

**“Education for Knowledge, Science and Culture”**

**-Shikshanmaharshi Dr. Bapuji Salunkhe.**

**Shri Swami Vivekanand Shikshan Sanstha's**

**VIVEKANAND COLLEGE (AUTONOMOUS),  
KOLHAPUR**



**SYLLABUS FOR**

**B.Sc.Part-II**

**MICROBIOLOGY**

**CBCS PATTERN**

**SYLLABUS TO BE IMPLEMENTED**

**From August 2022**

# VIVEKANAND COLLEGE, KOLHAPUR (AUTONOMOUS)

B.Sc.Part- II Semester –III

MICROBIOLOGY

THEORY ; 60 hrs (75 lectures)

Total Marks - 100 (paper –V and VI, Credit 4)

PAPER V DSC 1010 C1 :Microbial Physiology and Metabolism

Credit II

Marks - 50

Unit/credit – 1 (15 hrs)

Unit/credit – 2 (15 hrs)

PAPER VI DSC 1010 C2: Industrial and Applied Microbiology

Credit II

Marks - 50

Unit/credit – 1 (15 hrs)

Unit/credit – 2 (15 hrs)

B.Sc.Part- II Semester –IV

MICROBIOLOGY

THEORY ; 60 hrs (75 lectures)

Total Marks - 100 (paper –VII and VIII, Credit 4)

PAPER VII DSC 1010 D1 : Microbial Genetics and Molecular Biology

Credit II

Marks - 50

Unit/credit – 1 (15 hrs)

Unit/credit – 2 (15 hrs)

PAPER VIII DSC 1010 D2 : Basics in Medical Microbiology and Immunology

Credit II

Marks - 50

Unit/credit – 1 (15 hrs)

Unit/credit – 2 (15 hrs)

## Programme Specific Outcomes

- Upon completion of B.Sc. Microbiology programme , student will be able to -
- Perform the basic techniques related to screening, isolation and cultivation of microorganism from various sources.
- Understand microorganisms and their relationship with the environment
- Conduct the basic research with microorganism and perform the identification procedures required in food, milk and pharmaceutical industries.
- Follow the aseptic techniques and conduct the process of sterilization as well as perform the techniques to control the microorganisms.
- Produce and analyze the microbial product at laboratory level.

## STRUCTURE OF COURSE

<b>Sr. No</b>	<b>Course code</b>	<b>Title of the course</b>	<b>Theory</b>	<b>Internal</b>	<b>Total Marks</b>
<b>Semester III</b>					
1	DSC-1010C1	Microbial Physiology and Metabolism	70	30	100
2	DSC-1010C2	Industrial and Applied Microbiology	70	30	100
4	SEC –SC	Microbiological analysis of air and water	-	-	
5	AECC -ENV	Environmental Science			
<b>Semester IV</b>					
5	DSC-1010D 1	Microbial Genetics and Molecular Biology	70	30	100
6	DSC-1010 D2	Basics in Medical Microbiology and Immunology	70	30	100
8	SEC-SD	Microbial diagnosis in health clinics			50
9	AECC - ENV	Environmental Science			50

## B.Sc. Part II Microbiology

### SEMESTER-III

Paper V	DSC- 1010C : Microbial Physiology , Metabolism	No. of Hours per Unit/Credit
<p>Expected Course Outcomes –</p> <p>Upon successful completion of course, students are expected to be able to-</p> <ul style="list-style-type: none"><li>• Explain various phases of growth in bacteria and various environmental factors affecting it.</li><li>• Explain the microbial physiology , patterns of growth and various methods of bacterial growth measurement .</li><li>• Inter relate between anabolism and catabolism.</li><li>• Understand metabolic pathways &amp; mode of energy generation.</li><li>• Understand nutrient uptake and transport across the cell membrane .</li></ul>		
<b>Unit I/ Credit I</b>	<b>Microbial Physiology &amp; Metabolism</b>	15
	<p>A] Growth : Growth phases, measurement of growth, continuous growth, synchronous growth and diauxic growth</p> <p>B] Effect of environmental factors on microbial growth :</p> <p>i) Temperature: -</p> <p>a) Mesophiles, psychrophiles, thermophiles and hyperthermophiles.</p> <p>b)Thermal destruction of bacteria -</p> <p>D, F and Z values, TDP and TDT</p> <p>ii)pH -</p> <p>Neutrophiles, Acidophiles and Alkalophiles</p> <p>iii)Osmotic pressure –</p> <p>Isotonic, hypotonic and hypertonic environments, xerophiles and halophiles.</p> <p>iv)Heavy metals</p> <p>v) Radiations - U. V rays</p>	

