

**KUVEMPU**



**UNIVERSITY**

Dept. of P.G. Studies and Research in Microbiology  
Jnana Sahyadri, Shankaraghatta – 577451, Shivamogga, Karnataka.

Proceedings of Under Graduate Board of Studies in Microbiology held on 11<sup>th</sup> September 2023, 10.30 AM. at Department of P.G. Studies & Research in Microbiology, Kuvempu University, Shankaraghatta-577451.

**AGENDA**

1. Approval of NEP-Microbiology (UG) - V and VI Semester syllabus (Theory and Practical) implemented by Government of Karnataka for the academic year 2023-24.
2. Approval of Microbiology (UG) - V and VI Semester- Practical Examination Scheme for the academic year 2023-24.
3. Ratification of Microbiology (UG) - III and IV Semester syllabus (Theory and Practical) implemented by Government of Karnataka (KSHEC, Bangalore, Letter dated on 28-08-2023).

**DECISSION**

1. Board has discussed and approved of NEP-Microbiology (UG) - V and VI Semester syllabus (Theory and Practical) implemented by Government of Karnataka with minor modifications for the academic year 2023-24.
2. Board has discussed and approved of Microbiology (UG) - V and VI Semester- Practical Examination Scheme for the academic year 2023-24.
3. Board has discussed and ratified of Microbiology (UG) - III and IV Semester syllabus (Theory and Practical) implemented by Government of Karnataka (KSHEC, Bangalore, Letter dated on 28-08-2023).

**MEMBERS PRESENT** ;

1. **Dr. Rashmi Hosamani**  
Dept. of Microbiology  
University College of Science.  
Tumkur.

**External Member**

2. **Prof. N. Mallikarjun**  
Dept. of Microbiology  
Sahyadri Science College  
Shivamogga.

**Internal Member**

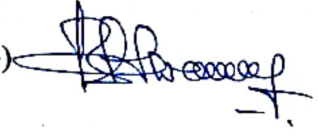
3. **Dr. Sudhama VN**  
Dept. of Botany  
Govt. Science College, Chitradurga.

Internal Member



4. **Prof. B. Thippeswamy**  
Dept. of Microbiology  
Jnanasahyadri,  
Kuvempu University.

Chairman (BOS-UG)



**MEMBERS ABSENT :**

1. **Dr. Nagalambika Prasad**  
Dept. of Microbiology  
JSSAHER, Mysore.

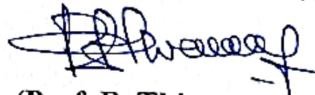
External Member

2. **Prof. R. Onkarappa**  
Dept. of Microbiology  
Sahyadri Science College  
Shivamogga.

Internal Member

The Chairman thanked all the members for their co-operation.

Chairman- BOS (UG)



(Prof. B. Thippeswamy)  
**CHAIRPERSON**

Beard of Studies in Microbiology  
Kuvempu University, Jnana Sahyadri  
Shankarghatta-577 451.

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**Scheme and Syllabus for**

**B.Sc., Microbiology**

**As one of the Two Major subjects (Double Major Model)(NEP-2020, based on Model curriculum of KSHCEC, Bengaluru)**

*for*

**V and VI Semesters**

**(with effect from 2023-24)**

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**Department of Post Graduate Studies and Research  
in Microbiology**

**Jnana Sahyadri Shankaraghatta, Shivamogga – 577451, Karnataka**

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**September - 2023.**

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**CHAIRPERSON**

**Department of Microbiology  
Kuvempu University, Jnana Sahyadri  
Shankaraghatta-577 451.**




**B. Sc., : Curriculum and Credit Framework for Undergraduate Programme**

Sem.	Discipline Specific Courses Core (DSC), Elective (DSE)(Credits) (L+T+P)	Minor/Multidisciplinary/Open Elective (OE) Courses(Credits) (L+T+P)	Ability Enhancement Courses (AEC) (Credits)(L+T+P) (Languages)	Skills Enhancement Courses (SEC) (Credits) (L+T+P)/ Value Added Courses (Credits) (L+T+P) (common for all UG Programs)/ Summer Internship.	Total Credits
I	DSC-A1(4), A2(2) DSC-B1(4), B2(2)	OE-1 (3)	L1-1(3), L2-1(3) (4 hrs each)	SEC-1: Digital Fluency (2) (1+0+2)/ Env. Studies (3)  Health, Wellness & Yoga (2) (1+0+2)	25/26
II	DSC-A3(4), A4(2), DSC-B3(4), B4(2)	OE-2 (3)	L1-2(3), L2-2(3) (4 hrs each)	Env. Studies (3)/ SEC-1: Digital Fluency (2)(1+0+2)  Sports/NCC/NSS/R&R(S&G) / Cultural (2)(0+0+4)	26/25
<b>Students exiting the programme after securing 46 credits will be awarded UG Certificate in Disciplines A and B provided they secure 4 credits in work based vocational courses during summer term or internship/Apprenticeship in addition to 6 credits from skill-based courses earned during the first year.</b>					
III	DSC-A5(4), A6(2), DSC-B5(4), B6(2)	OE-3 (3)/ India and Indian Constitution (3)	L1-3(3), L2-3(3) (4 hrs. each)	SEC-2: AI/Cyber Security/Financial Edu. & Inv. Aw. (2) (1+0+2)	25
IV	DSC-A7(4), A8(2), DSC-B7(4), B8(2)	India and Indian Constitution (3) / OE-3(3)	L1-4(3), L2-4(3) (4 hrs. each)	SEC-3: Financial Edu. & Inv. Aw. /AI/Cyber Security (2)(1+0+2)	25
<b>Students exiting the programme after securing 92 credits will be awarded UG Diploma in Disciplines A and B provided they secure additional 4 credits in skill based vocational courses offered during first- or second-year summer term.</b>					
V	DSC-A9(4), A10(2), A11(4), A12(2);	DSC-B9(4), B10(2), B11(4), B12(2)		SEC-4: Employability Skills/Cyber Security (3) (2+0+2)  Internship (2)	27
VI	DSC-A13(4), A14(2), A15(4), A16(2);	DSC-B13(4), B14(2), B15(4), B16(2)			26
<b>Students exiting the programme after 3-years will be awarded UG Degree in Disciplines A and B as double majors upon securing 136 credits and satisfying the minimum credit requirements under each category of courses prescribed.</b>					

  
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**List of Courses from I to VI Semesters for Undergraduate Programme in MICROBIOLOGY**

