

**Punyashlok Ahilyadevi Holkar Solapur University, Solapur**



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

**Name of the Faculty: Science & Technology**

**CHOICE BASED CREDIT SYSTEM**

**Syllabus: Microbiology**

**Name of the Course: B. Sc. Part- III (Sem. V & VI)**

**(Syllabus to be implemented from w.e.f. June 2021)**

**P.A.H.Solapur University, Solapur , Faculty of Science**  
**Choice Based Credit System (CBCS)**  
**B.Sc.-III Microbiology**  
**( 2021-2022 : W.e.f. June 2021)**

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**Introduction:**

The Curriculum development plays a very vital role in the development of quality of education. The education system should be such that students will be able to compete locally, regionally, nationally as well as globally. The present situation demands developing “learner-centric approach while redesigning of curriculum. There is also need to allow the flexibility in education system. The choice based credit system (CBCS) allows students to choose inter-disciplinary, intra-disciplinary courses, skill oriented papers and thus offers more flexibility for student. The courses can be evaluated following the grading system, which is considered to be better than the conventional marks system. In view of this,PAH Solapur University, Solapur has implemented Choice Based Credit System of Evaluation at Undergraduate level. While designing the syllabi of microbiology for undergraduate course for semester V and VI, an attempt has been made to follow the pattern given in the UGCs Undergraduate Template. This will help to bring a match across all the Indian universities.

Microbiology deals with the study of microorganisms. This branch of life science has immensely grown up widening its horizons and opening new frontiers of knowledge. The scope of microbiology as a subject is immense due to its ability to control all critical points of many fields like medical, dairy, pharmaceutical, industrial, clinical, research, water industry, agriculture, nanotechnology, etc. A career in microbiology is lucrative option. There is demand of trained microbiologists in a vast range of industries and institutes like research and development laboratories of government and private hospitals, research organizations, pharmaceutical, food, beverage and chemical industries. To cater the needs, discipline specific papers on industrial,agricultural,environmental,medicalmicrobiology,microbial biochemistry,virology,immunology have been included in the curriculum for semester V and VI. At the same time, the framework is so designed as to maintain standards of microbiology degree and the learning outcomes.

**Learning Outcomes based approach to Curriculum Planning:**

The Learning Outcomes-based Curriculum Framework (LOCF) for the B.Sc. (Honours) degree in Microbiology is designed to suit the need of the hour, in keeping with the emergence of new areas of microbiology. The framework is architected to allow for flexibility in programme design and course content development, while at the same time maintaining a basic uniformity in structure in comparison with other universities across the country. The programme is designed to build a strong microbiology knowledge base in the student and furthermore, acquaints the students with the applied aspects of this fascinating discipline as well. The student is thus equipped to pursue higher studies in an institution of her/his choice, and to apply the skills learnt in the programme to solving practical societal problems. The programme offers an elective course to the student for skill enhancement courses that prepares the student for an eventual job in academia or industry.

**Graduate Attributes in Microbiology:**

Some of the characteristic attributes of an Honors graduate in Microbiology include:

- **Disciplinary Knowledge acquisition:** gathers in-depth knowledge of basic and applied areas of microbiology.

- **Core microbiology laboratory skills:** understands various methods of safe handling, culturing and storage of microorganisms in the laboratory.
- **Interdisciplinary approach:** becomes aware of the role of microbiology in interdisciplinary research as well as in daily life.
- **Environmental literacy:** develops a basic understanding of the microbiological principles that have environmental implications, and gains an awareness of regulatory requirements and their compliance in biotechnology and microbiological research.
- **Thinking ability:** inculcates independent thinking and apply knowledge acquired.
- **Spirit of Team work:** Reveals the importance of interacting with and working alongside people from diverse backgrounds.
- **Global perspective:** becomes acquainted with standard international practices and emerging technologies used to study microbes.
- **Skills for Communication:** acquires oral as well as written skills through oral presentations of ongoing developments in the field and compiling of information in brief in written format.
- **Ethical awareness:** develops attitude of conducting their work with honesty
- **Self-motivation:** develops planning, organization and time management skills.
- **Digitally literatracy:** : acquires Skills of using computers for Bioinformatics and computation and appropriate software for analysis of genomics and proteomics data, and employing modern bioinformatics search tools to locate, retrieve, and evaluate location and biological annotation genes of different species.

### **Outline of Choice Based Credit System:**

1. **Core Course:** A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course.