	<p>C] Transport across cell membrane –</p> <p>Diffusion, active transport and group translocation.</p>	
<p><b>Unit II/ Credit II</b></p>	<p><b>Microbial Metabolism</b></p>	15
	<p>A] Catabolism of glucose –</p> <p>EMP, HMP, ED and TCA cycle.</p> <p>B] Fermentation: -</p> <p>Homolactic &amp; Heterolactic fermentation</p> <p>C] Bacterial electron transport chain –</p> <p>Components, flow of electrons &amp; mechanism of ATP generation – Chemiosmotic hypothesis.</p>	

Paper VI	DSC- 1010C : <b>Industrial and Applied Microbiology</b>	<b>No. of Hours per Unit/Credit</b>
<p>Expected Course Outcomes –            Upon successful completion of course, students are expected to be able to-</p> <ul style="list-style-type: none"> <li>• Learn and control bioreactor for maximizing the production.</li> <li>• Know the applications and limitations of different bioinformatics and statistical methods in biology.</li> <li>• Understand basic fermentation process, design of fermenters and their types.</li> <li>• Understand principle and working of various instruments used in laboratory.</li> <li>• Understand and design sampling methods for microbial examination of air.</li> </ul>		
<b>Unit I Credit I</b>	<b>Industrial Microbiology</b>	<b>15</b>
	<p>A)Basic concepts of fermentation.</p> <p>i)Definition, concept of primary and secondary metabolites.</p> <p>ii)Types of fermentations – Batch, continuous, dual and multiple fermentation.</p> <p>iii)Typical Fermentor design – Parts and their functions.</p> <p>iv) Factors affecting fermentation process.</p> <p style="padding-left: 40px;">a) Growth related factors-fermentation media,fermentation microorganism , inoculums preparation, design of fermentor , sterilization of fermentation media, aeration and agitation, Temperature, pH , foam production , contamination.</p> <p style="padding-left: 40px;">b) Purification related factors- product recovery.</p> <p>B)Fermentation media –</p> <p style="padding-left: 40px;">i) Major components - Water, carbon source, nitrogen source, precursors</p> <p style="padding-left: 40px;">ii) Minor components – growth factors, antifoam agents, chelating agents.</p> <p>C) Screening –</p> <p style="padding-left: 40px;">i) Types of screening - primary screening and secondary screening</p> <p style="padding-left: 40px;">ii) Primary screening of antibiotic , vitamin , organic acid and enzyme producers.</p> <p style="padding-left: 40px;">iii) Secondary screening with respect to antibiotic producers.</p>	

