B.SC MICROBIOLOGY SYLLABUS

B.SC - FIRST YEAR (SEMESTER -I)

The examination shall comprise of two theory papers, one in each semester and one practical in each Semester. Each theory paper will be of 3 Hrs. duration and carry 80 marks. The internal assessment will carry 20 marks. The practical examination will be of atleast 4 hours duration in one day and shall carry 50 marks.The following syllabi is prescribed on the basis of six lectures per week and 6 practical periods per batch per week. Each theory paper has been divided into 6 units. There shall be one question on every unit with internal choice for each of 12 marks & one compulsory question covering all the syllabus of Semester-I (8 marks).

SEMESTER- I

Fundamentals of Microbiology and Microbial Physiology

UNIT I : A. History of Microbiology:

a. Discovery of microscope- Leeuenhoek, Robert Hook.

b. Controversy over Spontaneous, generation, Contributions of Aristotle, Redi, Needham, Schulze and Schwan, Schroder& Vandusch, Louis Pasteur, John Tyndall.

c. Germ theory of diseases- Joseph Lister, Koch postulates,River postulates.

d. Pure culture concept- Joseph Lister, Koch, DeBarry.
B. Scope of Microbiology as a modern Science.

a. Industrial Microbiology, Environmental Microbiology,Medical microbiology, Food and Dairy Microbiology, Genetic engineering and Biotechnology.
b. Different types of Microorganisms (outline)
c. Distribution of Microrganisms in nature, and their beneficial and harmful activities.
UNIT II : A. Microscopy:

i) Definitions- Magnification, Resolving power, numerical aperture, focal length, Working Distance Aberrations,

ii) Objectives- Functions, low and high power objectives, Oil Immersion objectives,

iii) Ocular- Functions, Huygenian, Ramscdenl Hyperplane and compensating.

iv) Condensor- Functions, Abbe, parabolic
v) Iris diaphragm
B. Principles, construction, ray diagram and applications:

i) Compound Microscope,
ii) Darkfield Microscope,
iii) Phase Constrast microscope
iv) Fluorescent Microscope,
v) Electron Microscope.
C. Staining:
Dyes and Staining,- Definations, auxochromes, Chro-
mophore, mordents, chromogens, Leucostains, Principles and Methods of the following techniques:
i. Simple staining
ii. Differential- Gram, Acid fast,
iii. Structural-Endospore, flagella.
UNIT III : Classification of Microorganisms:
A. Bacterial Classification:i. Definition- Taxonomy, Classification, Taxonomic rank,Identification, Nomenclature,
ii. Bergy's manual of systematic Bacteriology, General char-acteristics enlisting all partswith major characters and examples(Vol.I to IV)
iii. Methods of Classification:

B.SC MICROBIOLOGY SYLLABUS

Intuitive,Numerical taxanomy,Genetic relatedness,
B. General characteristics of :

i. Viruses,
ii. Fungi (Including yeasts)
iii. Actinomycetes,
iv. Mycoplasma and Rickettsia

v. Algae

UNIT IV: Structural Organization of Bacteria:
a) Concept of prokaryoes and Eukaryotes; Comparison and
Differences.
b) Typical Bacterial cell

c) Shape, Size and Arrangement of Bacteria
d) Structure and functions of following:i. Capsule and slime layer

ii. Cell wall- Gram positive and Gram negative bacteria.

iii. Cytoplasmic membrane- fluid mosaic model

iv. Flagella- Arrangement, Mechanism of flagellar movement.

v. Pili-Arrangement and function

vi. Ribosomes- Procaryotic and Eucaryotic

vii. Plasmid- Definition, General characters, classes

viii. Bacterial chromosome

ix. Endospors- Structure and arrangements.

UNITV: A. Microbial Nutrition:

i. Basic Nutritional Requirements: Soures C, N, O, P, S,Energy, Macronutrients, Growth factors, water etc.

ii. Media; Synthetic, Nonsynthetic , Liquid and Solid, Semisolid, Differential, Enriched, Selective media. Role of beef extract, yeast extract, peptone, agar and gelatin.

iii. Determination of nutritional requirements: Auxanographic technique, Replica plating technique.

iv. Nutritional classification; on the basis of source of carbon and energy

B. Pure Culture Techniques:

i. Definition- Pure and Mixed culture:

ii. Methods of Isolation of Pure culture, Serial dilution, Streak plate, pour plate, spread plate, Enrichment culture, and single cell isolation method.

iii. Methods of preservation of pure culture- Agar slants, Saline suspension, Overlaying with oil, Freeze drying.

