

**B.Sc.III**  
**Microbiology**  
**Syllabus**  
**2012**  
(SEMESTER PATTERN)

**Solapur University**  
**Solapur**

**B.SC.III (MICROBIOLOGY) COURSE STRUCTURE:**

Paper No	Title of the paper	Theory	Lectures
	Semester- V		
Paper IX	Virology, Extremophiles and Bioinformatics	Theory	40 L
Paper X	Industrial Microbiology	Theory	40 L
Paper XI	Agricultural Microbiology	Theory	40 L
Paper XII	Immunology	Theory	40 L
	Semester- VI		
Paper XIII	Microbial Genetics	Theory	40 L
Paper XIV	Microbial Biochemistry	Theory	40 L
Paper XV	Environmental Microbiology	Theory	40 L
Paper XVI	Medical Microbiology	Theory	40 L
	Practical Courses		
	Practical I	Practical	20 P
	Practical II	Practical	20 P
	Practical III	Practical	20 P
	Practical IV	Practical	20 P
	Study Tour		

**SOLAPUR UNIVERSITY, SOLAPUR**  
**B.Sc.III MICROBIOLOGY SYLLABUS**

**Semester V**

**Paper IX: Virology, Extremophiles and Bioinformatics**

**Unit I Classification of Viruses** (8)

- A) Viral classification, LHT system and as per international committee
- B) Isolation, cultivation, purification and enumeration of viruses

**Unit II Reproduction of bacteriophages** (8)

- A) One step growth experiment
- B) Reproduction of ds DNA/ ss DNA / RNA bacteriophages
- C) Temperate phages and lysogeny of  $\lambda$  phages

**Unit III Animal Viruses** (8)

- A) Reproduction of Animal viruses: Adeno viruses and Influenza viruses
- B) Oncogenic Viruses- Types of cancer, Characteristics of cancerous cells,  
Types of Oncogenic viruses; DNA and RNA viruses,  
Hypotheses of Cancer: Somatic mutation, Viral gene and Defective immunity

**Unit IV Extremophiles:** (8)

General characteristics and their role in respective extreme environments-  
Acidophiles, Alkalophiles, Thermophiles, Psychrophiles, Barophiles, Osmophiles

**Unit V Bioinformatics** (8)

- A) Introduction to Bioinformatics. Use of bioinformatics in major research areas
- B) Major Bioinformatics Resources on Internet: National Centre for Biotechnology Information (NCBI)

i. The knowledge of various databases and bioinformatics tools available at NCBI resource

ii. The major content of the NCBI databases

iii. Purpose and applications in life sciences

- C) Protein data bank (PDB) and Nucleic acid sequence database (GenBank)

D) The Basic Local Alignment Search Tool (BLAST)

**References:**

1. Bergey's Manual of Determinative Bacteriology- Breed and Buchanan
2. General microbiology – Stanier
3. General microbiology – Pawar and Daginawala Vol I and II
4. Genetics of bacteria and their viruses – William Hays
5. Virology – Biswas
6. Introduction of Bioinformatics – Affwood, T.K.
7. Bioinformatics by Shalini Suri
8. Virology – Luria
9. Physiology and Biochemistry of Extremophiles by Charles Gerday and Nicolas Glansdorff (2007)
10. <http://www.ncbi.nlm.nih.gov/>
11. Prescott, Harley and Klein's Microbiology, Willey Sherwood Woolverton, McGraw – Hill International Edition, (2008)