<b>Unit II</b>  <b>Credit II</b>	<b>Applied Microbiology, Biostatistics and Bioinformatics</b>	<b>15</b>
	<p>A] Air Microbiology:</p> <ul style="list-style-type: none"> <li>i) Sources of microorganisms in air.</li>   <li>ii) Definitions of - a) Infectious dust, <ul style="list-style-type: none"> <li>b) Droplets,</li> <li>c) Droplet nuclei</li> </ul> </li>   <li>iii) Sampling methods for microbial examination of air - <ul style="list-style-type: none"> <li>a) Solid impaction - Sieve device</li> <li>b) Liquid Impingement – Bead-bubbler device</li> </ul> </li>   <li>iv) Gnotobiology- Introduction</li> </ul> <p>B] Bioinstrumentation :</p> <p>Principle , working and application of -</p> <ul style="list-style-type: none"> <li>i) Electrophoresis ( Agarose gel , PAGE )</li> <li>ii) UV – visible spectrophotometer.</li> </ul> <p>C] Biostatistics:</p> <ul style="list-style-type: none"> <li>i) Introduction</li> <li>ii) Data presentation – Tables and Graphs (Line and Histogram)</li> <li>iii) Central tendency: Mean, Median and Mode</li> <li>iv) Applications.</li> </ul> <p>D] Bioinformatics :</p> <ul style="list-style-type: none"> <li>i) Introduction of basic terminologies- Database , Genomics and Proteomics</li> <li>ii) Applications of bioinformatics.</li> </ul>	



SEC I	MICROBIOLOGICAL ANALYSIS OF AIR AND WATER	No. of Hours per Unit/Credit
<p>Upon successful completion of course, students are expected to be able to-</p> <ul style="list-style-type: none"> <li>• Use techniques for microbiological examination of water</li> <li>• Apply knowledge to control air and water born pathogens.</li> </ul>		
	<p><b>Unit 1 Aeromicrobiology</b>            Bioaerosols, Air borne microorganisms (bacteria, Viruses, fungi) and their impact on human health and environment, significance in food and pharma industries and operation theatres, allergens</p> <p><b>Unit 2 Air Sample Collection and Analysis</b>            Bioaerosol sampling, air samplers, methods of analysis, CFU, culture media for bacteria and fungi, Identification characteristics</p> <p><b>Unit 3 Control Measures</b>            Fate of bioaerosols, inactivation mechanisms – UV light, HEPA filters, desiccation, Incineration</p> <p><b>Unit 4 Water Microbiology</b>            Water borne diseases - Traveler’s diarrhea , Cholera</p> <p><b>Unit 5 Microbiological Analysis of Water</b>            Sample Collection, Treatment and safety of drinking (potable) water, methods to detect potability of water samples: (a) standard qualitative procedure: presumptive/MPN tests, confirmed and completed tests for faecal coliforms (b) Membrane filter technique and (c) Presence/absence tests</p> <p><b>Unit 6 Control Measures</b>            Precipitation, chemical disinfection, filtration, high temperature, UV light</p>	30

### Suggested Reading

1. da Silva N, Taniwaki MH, Junqueira VC, Silveira N, Nascimento MS, Gomes RAR (2012) Microbiological Examination Methods of Food and WaterA Laboratory Manual, CRC Press.
2. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4<sup>th</sup> edition. Benjamin/Cummings Science Publishing, USA
3. Maier RM, Pepper IL and Gerba CP. (2009). Environmental Microbiology. 2<sup>nd</sup> edition, Academic Press
4. Hurst CJ, Crawford RL, Garland JL, Lipson DA (2007) Manual of Environmental Microbiology, 3<sup>rd</sup> edition, ASM press