UNIT VI: Reproduction and Growth of Bacteria:

a) Reproduction: Binary fission, Budding, Fragmentation,Sporulation.

b) Growth rate and generation time- Definition, mathematical expression.

c) Bacterial growth curve

d) Synchronous culture: Definition, methods of isolation

(Helmstetter- Cummings Technique) and application.

e) Continuous culture: Definition, method (chemostat, and Turbidostat Techniques) and Application.

f) Measurement of Growth:

i. Cell number measurement- Breed method, Colony count

ii. Cell mass measurement- Dry weight and Turbidity measurement.

iii. Cell activity measurement- Biochemical activity

iv. Factors influencing bacterial Growth- Temperature, pH,Gaseous.

Microbiology Practicals:

1. Microscopy:

i. Different parts of compound microscope

ii. Use and Care of compound microscope

2. Construction, operation and utility of Laboratory equipments;

i. Autoclave

ii. Hot air oven

iii. Bacteriological Incubator

iv. pH meter

v. Centrifuge

vi. Colorimeter/ spectrophotometer

vii. Anaerobic Jar

viii. Bacteriological filters

ix. Laminar air flow

x. Air sampler

xi. BOD incubator

3. Preparation of Nutrient media:

i. Nutrient broth

ii. Nutrient agar

iii. PDA

4. Demonstration of bacteria from; Soil, Water, Air, Milk, Skin

5. Microscopic Examination of bacteria

i. Monochrome staining

ii. Gram's staining

iii. Acid fast staining

iv. Negative staining

v. Endospore staining

6. Hanging drop technique to demonstrate Bacterial motility

7. Measurement of size of bacteria

8. Cultivation and Demonstration of

i. Yeast- Saccharomyces cereviceae, Candida albicans.

ii. Molds- Mucor, Rhizopus, Penicillium, Aspergillus

9. Demonstration of

a) Protozoa-E.histolitica,Paramoeciu.

10. Isolation of Pure culture by

i) Streak plate ii) Pour plateiii) Spread plate .

11. Enumaration of bacteria in the given sample by standard plate count

12. Demonstration of Replica plate technique / auxanography.

Distribution of Marks

Ist Semester Microbiology Practicals

B.SC MICROBIOLOGY SYLLABUS

1. Major Experiment - 15 Marks

2. Minor Experiment - 10 Marks

3. Viva –Voce - 10 Marks

4. Spotting - 10 Marks

5. Laboratory Journal - 05 Marks

Total 50 Marks

List of Books Recommended For 1S and 2S Microbiology

1) General Microbiology : Stainer, Roger et. al.

2) General Virology : Luria, S.E.

3) Handbook of Genetics : Esser, K.

4) Fundamentals Principles of : A.J. Salle.

bacteriology

5) Microbiology : Pelczar, Chan, Krieg.(TMH)

6) Fundamental of Microbiology : Frobisher

7) General Microbiology Vol. I & II : Power & Daginawala.

(Himalaya Publication)

8) Zinsser Microbiology : W.K. Joklik

9) General Microbiology : W.G. Walter

10) Elements of Microbiology : M.J. Pelozar & E.C.S. Chan

11) Essays in Microbiology : J.N. Norris & M.H.

Richmond

12) Microbiology : L. Mckane & J. Kandel

(Essentials & Applications)

13) Basic Microbiolgy : Volk

14) Chemical Microbiology : Rose

15) Microbiology : Paul A. Ketchum.

(Introduction to Health of Professional)

16) Molecular Biology of the gene : J.D. Watson.

17) Molecular Genetics : Taylor J.H.

18) Gene Expression Vol. I, II III, IV : Lewin

19) Elementary Microbiology : Modi (Akta Prakashan) Vol. I & II

20) Basic experimental : Ronald M., Atlas, & Alfred Microbiology Miller E.Brown, Kenneth

W. Dobra, Lionas (1986)Prentice Hall - 316 PP)

21) General Microbiology : Robert F.Boyd (1984) times mirror / mosby college, Pub.

22) Fundamentals of Biostatistics : Satguru Prasad, Emkay(Biometry) Publications, Delhi.

23) Text Book of Microbiology : Dubey & Maheshwari(S.Chand, Publication)

24) Introduction to Computer by : Shrivastav (Macmillan)

25) Fundamentals of Computer : Rajaraman (PHL)

26) Office automotion : Bajaj (Macmillan)

27) Computer made simple : Taxilli.List of Books For PRACTICALS

1) Microbes in Action : Seely, Wander Mark

Tarporewala, Bombay

2) A Mannual of Microbiology : A.J. Salle.

Methods

3) Medical Microbiology Vol. II : R. Cruickshank

4) Microbiology Methods : Collins

5) Difco mannual

6) Bacteriological Techniques : F.J.Baker

7) Introduction to Microbial : Gunasekaran

Techniques

8) Biochemical methods : Sadashivam & Manickam

9) Laboratory Fundamentals of : Alcamo, I.E., Jones and Microbiolog.

