

# **SOLAPUR UNIVERSITY, SOLAPUR**



NAAC Accredited-2015  
'B' Grade (CGPA 2.62)

**Name of the Faculty-Science**

**Syllabus-(CBCS Pattern)**

**Name of the Course-B.Sc.-III**

**(Semester V & VI)**

**Microbiology**

**General Structure as per CBCS**

**With effect from June-2018**

**Solapur University, Solapur**  
**Faculty of Science**  
**Choice Based Credit System**

(W.e.f. June, 2018)

- **Title of the Course:** B.Sc.- Part III
- **Subject :**Microbiology

• **Choice Based Credit System:**

With the view to ensure worldwide recognition, acceptability, horizontal as well as vertical mobility for students completing under graduate degree, Solapur University has implemented Choice Based Credit System of Evaluation at Undergraduate level. Credit is a numerical value that indicates student's work load (Lectures, Lab work, Seminars, Tutorials, Field work, etc.) to complete a course unit. In most of the universities 15 contact hours constitute one credit. The contact hours are transformed into Credits. As per present norms, there are 4 contact hours per paper (subject) per week which works out to be **60** contact hours per paper (subject) per semester.

In Solapur University, for B. Sc.-III, there are 8 papers of the subject and Compulsory English paper. For B. Sc.-III, there are the 12 contact hours for 4 papers of subject per week. Therefore, total 3 contact hours per week for each paper. Each subject has **180** contact hours, which are transformed into 12 credits. As there are 4 contact hours per week for Compulsory English, 4 credits shall be assigned for Environmental Studies. Moreover, the grading system of evaluation is introduced for B. Sc. course, wherein process of Continuous Internal Evaluation is ensured. The candidate has to appear for Internal Evaluation of 30 marks and University Evaluation for 70 marks. It is 70 + 30 pattern of evaluation. It is applicable for theory and practical as well. The details regarding this evaluation system are as under.

• **Conversion of marks into Grades :**

A table for the conversion of the marks obtained by a student in each paper (out of 100) to grade and grade points is given below.

**Sr. No Range of Marks Grade Grade Point**

1. 80-100 O 10
  2. 70-79 A+ 9
  3. 60-69 A 8
  4. 55-59 B+ 7
  5. 50-54 B 6
  6. 45-49 C+ 5
  7. 40-44 C 4
  8. <39 FC 0 (Failed in Term Exam)
  9. <39 FR 0 (Failed in Internal Assessment)
- 3

**1. Grade Point Average at the end of the Semester (SGPA)**

$(G_1 \times C_1) + (G_2 \times C_2) + \dots$

SGPA = -----

$\Sigma C_i$

( $\Sigma C_i$ - The total number of credits offered by the student during a semester)

## 2. Cumulative Grade Point Average (CGPA)

$(G_1 \times C_1) + (G_2 \times C_2) + \dots$

CGPA = -----

$\Sigma C_i$

$\Sigma C_i$  - the total number of credits offered by the student upto and including the semester for which CGPA is calculated.)

**3. Final Grade Point Average (FGPA)** will be calculated in the similar manner for the total number of credits offered for completion of the said course.

Where:  $C_i$ : Credits allocated for the  $i$ th course

$G_i$ : Grade point scored in  $i$ th paper (Subject)

## 4. Conversion of average grade points into grades:

### SGPA/CGPA/FGPA Letter Grade

9.5 – 10 O

8.5 -9.49 A+

7.5 – 8.49 A

6.5 – 7.49 B+

5.5 – 6.49 B

4.5 – 5.49 C+

4.0 – 4.49 C

< 3.99 FC /F

FR

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**Solapur University, Solapur**

**Faculty of Science**

**Credit System Structure for B.Sc.III Microbiology**

**Semester V**

\* Total credits excluding Compulsory English

Abbreviations: L: lectures, T: Tutorials, P: Practicals; UA: University Assessment by End Semester Examination; CA: College assessment by Internal Continuous Examination

UA (University Assessment): University Theory paper shall be of 70 marks for 2.30 hrs duration

CA (College Assessment): The internal examination for Theory and Practical course.

Class Sem Subject No. of

Papers/

practicals

Hrs/Week Paper

Marks

UA CA Credit

s

Total

credits

L T P \*

B.Sc.III V

English -----

Microbiology Paper IX 3 - - 100 70 30 3

Microbiology Paper X 3 100 70 30 3

Microbiology Paper XI 3 - - 100 70 30 3

Microbiology Paper XII 3 - - 100 70 30 3

**Grand**

**Total**

**12 400 280 120 12 12**

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**Solapur University, Solapur**  
**Faculty of Science**  
**Credit System Structure for B.Sc.III Microbiology**

**Semester VI**

\* Total credits excluding Compulsory English

Abbreviations: L: lectures, T: Tutorials, P: Practicals; UA: University Assessment by End Semester Examination; CA: College assessment by Internal Continuous Examination

UA (University Assessment): University Theory paper shall be of 70 marks for 3.0 hrs duration

CA (College Assessment): The internal examination for theory and Practical course.