2. **Elective Course:** Generally a course which can be chosen from a pool of courses and which may be very specific or specialized or advanced or supportive to the discipline/subject of study or which provides an extended scope or which enables an exposure to some other discipline/subject/domain or nurtures the candidate's proficiency/skill is called an Elective Course.

Discipline Specific Elective (DSE) Course: Elective courses may be offered by the main discipline/subject of study is referred to as Discipline Specific Elective.

3. **Ability Enhancement Courses (AEC):** The Ability Enhancement (AE) Courses may be of two kinds: Ability Enhancement Compulsory Courses (AECC) and Skill Enhancement Courses (SEC). "AECC" courses are the courses based upon the content that leads to Knowledge enhancement; (i) Environmental Science and (ii) English/MIL Communication. These are mandatory for all disciplines. SEC courses are value-based and/or skill-based and are aimed at providing hands-on-training, competencies, skills, etc.

- **Credit:** Credit is a numerical value that indicates students work load (Lectures, Lab work, Seminar, 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. 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 20 marks and University Evaluation for 80 marks.

**PAH Solapur University, Solapur**  
**Faculty of Science-New**  
**Choice Based Credit System (CBCS)- (w.e.f.2021-22)**  
**Draft Structure for B. Sc-III**

Subject/ Core Course	Name and Type of the Paper		No. of papers/ Practical	Hrs/week			Total Marks Per Paper	UA	CA	Credits	
	Type	Name		L	T	P					
<b>Class :</b>	<b>B.Sc.- III Semester – V</b>										
Ability Enhancement Course(AECC)	English (Business English)		Paper- III	4.0	--	--	50	40	10	2.0	
<b>Discipline Specific Elective (DSE)</b> (Students can opt any one subjects among the three Subjects excluding interdisciplinary offered at B.Sc II.	DSE-1A- Virology		Paper- IX	4	--	--	100	80	20	4.0	
			DSE- 2 A- Agricultural Microbiology	Paper -X	4	--	--	100	80	20	4.0
			DSE- 3 A- Immunology	Paper- XI	4	--	--	100	80	20	4.0
			DSE 4 A-: Industrial Microbiology	Paper- XII	4	--	--	100	80	20	4.0
			(Add-on-self learning)* MOOC/SWAYAM COURSE/INTERNSHIP		--	--	--	--	--	--	4.0
<b>Grand Total</b>				<b>20</b>	<b>--</b>	<b>--</b>	<b>450</b>	<b>360</b>	<b>90</b>	<b>22</b>	
<b>Class :</b>	<b>B.Sc.- III Semester –VI</b>										
Ability Enhancement Course(AECC)	English (Business English)		Paper IV	4.0	--	--	50	40	10	2.0	
<b>DSE</b> (Students can opt any one subjects among the three Subjects excluding interdisciplinary offered at B.Sc. II.	DSE- 1B- Microbial Genetics		Paper -XIII	4.0	--	--	100	80	20	4.0	
			DSE- 2B- Microbial Biochemistry	Paper- XIV	4.0	--	--	100	80	20	4.0

	<b>DSE- 3B- Clinical Microbiology</b>	Paper- XV	4.0	--	--	100	80	20	4.0
	<b>DSE 4B- Environmental Microbiology</b>	Paper- XVI	4.0	--	--	100	80	20	4.0
	<b>SEC-</b>								
<b>Total (Theory)</b>			<b>20</b>	<b>--</b>	<b>--</b>	<b>450</b>	<b>360</b>	<b>90</b>	<b>18</b>
<b>DSE - Practical (Annual Exam)</b>	<b>DSE- 1 A&amp;B</b>	Practical- IX & XIII	--	--	5	100	80	20	4.0
	<b>DSE -2 A&amp;B</b>	Practical- X&XIV	--	--	5	100	80	20	4.0
	<b>DSE- 3 A&amp;B</b>	Practical- XI&XV			5	100	80	20	4.0
	<b>DSE- 4 A &amp; B</b>	Practical- XII & XVI			5	100	80	20	4.0
<b>Total (Practicals)</b>				<b>20</b>	<b>400</b>	<b>320</b>	<b>80</b>	<b>16</b>	
<b>Grand Total</b>			<b>40</b>		<b>20</b>	<b>1300</b>	<b>1140</b>	<b>160</b>	<b>56</b>

