"Dissemination of Education for Knowledge, Science and Culture"
-Shikshanmaharshi Dr. Bapuji Salunkhe

Shri Swami Vivekanand Shikshan Sanstha's

VIVEKANANDCOLLEGE, KOLHAPUR

(EMPOWERED AUTONOMOUS)

DEPARTMENT OF MICROBIOLOGY

Three/Four- Years UG Programme

Department/Subject Specific Core or Major (DSC)

NEP- Phase-II

Curriculum, Teaching and Evaluation Structure

(as per NEP-2020 Guidelines)

for

B.Sc.-I Microbiology
Semester-I&II

(Implemented from academic year 2024-25 onwards)

B.Sc.–I (Sem -I and II) Microbiology

Course Structure

Department of Microbiology

B.Sc.: Program Outcomes (POs):

PO 1: Disciplinary Knowledge: Graduates will gain in-depth understanding in their specific major or discipline, mastering the foundational principles and theories, as well as advanced concepts. Execute theoretical and practical knowledge developed from the specific curriculum.

PO 2: Problem-Solving Skills: Graduates will learn to use their knowledge to identify, analyze and solve problems related to their field of study.

PO 3: Analytical Skills: Graduates will gain the ability to collect, analyze, interpret, and apply data in a variety of contexts. They might also learn to use specialized software or equipment.

PO 4: Research Skills and Scientific Temper: Graduates might learn how to design and conduct experiments or studies, analyze results and draw conclusions. They might also learn to review and understand academic literature.

PO 5: Environment and Sustainability: Possess a sympathetic awareness of the environment while conducting research and scientific studies and focus on sustainable social development.

B.Sc. in Microbiology: Program Specific Outcomes (PSOs):

PSO1: Perform the basic techniques related to screening, isolation and cultivation of microorganism from various sources.

PSO2: Understand microorganisms and their relationship with the environment.

PSO3: Conduct the basic research with this microorganism and perform the diagnostic procedures required in food, milk and pharmaceutical industries**.**

PSO4: Follow the aseptic techniques and conduct the process of sterilization as well as perform the techniques to control the microorganism.

PSO5: Produce and analyze the microbial product at laboratory level.

VIVEKANANDCOLLEGE, KOLHAPUR(EMPOWEREDAUTONOMOUS)

Department of Microbiology Teaching and Evaluation scheme Three / Four-Years UG Program

Department/Subject Specific Core or Major (DSC)

First Year Semester- I & II

Sr. No.	Course Abbr.	Course code	Course Name	Teaching Scheme Hours/week		Examination Scheme and Marks				Course Credits
				TH	PR	ESE	CIE	PR	Marks	
Semester-I										
1	DSC-I	2DSC03MIC11	Introduction to Microbiology	2	-	40	10	-	50	2
2	DSC-II	2DSC03 MIC12	Bacteriology	2	-	40	10	-	50	2
3	DSC MIC-PR-I	2DSC03MIC19	DSC Microbiology Lab-1	-	4	-	-	25	25	2
4	OEC LFS - PR-I	2OEC03LFS14	Techniques in Microbiology I	-	4	-	-	25	25	2
Semester –I Total				**4**	**8**	**80**	**20**	**50**	**150**	**8**
Semester-II										
1	DSC-III	2DSC03MIC21	Basic Biochemistry-I	2	-	40	10	-	50	2
2	DSC-IV	2DSC03MIC22	Microbial nutrition and techniques	2	-	40	10	-	50	2
3	DSC ELE-PR-II	2DSC03MIC29	Techniques in Microbiology II	-	4	-	-	25	25	2
4	OECLFS-PR-II	2OEC03LFS24	DSC Microbiology Lab-1	-	4	-	-	25	25	2
Semester –II Total				**4**	**8**	**80**	**20**	**50**	**150**	**8**

Abbreviations: TH-Theory, PR-Practical, PRO- Project, ESE- End Semester Examination, CIE-Continuous Internal Examination

Note: Minimum passing for 10 marks Internal evaluation = 04 marks
Minimum passing for 40 marks Theory paper = 16 marks
Minimum passing for 25 marks Practical = 10 marks
Minimum passing for 50 marks Practical/FP/OJT = 20 marks
Minimum passing for 100 marks Practical/FP = 40 marks
Passing percentage for Democracy, Election and Good Governance (DEGG) and Environmental Studies papers should be 40%

Separate passing for each Head - ESE, CIE and Practicals

B.Sc. PART-I

SEMESTER- I

2DSC03MIC11: INTRODUCTION TO MICROBIOLOGY

Course Outcomes: Upon successful completion of the course, students are expected to be able to-

CO1: Acquire knowledge of the diversity, distribution & significance of different types of microorganisms.