Class Sem Subject No. of Papers/

practicals

Hrs/Week Paper

Marks

UA CA Credi

ts

Total

credits

L T P \*

B.Sc.III VI

English - - - - -

Microbiology Paper XIII 3 - - 100 70 30 3

Microbiology Paper XIV 3 100 70 30 3

Microbiology Paper XV 3 - - 100 70 30 3

Microbiology Paper XVI 3 100 70 30 3 12

B.Sc.III

Microbiology Practical V - - 3 100 70 30 3

Microbiology Practical VI - - 3 100 70 30 3

Microbiology Practical VII - - 3 100 70 30 3

Microbiology Practical VIII - - 3 100 70 30 3

Total 800 560 240 24 24

**Grand**

**Total**

**V&**

**VI**

**1200 840 360 36**

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**General Guidelines for Credit and Grading System**

**B.Sc.III**

1. The University follows Semester system
2. An academic year shall consist of two semesters
3. Each B.Sc. course shall consist of three years i.e. six semesters
4. Compulsory English shall remain a compulsory paper for B.Sc.Part- III students in both Semesters.
4. B.Sc.Part-III shall consist of two semesters: Semester V and Semester VI.  
In semester –V, there will be four theory papers of 100 marks each for the subject. Similarly, in semester VI there will be four theory papers of 100 marks each for the subject and English paper compulsory for every student in each semester.

The scheme of evaluation of performance of candidates shall be based on University assessment as well as College internal assessment as given below. For B.Sc.Part III Sem V & VI the internal assessment will be based on Unit tests, Home assignment, viva, practical, Project Work etc as given below. Practical examination of 400 marks for 4 practical courses shall be conducted at the end of VI<sup>th</sup> semester. The practical examination of 400 marks shall consist of 280 marks for University practical assessment and 120 marks for college internal assessment.

For University practical examination, there shall be appointment of two examiners. Both examiners shall be external and both be appointed by the University. The internal practical assessment shall be done as per scheme given below.

## 5. Scheme of evaluation:

As per the norms of the grading system of evaluation, out of 100 Marks, the candidate has to appear for College internal assessment of 30 marks and external evaluation (University Assessment) of 70 marks. Assessment scheme is given below.

### **Semester - V:**

#### **Theory: (100 marks)**

University Examination (70 Marks): No. of Theory papers: 4 Papers/Subject and Compulsory English (Total 5 Papers)

#### **Internal Continuous Assessment (30 Marks):**

Scheme of Marking: 15 Marks: Internal Test

15 Marks: Home assignment/Tutorials/Seminars/ Group discussion/ Viva/Field visit/Industry visit.

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### **Semester - VI: (100 marks)**

#### **Theory:**

University Examination (70 Marks): No of Theory papers: 4 Papers/Subject and Compulsory English (Total 5 Papers)

#### **Internal Continuous Assessment (30 Marks):**

Scheme of Marking: 15 Marks: Internal Test

15 Marks: Home assignment/Tutorials/ Seminars/ Group discussion/ Viva/ Field visit/Industry visit.

#### **Practical Examination:**

University Examination (280 Marks): No of Practicals: 4 Practicals /Subject

#### **Internal Continuous Assessment (120 Marks):**

Scheme of Marking: 80 Marks: Internal Test on any four practicals, 40 Marks: Lab Journal/viva, attendance, attitude etc.

## 6. Passing Standard

The student has to secure a minimum of 4.0 grade points (Grade C) in each paper. A student who secures less than 4.0 grade point (39% or less marks, Grade FC/FR) will be declared fail in that paper (subject) and shall be required to reappear for respective paper. A student who failed in University Examination (Theory) & passed in internal assessment of a same paper (subject) shall be given FC Grade. Such student will have to appear for University Examination only. A student who fails in Internal Assessment and passed in University examination (Theory) shall be given FR Grade. Such student will have to appear for both University examination as well as internal assessment. In case of Annual Pattern/Old Semester Pattern Students/candidates from the mark scheme the candidates shall appear for the same 70 marks paper of the external examination and his performance shall be scaled to 100 marks

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**Solapur University, Solapur**  
**Faculty of Science**  
**Choice Based Credit System (CBCS)**  
**(W.e.f.2018-19)**  
**Structure for B. Sc-III Microbiology**