## Paper X: Industrial Microbiology

- Unit I Food and dairy Microbiology** (6)
- A) Food as a substrate for microorganisms  
 B) Food Fermentations – i) Idli ii) Bread  
 C) Fermented dairy products: i) Cheese ii) curd iii) Yogurt
- Unit II Industrial Microbiology** (08)
- Industrial production of Alcoholic beverages
- A) Grape wine – Definition, types, production of White table wine, Red table wine, Sparkling wines - Champagne, California sherry,  
 Post fermentation spoilage of wines: Microbial and non microbial spoilage of wines, Defects in wine  
 B) Beer – Definition, types, production of Lager beer and Ales Beer.
- Unit III Industrial production of** (10)
- A) Streptomycin  
 B) Lysine  
 C) Biopolymers: Glucans and Dextrans  
 D) rDNA products – Insulin, Interferon
- Unit IV Quality control in fermentation industry:** (10)
- A) Test for sterility, pyrogenicity, allergy, carcinogenicity, toxicity for Pharmaceutical and health care and food products  
 B) Downstream processing:  
 Filtration, Cross flow filtration, Flocculation, Whole broth processing  
 Solvent extraction, Concentration, Centrifugation, Crystallization,  
 Distillation, Adsorption elution, Precipitation and Chromatography
- Unit V Recent trends in fermentation Industry** (06)
- A) Good manufacturing practices in fermentation industry  
 B) Computer applications in fermentation technology  
 C) Fermentation economics

### References

1. Principles of fermentation technology – Stanbury and Whitekar
2. Dairy Technology – Sukumar De
3. Pharmaceutical Microbiology – Huggo and
4. Biochemistry – Fox and Nelson
5. Industrial Microbiology – Prescott and Dunn
6. Microbial technology – Pepler
7. Food Microbiology – R.C. Dubey, D.K. Mahashwari
8. Advances in Biotechnology – S.W. Jogdand.
9. Textbook of Biotechnology – R.C. Dubey,
10. Biotechnology – B.D. Singh
11. Industrial Microbiology – Casida
12. Industrial Microbiology – Patel A.H.

## Paper XI: Agricultural Microbiology

### Unit I Soil Microbiology (6)

- A) Introduction - Definition, approaches to soil microbiology, current topics in soil microbiology
- B) Soil as an ecosystem
- C) Soil formation, structure and properties
- D) Soil microorganisms, types and their role

### Unit II Role of microorganisms in (8)

- A) Carbon cycle
- B) Nitrogen cycle
- C) Sulphur cycle
- D) Phosphorous cycle

### Unit III Composting: (10)

Compost production with reference to organic waste, availability of microorganisms, aeration, C:N:P ratio, moisture control, temperature, pH and time

- a) Green manure
- b) Farm yard manure
- c) Town compost
- d) Vermicompost
- B) Biodegradation of Cellulose, Lignin, Pesticides and Hydrocarbons (4)

### Unit IV Plant pathology (8)

- A) Common symptoms produced by plant pathogens
- B) Modes of transmission of Plant diseases:  
Oily spots on pomegranate – *Xanthomonas axynopodis*, white smut of sugarcane, soft rot of potato
- C) Control measures of plant diseases

### Unit V Applications of Biotechnology in Agriculture

#### References

1. Soil Microbiology – Subbarao, N.S.
2. Microbial dynamics and diversity – Desy Staley
3. Biology of Microorganisms – Brock, Parker, Madigen, 9th edition
4. Agricultural Microbiology- Bagyaraj and Ghosh
5. Plant Diseases- Singh R.S.
6. Soil Microbiology – Alexander.