CO2: Understand the structure & functions of various cell organelles of bacteria.

CO3: Explain bacterial taxonomy & systems for classification of microorganisms.

CO4: Understand the basic microbial structure &study the comparative characteristics of prokaryotes & eukaryotes.

Unit I	**History of microbiology and types of microorganisms**	**No. of HoursperUnit/ Credit**
	1. Spontaneous generation *vs*. biogenesis. 2.Contributions of: a) Antony Von Leeuwenhoek b) Edward Jenner c) Louis Pasteur d) Rober tKoch e) Joseph Lister f) Alexander Fleming g) Hargobindsingh Khorana. 3. Classification of microorganisms– a) Whittaker'sfive kingdom b) Carl Woese's three kingdom classification systems. 4.Taxonomic ranks 5. Beneficial and harmful activities of microorganisms.	**15**
Unit II	**Unit-2: Types of Microorganisms**	**15**
	1.General characteristics of different groups: a) Acellular microorganisms- Viruses, Viroids, Prions	

	b) Cellular microorganisms- with emphasis on distribution, occurrence and morphology. i) Bacteria, ii) Fungi, iii) Algae, iv) Protozoa c) Structure of Prokaryotic and eukaryotic cell. d) Difference between prokaryotic & eukaryotic microorganisms.	
Unit III	**BACTERIAL CELL ORGANIZATION**	**15**
	1. Cell size, shape and arrangement, 2. Reserve food materials– a) Nitrogenous b) Non-nitrogenous	
Unit IV	**CYTOLOGY OF BACTERIA**	**15**
	3. Structure and Function of- a) Cell-wall b) Cell membrane c) Capsule and slime layer. d)Flagella and Pili e) Ribosomes f) Mesosomes g) Inclusion bodies h) Nucleoid, chromosome and plasmids i) Endospore	**15**

Reference Books:

1.Microbiology by Pelczar, M. J. Jr., Chan E. C.S., Krieq, N.R. 5th edition, 1986 (McGraw Hills Publication).

2. General Microbiology by Stanier R. Y. 5th edition, McMilan, London.

3.General Microbiology Vol I and II by Powar and Daginawala, Himalaya Publications.

4. Microbiology by Prescott, Herley and Klein, IInd edition.

2DSC03MIC12: BACTERIOLOGY		
Course Outcomes – Upon successful completion of the course, students are expected to be able to– **CO1**: Get insight into working & importance of compound microscope. **CO2**: Use different techniques for sterilization of microbiological culture media & glasswares. **CO3**: Learn about principle, construction, working & applications of electron microscope. **CO4**: Comprehend various staining methods for identification of unknown microorganism.		
Unit I	**Unit-1: General Principles of Microscopy:**	**No. of Hours per Unit/Credit**
	1. Types of microscopes: a) Light microscopes b) Electron microscopes, 2.Light microscopy: a) Parts b) Image formation c) Magnification d) Numerical aperture e) Resolving power f) Working distance 3. Ray diagram, special features and applications of: c) Compound Microscope d) Phase Contrast Microscope e) Electron Microscope 4. Fluorescence Microscope	**15**
Unit II	**STAINS AND STAINING PROCEDURES**	**15**
	1. Classification of stains–Acidic, Basic and Neutral 2. Principles, Procedure, Mechanism of staining- f) Monochrome staining g) Negative staining	

	h) Differential staining: i) Gram's staining ii) Acid fast staining 3. Special staining methods i) Cell wall (Chance's method) j) Capsule (Manvel's method) k) Volutin granule (Albert's method)	
Unit III	**CONTROL OF MICROORGANISMS I**	**15**
	1. Definitions of– a) Sterilization b) Disinfection c) Antiseptic d) Germicide e) Microbiostasis f) Antisepsis g) Sanitization **2. Mode of action and applications of-** ❖ **Physical agents**: i) Temperature –Dry heat, Moist heat ii) Desiccation iii) Ultrasonication iv) Radiations– U.V. Ray, Gamma rays v) Filtration– Asbestos and Membrane filter	
Unit IV	**CONTROL OF MICROORGANISMS II**	**15**
	Mode of action and applications of- ❖ **Chemical Agents:** i) Phenol and Phenolic compounds ii) Alcohols (Ethyl alcohol) iii) Halogen compounds (chlorine and iodine)	

	iv) Heavy metals (Cu and Hg) v) Fumigation by Gaseous Agents – a) Ethylene oxide b) Beta-propiolactone c) formaldehyde vi) Osmotic Pressure	