Subject/ Core Course Microbiology	No. of papers/ Practical	Hrs/week			Total Marks Per Paper	UA	CA	Credits
		L	T	P				
<b>Class :→</b>		<b>B.Sc.- III Semester - V</b>						
<b>AECC-4 (English)</b>	Paper-III	4			100	70	30	4
<b>DSE-1-A</b>	Paper IX: MIC IX: Virology	3	--	--	100	70	30	3
<b>DSE-2-A</b>	Paper X: MIC X: Agricultural Microbiology	3	--	--	100	70	30	3
<b>DSE-3-A</b>	Paper XI: MIC XI: Immunology	3	--	--	100	70	30	3
<b>SEC-1</b>	Paper XII: MIC XII: Industrial Microbiology- I	3	--	--	100	70	30	3
<b>OR</b>								
<b>SEC-2</b>	Paper XII: MIC XII: Industrial Microbiology- II	3	--	--	100	70	30	3
<b>Total</b>		<b>16</b>	--	--	<b>500</b>	<b>350</b>	<b>150</b>	<b>16</b>
<b>Class :→</b>		<b>B.Sc.- III Semester - VI</b>						
<b>AECC-5 (English)</b>	Paper-IV	4			100	70	30	4
<b>DSE-1-B</b>	Paper XIII: MIC XIII: Microbial Genetics	3	--	--	100	70	30	3
<b>DSE-2-B</b>	Paper XIV: MIC XIV: Microbial Biochemistry	3	--	--	100	70	30	3
<b>DSE-3-B</b>	Paper XV: MIC XV: Environmental Microbiology	3	--	--	100	70	30	3
<b>SEC-3</b>	Paper XVI: MIC XVI Clinical Microbiology-I	3	--	--	100	70	30	3
<b>OR</b>								
<b>SEC-4</b>	Paper XVI: MIC XVI: Clinical Microbiology-II	3	--	--	100	70	30	3
<b>Total (Theory)</b>		<b>16</b>	--	--	<b>500</b>	<b>350</b>	<b>150</b>	<b>16</b>
<b>DSE-1-A&amp;B</b>	Practical V	--	--	5	100	70	30	3
<b>DSE-2-A&amp;B</b>	Practical VI	--	--	5	100	70	30	3
<b>DSE-3-A&amp;B</b>	Practical VII	--	--	5	100	70	30	3
<b>SEC-1,2,3,4</b>	Practical VIII	--	--	5	100	70	30	3
<b>Total (Pract.)</b>				<b>20</b>	<b>400</b>	<b>280</b>	<b>120</b>	<b>12</b>
<b>Grand Total</b>		<b>16</b>		<b>20</b>	<b>900</b>	<b>630</b>	<b>270</b>	<b>28</b>

# Ability Enhancement Course (AECC)

English (Communication Skills, Environmental Science)

# Core Course (DSC)

Chemistry/Physics/Electronics/Computer Science/Mathematics/Statistics/Botany/Zoology/  
Microbiology/Geology

# Skills Enhancement Course (SEC)

Geochemistry/Biochemistry/Meteorology/Plant Protection

# Discipline Specific Elective (DSE)

Chemistry/Physics/Electronics/Computer Science/Mathematics/Statistics/Botany/Zoology/  
Microbiology/Geology

## Summary of the Structure of B.Sc. Programme as per CBCS pattern

Class	Semester	Marks-Theory	Credits-Theory	Marks-Practical	Credits-Practicals	Total - credits
<b>B.Sc.-I</b>	I	900	24	-	-	24
	II	900	24	400	16	40
<b>B.Sc.-II</b>	III	600	18	-	-	18
	IV	600	18	600	24	42
<b>B.Sc.-III</b>	V	500	16	-	-	16
	VI	500	16	400	16	32
<b>Total</b>		<b>4000</b>	<b>116</b>	<b>1400</b>	<b>56</b>	<b>172</b>

### B.Sc.Programme :

- Total Marks : Theory + Practicals = 4000 +1400 =5400
- Credits : Theory + Practicals = 116 + 56 = 172
- Numbers of Papers Theory: Ability Enhancement Course(AECC) : 05  
Skill Enhancement Course (SEC) : 04  
Theory: Discipline Specific Elective Paper (DSE): 06  
Theory: Core Course (DSC) : 28

**Total : Theory Papers:43**

**Practical: Core Course (CC) : 11**

### Abbreviations :

- L: Lectures
- T: Tutorials
- P: Practicals
- UA : University Assessment
- CA : College Assessment
- DSC: Core Course
- AECC : Ability Enhancement Course
- DSE : Discipline Specific Elective Paper

**\*Indicates-non credit Course**

### Important Note:

- Board of Studies in the respective subject will design the curriculum/syllabus of the paper, Skills Enhancement Course (SEC-1,2,3,4) of the Paper Number (Paper – XII,XIII,XVII,XVIII)
- For B.Sc.-I, Sem -I and II. Papers of each subject are divided as per previous pattern to give more weightage and to reduce the stress of the students.
- Combined passing for DSC-A-Paper I&II, DSC-B-Paper III&IV,DSC-C-Paper V&VI, DSC-D-Paper VII&VIII,  
For B.Sc.III-Sem-V&VI, separate passing for DSE-A, DSE-B & SEC-1,2,3,4 papers
- Combined passing for B. Sc.- II Practicals ( Practical – III & IV)
- Combined passing for B. Sc-III Practicals (Practical – V,VI,VIII,VIII)
- The 30 marks of College level Assessment (CA) may be distributed as , 15 Marks for Internal Test and 15 Marks for Home Assignment/seminars/Viva/industrial visit/Group discussion etc.

## B.Sc.III - MICROBIOLOGY CBCS SYLLABUS Semester V

**DSE – 1- A: Paper MIC IX: Virology**

**Total Credits: 3**

**Contact hrs: 45**

**Unit I Introduction and Classification of Viruses (9)**

- A. General properties and structure of virus
- B. Viroids and Prions
- C. Viral classification on the basis of LHT system and as per international committee

**Unit II Reproduction of bacterial viruses (6)**

- A. T<sub>4</sub> Bacteriophage - Lytic cycle
- B. Temperate phages and lysogeny of  $\lambda$  phages

**Unit III Animal Viruses (12)**

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

**Unit IV Plant Viruses (9)**

- A. Viral plant Diseases - TMV, CMV, CaMV
- B. Prevention and Control of Plant Viral Diseases