Sem. No.	Course Category	Course Code	Course Title	Credits Assigned	Instructional hours per week		Duration of Exam (Hrs.)	Exam/ Evaluation Pattern (Marks)			
					Theor y	Practical		IA	Exam	Total	
V	DSC	DSC-5T	Microbial Genetics	4	4		2	40	60	100	
		DSC-5P	Microbial Genetics	2		4	3	25	25	50	
		DSC-6T	Food Microbiology	4	4		2	40	60	100	
		DSC-6P	Food Microbiology	2		4	3	25	25	50	
		SEC-4	Employability Skills/Cyber Security								
		DSC	DSC-7T	Immunology and Medical Microbiology	4	4		2	40	60	100
VI	DSC	DSC-7P	Immunology and Medical Microbiology	2		4	3	25	25	50	
		DSC-8T	Industrial Microbiology	4	4		2	40	60	100	
		DSC-8P	Industrial Microbiology	2		4	3	25	25	50	
		Internship	DSC-Internship	Internship / Project work	2		3-4 weeks (Report & Viva)				

  
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## B.Sc., Microbiology 5<sup>th</sup> Semester

Program Name	B.Sc. in MICROBIOLOGY	Semester	V
Course Title	MICROBIAL GENETICS (Theory)		
Course Code:	DSC-5T	No. of Credits	04
Contact hours	60 Hours (4 Hours per week)	Duration of SEA/Exam	2 hours
Formative Assessment Marks	40	Summative Assessment Marks	60

**Course Pre-requisite(s) :**

**Course Outcomes (COs) :** After the successful completion of the course, the student will be able to:

CO1 Understand the fundamental molecular principles of genetics

CO2 Understand relationship between phenotype and genotype in genetic traits;

CO3 Knowledge on the basis of genetic mapping in bacteria, linkage analysis in fungi.

Contents	60 Hrs
<p><b>Unit-1: Mendel's principles of inheritance:</b> Special features of pea plants as an ideal system to study genetics and Mendel's cross breeding experimental approach to prove genetic principles.</p> <p>Principles of dominance and Segregation; phenotype, genotype, traits controlled by genes, existence of alleles (dominant and recessive), segregation of alleles during the formation of gametes, aggregation of alleles during fertilization, monohybrid (single character) cross, F1 and F2 generation, heterozygous, homozygous, test cross to test genotype of F1 plants. Principle of independent assortment; Dihybrid (two characters) cross, pattern of assortment of alleles. Chromosomal basis of inheritance; chromosome number, haploid (n), diploid (2n).</p>	15 Hrs
<p><b>Unit-2: DNA as a Genetic material;</b> Griffith experiment of Transformation, Experimental evidences to show DNA as the genetic material, involvement of DNA in bacterial transformation by Avery, MacLeod and McCarty, Hershey and Chase experiment to prove DNA carries the genetic information in bacteriophage. RNA as genetic material in viruses.</p> <p><b>DNA Replication:</b> Bacterial cell cycle, Experimental proof for semi conservative replication, <i>Oric</i>, Direction of replication, Stages of replication, Role of DNA Polymerases and other enzymes in replication. Theta replication, Rolling circle model, Linear DNA replication</p> <p><b>Transcription:</b> Structure of bacterial RNA polymerase, Promoter concept, Recognition of promoters and DNA melting, Transcription bubble, Stages of transcription- initiation elongation and termination. Transcriptional attenuation.</p>	15 Hrs
<p><b>Unit 3: Molecular Biology :</b></p> <p><b>Translation:</b> Genetic code, rules governing the genetic code. tRNA structure, ribosome structure. Stages of translation –initiation, elongation and termination. Regulation of translation. Post translational modifications of proteins.</p> <p><b>Regulation of Gene Expression:</b> Gene regulation in bacteria. Operon concept, <i>lac</i> operon, <i>trp</i> operon, Control of gene expression in eukaryotes - Regulation through modification of gene structure- histone modifications, chromatin remodeling, DNA methylation. transcriptional activators, RNA interference.</p> <p><b>Mutations:</b> Mutations and their chemical basis, types of mutations – Spontaneous and induced mutations, physical and chemical agents of mutagenesis, the expression of mutations, mutant detection and selection.</p>	15 Hrs

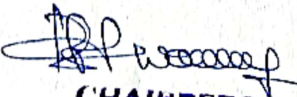
<p><b>Unit-4: Genetics of Viruses:</b> Structure and life cycle of Bacteriophage T4 and Lambda, lytic and lysogenic cycle of bacteriophage. Recombination and genome mapping in viruses.</p> <p><b>Genetics of Bacteria:</b> Structure and life cycle of bacteria, General principles of bacterial recombination, bacterial plasmids, fertility factors, resistance factors, col plasmids, other types of plasmids, transposable elements.</p> <p><b>Transformation:</b> Competence, compatibility, transformants.</p> <p><b>Conjugation:</b> F<sup>+</sup> x F<sup>-</sup> conjugation, Hfr conjugation, F' conjugation, Gene mapping in bacteria by conjugation.</p> <p><b>Transduction:</b> Generalized and specialized transduction, mapping the genome.</p> <p><b>Genetics of Fungi:</b> life cycle of Yeast and <i>Neurospora</i>, heterothallism, parasexuality, Tetrad analysis, two point and three point test cross, detecting linkage and mapping genes in yeast and <i>Neurospora</i>, recombination in fungi.</p>	<b>15 Hrs</b>
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**Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs 1-12)**

Course Outcomes (COs) / Program Outcomes (POs)	Program Outcomes (POs 1-12)											
	1	2	3	4	5	6	7	8	9	10	11	12
Understand the fundamental molecular principles of genetics		√		√			√					
Understand relationship between phenotype and genotype in genetic traits;		√					√				√	
Knowledge on the basis of genetic mapping in bacteria, linkage analysis in fungi.		√					√					√

**Pedagogy:** Lectures, Seminars, Industry/Institute Visits, Debates, Quiz, Project and Assignments

Formative Assessment for Theory	
Assessment Occasion/ type	Marks
Attendance	10
Seminar	10
Debate/Quiz/Assignment	10
Class test	10
<b>Total</b>	<b>40 Marks</b>
<i>Formative Assessment as per guidelines are compulsory</i>	

  
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## Practical: Microbial Genetics

Course Title	MICROBIAL GENETICS (Practical)	Practical Credits	02
Course Code	DSC-5P	Contact Hours	4 Hours/ week
Formative Assessment	25 Marks	Summative Assessment	25 Marks
<b>Practical Content</b>			
<b>Practicals - List of Experiments</b>			
1	Micropipeting: Volume Accuracy		
2	Study of semi-conservative replication of DNA through micrographs / schematic representations		
3	Mendelian inheritance in pea plant – monohybrid, dihybrid ratio through charts, Genetic problems		
4	Isolation of bacteria/fungal DNA		
5	Isolation of phages from sewage		
6	Bacterial survival against UV-radiation		
7	Isolation of antibiotic resistant mutant by gradient plate method		
8	Isolation and characterization of petite mutant in yeast		
9	Isolation of RNA from yeast.		
10	Replica plating technique		
11	Estimation of DNA		
12	Estimation of RNA		
13	Agarose gel electrophoresis		
14	T <sub>4</sub> phage, tRNA, Bacterial RNA, Transcription, Translation & Lac operon through Micrograph/Schematic representation		

### MICROBIAL GENETICS

#### Course Objectives:

The objectives of this course are to introduce students to:

- Basics of genetics and classical genetics covering prokaryotic and eukaryotic domains.
- Classical concepts of Mendelian genetics, recombination in bacteria and fungi.