### 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	500	20	--	--	20
	II	550	20	400	16	36
<b>B.Sc.-II</b>	III	350	14	--	--	14
	IV	350	14	300	12	26
<b>B.Sc.-III</b>	V	450	22	--	--	22
	VI	450	18	400	16	34
<b>Total</b>		2650	108	1100	44	152

#### B.Sc.Programme :

**Total Marks** : Theory + Practical's = 2650 +1100 =3850

**Credits** : Theory + Practical's = 108 + 44 = 152

**Numbers of Papers** Theory: Ability Enhancement Course(AECC) 05

Theory: Discipline Specific Elective Paper (DSE) 08

Theory: DSC 12

Skill Enhancement Courses /Add on 01

**Total** : Theory Papers 31

: Practical Papers 11

#### Abbreviations :

L: Lectures

T: Tutorials

P: Practicals

UA : University Assessment

CA : College Assessment

DSC / CC: Core Course

AEC : Ability Enhancement Course

DSE : Discipline Specific Elective Paper

SEC : Skill Enhancement Course  
GE : Generic Elective  
CA: Continuous Assessment  
ESE: End Semester Examination

**PAH SOLAPUR UNIVERSITY, SOLAPUR**  
**Faculty of Science**  
**Choice Based Credit System (CBCS)**  
**(W.e.f. 2021-22)**

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

• **Introduction:** This course provides a broad overview of Microbiology and to produces expert hands that would have sufficient knowledge and expertise to solve the urgent problems of the region by using Microbiology knowledge. The course structure is basic science centric where students learn core science and are taught necessary fundamental subject for that purpose.

• **Objectives of the course:** The objectives of B. Sc. Microbiology course are:

- 1) To impart knowledge with respect to the subject and its practicable applicability.
- 2) To enhance understanding of basic and advanced concepts in microbiology.
- 3) To develop the awareness of various emerging areas of Microbiology.
- 4) To train students for further studies helping in their bright career in the subject
- 5) To expose the students to different processes used in industries and in research field
- 6) To develop their ability to apply the knowledge of microbiology in day to day life.
- 7) To prepare the students to accept the challenges in life sciences.
- 8) To make students skillful to work in various industries, research labs and health sector.

**Course outcome and Advantages:** After completing the course students will be familiarized the with necessary laboratory techniques and tools of microbiology and provide an exposure in research, analytical and presentational skills. Microbiology has tremendous job potential. The successful students will be able well trained to get various microbiology related job. .

- Medium of Instruction: English
- Syllabus Structure:
- The University follows semester system.
- An academic year shall consist of two semesters.
- B.Sc. Part-III Microbiology shall consist of two semesters: Semester V and Semester VI

In semester V: there will be Four DSC papers having paper IX to XII of 100 marks each. There will a Compulsory paper on “Ability Enhancement Compulsory Course (AECC )” on English and one self learning compulsory course of any one from -MOOC/SWAYAM COURSE/INTERNSHIP

In Semester VI: there will be four DSC papers having paper XIII to paperXVI of 100 marks each. There will a Compulsory paper on “Ability Enhancement Compulsory Course (AECC )” on English

The scheme of evaluation of performance of candidates shall be based on University Assessment (UA) as well as College Internal Assessment (CA) as given below.

For B.Sc.Part-III Microbiology SemV& VI the “internal assessment” will be based on Internal tests, Home assignment, Tutorials, Open Book Examination, Seminars, Group discussion, Brain storming sessions etc. as given below.

- Practical course examination is of 100 marks shall be conducted at the end of semester II. The practical examination of 400 marks shall also consist of 320 marks for University practical assessment and 80 marks for college internal assessment (CA).
- **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 20 marks and external evaluation (University assessment) of 80 marks..

**Semester – V:** Theory: (100 marks): Comprising DSE-

- a) University Examination (UA) (80 marks): No. of theory papers: 4 (paper IX to paper XII)
- b) Internal Continuous Assessment (CA) (20 marks) No. of theory papers: 4 (paper IX to paper XII)
- c) Compulsory paper on “Ability Enhancement Compulsory Course (AECC)” on English
- d) One Add-on - self learning course MOOC/SWAYAM COURSE/INTERNSHIP/college level add on course

Internal test- Home assignment / tutorials / seminars / viva/ group discussion/ outreach programs.