B.SC FIRST YEAR (SEMESTER-ll)

2S Indsutrial Microbiology Fermentation Equipment & Techniques

UNIT-I : 1. Basic Fermentor design:Parts and their functions of Conventionalstirred tank fermentor

2. Fermentor Configurations

(a) Tubular Fermentor

(b) Fluidised bed fermentor

(c) Bubble Cap fermentor

UNIT-II: Instrumentation and control:

a) Basic concepts of control systems

b) Designs and working principles of instruments and systems for control of – temperature, pressure, foam,pH, redox potential, oxygen tension (DO), exit gas analysis, medium composition analysis

UNIT-III: Instrumentation in Industrial Laboratory :

(1) Principle , Working and Applications of Instruments in Industry:

a. pH meter

b. Colorimeter/Spectrophotometer

c. Polarimeter

d. Chromatography

(2) Computerisation in Industres-

(i) Introduction

(ii) Applications of computers in fermentation technology – data logging, data analysis, process control

(iii) Practical implementation of basic computer control strategies for enzyme production.

UNIT-IV: Methods of recovery and purification of fermentation products

a) Precipitation, filtration and centrifugation

b) Cell disruption

c) Liquid-liquid extraction and solvent recovery

e) Chromatography – adsorption, ion exchange, gel, affinity.

f) Distillation

g) Cr ystallisation

UNIT-V : Detection and Assay of f ermentation products-

a) Physical and Chemical assays

b) Biological assay of Vitamins andAntibiotics

UNIT-VI : Fermentation Economics
Fermentation economics with respect to raw material, production process, recover y process and product economics,product patenting

Practicals :- Semester-II

1. Primary screening of:a) Amylase producers b) Protease producers c) Antibiotic producers
2. Demonstration of antimicrobial activity of actinomycetes by the Giant Colony technique

3. Separation of amino acids, sugars, organic acids by paper and thin layer chromatography.

4. Demonstration of basic fermentation process :- Yoghurt, bread and idli.

5. Industrial Study tour

The distribution of marks in practical shall be as follows :

A) Two short experiment -20 marks (10 Each)

B) One long experiment -15 marks

C) Viva voce -10 marks

D) Industrial Study Tour Report -03 marks

E) Practical Record -02 marks

Total -50 marks

List of Reference Books :-

1. Quantitative Bioassay – D. Hancroft, T. Hector and F. Rowell. John

Wiley & Sons for Analytical Chemistry by Opening Learning (ACOL)series.

2. Microbial Technology, Volumes I & II – H. J. Peppler. AcademicPress

3. Isolation Methods for Microbiologists, Volumes I & II – Gibbs andShapton, Academic Press.
4. Industrial Microbiology by A.H.Patel
5. Industrial Microbiology – L. E. Casida Jr. John Wiley and Sons.
6. Experimental Microbiology – R. J. Patel and K. R. Patel, AdityaPublishers, Ahmedabad
7. A Compendium of Good Practices in Biotechnology – Biotol Series
8. Principles of Fermentation Technology – Stanbury and Whitaker.Pergamon Press.

9. General Microbiology – R. Y. Stanier and other s. Macmillan Press Ltd.

27. BIOTECHNOLOGY (Regular / Vocational)

2S-BIOTECHNOLOGY(Microbiology)

UNIT I : Scope and importance of Microbiology:- Size, shape and arrangement of bacteria, Typical bacterial cell.

Microscopy : Resolving power, Numerical aperture, Optical,TEM and SEM.

Staining techniques : Simple, Gram, Negative, Acid fast andEndospore staining.

Sterilization methods : Physical and chemical.

UNIT II : Microbial cell Structure:

Cell wall, Cytoplasmic membrane, and flagella.Nutritional classification of microorganisms on the basis of carbon and energy source (Autotrophs, Hetrotrophs, Phototrophs and chemotrophs)Classification of bacteria according to Bergey's Manual of Systematic Bacteriology Microbes in extreme environment (Thermophiles, Halophiles,and Methanogens)
UNIT III: Microbial Metabolism:Energy production by aerobic and anaerobic processes,

(Glycolysis, Kreb's cycle, Electron transport chain, Fermentation,and Photosynthesis)
Microbial Associations: Symbiosis (Rhizobium, Mycorrhiza),and Antibiosis,Nitrogen fixing microorganisms in agriculture : (Azotobacter,Rhizobium, Cyanobacteria)
UNIT IV: Industrially useful Microorganisms:Fermentation industry : (Saccharomyces cereviceae, and Lactobacillus)
Antibiotic Industry : (Penicillum and Streptomyces)Enzyme Industry : (Aspergillus)

Food Industry: Cheese production (Penicillun roquefortii)

