ST. PHILOMENA'S COLLEGE (AUTONOMOUS)

Affiliated to University of Mysore
Accredited by NAAC with 'B^{++}' Grade
Bannimantap, Mysore, Karnataka,
India-570015

DEPARTMENT OF MICROBIOLOGY

The Board of Studies in Microbiology which met on 23.08.2024 has approved the syllabus and pattern of examination for Semester V & VI (NEP) for the Academic Year 2024-25

BOS COMMITTEE MEMBERS

Sl. No.	Name	Designation
1	PROF.SYEDA FARHANA PARVEEN	Chairperson
2	DR. SATISH S.	Member(University Nominee)
3.	DR. PRAKASH M. HALAMI	Member(College Nominee)
4	PROF.SHEEMA KOUSER	Member(Other University)
5	PROF. UZMA BATHOOL	Member
6.	MS.CHRIS CHERITA	Member(Alumnus)

V Semester B.Sc. (MICROBIOLOGY)
Core Course Content

Course Title: **MICROBIAL GENETICS AND MOLECULAR BIOLOGY (Paper V)**	Course Credits: **4**
Course Code: **MIBDSC501**	L-T-P per week: **4-0-4**
Total Contact Hours**: 60**	
Formative Assessment Marks:**40**	Summative Assessment Marks: **60**
Pedagogy: Written Assignment/Presentation/Project / Term Papers/Seminar/Field studies	

Formative Assessment		
Assessment Occasion	**Assessment type**	**Weightage in Marks**
C1 First component	Test-20 marks test for 60 minutes	10
C1 Second Component	Assignment	10
C2 First component	Test-20 marks test for 60 minutes	10
C2 Second Component	Quiz	10
	Total	**40**

Note: Any two different activities for C2 First component and C2 Second component can be selected from the below **Quiz/Project/Class room exercise/Practice exercise/Educational (industry/ institutes/ NGOs) visit/ field trip/ Field work/Viva voce/Role Play/Charts/ Models/Case study/Group discussion/Crosswords/Presentation/seminar/Review – movie / Book/Research articles/e – content preparation**

Course Objectives:

1. To learn the basics of genetics, bacterial genetics and the genetic material DNA
2. To study the fundamental life processes viz. DNA replication, RNA synthesis and protein synthesis
3. To understand the mechanism of gene expression and regulation
4. To study the genetics of viruses and fungi and understand the nature, types and repair of mutations

Course Learning Outcomes

After the successful completion of the course, the student will be able to;

CO1: Describe the experimental evidences to prove DNA as genetic material and differentiate various methods of recombination in bacteria.
CO2.: Explain the chemical basis of heredity and concepts involved in replication, transcription in bacteria
CO3 : Explain gene expression and outline regulatory mechanisms that control cellular processes in bacteria
CO4: Explain the genetics of viruses and fungi and mutation

V Sem: Content of Course 5 Theory : MICROBIAL GENETICS AND MOLECULAR BIOLOGY	**60 Hrs.**
Unit 1 : DNA as genetic material and Bacterial genetics	**15 Hrs.**

DNA as a genetic material: Griffith's Transformation experiment, Avery, MacLeod and McCarty experiment, Hershey and Chase experiment to prove DNA as the genetic material. Fraenkel- Conrat experiment to prove RNA as genetic material. Structure and organization of chromosomes in prokaryotes and eukaryotes. Plasmid-types (F plasmid, R plasmid & Ti plasmid), Transposons in Prokaryotes.

Bacterial genetics: Mechanism of genetic exchange in bacteria: Bacterial transformation - Principle and Types of transformation mechanisms found in prokaryotes. Bacterial Conjugation: U-tube experiment, properties of the F plasmid, F^+ x F-conjugation, F′ x F-conjugation, Hfr x F- conjugation, Transduction: Generalized and specialized transduction.

Unit 2: Genetic Material, Gene concept, DNA Replication and Transcription	**15 Hrs.**

Genetic Material: Chemical basis of heredity, Watson and Crick model of DNA, DNA types. RNA-types, structure, importance. Modern concept of gene -cistron, muton, recon, one gene- one enzyme and one gene – one polypeptide concept.
DNA Replication: Replicon, Enzymes and proteins involved in DNA replication- DNA polymerases, DNA ligase, primase, telomerase. General mechanism of replication in prokaryotes. Models of DNA replication including rolling circle, Θ (theta) mode of replication.
Transcription: Structure of bacterial RNA polymerase, Promoter concept, Recognition of promoters and DNA melting, Transcription bubble, Stages of transcription- initiation elongation and termination. Post- transcriptional processing.

