenic bacterium or fungus from diseased tissues.
4. Demonstration of microbial antagonism in the laboratory.
5. Demonstration of cellulolytic activity by a mold/ bacterium in the lab (plate assay).
6. Study of some common molds and bacteria from soil.

VITH SEMESTER

1. Production of wine from grapes in the laboratory.
2. Isolation of Azotobacter from soil.
3. Isolation of Rhizobium from legume root nodules.
4. Preparation of biofertilizer from Azotobacter and Rhizobium in the laboratory.
5. Culturing and identification of yeast in the lab.
6. Demonstration of amylolytic and proteolytic activity by mold/bacterium.
7. Demonstration of antibiotic sensitivity test.