**Unit V Techniques in Virology (9)**

- A. Isolation, cultivation, Purification and Enumeration of viruses
- B. One step growth experiment

**References:**

1. General microbiology – Stanier
2. General microbiology – Pawar and Dagainawala Vol I and II
3. Genetics of bacteria and their viruses – William Hays
4. Virology – Biswas
5. Virology – Luria
6. Microbiology - Prescott, Harley and Klein's, Willey Sherwood Woolverton, McGraw – Hill International Edition, (2008).
7. Plant viruses- by Mathews
8. Microbiology by Davis
9. Plant diseases by Singh



## DSE – 2 – A: Paper MIC - X: Agricultural Microbiology

Total Credits: 3

Contact hrs: 45

### Unit I Introduction to Soil Microbiology

(7)

- A. Introduction - Definition, Soil formation, types, structure and properties
- B. Soil as an ecosystem
- C. Soil microorganisms, types and their role

### Unit II Role of microorganisms in elemental cycle

(9)

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

### Unit III Composting and Biodegradation

(13)

- A. Compost production with reference to organic waste, types of microorganisms, and factors affecting - aeration, C:N:P ratio, moisture content, temperature, pH, and period of composting.
  - 1. Green manure
  - 2. Farm yard manure
  - 3. Town compost
  - 4. Vermicompost
- B. Biodegradation of Cellulose, hemicelluloses, Lignin, and Pesticides

### Unit IV Plant pathology

(9)

- 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

(7)

- A. Biofertilisers (Azo and Rhizo and PSB) production and applications.
- B. Bioinsecticides – *Bacillus thuriengensis* and *Trichoderma viridae*
- C. Genetically Modified Crops with examples

### 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.
7. Industrial Microbiology – Patel A.H.
8. Textbook of Biotechnology – R.C. Dubey,

## DSE – 3 – A: Paper MIC - XI: Immunology

**Total Credits: 3**  
**Contact hrs: 45**

### **Unit I. Immune Response** (10)

A) Adaptive Immunity

a) Humoral (antibody) mediated response –Cells involved and mechanism

b) Cell mediated – cells involved, mechanism (endogenous and exogenous pathways); cytokines and their role

c) **Monoclonal antibodies** – i) Production (hybridoma technology) ii) Applications of Monoclonal antibodies in Diagnosis, Research and Treatment

### **Unit II. Major Histocompatibility complex** (12)

A. Organization of MHC genes in man, Classes of MHC molecules – structure and their role,

B. HLA typing

C. Types of grafts and their rejection.

### **Unit III. Complement system** (05)

A. Components of complement and their properties,

B. Activation of complement –classical and alternate pathway

C. Biological effects of complement

### **Unit IV Immunological disorders** (12)

**A. Hypersensitivity** – Classification - based on 1. Time: Immediate and delayed type hypersensitivity

2. Mechanism of Pathogenesis

a) **Type I** : Anaphylaxis, Atopy

b) **Type II** : Autohaemolytic anemia

c) **Type III** : Arthus reaction, Serum sickness

d) **Type IV**: contact dermatitis, Allergy of infection

**B. Autoimmunity** :a. Mechanism of Autoimmunity

b. Types of Autoimmune diseases- a) Hemocytolytic b) Organ Specific

(Graves disease, Myasthenia gravis) c) Non organ specific (S.L.E., R.A.)

### **Unit V Immunohaematology** (6)

A. ABO blood group system

B. Rh blood group system

C. Blood transfusion reaction and its complications

### **References**

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. Medical laboratory technology – RamnaikSood

6. Diagnostic Microbiology – Bailey's and Scotts

7. Immunology – a problem approach by Wood, Hood and Weison

8. Medical Bacteriology – Dey and Dey

9. Handbook of Immunology- G.P. Talwar (1983) Vikas Publishing Pvt. Ltd

10. Textbooks of medical microbiology- Anant Narayan

11. Immunology & Serology- Carpenter.

**SEC – 1 : Paper MIC – XII : Industrial Microbiology – I**

**Total Credits: 3**

**Contact hrs: 45**

**Unit I Food Microbiology**

**(10)**

- A. Food as a substrate for microorganisms
- B. Food Spoilage (Meat and Poultry, Fruits and Vegetables)& food borne diseases-food infection (Salmonella) & food poisoning (Clostridium)
- C. Principle and methods of food preservation
- D. Food Fermentations – i) Idli ii) Bread

**Unit II Dairy Microbiology**

**(07)**

- a. Spoilage of milk
- b. Fermented dairy products: i) Cheese ii) curd iii) Yogurt

**Unit III Industrial production of**

**(10)**

- A. Streptomycin
- B. Lysine
- C. rDNA products – Insulin

**Unit IV Production of alcoholic beverages**

**(8)**

- A. Grape wine – Definition, types, production of White table wine and Red table wine
- B. Post fermentation spoilage of wines: Microbial and non microbial spoilage of wines
- C. Beer – Definition, types, production of Lager beer and Ales Beer.