## Paper XII: Immunology

<b>Unit I Complement system</b>	4
A) Components of complement and their properties, B) Activation of complement –classical and alternate pathway C) Biological effects of complement	
<b>Unit II Major Histocompatibility complex</b>	8
A) Organization of MHC genes in man Classes of MHC molecules – structure and their role B) Adaptive immunology a) Humoral (antibody) mediated response –Cells involved and mechanism b) Cell mediated – cells involved, mechanism; cytokines and their role	
<b>Unit III A) Monoclonal antibodies</b> – i) Production (hybridoma technology) ii) Applications of Monoclonal antibodies in Diagnosis, Research and Treatment	6
B) <b>Basis of antibody diversity:</b> Basic concept of Immunoglobulin gene, structure and its expression	
<b>Unit IV A) Immunological tolerance</b>	2
B) <b>Autoimmunity :</b> i) Mechanism ii) Classification of Autoimmune diseases- a) Hemocytolytic b) Organ specific(Hashimotos disease, Graves disease, Myasthenia gravis, Pernicious anemia) c) Non organ specific(S.L.E., R.A.)	
C) <b>Hypersensitivity :</b>	10
a) Introduction b) Types: i) Based on time required for manifestation-Immediate and delayed. ii)Based on pathogenesis ( TypeI:Anaphylaxis,Atopy; Type II, TypeIII:Arthus reaction, Serum sickness, Type IV:Delayed)	
D) <b>Transplantation Immunology</b>	4
i) Terminologies ii) Classes of Transplants iii) Mechanisms of graft rejection iv) Prevention of graft Rejection v) HLA typing	
<b>Unit V Immunoematology:</b>	6
A) ABO blood group system B) Rh blood group system C) Blood transfusion reaction and its complications D) Immunoprophalaxis – Conventional and new generation vaccines	
<b>References</b>	
1. Essentials of Immunology Roitt Evan, Brostoff J. Male D. (1993) 6th Edition.	
2. Immunology - Kuby J. (1996) - W.H. Freeman and Co.	
3. Immunology – Fudenberg	
4. Medical Microbiology - Davis and Dulbecco	
5. Parasitology – Chattergii	
6. Medical laboratory technology – Ramnaik Sood	
7. Diagnostic Microbiology – Bailey’s and Scotts	
8. Immunology – a problem approach by Wood, Hood and Weison	
9. Medical Bacteriology – Dey and Dey	
10. Handbook of Immunology- G.P. Talwar (1983) Vikas Publishing Pvt. Ltd	

## Semester VI

### Paper XIII: Microbial Genetics

<b>Unit I: Basic concepts of microbial genetics</b>	8
A) Structural organization of <i>Escherichia coli</i> chromosome, folded fiber model	
B) Replication of DNA: Enzymes involved and mechanisms of replication	
C) Transcription: RNA polymerase enzyme, process and post transcriptional modification	
D) Operon concept – Lac Operon	
<b>Unit II: Bacterial mutations</b>	8
A) Effect of mutation on translation	
B) Effect of mutation on phenotypes	
C) Time course of phenotypic expression	
D) Selection, detection & adaptation of mutants	
<b>Unit III: Genetic complementation</b>	4
A) Mutation in bacteriophages	
B) Cis-trans test	
<b>Unit IV: Genetic engineering and Protein engineering</b>	12
A) Introduction, Tools and Techniques of Genetic engineering	
B) Applications of Genetic engineering	
C) Protein Engineering – concept and applications	
<b>Unit V: Techniques in molecular biology</b>	8
A) Electrophoresis of DNA.	
B) DNA sequencing – Maxam and Gilbert's method	
C) DNA finger printing- method and applications	

#### References:

1. General microbiology – Stanier
2. General microbiology – Pawar and Daginawala Vol I and II
3. Biochemistry – Lehninger
4. Molecular Biology of Gene – J.D. Watson
5. Recombinant DNA – J.D. Watson
6. Microbiology - Davis
7. Biochemistry - Purohit
9. Genetics of bacteria and their viruses – William Hays

## Paper XIV: Microbial Biochemistry

### Unit I Enzyme kinetics and regulation 10

- A) Definition, properties, structure, specificity, mechanism of action  
(Lock and key model, induced fit hypothesis)
- B) Allosteric enzymes – Definition, Two models explaining mechanism of action (Sequential and Concerted)
- C) Ribosymes and Isozymes
- D) Factors affecting catalytic efficiency of enzymes
  - i) Proximity, orientation ii) Strain and distortion iii) Acid base catalysis iv) Covalent catalysis
- E) Enzyme kinetics – Derivation of Michaelis Menten equation, Significance of  $K_m$  and  $V_{max}$
- F) Regulation of enzyme synthesis
  - i) Positive control – Arabinose Operon ii) End product repression – Tryptophan Operon
  - iii) Catabolite repression