REFERENCE BOOKS:

1. A Biologics guide to principles, techniques of Practical Biochemistry by K. Wilson and K. H. Goulding, Edward Arnold Publication.
2. General Microbiology VolI and II by Powar and Daginawala, Himalaya Publications
3. Microbiology by Prescott, Herley and Klein, IInd edition.
4. Bacteriological Techniques by F.K. Baker
5. Introduction to Microbial Techniques by Gunasekaran

B.Sc. PART I

SEMESTER-II

2DSC03MIC21: BASIC BIOCHEMISTRY		
Course Outcomes – Upon successful completion of the course, students are expected to be able to: **CO1**: Understand building blocks of proteins & formation of polypeptides. **CO2**: Explain structure of carbohydrates & it's types with key properties. **CO3**: Learn about basic concepts of enzyme biochemistry including its structure & functions. **CO4**: Understand how nucleic acids are organized & their types.		
Unit I	**PROTEINS**	**No. of Hours Per Unit/Credit**
	❖ **Proteins:** 1) Introduction to amino acids, peptide bond. 2) Types of amino acids based on R group– a) Nonpolar, aliphatic amino acids. b) Polar, Uncharged amino acids. c) Aromatic amino acids. d) Positively charged (basic) amino acids e) Negatively charged (acidic) amino acids. 3) Structural levels of proteins: primary, secondary, tertiary and quaternary.	**15**
Unit I	**ENZYMES**	**15**
	❖ **Enzymes** 1) Definition and types of enzymes 2) Concept of apoenzyme, coenzyme, cofactor and active site 3) Mechanism of Enzyme Action- Lock and key hypothesis, Induced fit hypothesis.	

Unit III	**CARBOHYDRATES**	**15**
	1) Monosaccharides: Classification based on aldehyde and ketone groups; structure of Ribose, Deoxyribose, Glucose, and Fructose. 2) Disaccharides: Glycosidic bond, structure of lactose and sucrose. 3) Polysaccharides: Structure of starch, glycogen and cellulose.	
Unit IV	**LIPIDS AND NUCLEIC ACIDS**	**15**
	B. Lipids: 1) Simple lipids– Fats, oils and waxes. 2) Compound lipids–Phospholipid, Glycolipids 3) Derived lipids–Cholesterol **C. Nucleic Acids:** 1) DNA – Structure (Watson and Crick Model) and function. RNA–Types (m-RNA, t-RNA, r-RNA), structure & functions.	

REFERENCE BOOKS:

1. Biochemical methods by Sadasivam & Manickam
2. Elementary Microbiology Vol. I by Dr. H. A. Modi, Akta Prakashan, Nadiad, Gujrat.
3. Principles of Biochemistry by Nelson and Cox (Lehninger) – Fifth edition.
4. Biochemistry by Lubert Stryer, Jeremy M. Berg John L. Tymoczko, Seventh edition.

2DSC03MIC22: MICROBIAL NUTRITION AND TECHNIQUES

Course Outcomes – Upon successful completion of the course, students are expected to be able to –

1. Understand basic techniques used in microbiological laboratory.
2. To use techniques for isolation of bacteria.
3. Know use & applications of instruments used in microbiological laboratory.
4. Study various basic methods used in identification bacteria.
5. Know preparation of various culture media used in study of bacteria

Unit I	**MICROBIAL NUTRITION**	**No. of Hours Per Unit /Credit**
	A) Microbial Nutrition **1) Nutritional requirements of microorganisms:** a) Water; b) Micronutrients; c) Macronutrients d) Carbon, e) Energy source f) Oxygen and Hydrogen g) Nitrogen, h) Sulfur and Phosphorous i) Growth factors. Concept of auxotroph, Prototroph and fastidious organisms based on Growth factors. **2) Nutritional types of microorganism based on carbon and energy sources.** a) Autotrophs b) Heterotrophs c) Phototrophs d) Chemotrophs e) Photoautotrophs f) Chemoautotrophs g) Photoheterotrophsh. h) Chemoheterotrophs.	**15**