#### Student Learning Outcomes:

At the end of the course, students should be able to:

- Describe fundamental molecular principles of genetics;
- Understand relationship between phenotype and genotype in human genetic traits;
- Evaluate the basics of genetic mapping in bacteria, linkage analysis in fungi.

**Pedagogy:** Experiential learning, Problem solving, Project

Formative Assessment for Practical	
Assessment Occasion/ type	Marks
Class Records	05
Test	10
Attendance	05
Performance	05
<b>Total</b>	<b>25 Marks</b>
<i>Formative Assessment as per guidelines are compulsory</i>	

#### References :


1. Microbial Genetics by Maloy et al., 1994. Jones and Bartlett Publishers.
2. Molecular Genetics of Bacteria by J. W. Dale. 1994. John Wiley and Sons.
3. Modern Microbial Genetics. 1991 by Streips and Yasbin. Niley Ltd.
4. Molecular Biology of the Gene 4th Edition by J.D. Watson, N.H. Hopkins, J.W. Roberts, J.A. Steitz and A.M. Weiner. 1987, The Benjamin / Cummings Publications Co. Inc. California.
5. Gene VII by Lewin Oxford University Press. 2000.
6. Bacterial and Bacteriophage Genetics. 4<sup>th</sup> Editions by Birge.
7. Microbial Genetics by Freifelder. 4th Edition.
8. Organization of Prokaryotic Genome. 1999 by Robert L. Charlebois, ASM Publications.
9. Molecular Genetics of Bacteria, 1997 by Larry, Snyder and Wendy, Champness, ASM



## B.Sc., Microbiology 5<sup>th</sup> Semester

Program Name	BSc in Microbiology	Semester	V
Course Title	FOOD MICROBIOLOGY (Theory)		
Course Code:	DSC-6T	No. of Credits	04
Contact hours	60 Hours (4 Hours per week)	Duration of SEA/Exam	2 hours
Formative Assessment Marks	40	Summative Assessment Marks	60

<b>Course Pre-requisite(s):</b>	
<b>Course Outcomes (COs):</b> After the successful completion of the course, the student will be able to:	
CO1. To understand the association of microbes in food and the quality testing of food CO2. To understand the preservation and food safety protocols CO3. To understand the methods of spoilage of food and the diseases associated with it CO4. To learn the properties of milk and the types of preservation of milk. CO5. To learn the types of fermented food and dairy products and its significance	
<b>CONTENTS</b>	<b>60 Hrs</b>
<b>Unit 1-Microbes and food :</b> Food as a substrate for microorganisms- Intrinsic and extrinsic parameters affecting the growth of microbes. Microorganisms in food and their sources (molds, yeast and bacteria) <b>Food borne infections</b> and intoxication <i>Staphylococcus, Clostridium, Salmonella, Bacillus, Brucella, Listeria</i> . Mycotoxin, Phycotoxins <b>Fermented Food :</b> Fermented vegetable-sauerkraut, pickles. Meat- sausage. Beverages kombucha. Sourdough. Microbes as food- SCP, SCO. Nutraceuticals and Synbiotics	15 hrs
<b>Unit 2 : Water quality in food safety:</b> Water sample collection, methods to detect potability of water samples: presumptive/MPN tests, confirmed and completed tests for faecal coliforms, SPC, IMViC reactions, membrane filter technique. Water borne pathogens, Control of water borne pathogens- Precipitation, filtration, chemical disinfection, UV light. <b>Food Biotechnology:</b> Single cell protein – <i>Spirulina, Fusarium, Saccharomyces</i> ; fermented foods, mushroom technology; fungal foods; microbial production of flavours, natural food colourants from bacteria, fungi and algae, enzymes for food processing (protease, lipase, invertase,) sweeteners, food waste management,	15hrs
<b>Unit 3-Spoilage of Food, Preservation and Food safety-</b> <b>Spoilage :</b> Principles of food spoilage. Sources of food contamination, Types of spoilage. Spoilage of meat and poultry, Fish and sea foods. Spoilage cereals, fruits and vegetables. Spoilage of canned food. <b>Preservation :</b> Principles of food Preservation. Methods of preservation-Physical (temperature, drying, irradiation), chemical (Class I and Class II). Bio preservation. Canning, Food Packaging-Types of packaging materials, properties and benefits. <b>Quality testing of food-</b> Rapid microbiological methods, Examination of faecal streptococci <b>Food sanitation and control-</b> Good Hygiene practices, GLP, GMP (Waste treatment disposal methods), HACCP, FSSAI, FDA and BIS, Food control agencies and their regulations.	15hrs

  
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Department of Microbiology

7. J. J. Somaiya University, Jnana Sahyadri,  
Shankarghatta-577 451.

<p><b>Unit 4-Dairy Microbiology :</b> History. Properties of milk. Types of milk- dried, liquid, condensed.</p> <p><b>Microorganisms in milk.</b> Starter culture and its types-(single, mixed) Sources of contamination of milk. Microbiological analysis of milk- Rapid platform tests (organoleptic, alcohol, COB, alcohol test, Phosphatase test, DMC, sedimentation test.). Reductase tests. SPC. Preservation of milk- Pasteurization. Dehydration, sterilization. . Packing of milk and dairy products.</p> <p><b>Fermentation in milk:</b> Lactic acid, gassy fermentation, souring</p> <p><b>Dairy products:</b> Cheese- Types and production (Cheddar), Tofu, Yoghurt, Acidophilus milk. Prebiotics, Probiotics.</p>	15 hrs
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**Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs 1-15)**

Course Outcomes (COs) / Program Outcomes (POs)	Program Outcomes (POs)														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
To understand the association of microbes in food and the quality testing of food		√						√			√	√			
To understand the preservation and food safety protocols		√					√			√					
To understand the methods of spoilage of food and the diseases associated with it		√		√											
To learn the properties of milk and the types of preservation of milk.	√	√													
To learn the types of fermented food and dairy products and its significance				√	√			√							

**Pedagogy:** Lectures, Seminars, Industry/Institute Visits, Debates, Quiz, Project and Assignments

Formative Assessment for Theory	
Assessment Occasion/ type	Marks
Attendance	10
Seminar	10
Debate/Quiz/Assignment	10
Class test	10
<b>Total</b>	<b>40 Marks</b>
<i>Formative Assessment as per guidelines are compulsory</i>	