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**Semester – VI:** Theory: (100 marks): Comprising DSE-

- a) University Examination (UA) (80 marks): No. of theory papers: 4 (paper XIII to paper XVI)
- b) Internal Continuous Assessment (CA) (20 marks) No. of theory papers: 4 (paper XIII to paper XVI)

Internal test- Home assignment / tutorials / seminars / viva/ group discussion/ outreach programs.

**Practical Examination:** (400 marks)

University Examination (320 marks): Number of practicals : 04

Practical-I: Based on Papers- IX & XIII (80 UA + 20 CA)

Practical-II: Based on Papers- X & XIV :(80 UA + 20 CA)

Practical-III: Based on papers -XI& XV :(80 UA + 20 CA)

Practical-IV: Based on papers -XII& XVI :(80 UA + 20 CA)

**Internal Continuous Assessment:** Total 80

- (a) Internal practical test and
- (b) Viva/group discussion/model or chart/attitude/attendance/overall behavior
- (c) University practical examination of 320 marks (Practical I to IV for Four separate days) will be conducted at the end of semester VI

**Passing Standard:**

The student has to secure a minimum of 4.0 grade points (Grade C) in each paper.

A student who secure less than 4.0 grade point (39% or less marks, Grade FC/FR) will be declared fail in that paper and shall be required to reappear for respective paper. A student who failed in University Examination (theory) and passed in internal assessment of a same paper shall be given FC Grade. Such student will have to reappear 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 reappear 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 stipulated marks of external examination and his/her performance shall be scaled to 100 marks.

• **ATKT:**

passed in all papers except 6 (six) papers combined together of semester III and IV of B.Sc. Part-II Microbiology examination and clearly passed in B.Sc. Part-I-Microbiology shall be permitted to enter upon the course of Semester V of B.Sc. III Microbiology.



**PAH SOLAPUR UNIVERSITY, SOLAPUR**  
Faculty of Science and technology  
New CBCS Structure for B.Sc – III Microbiology Theory -

**Semester V**

Paper No.	Title of Paper	Hrs/Week			Paper Marks	UA	CA	Credits
		L	T	P				
Ability Enhancement Course(AECC)	<b>English (Business English)</b>	4	-	-	50	40	10	2
DSE-IX	<b>DSE- 1A-</b> Virology	4	-	-	100	80	20	4
DSE-X	<b>DSE- 2A-</b> Agricultural Microbiology	4	-	-	100	80	20	4
DSE-XI	<b>DSE- 3A-</b> Immunology	4	-	-	100	80	20	4
DSE-XII	<b>DSE 4A-</b> Industrial Microbiology	4	-	-	100	80	20	4
SEC-	<b>Add-on-self learning - MOOC/SWAYAM COURSE/INTERNSHIP</b>	--	-	--	--	--	--	4
Total		20	-	-	450	360	90	22

**Semester –VI**

Paper No.	Title of Paper	Hrs/Week			Paper Marks	UA	CA	Credits
		L	T	P				
Ability Enhancement Course(AECC)	<b>English (Business English)</b>	4	-	-	50	40	10	2
DSE- -XIII	<b>DSE- 1B-</b> Microbial Genetics	4	-	-	100	80	20	4
DSE-XIV	<b>DSE- 2B-</b> Environmental Microbiology	4	-	-	100	80	20	4
DSE-XV	<b>DSE- 3B-</b> Clinical microbiology Microbiology	4	-	-	100	80	20	4
DSE-A	<b>DSE 4B-</b> Microbial Biochemistry	4	-	-	100	80	20	4
SEC-								
Total		20			450	360	90	18

Practical No.	Paper No. based on	Title of Paper	Hrs/Week			Paper Marks	UA	CA	Credits
			L	T	P				
<b>I</b>	Papers - IX & XIII	<b>DSE-1A-</b> Virology <b>AND</b> <b>DSE- 1B-</b> Microbial Genetics	-	-	5	100	80	20	4
<b>II</b>	Papers - X&XI V	<b>DSE- 2 A -</b> Agricultural Microbiology <b>AND</b> <b>DSE- 2B -</b> Environmental Microbiology	-	-	5	100	80	20	4
<b>III</b>	Papers - XI&X V	<b>DSE- 3A-</b> Immunology <b>AND</b> <b>DSE- 3 B -</b> Clinical Microbiology	-	-	5	100	80	20	4
<b>IV</b>	Papers - XII & XVI	<b>DSE 4 A- :</b> Industrial Microbiology <b>AND</b> <b>DSE 4B-</b> Microbial Biochemistry	-	-	5	100	80	20	4
	<b>Total</b>		-	-	<b>20</b>	<b>400</b>	<b>320</b>	<b>80</b>	<b>16</b>