Unit 3: Gene expression and Regulation	**15 Hrs.**

Gene expression: Gene-protein relationship, Genetic code- features, Wobble hypothesis. Translational machinery, Charging of tRNA, aminoacyl-tRNA synthases, Mechanisms of initiation, elongation and termination of polypeptide synthesis in prokaryotes. Post translational modifications of proteins. Protein maturation and secretion- protein splicing, molecular chaperones.

Gene regulation: Regulatory mechanisms in bacteria. Operon concept, polycistronic mRNA. Concept of inducible and constitutive genes. lac operon - negative and positive regulation; inducer- allolactose, lac repressor- structure , mechanism of binding to operator. Catabolite repression of lac operon and regulation by CAP. *trp* operon regulation – repressor control and attenuator control.

Unit 4: Genetics of Viruses, Fungi and Mutation	**15 Hrs.**

Genetics of Viruses: Genetic recombination in phages, Heterozygosity in phages. Temperate phage and prophage, Non-genetic interaction of viral gene products, Complementation, Phenotypic mixing, Genotypic mixing and interference.

Genetics of Fungi: Life cycle of *Neurospora crassa*, Tetrad analysis: unordered tetrad analysis in yeast, ordered tetrad analysis in *Neurospora*, two point and three point test cross.

Mutation: Nature and types, Mutagenic agents: physical and chemical mutagens, damage and repair of DNA: Photoreactivation and SOS repair, Ames test.

Course Title	**MICROBIAL GENETICS AND MOLECULAR BIOLOGY (Practical)**

Course Code	**MIBDSCP501**	**No. of Credits**	**02**
Contact Hours	**60 (4 Hrs. per session)**	**Duration of SEA/Exam (Hrs.)**	**03**
Formative Assessment Marks	**25**	**Summative Assessment Marks**	**25**

CONTENT

1. Use of Micropipettes: Moving very small volumes accurately.
2. Isolation of DNA from microbial source.
3. Estimation of DNA by Diphenylamine method.
4. Estimation of RNA by Orcinol method.
5. Isolation of coliphages from sewage.
6. Isolation of antibiotic resistant mutants by gradient plate method.
7. Preparation of master and replica plates.
8. Study of survival curve of bacteria after exposure to ultraviolet (UV) light.
9. Preparation of competent cells for bacterial transformation.
10. Demonstration of bacterial conjugation by plate mating method.
11. Determination of purity of DNA.
12. Visualization of genomic DNA by agarose gel electrophoresis.
13. β- Galactosidase activity assay in Yeast.
14. Resolution and visualization of proteins by Polyacrylamide Gel Electrophoresis (SDS PAGE).
15. Study of Griffith`s experiment, conjugation, transduction, plasmid DNA, T4 phage, ordered tetrad analysis in *Neurospora*, two-point and three-point test cross result, Watson and Crick model of DNA, tRNA, semi conservative replication of DNA, bacterial RNA polymerase, transcription, translation, *lac* operon, Ames test through micrographs/schematic representations

Note: *Visit to Molecular biology laboratory.*

Text Books / References

1. Maloy *et al*., (1994). **Microbial Genetics**. Jones and Bartlett Publishers.
2. Dale, J. W. (1994). **Molecular Genetics of Bacteria**. John Wiley and Sons.
3. Streips and Yasbin, (1991). **Modern Microbial Genetics**. Wiley- Liss Publ.
4. J. D. Watson, N. H. Hopkins, J. W. Roberts, J. A. Steitz and A. M. Weiner.(1987). **Molecular Biology of the Gene** 4th Edition by, Benjamin / Cummings Publications Co. Inc. California.
5. Lewin, (2000). **Gene VII** . Oxford University Press.
6. Birge .**Bacterial and Bacteriophage Genetics**. 4th Edition..
7. Frefielder .**Microbial Genetics**. 4th Edition.
8. Robert L.Charlebois,(1999) **Organization of Prokayotic Genome.** ASM Publications.
9. Molecular Genetics of Bacteria, 1997 by Larry, Snyder and Wendy, Champness, ASM
10. James, D. Watson, Tania A. Baker, Stephen P. Bell, Alexander Gann, Michael Levine, Richard Losick. (2017).**Molecular Biology of the Gene,** 7th edition.
11. Freifelder, George M Malacinski (2015) .**Essentials of Molecular Biology**., 4th ed.
12. Alberts Bruce, Johnson, A., Lewis, J., Raff, M., Roberts, K., Walter, P. (2014). **Molecular Biology of the Cell.** 5th Edition, Taylor and Francis. New York, USA.
13. Tropp, B. E. (2012) **Molecular Biology: Genes to Proteins**. 4rd Edition, Jones & Bartlett, Learning, Burlington, MA
14. Allison A. Elizabeth (2012). **Fundamental Molecular Biology**, 2nd Edition. J Willey and Sons, Hoboken, New Jersey
15. Frederick, M., Ausubel, Roger Brent, Robert, E., Kingston, David, D., Moore, J. G. Seidman, John A.Smith, Kevin Struhl (2003). **Current Protocols in Molecular Biology.** John Wiley & Sons, New York, United States.
16. Sambrook, J. F. and Russell, D. W. (2001). **Molecular Cloning: a Laboratory Manual**. 3rd edition. Cold Spring Harbor, N.Y. Cold Spring Harbor Laboratory Press
17. Yılmaz, M., Ozic, C., Gok, İ. (2012). **Principles of Nucleic Acid Separation by Agarose Gel Electrophoresis. Gel Electrophoresis - Principles and Basics,** Dr. Magdeldin S (Ed.), ISBN: 978- 953-51-0458-2, InTech.