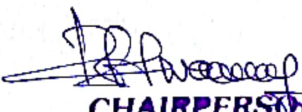
## Practical: Food Microbiology

Course Title	FOOD MICROBIOLOGY (Practical)	Practical Credits	02
Course Code	DSC-6P	Contact Hours	4 Hours/ week
Formative Assessment	25 Marks	Summative Assessment	25 Marks
<b>Practical Content</b>			
<ol style="list-style-type: none"> <li>1. Isolation of bacteria and fungi from infected fruits and vegetables</li> <li>2. Isolation of bacteria and fungi from fermented food and stored/ preserved food.</li> <li>3. Reductase tests-MBRT/Resazurin</li> <li>4. Estimation of Titrable acidity in milk.</li> <li>5. Fat estimation – Gerber’s method</li> <li>6. Bacterial examination by SPC, DMC</li> <li>7. Estimation of lactic acid in milk</li> <li>8. Production of yoghurt</li> <li>9. Study of food borne pathogens- <i>Staphylococcus</i>, <i>Salmonella</i>, <i>Aspergillus</i>, <i>Clostridium</i></li> <li>10. Significant microbes in Food and Dairy <i>Lactobacillus</i>, <i>Streptococcus</i>, <i>Penicillium</i>, <i>Rhizopus</i></li> <li>11. Detection of Aflatoxin by TLC</li> <li>12. Standard analysis of water samples and Determination of MPN</li> <li>13. Biochemical differentiation of Enterobacteriaceae isolates by IMViC reactions.</li> <li>14. Measurement of Biochemical Oxygen Demand (BOD) of food processing wastewater.</li> </ol>			

**Note:** Visit to food industry/Dairy/Water treatment plant

**Pedagogy:** Experiential learning, Problem solving, Project

<b>Formative Assessment for Practical</b>	
<b>Assessment Occasion/ type</b>	<b>Marks</b>
Class Records	05
Test	10
Attendance	05
Performance	05
<b>Total</b>	<b>25 Marks</b>
<i>Formative Assessment as per guidelines are compulsory</i>	

  
**CHAIRPERSON**  
 Department of Microbiology  
 Kavayitri University, Jnana Sahyadri  
 Shankarghatta-577 451.

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**References**


1	Adams, M.R and Moss, MO. 1995. Food Microbiology. The Royal Society of Chemistry, Cambridge
2	James. M. Jay, 1992, Modern food microbiology 4ed.
3	Frazier W.C. and Westhoff C.D. 2008 Food Microbiology. Tata McGraw Hill Publishing Company Limited, New Delhi, India.
4	Doyle M. P. and Beuchat L. R. (2007). Food Microbiology- Fundamentals. Frontiers, ASM Press.
5	Garbutt J. (1997). Essentials of Food Microbiology, Arnold- International Students edition, London. 8. Marriott N. G. and Gravani R. B. (2006).
6	Principles of Food Sanitation, Food Science text Series, Springer International, New York, USA.
7	Thomas J., Matthews, Karl; Kniel, Kalmia E (2017), Food Microbiology: An Introduction, American Society for (ASM).
8	Deak T. and Beuchat L. R. (1996). Hand Book of Food Spoilage Yeasts, CRC Press, New York.
9	Michael, J. Pelczar, Jr. E. C. S. Chan, Moel: Microbiology, Mc Graw Hill Book Company, New York).
10	Mitchell, R. (1992), Introduction to Environmental Microbiology, Prentice Hall Inc, Englewood Cliffs.
11	Jay, J. M. (1985). Modern Food Microbiology. CBS Publishers and distributors, New Delhi.

## B.Sc., Microbiology 6<sup>th</sup> Semester

Program Name	BSc in Microbiology	Semester	VI
Course Title	IMMUNOLOGY AND MEDICAL MICROBIOLOGY (Theory)		
Course Code:	DSC-7T	No. of Credits	4
Contact hours	60 Hours (4 hours per week)	Duration of SEA/Exam	2 hours
Formative Assessment Marks	40	Summative Assessment Marks	60

Course Pre-requisite(s): Common to the Course Programme at Entry Level
Course Outcomes (COs): After the successful completion of the course, the student will be able to: CO1: To gain a preliminary understanding about various immune mechanisms. CO2: To familiarize with Immunological techniques and serodiagnosis of infectious diseases CO3: To understand pathogenic bacterial infections, symptoms, diagnosis and treatment process. CO4: To understand pathogenic bacterial infections, symptoms, diagnosis and To understand pathogenic bacterial infections, symptoms, diagnosis and treatment process treatment process

Contents	60 Hrs
<p><b>Unit-1: Introduction to Immune system ;</b> Historical perspective of immunology; Edward Jenner, Luis Pasteur, attenuation. Immunity; Natural (active and passive) and artificial (active and passive) with example, Innate and acquired, Humoral and cell mediated. Early theories to explain the formation and specificity of antibody; Selective, instructional and clonal selection. Cells and organs of immune system: Hematopoiesis, cytokines, properties and functions of B and T Lymphocytes, Natural killer (NK) cells, Granulocytes (Neutrophils, Eosinophils and Basophils), Monocytes and macrophages, Dendritic cells and Mast cells. Primary lymphoid organs; Bone marrow and Thymus. Secondary lymphoid organs; Spleen and Lymphnodes. Lymphoid tissues-MALT&amp;GALT.</p>	15 hrs.
<p><b>Unit-2: Antigen and Antibody</b></p> <p><b>Antigen:</b> Immunogenicity and antigenicity, epitopes, haptens. Properties of antigen contribute to immunogenicity; Chemical nature (proteins, carbohydrates, lipids and nucleic acids), degree of foreignness, molecular weight, chemical composition and complexity, degradability. Adjuvants (alum, Freund's incomplete and complete) and their importance. Epitopes.</p> <p><b>Antibody:</b> Basic structure of antibody, light and heavy chain, variable and constant region, hinge region. Structure and functions of different types of antibodies (IgM, IgG, IgA, IgE, and IgD).Antibody mediated effector functions; opsonization, complement activation and antibody dependent cell mediated cytotoxicity (ADCC). Antigenic determinants on immunoglobulins:Isotype, allotype and idiotype. Polyclonal Monoclonal antibody production .</p> <p><b>Complement system:</b> Functions of complement components, Complement activation, type of complement activation pathways, membrane attack complex (MAC), complement fixation,</p> <p><b>Hypersensitive reaction:</b> Classification, Type I, Type II, Type III and Type IV,</p> <p><b>Antigen-antibody interactions:</b> Definition of affinity and avidity. Agglutination, Immunoprecipitation; Radial diffusion (Mancini) and double diffusion (Ouchterlony), Enzyme linked immune-sorbent assay (ELISA): Direct, indirect and sandwich ELISA. Radioimmunoassay (RIA). Immunofluorescence.</p>	15 hrs.