**Abbreviations:**

L: Lectures

T: Tutorials

P: Practicals

UA: University Assessment by End Semester Examination

CA: College Assessment by Internal Continuous Examination

**PAH SOLAPUR UNIVERSITY, SOLAPUR (CBCS)**  
**Theory Syllabus**  
**B.Sc. III-Microbiology (Semester-V)**  
**w. e. f. June 2021**

**[Credits -4, Total Lectures-60]**

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

- Unit I Introduction and Classification of Viruses (11)**
- 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 (11)**
- A. T<sub>4</sub> Bacteriophage - Lytic cycle
  - B. Temperate phages and lysogeny of  $\lambda$  phages
- Unit III Animal Viruses (14)**
- 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 (12)**
- A. Viral plant Diseases – Tobacco mosaic virus[TMV],Cauliflower Mosaic virus[ CaMV]
  - B. Prevention and Control of Plant Viral Diseases
- Unit V Techniques in Virology (12)**
- A. Isolation, cultivation,Purification and Enumeration of viruses
  - B. One step growth experiment

**References:**

1. General microbiology – Stanier
2. General microbiology – Pawar and Daginawala 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

**PAH SOLAPUR UNIVERSITY, SOLAPUR (CBCS)**  
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**B.Sc. III-Microbiology (Semester-V)**  
**w. e. f. June 2021**

[Credits -4, Total Lectures-60]

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

**Unit I- Introduction to Soil Microbiology** (11)

- A. Introduction to soil– Definition of soil, Soil formation, types, structure and properties
- B. Soil as an ecosystem, rhizosphere and phyllosphere
- C. Soil microorganisms, types and their role in soil fertility, humus.
- D. Interactions in soil.

**Unit II- Role of microorganisms in elemental cycle** (11)

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

**Unit III- Composting and Biodegradation** (14)

- 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, Pectin, and Pesticides

**Unit IV- Plant pathology** (12)

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

**Unit V Applications of Biotechnology in Agriculture** (12)

- A. Biofertilisers (Azo and Rhizo and PSB) production and applications.
- B. Bioinsecticides – *Bacillus thuringiensis* and *Trichoderma viridae*, Other examples
- C. Genetically Modified Crops with examples
- D. Viral pesticides: Concepts & applications

**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,

**PAH SOLAPUR UNIVERSITY, SOLAPUR (CBCS)**  
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[Credits -4, Total Lectures-60]

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

**Unit I. Immune system and Adaptive Immunity** (16)

**A] Immune system**

a] structure & function of lymphoid organs:

1] Primary and organs - Thymus, bone marrow,

2] Secondary lymphoid organs-- spleen, lymph node and Mucosa associated lymphoid tissue (MALT)

b] cells of immune system & their role

i]. Classification of cells of immune system - Lymphoid and myeloid cells

ii]. Structure and functions of Lymphoid cells - T cells and T cell subsets, NK cells, B cells and dendritic cells

iii]. Structure and functions of myeloid cells - Granulocytes, Monocytes and macrophages

**B] 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) Primary and secondary immune response

d) **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**

(06)

A. Components of complement and their properties,

B. Activation of complement - classical and alternate pathway

C. Biological effects of complement

**Unit IV Immunological disorders**

(16)

**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) Hemolytic b) Organ Specific (Graves disease, Myasthenia gravis, pernicious anemia)

c) Non organ specific (S.L.E., R.A.)

**Unit V Immunohaematology**

**(10)**

- 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.



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**w. e. f. June 2021**

[Credits -4, Total Lectures-60]

**DSC – 4A : Paper MIC – XII : Industrial Microbiology**

**Unit I Food Microbiology** (11)

- 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** (11)

- A] Spoilage of milk
- B] Fermented dairy products: i) Cheese ii) Yogurt

**Unit III Industrial production of** (12)

- A. Streptomycin
- B. Lysine
- C. rDNA products – Insulin
- D. Vitamin B12

**Unit IV Production of alcoholic beverages** (12)

- 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:** (14)