Biofertilizers : (Azotobacter, Rhizobium, and PSB)Single cell protein : (spirullina)
UNITV:Pathogenic microorganisms:Elementary knowledge of diseases caused by bacteria (Ty

phoid, Tuberculosis, Cholera), viruses (AIDS, Polio, Hepatitis) and fungi (Dermatophytes)
Mycoplasma: structure, pathogenicity and laboratory diagnosis.Host parasite relationship.Host defense mechanisms against microorganisms (Non specific and specific)

UNIT VI: Basic techniques in Microbiology: Spectroscopy (Beer Lambert's law, Components, working and applications of Colorimeter, and UV- VIS Spectrophotometer)Chromatography; (Paper, and Thin layer) Electrophoresis;(Paper and Gel)
Role of Radioactive isotopes in Biotechnology

Practicals

1. Cleaning of glasswares, preparation of media, cotton plugging &sterlization.

2. Isolation of microbes from different environments (water, soil, air,human body and plants)
3. Enumeration of microorganisms by Standard plate count.
4. Identification of isolated bacteria : (Simple, Gram , Endospore, and Negative staining)
5. Biochemical characterization of micro organisms (Sugar fermenta-

tion and IMViC test)

6. Growth curve of microorganisms.

7. Antibiotic sensitivity of microbes by disc diffusion method.

8. One step growth of bacteriophage.

9. Alcoholic & mixed-acid fermentation.

10. Isolation of microorganisms from leaf.

11. Isolation of Rhizobium from root nodules.

12. Study tour / Visit to laboratories /IndustriesDistribution of Practical Marks :-

(1) Major Experiment 12 Marks

(2) Minor Experiment 08 Marks

(3) Spotting 10 Marks

(4) Viva 10 Marks

(5) Practical Record 05 Marks

(6) Study Tour/Visit 05 Marks

Total 50 Marks

Reference Books (For Sem-II)

1) Microbiology-Pelczar

2) General Microbiology – Stanier

3) General Microbiology, Vol.I and II-Powar and Daginawala

4) General Microbiology- Sulia

5) Textbook of Microbiology-Ananthanarayan

6) Text book of Microbiology- Dubey and Maheshwari

7) Elementary Microbiology Vol. I and II – H.A. Modi

8) Stains and staining Procedures-Desai and Desai

9) Experimental Microbiology-Rakesh Patel

10) Experimental Microbiology-Dubey and Maheshwari

B.SC SECOND YEAR (SEMESTER- lll)

Molecular Biology and Genetic Engineering

Unit I: Gene multiplication and expression

a) Concept of gene – Definition of Gene, Muton, recon,cistron, gene within gene, split gene.
b) Replication of DNA- Modes of replication, (Conservative, Semiconservative and Dispersive).Experiment of Meselson and Stahl to proveemiconservative mode of replication. Mechanism of replication with enzymes involved, models of replication: Knife and fork, rolling circle.

c) DNA repair mechanisms- light and dark.

d) Genetic code- Characteristic features of genetic code.

e) Out line of Protein synthesis- Transcription and

Translation.

Unit II: Gene : Regulation and Mutation
a) Gene regulation Mechanisms - lac operon , trpoperon.
b) Mutation- Definition & types of mutations - Basepair substitution, frame-shift, point, missense,nonsense & silent mutations, Random Vs. Directedmutation,
Rate of mutation, Effect of Mutation on Phenotype,

c) Genetic suppressions:- Intragenic (Intracodon suppression, reading frame Suppression) and extragenic suppression (Non sense and Missense Suppression).
d) Molecular basis of spontaneous and inducedmutations - Spontaneous mutation (Tautomerism),Induced Mutation (Chemical Mutagens) e.g. Base analogues, Nitrous Oxide, Hydroxylamine, Acridine dyes, Physical mutagens e.g. X-rays, Gamma rays,U.V. light.
Unit III: Genetic recombination Mechanism of recombination :Breakage and reunion, breakage and copying, completecopy choice.Transfer of genetic material in prokaryotes:

a) Transformation: Experiment of Griffith. Avery,MacLeod and McCarty experiment to prove GeneticTransformation. Mechanism ofTransformation.
b) Transduction: Experiment of Zinder and Lederberg.General mechanism of Transduction. Types of Transduction: Generalized and Restricted, Completeand Abortive, Low Frequency and High FrequencyTransduction. Comparison between Transformationand Transduction.

c) Conjugation: Experiment of Lederberg and Tatum,Experiment of Davis, Nature and function of FPlasmid. Hfr formation. Various Mating types.Mechanism of conjugation: i)F+ x F- ii) Hfr X F . F'Plasmid and Sexduction.

Unit IV: Tools of Genetic Engineering:

a) Introduction to basic technique of genetic engineering.
b) Enzymes for splicing: Restriction endonucleases.
c) Range of DNA manipulating enzymes: Nucleases,Ligases, Polymerases, DNA modifying enzymes,Topoisomerases.
d) Vectors: Ideal characters and types: Plasmid, Cosmid and Bacteriophage.