Unit II	CULTURE MEDIA	No. of Hours Per Unit /Credit
	Culture media: 1) Components of media 2) Types of media based on- a) Physical state-i. Solid media, ii. liquid media, iii. semisolid media b) Chemical nature- i. Natural media, ii. Synthetic media iii. Complex media c) Function - i. Selective media ii. Differential media iii. Enriched media iv. Enrichment media **D. Cultivation of microorganisms:** 1) Use of culture media for cultivation. 2) Conditions required for growth of the microorganisms	**15**
Unit III	**ENRICHMENT AND ISOLATION OF MICROORGANISMS FROM NATURAL ENVIRONMENT**	**15**
	❖ **Enrichment and Isolation of Microorganisms from natural environment.** 1) Pure culture techniques– a. Streak plate, b. Spread plate, c. Pour Plate. 2) Isolation and cultivation of anaerobic organisms by using media components and by exclusion of air. B**. Preservation of microbial cultures by–** 1) Subculturing,	

	2) Overlaying cultures with mineral oils 3) Storage at low temperature, 4) Lyophilization.	
Unit IV	**SYSTEMATIC STUDY OF PURE CULTURES**	**15**
	❖ **Systematic study of pure cultures:** 1) Morphological characteristics. 2) Cultural characteristics– Colony characteristics on solid media, growth in liquid media. 3) Biochemical Characteristics - i) Sugar fermentation ii) H2Sgasproduction iii) Detection of enzyme activity– Amylase, Caseinase, Catalase 4) Serological characters **Concept of Culture collection centers.**	

REFERENCEBOOK:

1. A text book of Microbiology by Ananthnarayan – Orient Longman, Bombay
2. General Microbiology by Stanier R. Y. Vth edition, McMilan, London.
3. General Microbiology Vol I and II by Powar and Daginawala, Himalaya Publications
4. Microbiology by Prescott, Herley and Klein, IInd edition.

DSC MICRO PR-I MICROBIOLOGY LAB-I		
Credit 2	**INTRODUCTION TO MICROBIOLOGY ANDBACTERIOLOGY**	**No. of hours per Unit/ Credit**
	1.) Preparationsof- a) Stains (0.5% basic fuchsin, 0.5% crystal violet), b) Reagents (phosphate buffer of pH 7,1N and 1M solutions of HCL and NaOH), c)physiologicalsaline. 2) Biosafety- a) Table disinfection, b) Handwash, c) Use of aprons d) Proper disposal of used material, e) Aseptic techniques, f) Cleaning and sterilization of glassware's 3) Study of Laboratory instruments used in the Microbiology laboratory: g) Laminar air flow h) Autoclave, incubator i) Hot air oven j) Colorimeter k) Colony counter l) Bacteriological filter assembly 4) Study of compound microscope. 5) Microscopic observation of bacteria: m) Monochrome staining, n) Negative staining, o) Gram's staining, p)Motility by Hanging-drop method. q) Cell wall staining (Chance's method), r) Capsule staining (Manuval's method), s) Volutine granule staining (Albert's method) t) Demonstration of Acid–Fast staining 6) Preparation of liquid and solid culture media-. u) Agar plates v) Slants w) Peptone water d) Nutrient broth e) Nutrient agar f) Sabourauds agar	**30**

	g) Potato Dextrose agar h) Glucose yeast extract agar; i) MacConkey's agar. 7) Preparation of solid and liquid medium and assuring its sterility by autoclave and hot air oven. 8) Sterilization of glassware using Hot Air Oven and assessment for sterility 9) Fungal Mounting-*Penicillium and Aspergillus* 10) Personal hygiene- Demonstration of presence of bacteria from hands, teeth and skin (swabbing) by cultivation methods. 11) Detection of enzyme production ability of bacteria- i) Amylase ii) Catalase iii) Caseinase	

ReferenceBooks:

1) Stains and Staining procedures by Desai and Desai.

2) Introduction to Practical Biochemistry by D. Plummer, J Wiley and Sons.

3) Bacteriological techniques by F.J. Baker.

4) Introduction to Microbial techniques by Gunasekaran.