**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

**PAH SOLAPUR UNIVERSITY, SOLAPUR (CBCS)**

**Theory Syllabus**

**B.Sc. III-Microbiology (Semester-V)**

**w. e. f. June 2021**

**[Credits -4, Total Lectures-60]**

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

**Unit I: Basic concepts of microbial genetics (11)**

- 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 (12)**

- 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 (14)**

- 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 (12)**

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

**Unit V Bioinformatics (11)**

- 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/>



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**DSE – 2 – B Paper MIC - XIV: Environmental Microbiology**

**Unit I: Air microbiology and biosafety issues** **(16)**

- A] Concept and definition of biosafety, objectives of biosafety, NIH guidelines
- B] Regulatory framework of biosafety in India-
  - a] Recombinant DNA, Advisory committee [RDAC]
  - b] Institutional biosafety committee [ISBC]
  - c] State biosafety coordination committee [SBCC]
  - d] District level biosafety committee [DLBC]
- C] Microorganisms in air – Launching, transport and deposition of aerosols, survival of microorganisms in air
- D] Significance of microorganisms in air (extramural and intramural)
- E] Methods to study air borne microorganisms. Sampling, qualitative and quantitative methods.
- F] Bioaerosol control (ventilation, filtration, biocidal control, UV gaseous (quarantine))

**Unit II : Marine microbiology and Fresh water ecosystem** **(10)**

- 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:** **(8)**

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

**Unit IV Environmental impact assessment and Industrial Waste Management:** **(12)**

- 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 and carbon sequestration** **(14)**

- 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,

C) Concept of carbon sequestration and carbon credit

**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

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**DSE – 3 B– Paper MIC - XV: Clinical Microbiology**

**Unit I: Microbial diseases**

**(24)**

(characters of etiological agent, , modes of transmission, pathogenesis, symptoms, laboratory diagnosis, prophylaxis and treatment of following diseases)

**1. Bacterial:** 1. Pseudomonas aeruginosa 2. Mycobacterium leprae 3. Clostridium perfringens 4. Vibrio cholerae

**2. Viral:** 1. Rabies 2. AIDS 3. Swine flu 4. Ebola

**3. Fungal:** 1. Dermatophycoses [Tinea], 2. cryptococcosis

**4. protozoal:** 1. Malaria 2. Giardiasis

**Unit II :Biomedical Waste Management**

**(06)**

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

**Unit III mechanism of Pathogenicity –**

**(8)**

**1.** Definition & Concept

**2.** Basic principles of Microbial adhesion

**3.** Mechanism of Bacterial invasion

**4.** Bacterial toxins – Types & mechanism of action

**5.** Mechanism of pathogenicity of viral & fungal infections

**Unit IV: Vaccinology & bioweapons**

**(8)**

**1.** Basic concept

**2.** Types: A] traditional-live attenuated, killed, toxoids

B] New generation vaccines: subunit, Recombinant, conjugated, DNA

**3.** Definition, Characteristics of bioweapons, Advantages & disadvantages of bioweapons, Examples

**Unit-V : Chemotherapy**

**(14)**

**1.** Ideal characteristics of chemotherapeutic agents

**2.** Mechanism of action of different chemotherapeutic agents:

A] antibiotics

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,

B] antiviral agents

C] antifungal agents

D] antiprotozoal agents

**3.** Mechanism of antibiotic resistance

**4.** Tests to guide chemotherapy: diffusion and broth dilution methods



**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 – RamnaikSood
9. Diagnostic Microbiology – Bailey's and Scotts
10. Medical Bacteriology – Dey and Dey

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**DSE – 4– B: Paper MIC - XVI: Microbial Biochemistry**

**Unit I Enzyme, Enzyme kinetics and regulation** (16)

**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 MichaelisMenten 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** (10)

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:** (10)

A. Carbon

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

C. Sulphur

**Unit IV Bioenergetics:**

A) Pyruvate as key metabolite in Carbohydrate metabolism (14)

**B) Metabolic Pathways**

i) ED pathway

ii) Glyoxylate bypass

iii) Pentose Phosphate Pathway

iv) Phosphoketolase pathway

**C) Bioluminescence**

**Unit VBiosynthesisof:****(10)**

A) Nucleotides- Purines and pyrimidines 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 – Pepler
12. Biochemistry – A problem approach by Wood, Hood and Weison

**PAH SOLAPUR UNIVERSITY, SOLAPUR (CBCS)**  
**B.Sc. III-Microbiology**  
**w. e. f. June 2021 --Practicals Syllabus**  
**( Credits-4 )**