Unit V: Techniques of genetic engineering:

a) Isolation of Genomic and Plasmid DNA from bacteria,Analysis of DNA fragment size by agarose gelelectrophoresis.
b) Introducing l??DNA into host cell, competent cells,transduction of cells and identification of transformedcell (e.g. Antibiotic resistance gene in Plasmid)Selection of clones: Direct (colony hybridization) and Indirect method (southern blotting).

c) Definition, method and applications of gene mapping,DNA sequencing (by microarray) and PCR.
d) Introduction to expression of clonedgenes.Construction of gene library. Cells for cloning.Unit VI : Applications of Genetic Engineering:

a) Health care biotechnology: - Recombinant Insulin,Recombinant Hepatitis vaccine, Gene therapy, DNA probes in diagnosis.
b) Agricultural biotechnology: - Transgenic plants.
c) Environmental biotechnology: - Genetically engineered microbes for pollution control.
d) Industrial biotechnology: - Strain improvement for industrial product.

Practicals
1. Isolation of genomic DNA from bacteria.
2. Demonstration of agarose gel electrophoresis.
3. Genetic recombination in bacteria.
a) Transformation b) Conjugation
4. Estimation of DNA and RNA.
5. Isolation of fermentative mutant using physical mutagen (U.V.radiation).
6. Detection of streptomycin (antibiotic resistant mutant) by replicaplating technique.

7. Transformation of plasmid DNA using CaCl2

Distribution of marks
III Semester Microbiology practicals

1. Major experiment - 15 Marks

2. Minor experiment - 10 Marks

3. Viva-Voce - 10 Marks

4. Spotting - 10 Marks

5. Laboratory journal - 05 Marks

TOTAL 50 Marks

Books Recommended For SEM- III:-1. Recombinant DNA:-James. D. Watson, John. Tooze, David.Kutz

2 Introduction to Genetic Engineering: - Nicholas

3. An Introduction to Genetic Analysis: - David Suzuki, Anthony.Griffths

4. Biochemistry: - Lehninger

5 General Microbiology. Vol 1& II. : - Powar & Daginawala

6 Molecular Biology of the Cell: - J. D. Watson, D. Bray

7 The DNA Story: - J. D. Watson

8 Genetics of Prokaryotes: - Srivastava et.al

9 Genes: - Pramod Kumar

10. Genetic Engineering and its Applications - Joshi P.

11 Gene Transfer and Expreesion a Laboratory Manual: - MichaelKriegler

12 Concept in biotechnology: - D. Balasubramanium

13 Essential Genetics: - Daniel. Hartl.

PRACTICALS :1. Microbes in Action : Saley, Wandermark, Tarporewala, Bombay.

2. Medical Microbiology Vol.II : R.Cruickshank.

3. A mannual of Microbiological : A.J.Salle. Methods.
4. Microbiological Methods : Collins
5. Difco mannual

B.SC SECOND YEAR (SEMESTER-IV)

MEDICAL MICROBIOLOGY

The examination shall comprise of two theory papers, one in each semester and one practical in each semester. Each theory paperwill be of 3 hours duration and carry 80 marks. The internal assessmentwill carry 20 marks. The practical examination will be of at least 4 hoursduration in one day and shall carry 50 marks.The following syllabus is prescribed on the basis of six lecturesper week and 6 practical periods per batch per week. Each theory paper has been divided into 6 units. There shall be one question on every unitwith internal choice for each of 12 marks & one compulsory questio covering all the syllabus of semester-IV (8 Marks).

B SC FINAL YEAR(SEMISTER -IV)

Medical Microbiology

Unit I : Epidemiology

a) Definition, classification and scope of epidemiology.

b) Infection- Types of infection c) Normal flora of human body.

d) Infection process, pathogenicity and virulence, Microbial virulence factors: toxins, enzymes
e) Control of communicable diseases.
Unit II : Immunology
a) Organs and cells of immune system
b) General Nonspecific factors- Physiological barriers,Natural cellular factors, Natural humoral factors.

c) Immunity- Definition and classification
d) Innate immunity- Species, Racial, Individual, Herd immunity.

e) Acquired immunity- Active and passive immunity,

f) Immune response and hypersensitivity

Unit III : Serology
a) Antigens- Definition, types and factors determiningantigenicity, Bacterial antigens.
b) Antibodies- Definition, Structure, classification,Properties and differences,

monoclonal antibodies.
c) Antigen Antibody reactions- Agglutination,

Precipitation, Complement fixation test, ELISA and

RIA.Unit IV : Pathogenic Bacteria
Study of following bacteria with respect to their morphology, cultural and biochemical properties,antigenic structure, pathogenesis, laboratory diagnosis and prophylaxis:
a) Staphylococcus aureus.
b) Clostridium tetani.
c) Salmonella typhi.
d) Mycobacterium tuberculosis.
e) Treponema pallidum.
f) Vibrio cholerae.
Unit V : Other Pathogenic organisms

a) Viruses- AIDS , Hepatitis, Polio, Rabies.