5) Biochemical methods by Sadasivam and D. Manickam.

6) Laboratory methods in Biochemistry by J. Jayaraman.

7) Experimental Microbiology by Patel & Patel.

DSC MICRO PR-I MICROBIOLOGY LAB-II		
Credit 2	**INTRODUCTION TO MICROBIOLOGY ANDBACTERIOLOGY**	**No. of HoursperUnit/Credit**
	1) Isolation of pure cultures of bacteria by four quadrant streaking method**,** and studies of Colony characteristics, Gram staining and motility of– *i) Escherichia coli* *ii) Bacillus species* *iii)Staphylococcus aureus* 2) Biochemical tests: a. Detection of glucose and lactose fermentation ability of bacteria b. Detection of H_2S production ability of bacteria 3) Preparation of serial dilutions of water and soil for isolation of bacteria. **4)** Isolation of bacteria from water (spread plate technique) and soil (pour plate technique) by preparation of serial dilutions. **5)** . Enumeration of bacteria from water and milk by SPC method. 6) Isolation of actinomycetes from soil by slide culture technique	**30**

Reference Books:

1) Introduction to Practical Biochemistry by D. Plummer, J Wiley and Sons.

2) Bacteriological techniques by F.J. Baker.

3) Introduction to Microbial techniques by Gunasekaran.

4) Biochemical methods by Sadasivam and D. Manickam.

5) Laboratory methods in Biochemistry by J. Jayaraman.

6) Experimental Microbiology by Patel & Patel.

OEC LFS-PR-I Techniques in Microbiology-I

Course Outcomes -

Upon successful completion of course, students are expected to be able to-

1) Understand basic techniques used in microbiological laboratory.
2) To use techniques for isolation of bacteria.
3) Know use & applications of instruments used in microbiological laboratory.
4) Study various basic methods used in identification bacteria.
5) Know preparation of various culture media used in study of bacteria

Credit **2**		**No. of hours per Unit/ Credit**
	1) Study of compound microscope. 2) Preparations of- a) Stains (0.5%basic fuchsin, 0.5% crystal violet) b) Physiological saline. 3) Biosafety- a) Table disinfection, b) handwash, c) use of aprons d) proper disposal of used material, e) Aseptic techniques, f) Cleaning and sterilization of glass wares. 4) Study of Laboratory instruments used in the microbiology laboratory: a) Laminar airflow b) autoclave, incubator c) hot air oven d) colorimeter e) colony counter 5) Sterilization of glassware using Hot Air Oven and assessment for sterility 6) Microscopic observation of bacteria: a) Monochrome staining b) Gram's staining, c) Motility by Hanging- drop method. 7) Preparation of liquid and solid culture media-. a) Agar plates b) slants c) Peptone water d) Nutrient broth e) Nutrient agar	**15**

	f) Potato Dextrose agar g) MacConkey's agar. 8) Isolation of bacteria from water by four quadrant method. 9) Isolation of bacteria from water (spread plate technique) by preparation of serial dilutions 10) Passive air sampling for bacteria 11) Personal hygiene- Demonstration of presence of bacteria from hands and skin (swabbing) by cultivation methods.	

REFERENCES:

1) Stains and Staining procedures by Desai and Desai.
2) Bacteriological techniques by F. J. Baker.
3) Introduction to Microbial techniques by Gunasekaran.
4) Experimental Microbiology by Patel & Patel.

OEC LFS-PR-I Techniques in Microbiology-II

Course outcome's

Upon successful completion of course, students are expected to be able to-

1) Students will gain practical knowledge to identify a specific bacterium on the basis of morphological, cultural, biochemical serological characteristics.
2) Students will develop practical hand by using these techniques.
3) Students will learn about the effect of pH, temperature, salt, antibiotics on growth of microorganism.
4) Students will gain knowledge about how to detect susceptibility of antibiotics on microorganisms.