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**PRACTICAL COURSE**

**Practical V:**

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:**

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. Microbiological analysis Drinking water: Presumptive, Confirmed and Completed test
9. Determination of potability of water by MPN.
10. Waste water analysis: Chemical Oxygen Demand (COD)
11. Biological Oxygen Demand (BOD)

**Practical VII:**

1. Separation and Preservation of Serum and Plasma
2. Widal test (quantitative test), RA test, Pregnancy test
3. Haematology –
  - 1] Estimation of Hb by Sahlis method
  - 2] Total blood cell count: RBC count, WBC count,
  - 3] differential WBC count
  - 4] Determination of Erythrocyte sedimentation Rate
4. Isolation of pathogen from clinical sample *Pseudomonas aeruginosa/E.coli*
5. 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

6. Antimicrobial susceptibility testing by disc diffusion method

7. Urine analysis :

A] Microscopic examination – pus cells, RBC, bacteria, crystals.

B] Chemical examination –

1] glucose (Benedict's method),

2] protein (acetic acid),

3] bile salt (sulphur method),

4] ketone bodies (Rothera's test)

### **Practical VIII:**

1. Examination of milk

i) DMC

ii) Quantitative analysis of milk by SPC (using nutrient agar)

2. Phosphatase Test (qualitative)

3. Isolation and identification of microorganisms from spoiled food

4. Bioassay of Streptomycin

5. Estimation of alcohol by using  $K_2Cr_2O_7$

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

7. Immobilization of enzyme by using Sodium alginate

8. Thin layer chromatography- amino acid

9. Study of Substrate concentration on enzyme activity.

10. Purification of enzyme and study of its activity

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

12. Bioassay of Vitamin B12

13. Sterility testing of media and pharmaceutical

products

14. Isolation of Lactic acid Bacteria (MRS Medium)

15. Amylase assay (Iodometric method)

## **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**

- 1) One major experiment: 30 marks
- 2) Two minor experiment: 15 marks each
- 3) Journal: 5 marks
- 4) Viva:10

#### **Total marks:**

Practical V:	75
Practical VI:	75
Practical VII:	75
Practical VIII:	75
Tour Report :	20
<b>Total Marks:</b>	<b>320</b>

Practical V      Marks: 75

### **Que1. Major Experiments**

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

OR

Isolation of coliphages from sewage

## Que2. Minor Experiments

One step growth curve

OR

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

OR

Cultivation of Viruses in Embryonated chicken egg

OR

Study of Virally infected lesions of Plant materials

OR

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

## Que3. Minor Experiments

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.

OR

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

## Practical VI

### Que 1 Major Experiment

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

Biological Oxygen Demand (BOD)

OR

Microbiological analysis Drinking water: Presumptive, Confirmed and Completed test

### Que2 Minor Experiment

SPC of market **Biofertilizers**.

OR

Determination of potability of water by MPN.

### **Que 3 Minor Experiment**

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

Waste water analysis: Chemical Oxygen Demand (COD)

## **Practical VII**

### **Que. 1 Major Experiment**

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

### **Que 2 Minor Experiment**

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

OR

Estimation of Hb by Sahlis method

OR

RBC count/ WBC count/differential WBC count

OR

Determination of Erythrocyte sedimentation Rate

OR

Microscopic examination – pus cells, RBC, bacteria, crystals.

OR

Chemical examination – glucose (benedict's method),protein (acetic acid),bile salt (sulphur method), ketone bodies (Rothera's test)



**Que. 3 Minor Experiment**

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

OR

Antimicrobial susceptibility testing by disc diffusion method

**Practical VIII**

**Que 1 Major experiment**

Bioassay of Streptomycin

OR

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

OR

Isolation and identification of microorganisms from spoiled food

OR

Examination of milk -DMC & Quantitative analysis of milk by SPC (using nutrient agar)

OR

Isolation of Lactic acid Bacteria (MRS Medium)

**Que 2 Minor Experiment**

Phosphatase Test(qualitative)

OR

Estimation of alcohol by using K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub>

OR

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

OR

Sterility testing of media and pharmaceutical products

OR

Amylase assay (Iodometric method)

**Que 3 Minor Experiment**

.Immobilization of enzyme by using Sodium alginate

OR

Thin layer chromatography- amino acid

OR

Study of Substrate concentration on enzyme activity.

OR

Purification of enzyme and study of its activity

OR

Estimation of Citric acid by titration method

**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