### Unit II Extraction, purification and assay of enzymes 6

- A) Extraction, cell disruption and homogenization of membrane bound enzymes
- B) Purification of enzymes on the basis of differences in- i) Molecular size ii) Solubility  
iii) Electric charge iv) Adsorption characteristics) Biological affinity
- C) Immobilization of enzymes – Methods and applications
- D) Assay of enzymes (parameters: enzyme activity, Specific activity, turnover number, Bioassay)

### Unit III Assimilation of: 6

- i) Carbon
- ii) Nitrogen –  $N_2$  and  $NH_3$  (GOGAT)
- iii) Sulphur

### Unit IV Bioenergetics:

- A) Metabolic Pathways 8
  - i) Glyoxylate bypass
  - ii) PP Pathway
  - iii) ED pathway
  - iv) Phosphoketolase pathway
  - v) Bioluminescence
- B) Pyruvate as key metabolite in Carbohydrate metabolism

### Unit V Biosynthesis of: 10

- A) Nucleotides
- B) Protein
- C) Peptidoglycan

**References:**

1. Biochemistry – Lehninger
2. Molecular Biology of Gene – J.D. Watson
3. Biochemistry - Purohit
4. Principles and techniques of Practical Biochemistry – K. Wilsons J.Walkar.
5. Analytical Chemistry – Robert B. Dilts
6. Chromatographic methods by Braithwaite and White
7. Outline of Biochemistry – Cohn and Stump
8. Biochemistry – West and Todd Russel
9. Biochemistry – Lehninger
10. Enzymes – Dixon and Web
11. Biological chemistry – Mahler and Cordes
12. Nature of Enzymology – R.L. Foster
13. Enzyme structure and Mechanism – Alen fereht
14. Biochemistry – Fox and Nelson
15. Microbial technology – Peppler
16. Biochemistry – A problem approach by Wood, Hood and Weison

## Paper XV: Environmental Microbiology

<b>Unit I Air microbiology</b>	8
A) Microorganisms in air – Launching, transport and deposition of aerosols, survival of microorganisms in air	
B) Significance of microorganisms in air (extramural and intramural)	
C) Methods to study air borne microorganisms. Sampling, qualitative and quantitative methods.	
D) Bioaerosol control (ventilation, filtration, biocidal control, UV gaseous (quarantine)	
E) Sources, types, effects, control of air pollution. Depletion of ozone layer (causes, impact and control)	
F) Biological safety	
G) Germ free animal and Gnotobiology	
<b>Unit II A) Marine microbiology</b>	8
Types of microorganisms in fresh and marine water, estuaries, methods to study aquatic microorganisms. Characteristics of marine environment, types of organisms and their role.	
B) Eutrophication: a) Classification of lakes b) Sources C) Consequences d) Control	
<b>Unit III Microbiology of potable water:</b>	8
Definition of potable water, Standard for potability, Municipal water purification process, Microorganisms as Bioindicators of fecal pollution, Routine bacteriological analysis of water.	
<b>Unit IV Environmental impact assessment:</b>	10
A) Waste water assessment and management, types of wastes, chemical assessment, microflora, BOD, COD, treatment and disposal of waste water.	
B) Assessment and management of pollutants – toxic elements, their sources and effects and bioremediation (Lead, mercury, arsenic and radioactive substances)	
C) i) Environmental standards ii) Environmental legislations iii) Environmental education and awareness	
<b>Unit V A) Bio-leaching:</b>	6
Introduction, Microorganisms involved, Biochemistry of microbial leaching, Commercial leaching – slope, heap, in situ leaching, Leaching of Copper and Uranium	
B) Oil recovery: Methods – primary, secondary, and microbially enhanced, Biotechnological solution of oil recovery	
C) Characteristics and treatment of wastes from different industries –paper and pulp, sugar and distillery, textile, and dairy industries	
D) Treatment of Biomedical waste	