  
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<p><b>Unit-3: Normal microflora of the human body and host pathogen interaction</b>  <b>Normal microflora of the human body:</b> Importance of normal microflora, normal microflora of skin, throat, gastrointestinal tract, urogenital tract  <b>Host pathogen interaction:</b> Definitions - Infection, Invasion, Pathogen, Pathogenicity, Virulence, Toxigenicity, Carriers and their types, Opportunistic infections, Nosocomial infections - Sources and mode of Transmission of infection, Pathophysiological effects of LPS. Sample collection, transport and diagnosis.  <b>Medical Bacteriology</b>  The following diseases in detail with Etiology, Symptoms, mode of transmission, Laboratory diagnosis, prophylaxis and Treatment of respiratory diseases: <i>Streptococcus pyogenes</i>, <i>Mycobacterium tuberculosis</i>  Gastrointestinal Diseases: <i>Escherichia coli</i>, <i>Salmonella typhi</i>, <i>Staphylococcus aureus</i>, <i>Clostridium tetani</i>,</p>	15 hrs.
<p><b>Unit-4: Medical Virology Parasitology and Mycology:</b> Symptoms, mode of transmission, prophylaxis and control of Hepatitis-B, Rabies, Dengue, AIDS, Corona and Chikungunya. Malaria, Kala-azar, Amoebic dysentery. Fungal infections: Cutaneous mycoses- Tinea infections, Systemic mycoses- Histoplasmosis and Opportunistic mycoses- Candidiasis.  <b>Antimicrobial agents:</b> General characteristics and mode of action  Antibacterial agents: Inhibitor of nucleic acid synthesis; Inhibitor of cell wall synthesis; Inhibitor of cell membrane function; Inhibitor of protein synthesis; Inhibitor of metabolism. Mechanism of action of antifungal agents: Amphotericin B, Griseofulvin; Antiviral agents: Acyclovir, Azidothymidine. Antibiotic resistance, MDR, XDR, MRSA, NDM-1.</p>	15 Hrs

**Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs 1-15)**

Course Outcomes (COs) / Program Outcomes (POs)	Program Outcomes (POs)														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
To gain a preliminary understanding about various immune mechanisms.	√														
To familiarize with Immunological techniques and serodiagnosis of infectious diseases		√	√							√					
To understand pathogenic bacterial infections, symptoms, diagnosis and treatment process	√			√						√					
To understand pathogenic bacterial infections, symptoms, diagnosis and To understand pathogenic bacterial infections, symptoms, diagnosis and treatment process	√				√	√				√					

**Pedagogy :** Lectures, Seminars, Industry/Institute Visits, Debates, Quiz, Project and Assignments

Formative Assessment for Theory	
Assessment Occasion/ type	Marks
Attendance	10 Marks
Class Test	10 Marks
Debate/Quiz/Assignment	10 Marks
Seminar	10 Marks
<b>Total</b>	<b>40 Marks</b>
<i>Formative Assessment as per guidelines are compulsory</i>	

## Practical: Immunology & Medical Microbiology

Course Title	IMMUNOLOGY AND MEDICAL MICROBIOLOGY (Practical)	Practical Credits	2
Course Code	DSC-7P	Contact Hours	4Hours/week
Formative Assessment	25 Marks	Summative Assessment	25 Marks
<b>Practical Content</b>			

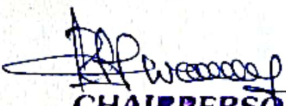
1	Identification of human blood groups.
2	Perform WBC of the given blood sample using haemocytometer.
3	Perform Differential Leukocyte Count of the given blood sample.
4	Demonstration: separate plasma/serum from the blood sample.
5	Perform immunodiffusion by Ouchterlony method.
6	Demonstration of Single Radial Immuno Diffusion.
7	WIDAL Test/HCG Test/RPR Test
8	Study of composition and use of important differential media for identification of pathogenic bacteria: EMB Agar, MacConkey agar, Mannitol salt agar, Deoxycholate citrate agar, TCBS agar.
9	Study of bacterial flora of skin by swab method
10	Identify bacteria ( <i>E. coli</i> , <i>Bacillus</i> ) using laboratory strains on the basis of cultural, morphological and biochemical characteristics: IMViC, TSI, nitrate reduction, urease production and catalase tests
11	Cultural, morphological and biochemical characteristics of <i>Staphylococcus</i>
12	Study of various stages of Malarial parasite in RBCs using permanent mounts
13	Perform antibiotic sensitivity by Kirby-Bauer method
14	Study symptoms of the diseases with the help of photographs: Polio, anthrax, herpes, chicken pox, HPV warts, Candidiasis, dermatomycoses, ring worms

**Note :** Visit to pharmaceutical and pathology laboratory

**Pedagogy:** Experiential learning, Problem solving, Project

Formative Assessment for Practical	
Assessment Occasion/ type	Marks
Attendance	05 Marks
Records	05 Marks
Performance	05 Marks
Test	10 Marks
<b>Total</b>	<b>25 Marks</b>

*Formative Assessment as per guidelines are compulsory*

  
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References	
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## B.Sc., Microbiology 6<sup>th</sup> Semester


Program Name	BSc in Microbiology	Semester	VI
Course Title	INDUSTRIAL MICROBIOLOGY		
Course Code:	DSC-8T	No. of Credits	4
Contact hours	60 Hours (4 Hours per week)	Duration of SEA/Exam	2 hours
Formative Assessment Marks	40	Summative Assessment Marks	60

**Course Pre-requisite(s): Common to the Course Programme at Entry Level**

**Course Outcomes (COs):** After the successful completion of the course, the student will be able to:

- CO1. Learn the overview of scope and importance of industrially important microbes
- CO2. Acquaint with different types of fermentation processes and equipments
- CO3. Evaluate the factors influencing the enhancement of cell and product formation during fermentation
- CO4. Acquire the knowledge of the production of value-added products
- CO5. Acquire the knowledge of purification of value-added products

Contents	60 Hrs
<b>Unit-1: Introduction to Industrial microbiology:</b> Scope and concepts; Criteria for selection of industrially important microbes; Preservation of industrially important microbes. Types of fermentation process: Submerged fermentation, Solid state fermentation (Koji), batch fermentation, continuous fermentation, kinetics of fermentation process.	15 Hrs
<b>Unit-2: Fermentors:</b> Basic features; design and components of a bioreactor; Specialized bioreactors and their applications: tubular bio reactors, fluidized bed reactor, packed bed reactors, membrane bioreactors, Photo-bioreactors and anaerobic bioreactors; Sterilization of fermentor, Control of air, temperature, pH, foaming and feed; Aseptic inoculation and sampling methods; Scale up of fermentation process-Merits and demerits. <b>Fermentation media:</b> Strategies for media formulation; Natural and synthetic media; Role of buffers, precursors, inhibitors, Antifoaming agents, inducers and micronutrients.	15 Hrs
<b>Unit-3:</b> General production strategies of microbial products and Downstream processing: Antibiotic, Enzymes, anti-cholesterol compound, anti-cancerous compound, hormones. <b>Objectives and significance of downstream processing:</b> Overview of steps in extraction and purification of product; Filtration and centrifugation; cell disruption- Physical, chemical and biological methods; Product extraction; product purification, recovery and product testing. <b>Microbial production of industrial products:</b> Industrial production and uses of Ethyl alcohol, wine, Penicillin, Lactic acid, Citric acid, Oyster mushroom cultivation. <b>Enzyme immobilization;</b> Introduction, Techniques and Applications.	15 Hrs