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B.Sc.Part-II CBCS Syllabus

Semester: IV

MICROBIOLOGY-DSC – 1010 D

Theory : 60 Hours (75 Lectures) Credits -4

<b>Paper VII</b>	<b>DSC- 1010D1 : Microbial Genetics and Molecular Biology</b>	<b>No. of Hours per Unit/Credit</b>
<p>Upon successful completion of course, students are expected to be able to-</p> <ul style="list-style-type: none"> <li>• Understand basic concepts of gene, mutation and DNA repair and recombination.</li> <li>• Describe the importance of genetic code &amp; discuss molecular mechanism underlying mutation ,</li> <li>• Understand &amp; explain the various gene transfer mechanisms in bacteria .</li> <li>• Explain various terms used in medical microbiology, different modes of transmission, prevention and control of microbial diseases.</li> <li>• Describe the types of cells and organs involved in immune system.</li> </ul>		
<b>Unit I/ Credit</b>	<b>Microbial Genetics</b>	<b>15</b>
	<p>A) Basic concepts of genetics –</p> <p style="padding-left: 40px;">i)Basic terminologies – Gene, genome, genotype, phenotype, mutagen, recon, muton, cistron, split genes.</p> <p style="padding-left: 40px;">ii)Forms of DNA</p> <p style="padding-left: 40px;">iii) Genetic code – definition and properties of genetic code.</p> <p style="padding-left: 40px;">iv) Organization of Chromosomal DNA in <i>E.coli</i>.</p> <p>B) Mutation: -</p> <p style="padding-left: 40px;">i) Basic Concepts of Mutation: Base pair substitutions, Frame shift missense, nonsense, neutral, silent , pleiotropic and suppressor mutations.</p> <p style="padding-left: 40px;">ii) Spontaneous mutation – Definition and basic concepts.</p> <p style="padding-left: 40px;">iii) Induced mutations –</p> <p style="padding-left: 80px;">Definition and mechanism of mutagenesis by –</p> <p style="padding-left: 40px;">a) Base analogues : 5-Bromouracil and 2- aminopurines</p> <p style="padding-left: 40px;">b) Mutagens modifying nitrogen bases-</p> <p style="padding-left: 80px;">Nitrous acid</p> <p style="padding-left: 80px;">Hydroxylamine</p> <p style="padding-left: 80px;">Alkylating agents</p>	

	<p>iv) Mutagens that distort DNA –</p> <p>a) acridine dyes</p> <p>b) UV light</p>	
<b>Unit II/Credit II</b>	<b>Molecular Biology</b>	<b>15</b>
	<p>A] Gene transfer in bacteria.</p> <p>i) Fate of exogenote in recipient cell.</p> <p>ii) Modes of gene transfer –</p> <p>a) Transformation.</p> <p>b) Conjugation</p> <p>c) Transduction</p> <p>B] DNA repair : i) Photo reactivation</p> <p>ii) Dark repair mechanism ( Excision repair)</p> <p>C]Plasmids – i) Natural – Properties, types , structure &amp;applications</p> <p>ii)Artificial -pBR 322- structure and applications</p>	

Paper VIII	Basics in Medical Microbiology and Immunology	No. of Hours per Unit/Credit
<p>Upon successful completion of course, students are expected to be able to-</p> <ul style="list-style-type: none"> <li>• Understand basic principles of medical microbiology &amp; infectious disease.</li> <li>• Explain various ways of prevention and control of microbial diseases.</li> <li>• Understand the silent features of Ag-Ab reaction &amp; its uses.</li> <li>• Describe the types of organs involved in immune system.</li> </ul>		
<b>Unit I Credit I</b>	<b>Medical Microbiology</b>	<b>10</b>
	<p>A] Definitions – Host, Parasite, Saprophytes, Commensal, Infection, Etiological agent, Disease, Pathogen, Opportunistic pathogen, True pathogen, Virulence, Pathogenicity, Fomite, Incubation period, Carriers, Morbidity rate, Mortality rate, epidemiology, etiology, Prophylaxis, Antigen, Antibody, Hapten, Vaccine, Immunity.</p> <p>B] Virulence factors -production of endotoxins, exotoxins, enzymes, ability to escape from phagocytosis.</p> <p>C]Types of infections – Chronic, acute, primary, secondary, reinfection, Iatrogenic, congenital, local, generalized, Covert, Overt, Simple, Mixed, Endogenous, Exogenous, Latent, Pyogenic, Nosocomial.</p> <p>D] Types of diseases – i) Epidemic –E.g.Influenza,Cholera  ii) Endemic – E.g. Common cold,Typhoid  iii) Pandemic – E.g. SARS ,Corona  iv) Sporadic – E.g. Polio</p> <p>E] Modes of transmission of diseases  i) Air-borne transmission,  ii) Vehicle transmission  iii) Contact transmission  iv)Vector borne transmission</p> <p>F] General principles of prevention and control of microbial diseases.</p> <p>G] Normal flora of human body &amp; its significance (flora of skin, throat,</p>	