Blueprint of End semester examination

B. Sc. MICROBIOLOGY

Duration: 2 $^{1}/_{2}$ Hours **Maximum: 60 Marks**

All questions are compulsory

Draw neat labeled diagrams wherever necessary

Q. No. I **Define/Expand any EIGHT of the following** **2X8=16**

(1) **(2)**

(3) **(4)**

(5) **(6)**

(7) **(8)**

(9) **(10)**

Q. No. II **Write short notes on any SIX of the following** **4X6=24**

(11) **(12)**

(13) **(14)**

(15) **(16)**

(17) **(18)**

Q. No. III **Answer any TWO of the following** **10X2=20**

(19) **(21)**

(20) **(22)**

ST.PHILOMENA'S COLLEGE (AUTONOMOUS), MYSURU-15

V SEM (NEP) SCHEME OF PRACTICAL EXAMINATION

Practical V: Microbial Genetics and Molecular Biology (MIBDSCP501)

Duration: 3 hours **Max. Marks: 25**

I. Demonstrate / Perform the experiment **A** giving principle and procedure Record the result. **08 marks**

(Estimation of DNA/Estimation of RNA/Isolation of antibiotic resistant mutant by gradient plate method/preparation of replica plates/UV survival curve of bacteria/Bacterial conjugation)
Demonstration-2 marks, Principle-2 marks, Procedure-2 marks, Result-2 marks

II. Write the protocol for the experiment **B.** **05 marks**
(Isolation of DNA from bacteria/preparation of competent cells/Isolation of coliphages from sewage/Agarose gel electrophoresis/SDS-PAGE)
Principle-2 marks, Procedure-3 marks

III. Write critical notes on **C,D, E** & **F** **4 X 2 = 08 marks**

(Griffith`s experiment, conjugation, transduction, plasmid DNA, T4 phage, ordered tetrad analysis in *Neurospora*, Watson and Crick model of DNA, tRNA, semi-conservative replication of DNA, bacterial RNA polymerase, transcription, translation and *lac* operon)

IV. Viva **04 marks**

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V Semester B.Sc. (MICROBIOLOGY)

Core Course Content

Course Title: **FOOD MICROBIOLOGY (Paper VI)**	Course Credits: **4**
Course Code: **MIBDSC502**	L-T-P per week: 4-0-4
Total Contact Hours**: 60**	
Formative Assessment Marks:40	Summative Assessment Marks:60
Pedagogy: Written Assignment/Presentation/Project / Term Papers/Seminar/Field studies	

Formative Assessment		
Assessment Occasion	**Assessment type**	**Weightage in Marks**
C1 First component	Test-20 marks test for 60 minutes	10
C1 Second Component	Assignment	10
C2 First component	Test-20 marks test for 60 minutes	10
C2 Second Component	Quiz	10
	Total	**40**

Note: Any two different activities for C2 First component and C2 Second component can be selected from the below **Quiz/Project/Class room exercise/Practice exercise/Educational (industry/ institutes/ NGOs) visit/ field trip/ Field work/Viva voce/Role Play/Charts/ Models/Case study/Group discussion/Crosswords/Presentation/seminar/Review – movie / Book/Research articles/e – content preparation**

Course Objectives:

1. To study the role of microorganisms in food production and plant disease
2. To understand the importance of microorganisms from air and water in food processing
3. To understand the role of microorganisms in food spoilage
4. To learn food preservation techniques and study Microbiology of dairy industry

Course Learning Outcomes

CO1 Discuss the association of microorganisms with food, principles and types of food spoilage, preservation, food safety protocols and the quality testing of food

CO2 Explain the properties of milk, the types of preservation of milk, describe the types of fermented food and dairy products and their significance

CO3 Explain the role of microorganisms in food production and diseases of crop plants

CO4 Explain the importance of microbial quality of air and water in food processing

V Sem. Content of Course 6: Theory: Food Microbiology	**60 Hrs.**
Unit 1: Food spoilage, Infection, Intoxication and Preservation	**15 Hrs.**

Microbes and food: Food as a substrate for microorganisms- Intrinsic and extrinsic parameters affecting the growth of microbes.
Spoilage: Principles of food spoilage, Sources of food contamination, Spoilage of meat, poultry, fish, cereals, fruit and vegetables, canned food.
Food- borne infection(Salmonellosis)
Food- borne intoxication (Botulism and Mycotoxicosis- Aflatoxicosis).
Food preservation: Principles of food preservation. Methods of preservation-Physical (high temperature, low temperature, drying, irradiation, HPP), chemical (Class I and Class II), Biopreservation (Nisins).

Food Packaging- Types of packaging materials, properties and benefits. Food sanitation and control- Good Hygiene practices, GLP, GMP, HACCP, FSSAI, FDA and BIS in brief.

Unit 2: Microbiology of milk, fermented food products, microorganisms as food	**15 Hrs.**

Dairy Microbiology: Composition of milk. Sources of contamination of milk. Biochemical changes of milk- souring, gassy fermentation, proteolysis, lipolysis, and ropiness. Microbiological analysis of milk- Rapid platform tests (COB, Phosphatase test, DMC), SPC and Reduction tests. Preservation of milk and milk products- Pasteurization, desiccation, sterilization. Packing of milk and dairy products.

Fermented foods: Starter culture- types and role. Fermented milk products (Cheese- types, Yoghurt, Acidophilus milk), vegetables (sauerkraut) Meat (sausage) and fish (fish sauce).
Microorganisms as food- Oyster mushroom cultivation, SCP, SCO. Prebiotics, Probiotics, Synbiotics and Nutraceuticals.

Unit 3: Production of food crops, Crop diseases	**15 Hrs.**

Role of microbes in food crop production: Soil microorganisms, and their role in soil fertility. Interactions among soil microorganisms. Mycorrhizae.
Biofertilizers: Definition, Mass production, mode of application, advantages and limitations of *Rhizobium, Azotobacter, Azospirillum*, cyanobacterial fertilizers.

Biopesticides: Definition, types- bacterial, viral and fungal-mode of action, factors influencing, target pests. Microbial herbicides.

Diseases of food crops: Study of symptoms, etiology, epidemiology and management of diseases caused by fungi (Downy mildew of grapes, Tikka disease of groundnut, Blast disease of paddy), bacteria (Citrus canker, Bacterial blight of rice), viruses (Bean mosaic, Papaya ring spot) and viroids (Potato spindle tuber disease). Post-harvest diseases.

Unit 4: Microbial quality of air and water for food processing	**15 Hrs.**

Bioaerosols in food: Air borne microbes and their impact on food. Bioaerosol sampling: Vertical cylinder spore trap, Hirst spore trap, Rotorod sampler, Andersen sampler, impingers and filtration. Control of bioaerosols- UV light, HEPA filters, desiccation, Incineration.

Water quality in food safety: Water sample collection, standard methods to determine potability of water samples: presumptive/MPN test, confirmed and completed tests for fecal coliforms, SPC, IMViC reactions, membrane filter technique. Water- borne pathogens. Water purification for control of water- borne pathogens- coagulation and sedimentation, filtration, chemical disinfection, UV light.