### References:

1. Physiology and Biochemistry of Extremophiles- Charles Gerday and Nicolas Glansdorff
2. Environmental Microbiology – Maier
3. Microbial ecology – Fundamentals and applications - Atlas and Bartha
4. Microbial dynamics and diversity – Desy Staley
5. Biology of Microorganisms – Brock, Parker, Madigen, 9th edition
6. Microbiology – Prescott and Harley, 5th edition

## Paper XVI: Medical Microbiology

### Unit I

- A) Pathogenicity of viruses, fungi and protozoa (4)  
 B) Hospital infection – factors contributing, common types, diagnosis and prophylaxis

### Unit II Bacterial diseases

(Morphological, cultural and biochemical characters, antigenic structures, modes of transmission, pathogenesis, symptoms, laboratory diagnosis, prophylaxis and treatment of following diseases) (10)

1. *Pseudomonas aeruginosa*
2. *Mycobacterium leprae*
3. *Helicobacter pylori*
4. *Treponema pallidum*
5. *Clostridium perfringens*
6. *Klebsiella pneumoniae*
7. *Vibrio cholerae*

### Unit III Viral Diseases

(Morphology, cultural and biochemical characters, antigenic structures, modes of transmission, pathogenesis, symptoms, laboratory diagnosis, prophylaxis and treatment of following diseases) (10)

1. Herpes (Simplex)
2. Rabies
3. Hepatitis A and B
4. AIDS

### Unit IV Fungal, Protozoan Diseases and Biological Warfare

- a. Candidiasis (6)  
 b. Malaria (all four with comparative account)  
 c. Biological warfare –Use of biological agents - bacteria, viruses, or other disease-causing agents as biological weapons

### Unit V Chemotherapy

- A) Antimicrobial Drugs (10)  
 B) Properties of ideal Antimicrobial drugs  
 C) Mode of action of following antimicrobial drugs:  
 i) Acting on Cell Wall: Penicillin, Bacitracin, Vancomycin,  
 ii) Acting on Protein Synthesis: Streptomycin, Chloramphenicol,  
 iii) Acting on nucleic acid synthesis: quinolones, rifampicin  
 iv) Drugs Acting on cell membrane: Sulphonamide, Trimethoprim,  
 v) Antiviral drug: Azidothymidine,  
 vi) Antifungal Drugs: Amphotericin, Nystatin  
 D) Tests to guide chemotherapy a) diffusion tests b) broth dilution tests  
 E) Mechanisms of drug resistance

**References:**

1. Pharmaceutical Microbiology – Huggo
2. Text book of Medical Microbiology – Ananthnarayan
3. Review of Medical Microbiology – Jawetz et al
4. Microbiology – Zinsser
5. Medical Microbiology – Cruickshank
6. Medical Microbiology - Davis and Dulbecco
7. Parasitology – Chattergii
8. Medical laboratory technology – Ramnaik Sood
9. Diagnostic Microbiology – Bailey's and Scotts
10. Medical Bacteriology – Dey and Dey

## PRACTICAL COURSE

### Practical I:

1. Isolation of DNA from bacteria by J. Marmur's method
2. Electrophoretic separation of DNA
3. Isolation of coliphages from sewage
4. One step growth curve
5. Determination of dose of U.V. by UV survival curve (comparative study of *Escherichia coli* and *Staphylococcus aureus*.)
7. Isolation of Lac negative mutants of *E.coli* by visual detection method.
8. Isolation of Streptomycin resistant mutants by gradient plate technique.
9. Isolation of Vitamin B12 requiring (auxotrophic) mutants by replica plate technique.
10. Diauxic growth curve of *Escherichia coli* (glucose and lactose).
11. Browsing of National Centre for Biotechnology Information (NCBI) website.
12. Exploring protein sequence database (PDB) and GenBank and BLAST.