SEC II	<b>MICROBIAL DIAGNOSIS IN HEALTH CLINICS</b>	No. of Hours per Unit/Credit
<p>Upon successful completion of course, students are expected to be able to-</p> <ul style="list-style-type: none"> <li>• Apply the knowledge of laboratory diagnosis of pathogen.</li> <li>• Understand different clinical sample collection techniques and its preservation.</li> </ul>		
	<p><b>Unit 1 Importance of Diagnosis of Diseases</b> Bacterial, Viral, Fungal and Protozoan Diseases of various human body systems, Disease associated clinical samples for diagnosis.</p> <p><b>Unit 2 Collection of Clinical Samples</b> How to collect clinical samples (oral cavity, throat, skin, Blood, CSF, urine and faeces) and precautions required. Method of transport of clinical samples to laboratory and storage.</p> <p><b>Unit 3 Microbial examination of clinical samples</b> Examination of sample by staining - Gram stain, Ziehl-Neelson staining for tuberculosis, Giemsa-stained thin blood film for malaria Serological Methods - Agglutination, ELISA, immune fluorescence .</p> <p><b>Unit 4: Kits for Rapid Detection of Pathogens</b> Typhoid, Dengue and HIV, Swine flu</p>	<p>No of Hours: 7</p> <p>No of Hours: 8</p> <p>No of Hours: 8</p> <p>No of Hours: 7</p>

### SUGGESTED READING

1. Ananthanarayan R and Paniker CKJ (2009)Textbook of Microbiology, 8th edition, Universities Press Private Ltd.
2. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013) Jawetz, Melnick and Adelberg's Medical Microbiology. 26th edition. McGraw Hill Publication
3. Randhawa, VS, Mehta G and Sharma KB (2009) Practicals and Viva in Medical Microbiology 2nd edition, Elsevier India Pvt Ltd
4. Tille P (2013) Bailey's and Scott's Diagnostic Microbiology, 13<sup>th</sup> edition, Mosby
5. Collee JG, Fraser, AG, Marmion, BP, Simmons A (2007) Mackie and McCartney Practical MedicalMicrobiology, 14<sup>th</sup> edition, Elsevier.



Paper III	Practical Course : (CREDITS:02; TOTAL HOURS : 30)	No. of Hours per Unit/Credit
	<ol style="list-style-type: none"> <li>1. Micrometry.</li> <li>2. Stains and staining procedures :               <ol style="list-style-type: none"> <li>i) Spore staining (Dorner's method)</li> <li>ii) Flagella staining (Bailey's method)</li> <li>iii) Nucleus staining (Giemsa's method) using yeast cells.</li> </ol> </li> <li>3. Preparation of media :               <p>Tripalsugar iron agar, Gelatin agar, Amino acid decarboxylation medium, Amino acid deamination medium, Arginine broth, Christensen's medium, Peptone nitrate broth, Hugh and Leifson's medium, Egg-Yolk agar, Mannitol salt agar.</p> </li> <li>4. Biochemical tests :               <ol style="list-style-type: none"> <li>(i) Gelatin hydrolysis test.</li> <li>(ii) Amino acid decarboxylation test</li> <li>(iii) Amino acid deamination test</li> <li>(iv) Arginine hydrolysis test</li> <li>(v) Urea hydrolysis test</li> <li>(vi) Nitrate reduction test</li> <li>(vii) Hugh and Leifson's test</li> <li>(viii) Oxidase test</li> <li>(ix) Lecithinase test</li> </ol> </li> </ol>	<b>30</b>