  
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<b>Unit-4: Biotechnology</b> <b>Microbial synthesis of commercial products-</b> protein pharmaceuticals and Interferons; bioplastics (PHB, PHA), microbial enzymes, microbial metabolites –, amino acids, <b>Recombinant products:</b> Products of human therapeutic interest - insulin, hGH, antisense molecules. Bt Cotton, Bt Brinjal. Gene therapy, recombinant vaccines. Biological, ethical and social issues of gene cloning and IPR. Gene Library: Construction and application of cDNA and genomic libraries. Application of recombinant microorganisms in basic research, industry, medicine, agriculture, environment.	15 Hrs
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**Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs 1-15)**

Course Outcomes (COs) / Program Outcomes (POs)	Program Outcomes (POs)														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Learn the overview of scope and importance of industrially important microbes	√														
Acquaint with different types of fermentation processes and equipments												√			
Evaluate the factors influencing the enhancement of cell and product formation during fermentation								√							
Acquire the knowledge of the production of value-added products												√			
Acquire the knowledge of purification of value-added products												√			

**Pedagogy:** Lectures, Seminars, Industry/Institute Visits, Debates, Quiz, Project and Assignments

Formative Assessment for Theory	
Assessment Occasion/ type	Marks
Attendance	10 Marks
Class Test	10 Marks
Debate/Quiz/Assignment	10 Marks
Seminar	10 Marks
<b>Total</b>	<b>40 Marks</b>
<i>Formative Assessment as per guidelines are compulsory</i>	

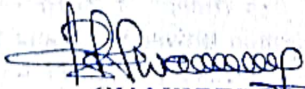
## Practical: Immunology & Medical Microbiology

Course Title	INDUSTRIAL MICROBIOLOGY (Practical)	Practical Credits	2
Course Code	DSC-8P	Contact Hours	4 Hours/ Week
Formative Assessment	25 Marks	Summative Assessment	25 Marks
<b>PRACTICAL CONTENT</b>			
<ol style="list-style-type: none"> <li>1. Demonstration of a basic fermentor</li> <li>2. Preparation of natural medium used in a industry</li> <li>3. Preparation of synthetic medium used in a industry</li> <li>4. Production of amylase/protease/cellulase/pectinase/invertase by solid substrate fermentation(with Atleast 2 substrates)</li> <li>5. Production of enzyme (amylase/protease/cellulase/invertase by submerged fermentation)</li> <li>6. Preservation of microbes with glycerol/soil.</li> <li>7. Air filter challenge test</li> <li>8. Production and estimation of any one secondary metabolite</li> <li>9. Cell immobilization (Sodium alginate method)</li> <li>10. Cultivation and processing of edible Mushroom.</li> <li>11. Preparation of wine from grapes.</li> <li>12. Preparation of alcohol using jaggery/molasses.</li> <li>13. Estimation of citric acid produced from <i>Aspergillus niger</i> by titrimetric method</li> <li>14. Estimation of % alcohol in a given sample by specific gravity bottle method</li> <li>15. Study of cloning techniques through charts, figures</li> </ol>			


**Note: Visit to distilleries and Industrial laboratory.**

**Pedagogy:** Experiential learning, Problem solving, Project

Formative Assessment for Practical	
Assessment Occasion/ type	Marks
Attendance	05 Marks
Records	05 Marks
Performance	05 Marks
Test	10 Marks
<b>Total</b>	<b>25 Marks</b>
<i>Formative Assessment as per guidelines are compulsory</i>	

  
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13	Russell PJ. (2009). i Genetics- A Molecular Approach. 3rd Ed, Benjamin Cummings
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**B.Sc., V Semester Microbiology**  
**DSC – 5P**  
**NEP-Practical Internal Examination**  
**Course V: Microbial Genetics**

**Time: 01 Hour**

**Max Marks: 25**

1. Perform/ demonstrate the experiment **A** \_\_\_\_\_ with principle and procedure. Record the results. **06 Marks**
2. Identify the micro slides/ photographs/ models **B** and **C** giving reasons with labeled diagrams. **2X2 =04 Marks**
3. Class Record **15 Marks**

**B.Sc., V Semester Microbiology**  
**DSC – 5P**  
**NEP-Practical Internal Examination**  
**Course V: Microbial Genetics**

**Time: 01 Hour**

**Max Marks: 25**


1. Perform/ demonstrate the experiment **A** \_\_\_ with principle and procedure. Record the results. **06 Marks**  
  
[Preparation/ Performance-3 marks; Principle-1; Procedure-1 mark; Result-1 mark]  
  
(Isolation of DNA/ RNA from microbial source/ Estimation of DNA by DPA method/ Estimation of RNA orcinol method/ Demonstration of AMES test/ Visualization of DNA in agarose gel electrophoresis/ Replica plating technique/ preparation of buffers for electrophoresis/ Casting of gel/ Genetics problems)
2. Identify the micro slides/ photographs/ models **B** and **C** giving reasons with labeled diagrams. **2X2=04 Marks**

[Identification- ½ marks; Reasons- 1 mark; Labeled diagram ½ marks]

(Micropipettes/ Agarose gel electrophoresis assembly/ Replica plating technique/ Charts on Transformation/ Conjugation/ Transduction/ Transcription/ Translation/ Lac operon through microphotograph/ Semi conservative mode of DNA replication/ Restriction enzymes)

3. Class Record

**15 Marks**

  
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**B.Sc., V Semester Microbiology**  
**DSC – 5P**  
**NEP Practical External Examination**  
**Course V: Microbial Genetics**

**Time: 03 Hours**

**Max. Marks: 25**

1. Perform/ demonstrate the experiment A \_\_\_\_\_ with principle and procedure.  
Record the results. **08 Marks**
2. Make a temporary preparation of the given materials B Identify the same with  
labeled diagram and reasons. **06 Marks**
3. Identify the micro slides/ photographs/ models C, D and E giving reasons with  
labeled diagrams. **3X2=06 Marks**
4. Viva-voce **05 Marks**

**B.Sc., V Semester Microbiology**  
**DSC – 5P**  
**NEP Practical External Examination**  
**Course V: Microbial Genetics**

**Time: 03 Hours**

**Max. Marks: 25**

1. Perform/ demonstrate the experiment A \_\_\_\_\_ with principle and procedure. Record the  
results. **08 Marks**  
  
[Preparation/ Performance-5 marks; Principle-1 mark; Procedure-1 mark; Result- 1 mark]  
  