### Practical II:

1. Examination of milk **i)** DMC **ii)** Quantitative analysis of milk by SPC (using nutrient agar)
2. Phosphatase Test (qualitative)
3. Bioassay of Vitamin B12
4. Bioassay of Penicillin
5. Production of wine by using Jaggery medium by *S. cerevisiae* - examination of pH, colour, taste.
6. Estimation of alcohol by using K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub>
7. Sterility testing of media
8. Immobilization of enzyme by using Sodium alginate
9. Thin layer chromatography- amino acid
10. Demonstration of crude recovery of amylase enzyme & Amylase assay
11. Isolation of Lactic acid Bacteria (MRS Medium)
12. Estimation of Citric acid by titration method

**Practical III:**

1. Isolation of **Azotobacter** from soil. (Identification up to genus level)
2. Isolation of **Rhizobium** from root nodules.
3. Isolation of **Phosphate solubilising** bacteria from soil.
4. Isolation of **Xanthomonas** from infected plant material
5. SPC of market **Biofertilizers**.
6. Estimation of available nitrogen from soil.
7. Estimation of available phosphorous from soil (Stannous chloride method)
8. Estimation of Calcium and Magnesium from soil (EDTA method)
  
9. Determination of organic carbon contents of soil (Walkley and Black method)
  
10. Microbiological analysis Drinking water: Presumptive, Confirmed and Completed test.
11. Determination of potability of water by MPN.
12. Waste water analysis: Chemical Oxygen Demand (COD), Biological Oxygen Demand (BOD)

**Practical IV:**

1. Preparation of Tri sugar iron agar (TSI) medium slants and study of biochemical reactions on (TSI) slant.
2. Determination of minimum inhibitory concentration (MIC).of penicillin on *S.aureus*.
3. Antibiotic sensitivity test (by disc diffusion method)
4. Study of determination of effectiveness of antiseptic agents (– tincture iodine, 3% H<sub>2</sub>O<sub>2</sub>, 70% alcohol, 5% chlorine bleach) against selected organisms (*Escherichia coli*, *Staphylococcus aureus*, *Bacillus*) by disc diffusion method
5. A. Isolation of pathogen from clinical sample
  - a) *Pseudomonas aeruginosa*
  - b) *Klebsiella pneumoniae*
  - c) *Corynebacterium diphtheria*
 B.Isolation and identification of member of Enterobacteriaceae (Maximum Two) up to species level from biomedical waste (Gram staining, colony characterization, motility and biochemical tests – IMViC, H<sub>2</sub>S, oxidase, catalase, urea hydrolysis, gelatin hydrolysis, phenylalanine deaminase test, lysine decarboxylase test, sugar fermentation)
6. Widal test (quantitative test)
7. Haematology – RBC count, WBC count, differential WBC count, Erythrocyte sedimentation rate (ESR) , Hemoglobin estimation and demonstration of malarial parasite.
8. Urine analysis
  - a) Microscopic examination – pus cells, RBC, bacteria, crystals.
  - b) Chemical examination – glucose (benedict's method, protein (acetic acid), bile salt (sulphur method) ketone bodies (Rothera's test)
9. Immunodiffusion test.
10. Study of synergistic action of antibiotics

## Practical Examination

A) The practical examination will be conducted on four (4) consecutive days for not less than 6 hours on each day of the practical examination.

B) Each candidate must produce a certificate from the Head of the Department in his/her college stating that he/she has completed in a satisfactory manner the practical course on the guidelines laid down from time to time by Academic council on the recommendation of Board of studies and has recorded his/her observations in the laboratory journal and written a report on each exercise performed. Every journal is to be checked and signed periodically by a member teaching staff and certified by the Head of the Department at the end of the year. Candidates are to produce their journal at the time of practical examination. Candidate has to visit two places of Microbiological interest (Pharmaceutical industry, Dairy, Research institutes etc) and submit the report of their visit at the time of examination. The report should be duly certified by the Head of the Department.

### Distribution of Marks for practical examination

For practical I, II, III, IV each.