Paper IV	(CREDITS:02; TOTAL HOURS : 30)	
	<ol style="list-style-type: none"> <li>1. Effect of environmental factor on microorganisms : <ol style="list-style-type: none"> <li>(i) Temperature</li> <li>(ii) pH</li> <li>(iii) Heavy metals – Copper</li> <li>(v) Salt (NaCl)</li> </ol> </li> <li>2. Primary Screening of - <ol style="list-style-type: none"> <li>(i) Antibiotic producers – crowded plate technique.</li> <li>(ii) Amylase producers.</li> </ol> </li> <li>3. Isolation and identification of pathogenic microorganisms from clinical sample. <ol style="list-style-type: none"> <li>(a) <i>Salmonella species</i>                      (b) <i>S. aureus</i></li> <li>(c) <i>Proteus species</i></li> </ol> </li> <li>4. Determination of Blood groups – ABO and Rh.</li> <li>5. Determination of growth phases of <i>E.coli</i> by Optical density.</li> <li>6. Study of diauxic growth</li> <li>7. Serological tests - Widal test – qualitative slide test,</li> <li>8. Biostatistics – Measures of central tendency : Mean, Median and Mode</li> <li>9. U.V. Survival curve</li> </ol>	30

## Practical Examination

- (A) The practical examination will be conducted on 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 the 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 year. Candidates must produce their journals at the time of practical examinations.
- (C) Candidates have to visit at least one place of microbiological interest (pharmaceutical / industry/dairy/research institute etc.) and submit the report of their visit

### Nature of the Practical Examination Question Paper and Distribution Marks

	Marks
Q.1 Determination of lag phase / staining	15
Q.2 Isolation and identification of pathogen from clinical sample	20
Q.3 Serology / blood groups	05
Q.4 Primary screening technique / isolation of lac negative mutant	10
Q.5 Biochemical tests	10
Q.6 Effect of environmental factors	10
Q.7 Spot tests (on culture media)	10
Q.9 Journal	10
Q.10 Tour report	10

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Total marks – 100

### **Books Recommended for Theory Papers**

1. Foundation in Microbiology – by Kathleen Park talaro, Arther Talaro.
2. Introduction to Microbiology – John I. Ingraham, Catherine A. Ingraham A. Ingraham A. Ingraham, Ronald M; Second edition.
3. Zinsser’s Microbiology – by Wolfgang K. Joklik, (1995) Mc Graw-Hill Co.
4. Microbial Genetics – by Stanley R. Maloy, David Freifelder and John E. Cronan.
5. Molecular Genetics of Bacteria – by Larry Snyder, Wendy Champness.
6. Microbiology – Pelczar, Reid and Chan
7. Fundamentals of Microbiology – Frobisher et al.
8. Fundamental principles of Bacteriology – A. G. Salle.
9. Industrial microbiology – Prescott and Dunn
10. Industrial microbiology – Casida, E.
11. Industrial microbiology – Miller and Litsky
12. General Microbiology – R. Y. Stainer
13. Chemical Microbiology – A. H. Rose.
14. General Microbiology – Vol. I and Vol. II – Pawar and Diganawala
15. Text book of Microbiology – Ananthnarayan
16. Biochemistry – Lehninger.
17. Outlines of Biochemistry – Cohn and Stumph
18. A Text book of Microbiology – R. Dubey, D. K. Maneshwari, S. Chand Co. Ltd. Ramnagar New Delhi 110055

### **Books recommended for Practicals**

1. Manual of Diagnostic Microbiology – Wadher and Boosreddy.
2. Diagnostic Microbiology – Fingold.
3. Introduction to Microbial technique – Gunasekaran.
4. Biochemical methods – Sadashivam and Manickam.
5. Basic and Practical Microbiology – Atlas.
6. Bacteriological techniques F. J. Baker.
7. Laboratory Fundamentals of Microbiology – Alcamo, I. E.
8. Clinical Microbiology – Ramnik Sood.
9. Medical Lab Technology – Mukharji Vol. II
10. Medical Lab Technology – Godkar
11. Medical Microbiology – Cruickshank et al. Vol. II.