(Isolation of DNA/ RNA from microbial source/ Estimation of DNA by DPA method/  
Estimation of RNA by Orcinol method/ Demonstration of AMES test)
2. Perform/ demonstrate the experiment B with principle and procedure. Record the results. **06 Marks**  
[Identification- ½ marks; Reasons -1 mark; Labeled diagram- ½ mark]  
  
(Replica plating technique/ preparation of buffers for electrophoresis/ Casting of gel/  
Genetics problems)
3. Identify the micro slides/ photographs/ models C, D and E giving reasons with labeled  
diagrams **3X2=06 Marks**  
[Identification- ½ marks; Reasons- 1 mark; Labeled diagram ½ marks]  
  
(Micropipettes/ Agarose gel electrophoresis assembly/ Replica plating technique/  
Charts on Transformation/ Conjugation/ Transduction/ Transcription/ Translation/  
Lac operon through microphotograph/ Semi conservative mode of DNA replication/  
Restriction enzymes)
4. Viva-voce **05 Marks**

**B.Sc., V Semester Microbiology**  
**DSC – 6P**  
**NEP-Practical Internal Examination**  
**Course V: Food Microbiology**

**Time: 01 Hour**

**Max Marks: 25**

1. Perform/ demonstrate the experiment A \_\_\_\_\_ with principle and procedure. Record the results. **06 Marks**
2. Identify the micro slides/ photographs/ models B and C giving reasons with labeled diagrams. **2X2 =04 Marks**
3. Class Record **15 Marks**

**B.Sc., V Semester Microbiology**  
**DSC – 6P**  
**NEP-Practical Internal Examination**  
**Course V: Food Microbiology**

**Time: 01 Hour**

**Max Marks: 25**

1. Perform/ demonstrate the experiment A \_\_\_\_ with principle and procedure. Record the results. **06 Marks**

[Preparation/ Performance-3 marks; Principle-1; Procedure-1 mark; Result-1 mark]

Isolation of bacteria and fungi from serial dilution (spoiled fruits/vegetables), Isolation of bacteria fungi from fermented food and stored food, Bacteriological quality of water by MPN, Turbidity test, Bacteriological examination of milk by DMC / SPC/ /Methylene blue reduction test/Resazurin reduction test, Estimation of lactic acid in milk.

2. Identify the micro slides/ photographs/ models B and C giving reasons with labeled diagrams. **2X2=04 Marks**

[Identification- ½ marks; Reasons- 1 mark; Labeled diagram ½ marks]

MPN test, Turbidity test, Methylene blue reduction test/ Resazurin reduction test  
Canned food/Cheddar cheese/Yoghurt/Pickles, DMC, Spoiled fruit, Spoiled vegetable, Salt, Sugar, Vinegar, Benzoic acid, potassium metabi-sulphite, EMB agar, TLC plate, Food borne pathogens- photographs/ slides of *Stapylococcus*, *Salmonella*, *Aspergillus*, *Clostridium*

3. Class Record **15 Marks**

  
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**B.Sc., V Semester Microbiology**  
**DSC – 6P**  
**NEP-Practical External Examination**  
**Course V: Food Microbiology**

**Time: 03 Hours**

**Max. Marks: 25**

1. Perform/ demonstrate the experiment **A**\_\_\_\_\_with principle and procedure. Record the results. **08 Marks**
2. Make a temporary preparation of the given materials **B** Identify the same with labeled diagram and reasons. **06 Marks**
3. Identify the micro slides/ photographs/ models **C, D** and **E** giving reasons with labeled diagrams. **3X2=06 Marks**
4. Viva-voce **05 Marks**

**B.Sc., V Semester Microbiology**  
**DSC – 6P**  
**NEP-Practical External Examination**  
**Course V: Food Microbiology**

**Time: 03 Hours**

**Max. Marks: 25**

1. Perform/ demonstrate the experiment **A**\_\_\_with principle and procedure. Record the results. **08 Marks**  
[Preparation/ Performance-5 marks; Principle-1 mark; Procedure-1 mark; Result- 1 mark]

Isolation of bacteria and fungi from a) spoiled fruits/vegetables b) fermented food and stored food, Standard analysis of water samples by MPN test, Bacteriological examination of milk by SPC, Methylene blue reduction test

2. Make a temporary preparation/ Mounting of the given materials **B**,\_\_\_\_\_Identify the same with labeled diagram and reasons **06 Marks**

[Identification- ½ marks; Reasons -1 mark; Labeled diagram- ½ mark]

DMC/ Resazurin reduction test/ titrable acidity of milk/ Turbidity test

3. Identify the micro slides/ photographs/ models **C, D** and **E** giving reasons with labeled diagrams **3X2=06 Marks**  
[Identification- ½ mark; Reasons- 1 mark; Labeled diagram ½ marks]
4. MPN test, Turbidity test, Methylene blue reduction test/ Resazurin reduction test Canned food/Cheddar cheese/Yoghurt/Pickles, DMC, Spoiled fruit, Spoiled vegetable, Salt, Sugar, Vinegar, Benzoic acid, potassium metabi-sulphite, EMB agar, TLC plate, Food borne pathogens- photographs/ slides of *Stapylococcus*, *Salmonella*, *Aspergillus*, *Clostridium*
5. Viva-voce **05 Marks**



**B.Sc., VI Semester Microbiology**

**DSC – 7P**

**NEP-Practical Internal Examination**

**Course VI: Immunology and Medical Microbiology**

**Time: 01 Hour**

**Max Marks: 25**

1. Perform/ demonstrate the experiment A \_\_\_\_\_ with principle and procedure.  
Record the results. **06 Marks**
2. Identify the micro slides/ photographs/ models B and C giving reasons with labeled diagrams. **2X2 =04 Marks**
3. Class Record **15 Marks**

**B.Sc., VI Semester Microbiology**

**DSC – 7P**

**NEP-Practical Internal Examination**

**Course VI: Immunology and Medical Microbiology**

**Time: 01 Hour**

**Max Marks: 25**

1. Perform/ demonstrate the experiment A \_\_\_\_\_ with principle and procedure.  
Record the results. **06 Marks**

[Preparation/ Performance-3 marks; Principle-1; Procedure-1 mark; Result-1 mark]

Blood group determination/WBC count/Differential leukocyte count/Separation of serum/Plasma blood/Immunodiffusion (SRID)/IMVIC/WIDAL/RPR test/HCG/VDRL

2. Identify the micro slides/ photographs/ models B and C giving reasons with labeled diagrams. **2X2=04 Marks**

[Identification- ½ marks; Reasons- 1 mark; Labeled diagram ½ marks]

Microscopic examination of pathogenic microorganisms-*Mycobacterium tuberculosis*/*E.coli*/*Salmonella typhi*/*Vibrio cholera*/*Trponema pallidum*/*Staphylococcus aureus*/*Clostridium sp*/Stages of malarial parasite/Media-EMB Agar/Macconkey's agar/Mannitol salt agar/Deoxy citrate agar/TCBS