b) Rickettsias- R. prowazekii

c) Protozoa- E. histolytica

d) Fungi-C. albicans

Unit VI : Antimicrobial chemotherapy

a) Ideal characters of chemotherapeutic agents

b) Major antimicrobial agents and its clinical uses:

i) Antibacterial agents: Rifampicin,

Chloramphenicol, Streptomycin ann

Ciprofloxacin

ii) Antiviral agents: Azidothymidine, Amantadine.

iii) Antifungal agents: Griseofulvin, Amphotericin B,Imidazoles.

c) Basic mechanism of antibiotic action
d) Antimicrobial susceptibility testing: Introduction to CLSI (NCCLS), MIC.Disc diffusion, agar dilution, broth dilution (macro and micro).

Practicals
1. Studies of microbial enzymes and biochemical tests:a) Urease b) Coagulase c) Oxidase d) IMViC e) Sugar fermentation
2. Isolation and Identification of following bacteria:
a) Staphylococcus aureus b) E. coli c) Salmonella typhi
3. Serological Tests:a) Widal b) Pregnancy test c) VDRL

4. Antibiotic sensitivity by Disc diffusion method.
5. Clinical investigations:
a) Blood grouping and Cross matching
b) TLC, DLC
c) Hemoglobin estimation
d) Test for carbohydrates and Proteins in Urine
e) Blood glucose and cholesterol
6. Cultural examination of Urine, Blood, Sputum, Stool, Pus, CSF.
7. Isolation of pathogenic fungi

8. Study Tour.

Distribution of marks

IV Semester Microbiology practicals

1. Major experiment - 15 Marks

2. Minor experiment - 10 Marks

3. Viva-Voce - 10 Marks

4. Spotting - 10 Marks

5. Laboratory journal - 05 Marks

TOTAL : 50 Marks

uestion covering all the syllabus of semester V(8 marks).

B.SC FINAL YEAR (SEMESTER - VI)

(Environmental Microbiology and Bioinstrumentation)

Unit-I: Microbial Associations and Air Microbiology

A. Microbial Associations : Definition and examples of positive(Mutualism, Commensalism, Synergism),negative (Antagonism,Competition, Parasitism) and neutral association.

b) Control of plankton problems

c) Eutrophication and its control.

Unit IV : Assessment of Water Quality and Treatment Bacteriological analysis of water:

i) Significance of bacteriological analysis of water.

ii) Collection and handling of water sample from various sources.
iii) Indicators of excretal pollution.
iv) Multiple tube dilution technique, MPN.
v) IMViC classification of coliform.
vi) Membrane filter technique for coliform and faecalStreptococci.

vii) ICMR and WHO Bacteriological standards of drinkingwater.
Unit V : A) Water Treatment
a) Self purification of water : Various zones and factorsresponsible for self purification.

b) Treatment of water : Aeration, Coagulation,Flocculation, Sedimentation and Filtration.c) Slow and Rapid sand filters : Construction, mechanism of filtration, differences.d) Methods of chlorination : Plain, super chlorination,ammoniachlorine treatment, Break-point chlorination
B)Waste Water Treatment
a) Aims of sewage treatment, composition of sewage.
b) Muncipal sewage treatment plant.
c) Preliminary treatment (seiving and Grit chamber)

d) Primary treatment(sedimentation)
e) Secondary treatment (Aerobic)
i) Trickling filter
ii) Activated sludge process
iii) Oxidation pond

f) Anaerobic sludge digestion113 114

B. Air Microbiology

a) The atmosphere and its layers.

b) Different types of microorganisms in air.

c) Techniques for microbiological analysis of air:

i) Solid impingement devices

ii) Liquid impingement devices.

d) Airborne diseases : Etiology, symptoms and prevention.
e) Control of microorganisms in air.

Unit-II : Microbiology of Soil.

a) Microorganisms in soil.

b) Rhizosphere.

c) Decomposition of plant and animal residues in soil.

d) Definition, formation, function and microbiology of humus and compost.

B.SC MICROBIOLOGY SYLLABUS

e) Biological Nitrogen fixation : Type of nitrogen fixing microorganisms, factors affecting and mechanism of symbiotic and non-symbiotic nitrogen fixation. Process of nodulation, nitrogenase complex, recombinant DNAand nitrogen fixation, legume inoculants.

f) Cycles of elements in nature :

i) Carbon cycle : CO2 fixation, organic carbond egradation.

ii) Nitrogen cycle : Proteolysis, amino acid degradation, Nitrification, Denitrification, Degradation of nucleic acids.
iii) Sulphur cycle
Iv) Phosphorus cycle.
v) Biofertilizers, biological pest control.
Unit III : Water Microbiology
a) Planktons : Definition, types, factors affecting growth of planktons, methods of enumeration, beneficial and harmful activities of planktons.

b) Control of plankton problems

c) Eutrophication and its control.