**Unit V Downstream processing and quality control:**

**(10)**

**A) Downstream processing:**

Filtration, Cross flow filtration, Flocculation, Whole broth processing  
Solvent extraction, Concentration, Centrifugation, Crystallization,  
Distillation, Adsorption elution, Precipitation and Chromatography

**B) Quality control in fermentation industry:** Test for sterility, pyrogenicity, allergy,  
Carcinogenicity, toxicity for Pharmaceutical and health care and food products

**References**

1. Principles of fermentation technology – Whitkar and Stanbury
2. Pharmaceutical Microbiology – Huggo
3. Biochemistry – Fox and Nelson
4. Industrial Microbiology – Prescott and Dunn
5. Microbial technology – Pepler
6. Advances in Biotechnology – S.W. Jogdand.
7. Textbook of Biotechnology – R.C. Dubey,
8. Biotechnology – B.D. Singh
9. Industrial Microbiology – Casida
10. Industrial Microbiology by A.H. Patel.
11. Food Microbiology: an Introduction by Adam and Dick
12. Food Microbiology by Frazier

## SEC – 2 : Paper MIC – XII: Industrial Microbiology – II

**Total Credits: 1.5**  
**Contact hrs: 23**

### **Unit I: Industrial Sterilization and Control of Contamination (10)**

- A) Sterilization of
  - 1. Bioreactor
  - 2. Other Mechanical System
  - 3. Fermentation Media
- B) Control of Contamination

### **Unit II : Specific Fermentations (07)**

- A) Amylase
- B) Vitamin B 12
- C) Citric Acid

### **Unit III : Fermented Food Products (08)**

- A) Fermented Food – Idli, Bread
- B) Dairy Product – Cheese, Yogurt

### **Unit IV: Downstream processing (10)**

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 (10)**

- A) Fermentation Economics
- B) Biosafety and Bioethics

### **References**

1. Principles of fermentation technology – Whitkar and Stanbury
2. Pharmaceutical Microbiology – Huggo
3. Industrial Microbiology – Prescott and Dunn
4. Microbial technology – Pepler
5. Advances in Biotechnology – S.W. Jogdand.
6. Textbook of Biotechnology – R.C. Dubey,
7. Biotechnology – B.D. Singh
8. Industrial Microbiology – Casida
9. Industrial Microbiology by A.H. Patel.
10. Food Microbiology by Frazear
11. An Introduction to Industrial Microbiology By S. Chand and Company Ltd.
12. Industrial Microbiology by Agrawal

# Semester VI

## DSE – 1 – B:PaperMIC - XIII: Microbial Genetics

**Total Credits:3**  
**Contact hrs: 45**

**Unit I: Basic concepts of microbial genetics** (9)

- A) Structural organization of *Escherichia coli* 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

**Unit II: Effect of mutation in bacteria** (10)

- A) Effect of mutation on translation
- B) Effect of mutation on phenotypes
- C) Time course of phenotypic expression
- D) Selection, detection and Isolation of mutants
- E) Genetic Complementation – Cis – Trans Test

**Unit III: Genetic engineering and Protein engineering** (12)

- A) Introduction, Tools and Techniques of Genetic engineering
- B) Applications of Genetic engineering
- C) Protein Engineering – concept and applications

**Unit IV : Techniques in molecular biology** (8)

- A) Electrophoresis of DNA.
- B) DNA sequencing – Sanger Dideoxy method
- C) DNA finger printing- method and applications

**Unit V Bioinformatics** (06)

- A. Introduction to Bioinformatics.
- B. Introduction to major bioinformatics resources on Internet: National Centre for Biotechnology Information (NCBI), DDBJ, EMBL.
- C) Protein data bank (PDB) and Nucleic acid sequence database (GenBank)
- D) The Basic Local Alignment Search Tool (BLAST)

**References:**

1. General microbiology – Stanier
2. General microbiology – Pawar and Dagainawala 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
8. Genetics of bacteria and their viruses – William Hays
9. <http://www.ncbi.nlm.nih.gov/>

## DSE – 2 – B: Paper MIC - XIV: Microbial Biochemistry

Total Credits:3

Contact hrs: 45

### Unit I Enzyme, Enzyme kinetics and regulation

(12)

#### A) Enzymes:

(i) Definition, properties, structure, specificity, mechanism of action (Lock and key model, induced fit hypothesis)

(ii) Allosteric enzymes – Definition, Two models explaining mechanism of action (Sequential and Concerted)

(iii) Ribozymes and Isozymes

iv) Factors affecting catalytic efficiency of enzymes

i) Proximity, orientation ii) Strain and distortion iii) Acid base catalysis iv) Covalent catalysis

B) **Enzyme kinetics** – Derivation of Michaelis-Menten equation, Significance of  $K_m$  and  $V_{max}$

#### C) 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) Cell disruption and homogenization of membrane bound enzymes, Extraction

B) Purification of enzymes on the basis of - i) Molecular size ii) Solubility

iii) Electric charge iv) Adsorption characteristics) Biological affinity

C) Immobilization of enzymes – Methods and applications

D) Assay of enzymes (enzyme unit, enzyme activity, Specific activity)

### Unit III Assimilation of:

(7)

A. Carbon

B. Nitrogen –  $N_2$  and  $NH_3$  (GOGAT)

C. Sulphur

### Unit IV Bioenergetics:

A) Pyruvate as key metabolite in Carbohydrate metabolism

(8)

B) Metabolic Pathways

i) PP Pathway

ii) Phosphoketolase pathway

C) Bioluminescence

### Unit V Biosynthesis of:

(12)