- 1) One major experiment: 20 marks
- 2) Two minor experiment: 10 marks each
- 3) Journal: 5 marks

Total marks:

Practical I: 45 Marks

Practical II: 45 Marks

Practical III: 45 Marks

Practical IV: 45 Marks

Tour Report : 20 Marks

**Total Marks: 200**

### Practical wise distribution of marks

#### Practical – I

A) **Major Experiments:** (20)

- i) Isolation of coli phages/ Mutants OR
- ii) Electrophoresis separation of DNA

B) **Minor experiments:** (20)

- 1) Diauxic growth / one step growth curve / Isolation of chromosomal DNA
- 2) Minimum lethal dose of U.V. by survival curve /Browsing of data banks (NCBI/ EBI/DDBJ)

#### Practical II

A) **Major Experiments:** (20)

- i) Bioassay of Penicillin / Vitamin B12 OR
- ii) Amylase assay/OR
- iii) TLC of amino acids OR
- iv) SPC of milk. OR
- v) Isolation of Lactic acid bacteria

B) **Minor experiments:** (20)

- 1) Direct microscopic count of milk / Phosphatase test (qualitative)
- 2) Immobilization of enzymes /Estimation of citric acid by titration/ alcohol by  $k_2Cr_2O_7$

**Practical III****A) Major Experiments: (20)**

- i) Isolation & identification of *Azotobacter/Rhizobium/Xanthomonas* OR
- ii) BOD of sewage sample OR
- iii) Estimation of nitrogen from soil

**B) Minor experiments: (20)**

- 1) COD of sewage sample OR  
Estimation of calcium/ Magnesium/ Organic carbon of soil.
- 2) Determination of MPN of given sample OR  
Confirmed and Completed test OR  
Isolation of phosphate Solubilizing bacteria

**Practical – IV****A) Major Experiments: (20)**

- i) Isolation and identification of:  
*Pseudomonas aeruginosa/ Klebsiella pneumoniae*

**OR**

- ii) Isolation and identification of Enterobacteriaceae up to species level from biomedical waste (Gram staining, colony characterization, motility and biochemical tests – IMViC, H<sub>2</sub>S, oxidase, catalase, urea hydrolysis, gelatin hydrolysis, phenylalanine deaminase test, lysine decarboxylase test, sugar fermentation test)

**B) Minor experiments: (20)**

- 1) Determination of Antibiotic sensitivity to common pathogens OR  
Determination of MIC of Penicillin for *S.aureus* OR  
Determination of effectiveness of Antiseptic agents
- 2) Widal Test OR  
Differential count of blood OR  
Microscopic Examination of urine sample OR  
Chemical Examination of Urine for glucose/ Protein/ bile salt/ Ketone bodies OR  
ESR of blood sample OR Hb estimation of blood sample

**List of the Minimum equipments and related requirements for B.Sc – III**

- 1) Replica plating units for genetics experiments: Two
- 2) Rotary shaker for fermentation experiments: One
- 3) Centrifuge (High speed): One
- 4) Hot plate: One
- 5) Hot air oven: One
- 6) Bacteriological incubator: One
- 7) Spectrophotometer: One
- 8) Research Microscope: one for each student
- 9) Haemocytometer: Two
- 10) Haemoglobinometer: Two
- 11) ESR stands and tubes: Two
- 12) Separate room for fine instruments of size 10'×15' feet dimension
- 13) A separate culture room of at least 10'×10' feet dimension
- 14) Electrophoresis assembly: One
- 15) Laminar air flow cabinet: One
- 16) Distillation assembly: One (Glass)
- 17) Reflux assembly: Four
- 18) Serological water bath: One
- 19) Colony counter: One
- 20) Refrigerator: One
- 21) TLC UNIT: One
- 22) Hand Refractometer
- 23) Computer with Internet facilities and printer: One
- 24) Micropipette: One
- 25) Anaerobic Jar: One
- 26) Heating Mantle: One
- 27) UV Chamber