Unit IV : Assessment of Water Quality and Treatment Bacteriological analysis of water:

i) Significance of bacteriological analysis of water.
ii) Collection and handling of water sample from various sources.
iii) Indicators of excretal pollution.
iv) Multiple tube dilution technique, MPN.v) IMViC classification of coliform.

vi) Membrane filter technique for coliform and faecal Streptococci.
vii) ICMR and WHO Bacteriological standards of drinking water.
Unit V : A) Water Treatment

a) Self purification of water : Various zones and factors responsible for self purification.

b) Treatment of water : Aeration, Coagulation,Flocculation, Sedimentation and Filtration.
c) Slow and Rapid sand filters : Construction, mechanism of filtration, differences.
d) Methods of chlorination : Plain, super chlorination,ammoniachlorine treatment, Break-point chlorination B)Waste Water Treatment

a) Aims of sewage treatment, composition of sewage.
b) Muncipal sewage treatment plant.
c) Preliminary treatment (seiving and Grit chamber)

d) Primary treatment(sedimentation)

e) Secondary treatment (Aerobic)

i) Trickling filter

ii) Activated sludge process

iii) Oxidation pond

f) Anaerobic sludge digestion

g) Domestic sewage treatment by septic tank and Imhoff tank.
h) Concept of COD,BOD.
i) Outline of bio-gas production
Unit VI : Bio-Instrumentation
a) Spectroscopy- Definition, Principle, types (UV&IR)& its applications.
b) Electrophoresis- Definition, Principle, types(Paper&Gel) & its applications.
c) Chromatography- Definition, Principle, types(Paper&TLC) & its applications.
d) I sotopic Tracer Techniques - Definition, Principle & applications.
Microbiology Practicals.

B.SC MICROBIOLOGY SYLLABUS

1. Bacteriological analysis of water and Waste Water.

a) Standard plate Count.

b) Multiple tube dilution technique (MPN for Coliform)

i) Presumptive test ii) Confirmatory testiii) Completed test.

c) IMViC test for coliform

d) Multiple tube dilution technique for faecal

strepto cocci.

e) Membrane filter technique for coliforms & faecal streptococci.

f) BOD estimation.

g) Isolation of Bacteriophage from Sewage.

h) Determination of Chlorine demand and residual chlorine.

2. Study of Soil Microbiology

a) Enumeration of Soil microorganisms.

b) Isolation of Azotobacter from Soil.

c) Isolation of Rhizobium from Soil

d) Isolation of Antibiotic producers from soil

3. Effect of Ultra-violet/Filtration on micro-organism present in water

4. Separation of amino acids and sugars by paper chromatography.

Distribution of marks for Microbiology practical Examination:

1. Major Experiment - 15 marks

2. Minor Experiment - 10 Marks

3. Viva Voce - 10 marks

4. Spotting - 10 marks

5. Laboratory Journals - 05 Marks

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Total - 50 marks

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List of Reference Books for 5S Microbiology:

1. Introduction to Soil Microbiology : Alexander Martin

2. Soil Microbiology : Subbaroa N.S.

3. Introduction to environmental Microbiology: Mitchell, Ralph

4. Sewage & Waste treatment : Hammer

5. Water Pollution : Zajic J.E.

6. Water Pollution Microbiology : Mitchell R.

7. Air Pollution : Perlins H.L.

8. Aquatic Microbiology : Stainner & Shewan

9. Introduction to Waste Water Treatment processes: Ramalhr R.S.

B.SC. FINAL (SEMESTER-V)

Industrial Fermentation, Food Microbiology and Metabolism

The examination shall comprise of two theory papers, one in each semester and one practical in each Semester. Each theory paper will be of 3 hours duration and carry 80 marks. The internal assessment will carry 20 marks. The following

syllabi is prescribed on the basis of six lectures per week and 6 practical periods per batch per week. Each theory paper have been devided into 6 units. There shall be one question on each unit, will internal choice and for each of 12 marks and one compulsory question covering all the syllabus of semester VI(8 marks) (Industrial Fermentation, Food Microbiology and Metabolism)

SEMESTER - V

Industrial Fermentation, Food Microbiology and Metabolism

Unit- I : Fermentation in General.

a) Definition and scope of Industrial microbiology and biotechnology.
b) Important classes of industrial microorganisms.
c) Fermentation :- Definition and types (batch and continuous, aerobic and anaerobic, surface and submerged fermentations)
d) Production strains
e) Screening :- Definition, Primary screening (crowded plate technique, auxonography, enrichment culture technique, use of indicator dyes), secondary screening.

f) Scale up process :- Definition and significance.

g) Inoculum buildup : Spore and vegetative inoculum.

h) General layout of fermentation plant :- Fermentation equipment and its uses.
i) Raw materials :- Composition and uses. Saccharine,starchy, cellulose raw materials, hydrocarbon and vegetable oils, nitrogenous material (corn steep liquor).
j) Antifoam agents.

k) Sterilization of media :- Batch and continous sterilization.
l) Detection and assay of fermentation products.