A) Nucleotides B) Protein C) Peptidoglycan

### References:

1. Molecular Biology of Gene – J.D. Watson

2. Principles and techniques of Practical Biochemistry – K. Wilsons J.Walkar.

3. Analytical Chemistry – Robert B. Dilts

4. Chromatographic methods by Braithwaite and White

5. Outline of Biochemistry – Cohn and Stump

6. Biochemistry – West and Todd Russel

7. Biochemistry – Lehninger

8. Enzymes – Dixon and Web

9. Biological chemistry – Mahler and Cordes

10. Nature of Enzymology – R.L. Foster

11. Microbial technology – Peppler

12. Biochemistry – A problem approach by Wood, Hood and Weison

## DSE – 3 – B Paper MIC - XV: Environmental Microbiology

**Total Credits: 3**  
**Contact hrs: 45**

### **Unit I Air microbiology** (9)

- 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

### **Unit II A) Marine microbiology and Fresh water ecosystem** (9)

- A. Microorganisms in marine water, methods to study aquatic microorganisms. Characteristics of marine environment, types of organisms and their role.
- B. Fresh water ecosystem : Eutrophication, Types of fresh water bodies a) Classification of lakes  
b) Sources c) Consequences d) Control

### **Unit III Extremophiles:** (9)

General characteristics of extremophiles and their role -  
Acidophiles, Alkalophiles, Thermophiles, Psychrophiles, Barophiles and Osmophiles

### **Unit IV Environmental impact assessment and Industrial Waste Management:** (9)

- A)Types of wastes, Waste water assessment and management, BOD, COD,
- B. **Industrial waste treatment** : Characteristics and treatment of wastes from different industries, – paper and pulp, sugar and distillery, textile, and dairy industries,
- C) Bioremediation :Lead, mercury, arsenic and radioactive substances

### **Unit V Geomicrobiology** (9)

- A) Introduction, Microorganisms involved, Biochemistry of microbial leaching, Commercial leaching – slope, heap, in situ leaching, Leaching of Iron, Copper and Uranium,
- B) Oilrecovery: Methods – primary, secondary, and microbially enhanced oil recovery,

### **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

## SEC – 3 – Paper MIC - XVI: Clinical Microbiology - I

Total Credits:1.5

Contact hrs: 23

### Unit I : Clinical Bacteriology

(13)

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

1. *Pseudomonas aeruginosa*
2. *Mycobacterium leprae*
3. *Helicobacter pylori*
4. *Treponema pallidum*
5. *Clostridium perfringens*
6. *Mycobacterium tuberculosis*
7. *Vibrio cholera*
8. *Leptospirosis*
9. *Rickettsia rickettsiae* (Epidemic Typhus Fever)

**Unit II Clinical Mycology** (Morphology, cultural and biochemical characters, antigenic structures, modes of transmission, pathogenesis, symptoms, laboratory diagnosis, prophylaxis and treatment of following diseases) (05)

1. Candidiasis
2. Aspergillosis
- 3.

### Unit III Clinical Parasitology

(Morphology, cultural and biochemical characters, antigenic structures, modes of transmission, pathogenesis, symptoms, laboratory diagnosis, prophylaxis and treatment of following diseases) (06)

1. Malaria
2. Giardiasis
3. Amoebiasis
- 4.

### Unit IV Clinical Virology

(11)

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

1. Herpes (Simplex)
2. Rabies
3. Hepatitis A and B
4. AIDS
5. Swine flu
6. Ebola

### Unit V Chemotherapy

(10)

A) Antimicrobial Drugs

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 folic acid synthesis: Sulphonamide, Trimethoprim,
- v. Antiviral drug: Azidothymidine,
- vi. Antifungal Drugs: Amphotericin, Nystatin

D) Methods of antibiotic sensitivity testing : i) Disc diffusion ii) MIC determination

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 – Chatterjee
8. Medical laboratory technology – Ramnaik Sood
9. Diagnostic Microbiology – Bailey's and Scotts
10. Medical Bacteriology – Dey and Dey



## SEC – 4– Paper MIC - XVI: Clinical Microbiology - II

**Total Credits:1.5**

**Contact hrs: 23**

### **Unit I Biomedical Waste Management (06)**

Laboratory disposal of – Sharp devices, Smear Slides, Cultures, Culture Media and Clinical Samples, Fomites

### **Unit II Automation in Bacteriology (06)**

Introduction, BACTEC System, ATB System, ViTEK System, API System

### **Unit III Epidemiology (12)**

A) Basics of Epidemiology

B) Emerging and re-emerging diseases

C) Mechanism of emergence of new pathogens – 1. Microbial Change and Adaptation 2. Horizontal Gene Transfer 3. Pathogenicity Islands

D) Control of Epidemics – a) Control of Transmission b) Control by Isolation c) Community based Control by Vaccination d) Public Health Organization for control – Introduction of CDC, WHO

E) Bioterrorism

F) Molecular Epidemiological Tools – Biotyping, Serotyping, Phage Typing, Ribotyping, RFLP and PCR

### **Unit IV Nosocomial Infection (Etiology, Transmission, Clinical Features, Laboratory Diagnosis, Prophylaxis and treatment) (16)**