Photographs of Polio/Hepatitis B/Rabies/Dengue/AIDS slides

3. Class Record

**15 Marks**

  
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**B.Sc., VI Semester Microbiology**

**DSC – 7P**

**NEP-Practical External Examination**

**Course VI: Immunology and Medical Microbiology**

**Time: 03 Hours**

**Max. Marks: 25**

1. Perform/ demonstrate the experiment A \_\_\_\_\_ with principle and procedure. Record the results. **08 Mars**
2. Make a temporary preparation of the given materials B Identify the same with labeled diagram and reasons. **06 Marks**
3. Identify the micro slides/ photographs/ models C, D and E giving reasons with labeled diagrams. **3X2=06 Marks**
4. *Viva-voce* **05 Marks**

**B.Sc., VI Semester Microbiology**

**DSC – 7P**

**NEP-Practical External Examination**

**Course VI: Immunology and Medical Microbiology**

**Time: 03 Hours**

**Max. Marks: 25**

1. Perform/ demonstrate the experiment A with principle and procedure. Record the results. **08 Marks**

[Preparation/ Performance-5 marks; Principle-1 mark; Procedure-1 mark; Result- 1 mark]

(Kirby Bauer method/ Identification of human blood groups/ WBC Count/ Differential leukocyte count of blood sample/ Separation of serum/ Plasma from blood sample/ Immuno diffusion test by Ouchterlony method/ SRID/ IMVIC test)

2. Perform/ demonstrate the experiment B with principle and procedure. Record the results **06 Marks**

[Identification- ½ marks; Reasons -1 mark; Labeled diagram- ½ mark]

WIDAL test (Slide)/ HCG test/ RPR test/ VDRL test/ coagulase test/ Germ tube test for *Candida albicans*/ Pathogenic bacteria- EMB agar/ Macconkey agar/ Mannitol salt agar/ Deoxycholate citrate agar/ Blood agar/ Chocolate agar/ Urease/ Catalase Test.

3. Identify the micro slides/ photographs/ models C, D and E giving reasons with labeled Diagrams **3X2=06 Marks**

[Identification- ½ marks; Reasons- 1 mark; Labeled diagram ½ marks]

Immunodiffusion/ Slides (SRID)/ Media-EMB agar/ Macconkey agar/ Mannitol salt agar/ Deoxycholate citrate agar/ TCBS agar/ Blood agar/ Chocolate agar/ Urease/ Catalase Test/ Morphology/ Cultural characteristics of Staphylococcus/ Streptococcus/ Different stages of malarial parasite in RBC/ Photographs/ Rabies/ Chickengunya/ AIDS/ Candidiasis/ Ahlets foot).

4. *Viva-voce* **05 Marks**
5. **Note: Visit to pharmaceutical and Pathology laboratory (Optional)**

**B.Sc., VI Semester Microbiology**  
**DSC – 8P**  
**NEP-Practical Internal Examination**  
**Course VI: Industrial Microbiology**

**Time: 01 Hour**

**Max Marks: 25**

1. Perform/ demonstrate the experiment A \_\_\_\_\_ with principle and procedure.  
Record the results. **06 Marks**
  
2. Identify the micro slides/ photographs/ models B and C giving reasons with labeled diagrams. **2X2 =04 Marks**
  
3. Class Record **15 Marks**

**B.Sc., VI Semester Microbiology**  
**DSC – 8P**  
**NEP-Practical Internal Examination**  
**Course VI: Industrial Microbiology**

**Time: 01 Hour**

**Max Marks: 25**

1. Perform/ demonstrate the experiment A \_\_\_\_\_ with principle and procedure.  
Record the results. **06 Marks**

[Preparation/ Performance-3 marks; Principle-1; Procedure-1 mark; Result-1 mark]

(Estimation of citric acid produced by *Aspergillus niger* (Titrometric analysis)  
/Preparation of lysis Buffers/ Enzyme immobilization technique/Estimation of % of alcohol by specific gravity method/ invertase activity in yeast/ primary screening for antibiotic production/ primary screening for enzyme production)


2. Identify the micro slides/ photographs/ models B and C giving reasons with labeled diagrams. **2X2=04 Marks**

[Identification- ½ marks; Reasons- 1 mark; Labeled diagram ½ marks]

Photographs / Charts /Models of Typical bioreactor/ wine / Flow charts On cultivation/  
and processing of edible mushroom/ Flow charts on production of Recombinant insulin/  
hGH/ Bt cotton/ Bt brinjal/ Gene therapy/ Recombinant vaccines /cDNA / Genomic  
libraries/ raw materials used industries

3. Class Record

**15 Marks**

  
**CHAIRPERSON**  
Department of Microbiology  
Kuvempu University, Jnana Sanyada  
Shankarhatta-577 451.

Time: 03 Hours

Max. Marks: 25

1. Perform/ demonstrate the experiment A \_\_\_\_\_ with principle and procedure. Record the results. **08 Mars**
2. Make a temporary preparation of the given materials B Identify the same with labeled diagram and reasons. **06 Marks**
3. Identify the micro slides/ photographs/ models C, D and E giving reasons with labeled diagrams. **3X2=06 Marks**
4. Viva-voce **05 Marks**

Time: 03 Hours

Max. Marks: 25

1. Perform/ demonstrate the experiment A \_\_\_\_\_ with principle and procedure. Record the results. **08 Marks**

[Preparation/ Performance-5 marks; Principle-1 mark; Procedure-1 mark; Result- 1 mark]  
(Estimation of citric acid produced by *Aspergillus niger* (Titrometric analysis) / Enzyme immobilization technique/Estimation of % of alcohol by specific gravity method/

2. Perform/ demonstrate the experiment B with principle and procedure. Record the results. **06 Marks**

[Identification- ½ marks; Reasons -1 mark; Labeled diagram- ½ mark]

Preparation of Buffers (Composition/Preparation & Uses)/ invertase activity in yeast/ primary screening for antibiotic production/ primary screening for enzyme production/ Enzyme immobilization technique/ Preservation of Industrially important Microorganisms in glycerol & soil/ preparation of alginate beads)

3. Identify the micro slides/ photographs/ models C, D and E giving reasons with labeled Diagrams **3X2=06 Marks**

[Identification- ½ marks; Reasons- 1 mark; Labeled diagram ½ marks]

Photographs / Charts/ types and parts of typical bioreactor/ wine / raw materials used industries/ enzyme immobilized beads/ Flow charts on cultivation and processing of edible mushroom/ Flow charts on production of Recombinant insulin/ hGH/ Bt cotton/ Bt brinjal/ Gene therapy/ Recombinant vaccines /cDNA / Genomic libraries/

4. Viva-voce **05 Marks**
5. Note: Visit to Distillery and Industrial laboratory