Unit- II : Industrial Productions I:
Microorganisms, raw material, inoculums buildup,fermentation conditions, recovery, uses and mechanism of the following products.
a) Ethyl-alcohol : From molasses and waste sulphite liquor.
b) Beer.
c) Wine (Red table and White table).
d) Acetone- Butanol from corn.

e) Citric acid
f) Vinegar- Fring's process

Unit- III : Industrial Productions II:
a) Baker's yeast : From molasses, Definition of compressed and active dry yeast.
b) Single cell protein : From bacteria.
c) Penicillin.
d) Amylase : Bacterial and fungal.
e) Vitamin B12.

Unit-IV : Microbiology of Milk
a) Definition
b) Composition and types of milk.
c) Sources of microorganisms in Milk.
d) Types of microorganisms in milk.
e) Pasteurization of milk : LHT, HTST, UHT. Phosphatase test.

f) Grades of milk.
g) Concentrated milk and milk powder.
h) Preparation of fermented milk products, butter and cheese.

Unit-V : Food Microbiology
a) Sources of contamination of fresh food.
b) Microbial spoilage of foods.
c) Preservation of foods :- Low and high temperature,dehydration, high osmotic pressure, chemical preservation, radiations and canning.
d) Fermented foods : Idli, pickles and sauerkraut.

B.SC MICROBIOLOGY SYLLABUS

e) Food poisoning : Food infection and food intoxication.

f) Indicators of food contamination as per WHO.

Unit VI : Enzymology and Metabolism

A Enzymology :

a) Nature and Definition.

b) Classification and nomenclature of enzymes.

c) Terminologies used in enzymology :- Enzyme, active site,substrate, co-enyme, cofactors, prosthetic group,poloenzyme, apoenzyme, activation energy,isoenzyme, allosteric enzyme, inhibitors, immobilised enzymes.

B Metabolism :

a) General strategies of metabolism.

b) EMP pathway, TCA cycle.

c) Oxidative phosphorylation and Electrontransport chain.

Microbiology Practicals:

1. A) Microbiological Examination of milk:

a) Plate count

b) Methylene blue reduction test (MBRT)

c) Phosphatses test

d) Test for coliform bacteria

e) Estimation of fats in milk

f) Milk testing for Adulteration

B) Demonstration of microbes in Curd.

2. A) Laboratory scale production, recovery and quantitative estimation of following products:

a) Ethyl alcohol. b) Citric Acid c) Amylase

B) Immobilisation of Yeast.

C) Production of Curd/ Pickle/ Cheese by

microorganisms

D) Production of wine from grapes/ other raw material

4. Microbiological Examination of Vegetables, fruits andFast Foods by

a) Plate Count

b) Test for Coliform bacteria.

c) Yeast & Molds.

Distribution of marks for Microbiology Practical Examination:

1. Major Experiment - 15 marks

2. Minor Experiment - 10 Marks

3. Viva Voce - 10 mark

4. Spotting - 10 marks

5. Laboratory Journals - 05 Marks

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Total - 50 marks

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List of Reference Books for 6S Microbiology:

1. Food Microbiology : Fazier W.C. & Westhoff D.C.

2. Fermented Foods (Vol.7) : Rose A.A.

3. Industrial Microbiology : Prescott S.C. & Dunn C.G.

4. Industrial Microbiology : Miller B.M. & W. Litsky

5. Industrial Microbiology : A.H. Patel

6. Microbial Technology : Pepller H.J. (Vol. I & II)

7. Industrial Microbiology : Casida L.E.

8. Principles of Fermentation : Stanbury, Peter F. & Technology Allan.Whitaker

9. Outlines of Diary Bacteriology : Sukumar De

10. Modern Food Microbiology : Jay, Mames M.

11. Principles of Industrial : Rhodes & Fletcher.Microbiology

12. Industrial Fermentation : Under Kofler & Hick.Vol. I & II

13. Dairy Microbiology : Foster Etal

14. Industrial Microbiology : Rose

BOOKS RECOMMENDED FOR PRACTICALS :

1. Microbes in Action : Seely, Wander Mark, Taraporewala, Bombay.

2. Mannual of Microbiological : A.J. Salle, Methods

3. Microbiological Methods : Collins

4. Difco Mannual.