A) Bacterial :*Streptococcus pyogenes*, *Staphylococcus aureus*, *E. coli*, *Proteus spp.*, *Pseudomonas aeruginosa*, *Klebsiella pneumonia*, *Mycobacterium tuberculosis*

B) Viral :HIV, Hepatitis, Swine Flu, Herpes

C) Fungal : Candidiasis, Aspergillosis

D)Protozoal :Malaria, Amoebiasis

### **Unit V Vaccines (05)**

a) Types

1. Attenuated, Live

2. Killed

3. Toxoids

4. Subunit Toxins

5. Recombinant

6. DNA

7. Conjugated

b) Adjuvant

### **References:**

1. Microbiology by Prescott, Harley and Klein, McGraw Hill Int.Edn.
2. Microbiology : An Introduction by Tortora, Funke and Case (Pearson Edn.)
3. Textbook of Microbiology by Anantnarayan and Panikar
4. Textbook of Medical Laboratory Techniques (Clinical Laboratory Science and Molecular Diagnosis) by Praful B. Godkar and Darshan P. Godkar

## PRACTICAL COURSE

### Practical V:

**Total Credits: 3**

**Contact hrs: 75**

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
6. Isolation of Lac negative mutants of *E.coli* by visual detection method.
7. Isolation of Streptomycin resistant mutants by gradient plate technique.
8. Isolation of Vitamin B12 requiring (auxotrophic) mutants by replica plate technique.
9. Cultivation of Viruses in Embryonated chicken egg
10. Study of Virally infected lesions of Plant materials
11. Browsing of National Centre for Biotechnology Information (NCBI), DDBJ and EMBL websites.
12. Exploring protein sequence database (PDB) and GeneBank and BLAST.

### Practical VI:

**Total Credits: 3**

**Contact hrs: 75**

1. Isolation of **Azotobacter** from soil. (Identification up to genus level)
2. Isolation of **Rhizobium** from root nodules.
3. Isolation of **Xanthomonas** from infected plant material
4. SPC of market **Biofertilizers**.
5. Estimation of available phosphorous from soil (Stannous chloride method)
6. Estimation of Calcium and Magnesium from soil (EDTA method)
7. Determination of organic carbon contents of soil (Walkley and Black method)
8. Diauxic growth curve of *Escherichia coli* (glucose and lactose).
9. Immobilization of enzyme by using Sodium alginate
10. Thin layer chromatography- amino acid
11. Study of Substrate concentration on enzyme activity.
12. Purification of enzyme by dialysis and study of its activity

### Practical VII:

**Total Credits: 3**

**Contact hrs: 75**

1. Study of Phagocytic index
2. Separation and Preservation of Serum and Plasma
3. Widal test (quantitative test), RA test, Pregnancy test
4. Haematology – RBC count, WBC count, differential WBC count, Erythrocyte sedimentation
5. Immunodiffusion test.
6. VDRL Test
7. Microbiological analysis Drinking water: Presumptive, Confirmed and Completed test
8. Determination of potability of water by MPN.
9. Waste water analysis: Chemical Oxygen Demand (COD)
10. Biological Oxygen Demand (BOD)
11. Study of Microflora from air (With reference to Morphological Characters)
12. Isolation of Thermophilic Bacteria

## **Practical VIII:**

### **A)**

1. Examination of milk **i)** DMC **ii)** Quantitative analysis of milk by SPC (using nutrient agar)
2. Phosphatase Test (qualitative)
3. Study of bacteria from spoiled food
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  $K_2Cr_2O_7$

### **B)**

1. Production of citric acid by *Aspergillus niger* and estimation of Citric acid by titration method
2. SPC Of Idli batter.
3. Bioassay of Vitamin B<sub>12</sub>
4. Sterility testing of media and pharmaceutical products
5. Isolation of Lactic acid Bacteria (MRS Medium)
6. Amylase assay (Iodometric method)

### **C)**

1. Isolation of pathogen from clinical sample *Pseudomonas aeruginosa/E.coli*
2. 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
3. Antimicrobial susceptibility testing by disc diffusion method
4. Study of synergistic action of antibiotics
5. Determination of minimum inhibitory concentration (MIC).of penicillin on *S.aureus*.
6. Urine analysis : Microscopic examination – pus cells, RBC, bacteria, crystals. Chemical examination – glucose (benedict's method, protein (acetic acid), bile salt (sulphur method), Bile pigment (Faucher's method) ketone bodies (Rothera's test)

### **D)**

1. Isolation of pathogen from clinical sample *Klebsiella pneumoniae*
2. Isolation of pathogen from clinical sample *Staphylococcus aureus*
3. Detection of malarial parasites in blood smears by Leishmans method
4. Preparation of killed TAB vaccine.
5. Isolation and study of cultural characteristics of pathogens from water.
6. Disposal of clinical specimens-sputum, urine, pus, blood and stool

## **Practical Examination**

A) The university practical examination will be conducted on four (4) consecutive days for not less than 6 hours on each day of the practical examination. The practical examination shall be conducted by the two external examiners appointed by the University.

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 V VI VII each.