Credits 2		**No. of hours per Unit/ Credit**
	1) Effect of temperature on growth of microorganism 2) Effect of pH on growth of microorganism 3) Effect of salt on growth of microorganism 4) Effect of antibiotics on growth of microorganism 5) Effect of heavy metals on growth of microorganism 6) Primary Screening of antibiotics producing microorganism (by Crowded Plate Technique) 7) Detection of antibacterial activity on growth of microorganisms by agar well Method 8) Detection of antifungal activity on growth of microorganisms by disc diffusion Method 9) Isolation of pure cultures of bacteria by four quadrant streaking method and study of colony characteristics, Gram staining and motility- a) *Bacillus species* b) *Staphylococcus aureus* c) *Escherichia coli* 10) Biochemical tests: a) Sugar fermentation test b) H2S test 11) Detection of enzyme production ability of bacteria a) Caseinase b) Catalase	**30**

	c) Amylase 12) Serological tests a) WIDAL test b) Blood group and Rh factor determination 13) Determination of size of bacteria by micrometry	

REFERENCES:

1) Introduction to Practical Biochemistry by D. Plummer, J Wiley and Sons.
2) Bacteriological techniques by F.J. Baker.
3) Introduction to Microbial techniques by Gunasekaran.
4) Biochemical methods by Sadasivam and D. Manickam.
5) Laboratory methods in Biochemistry by J. Jayaraman.
6) Experimental Microbiology by Patel & Patel.

EVALUATIONPATTERN

Scheme of Marking: Theory

Sem.	Course Code	Marks	Evaluation	Answer Books	Standard Of passing
I	2MIC03 DSC11	40	Semester wise	Asper Instruction	40%
II	2MIC03 DSC12	40	Semester wise	As per Instruction	40%
III	2MIC03 DSC21	40	Semester wise	As per Instruction	40%
IV	2MIC03 DSC22	40	Semester wise	As per Instruction	40%

Scheme of Marking: Continuous Internal Evaluation (CIE)

Sem.	Course Code	Marks	Evaluation	Sections	Answer Books	Standard of passing
I	2MIC03 DSC11	10	Semester wise	-	As per Instruction	40% (4marks)
II	2MIC03 DSC12	10	Semester wise	-	As per Instruction	40% (4marks)
III	2MIC03 DSC21	10	Semesterwise	-	As per Instruction	40% (4marks)
IV	2MIC03 DSC22	10	Semester wise	-	As per Instruction	40% (4marks)

Scheme of Marking: Practical

Sem.	CourseCode	Marks	Evaluation	Sections	Standardof Passing
I andII	MBP101	25	Semester wise	As per Instruction	40%
	MBP102	25		As per Instruction	

Nature of Question Paper

Instructions: 1) All the questions are **compulsory**.
2)Figures to the right indicate **full** marks.
3) Draw neat labeled diagrams **wherever** necessary.
4) Use of calculator is allowed.

Time:2 hours TotalMarks:40

PAPER-I/PAPER-II

Que. 1 Select correct alternative. (8)

i)
a) b) c) d)

ii)
a) b) c) d)

iii)
a) b) c) d)

iv)
a) b) c) d)

v)
a) b) c) d)

vi)
a) b) c) d)

vii)
a) b) c) d)

viii)
a) b) c) d)

Que. 2 Attempt any Two. (16)

i)
ii)
iii)

Que. 3 Attempt any Four. (16)

i)
ii)
iii)
iv)
v)
vi)

Practical Examination

A) Practical examination will be conducted in two consecutive days for six hours per day per batch of the practical examination

B) Each candidate must produce a certificate from the Head of the Department in her/his college, stating that he/she has completed in a satisfactory manner the practical course on lines laid down from time to time by Academic council on the recommendations of Board of Studies and that journal has been properly maintained. Every candidate must have recorded his/her observations in the laboratory journal and have written a report on each exercise performed. Every journal is to be checked and signed periodically by a member of teaching staff and certified by the Head of the Department at the end of the semester. Candidates must produce their journals at the time of practical examination.

Nature of Question Paper

Semester I/ Semester II

TotalMarks:25

Que. 1 Detection of enzyme activity- Amylase/ Catalase/ Caseinase 10

OR

Que. 1 Isolation of pure cultures of bacteria by four quadrant streaking method and study of colony characteristics, Gram staining and motility- *Bacillus species/ Staphylococcus aureus/ Escherichia coli*

OR

Que. 1 Enumeration of bacteria from water and milk by SPC method.

Que. 2 Microscopic observation of bacteria by- Cell wall staining/ Capsule staining 5

OR

Que. 2 Detection of H2S production/ Glucose or Lactose fermentation ability

Que. 3 Spotting's 5

Que. 4 Journal 3

Que. 5 Viva Voce 2