- 1) One major experiment: 30 marks
- 2) Two minor experiment: 15 marks each
- 3) Journal: 5 marks

For practical VIII .( Two out of A,B,Cand D)For each

- 1) One major experiment: 15 marks
- 2) One minor experiment: 8 marks
- 3) One minor experiment: 7 marks
- 4)Journal:2.5 marks

### **Total marks:**

Practical V: 65 Marks

Practical VI: 65 Marks

Practical VII: 65 Marks

Practical VIII: 2x 32.5=65 Marks

Tour Report : 20 Marks

**Total Marks: 280**

### **Practical wise distribution of marks for examination**

#### **Practical V:**

#### **Q1 (MARKS 30)**

Isolation of coliphages from sewage

OR

Isolation of Lac negative mutants of *E.coli* by visual detection method.

OR

Isolation of Streptomycin resistant mutants by gradient plate technique.

OR

Isolation of Vitamin B12 requiring (auxotrophic) mutants by replica plate technique.

#### **Q2(MARKS 15)**

Electrophoretic separation of DNA

OR

Determination of dose of U.V. by UV survival curve

OR

Study of Virally infected lesions of Plant materials

OR

Exploring protein sequence database (PDB) and GeneBank and BLAST.

#### **Q3(MARKS 15)**

Isolation of DNA from bacteria by J. Marmur's method .

OR

One step growth curve

OR

Cultivation of Viruses in Embryonated chicken egg .

OR

Browsing of National Centre for Biotechnology Information (NCBI), DDBJ and EMBL websites.

Q4 Journal (MARKS 5)

**Practical VI:**

**Q1(MARKS 30)**

Isolation of **Azotobacter** from soil. (Identification up to genus level

OR

Isolation of **Rhizobium** from root nodules.

OR

Isolation of **Xanthomonas** from infected plant material

OR

SPC of market **Biofertilizers**.

**Q2(MARKS 15)**

Diauxic growth curve of *Escherichia coli* (glucose and lactose)..

OR

Immobilization of enzyme by using Sodium alginate .

OR

Study of Substrate concentration on enzyme activity. .

OR

Purification of enzyme by dialysis and study of its activity .

**Q3(MARKS 15)**

Estimation of available phosphorous from soil (Stannous chloride method) .

OR

Estimation of Calcium and Magnesium from soil (EDTA method) .

OR

Determination of organic carbon contents of soil (Walkley and Black method) .

OR

Thin layer chromatography- amino acid .

Q4 Journal (MARKS 5)

**Practical VII:**

Q1.(MARKS 30)

Microbiological analysis Drinking water: Presumptive, Confirmed and Completed test

OR

Waste water analysis: Chemical Oxygen Demand (COD)

OR

.Biological Oxygen Demand (BOD)

OR

. Isolation of Thermophilic Bacteria

**Q2(MARKS 15)**

Study of Phagocytic index .

OR

Separation and Preservation of Serum and Plasma .

OR

VDRL Test .

OR

Determination of potability of water by MPN..

**Q3(MARKS 15)**

Widal test (quantitative test), RA test, Pregnancy test .

OR

.Haematology :RBC count, WBC count, differential WBC count, Erythrocyte sedimentation.

OR

Immunodiffusion test..

OR

Study of Microflora from air (With reference to Morphological Characters).

Q4 Journal (MARKS 5)

**Practical VIII:**

**A)**

Q1)(MARKS 15)

Quantitative analysis of milk by SPC (using nutrient agar)

. OR

Bioassay of Penicillin

Q2.(MARKS 8)

Study of bacteria from spoiled food .

OR

Production of wine by using Jaggery medium by *S. cerevisiae*- examination of pH, colour, taste.

OR

Estimation of alcohol by using  $K_2Cr_2O_7$ .

Q3(MARKS 7)

Examination of milk i) DMC

OR

Phosphatase Test (qualitative)

**B)**

Q1.(MARKS 15)

SPC Of Idli batter.

OR

Isolation of Lactic acid Bacteria

Q2.(MARKS 8)

Bioassay of Vitamin B<sub>12</sub>

OR

Amylase assay (Iodometric method)

Q3(MARKS 7)

Sterility testing of media and pharmaceutical products .

OR

Production of citric acid by *Aspergillus niger* and estimation of Citric acid by titration method

**C)**

Q1(MARKS 15)

Isolation of pathogen from clinical sample *Pseudomonas aeruginosa/E.coli*

OR

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

Q2.(MARKS 8)

Study of synergistic action of antibiotics .

OR

Urine analysis : Microscopic examination – pus cells, RBC, bacteria, crystals. Chemical examination – glucose (benedict's method, protein (acetic acid), bile salt (sulphur method), Bile pigment (Faucher's method) ketone bodies (Rothera's test) .

Q3(MARKS 7)

Antimicrobial susceptibility testing by disc diffusion method .

OR

Determination of minimum inhibitory concentration (MIC).of penicillin on *S.aureus*.

**D)**

Q1(MARKS 15)

Isolation of pathogen from clinical sample *Klebsiellapneumoniae*

OR

Isolation of pathogen from clinical sample *Staphylococcus aureus*

Q2.(MARKS 8)

Preparation of killed TAB vaccine..

OR

Isolation and study of cultural characteristics of pathogens from water.

Q3(MARKS 7)

Disposal of clinical specimens-sputum,urine,pus,blood and stool .

OR

Detection of malarial parasites in blood smears by Leishmansmethod .

### **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