Course Title		**FOOD MICROBIOLOGY (Practical)**	
Course Code	**MIBDSCP502**	**No. of Credits**	**02**
Contact Hours	**60 (4 Hrs. per session)**	**Duration of SEA/Exam (Hrs.)**	**03**
Formative Assessment Marks	**25**	**Summative Assessment Marks**	**25**

Content

1. Determination of mesophilic aerobic count in foods and expression of count in log CFU/g
2. Determination of SPC of raw and pasteurized milk samples
3. Turbidity test for the detection of boiled and unboiled milk to determine efficiency of sterilization of milk
4. Methylene blue and Resazurin reduction test for assessing the quality of raw milk
5. Cultivation of edible Mushroom(Oyster mushroom by bag method)
6. Culturing of *Spirulina sp*. as single cell protein.
7. Isolation and characterization of *Rhizobium spp*. from root nodules.
8. Microscopic observation of VAM fungi and *Anabaena azollae*
9. Demonstration of antagonism among soil microorganisms.
10. Study of diseased specimen of food crops mentioned in the theory syllabus
11. Determination of microbial contamination of air by Petri plate exposure method.
12. Standard analysis of water samples and determination of MPN.
13. Biochemical differentiation of Enterobacteriaceae isolates by IMViC reactions.
14. Determination of bacteriological quality of water by H_2S paper strip test.
15. Demonstration of air samplers, biofertilizer and biopesticide samples, photographs of water purification process, fermented food products, *Aspergillus* sp. on groundnut(Wet blotter test), *Penicillium* on orange

Note: *Visit to agricultural research station, water purification plant & food industry*

Text Books / References

1. Rangaswamy, G. and Bagyaraj, D. J. (2001), **Agricultural Microbiology**, 2nd ed. Prentice hall of India Pvt.Ltd., New Delhi.
2. . Rheinhermer, G. (1986). **Aquatic Microbiology**. John Wiley and Sons, New York.
3. Subha Rao, N. S., 1988. **Biofertilizers in Agriculture.** 2nd ed. Oxford and IBH Pub. Co., New Delhi.
4. Daniel Environmental Microbiology.
5. Grant, W. D. and P. E, Long: (1981). **Environmental Microbiology**, Thomson Litho ltd.
6. . Mehrotra, R. S., **Plant Pathology**, Tata McGraw Hill Publications Limited, New Delhi.
7. . Michael, J. Pelczar, Jr.E. C. S. Chan, Moel: **Microbiology**, McGraw Hill Book Company, New York).
9. Mitchell, R. (1992), **Introduction to Environmental Microbiology**, Prentice Hall Inc, Englewood Cliffs.
10. Adams, M. R. and Moss, M. O. (1995) **Food Microbiology**. Royal Society of Chemistry, Cambridge University Press.
11. Frazier & Westhoff, D. C. (1995) **Food Microbiology**. Tata McGraw Hill Pub. Company Ltd., New Dehli.
12. Jay, J. M. (1985). **Modern Food Microbiology**. CBS Publishers and distributors, New Delhi.
13. Doyle M. P. and Beuchat L. R. (2007). **Food Microbiology-Fundamentals**. Frontiers, ASM Press.
14. Garbutt J. (1997). **Essentials of Food Microbiology**, Arnold- International Students edition, London. 8. Marriott N. G. and Gravani R. B. (2006).
15. ThomasJ., Matthews,Karl; Kniel, Kalmia E (2017), **Food Microbiology: An Introduction**, American Society for Microbiology(ASM).
16. Deak T. and Beuchat L. R. (1996). **Hand Book of Food Spoilage Yeasts**, CRC Press, New York.

Blueprint of End semester examination

B. Sc. MICROBIOLOGY

Duration: 2 $^{1}/_{2}$ Hours **Maximum: 60 Marks**

All questions are compulsory

Draw neat labeled diagrams wherever necessary

Q. No. I **Define/Expand any EIGHT of the following** **2X8=16**

(1) **(2)**

(3) **(4)**

(5) **(6)**

(7) **(8)**

(9) **(10)**

Q. No. II **Write short notes on any SIX of the following** **4X6=24**

(11) **(12)**

(13) **(14)**

(15) **(16)**

(17) **(18)**

Q. No. III **Answer any TWO of the following** **10X2=20**

(19) **(21)**

(20) **(22)**

ST. PHILOMENA'S COLLEGE (AUTONOMOUS), MYSURU
V SEM (NEP) SCHEME OF PRACTICAL EXAMINATION
Practical VI: Food Microbiology (MIBDSCP502)

Duration: 3 hours **Max. Marks: 25**

I. Demonstrate / Perform the experiment **A** giving principle and procedure Record the result.

08 marks

(Determination of Microbial contamination of air by passive sampling method/ Standard analysis of water sample/ Determination of MPN/ IMViC reactions/ Determination of mesophilic aerobic count in foods)

Demonstration-2 marks, Principle-2 marks, Procedure-2 marks, Result-2 marks

II. Demonstrate the given experiment **'B'.** Write the principle and procedure. Record the result

. **05 marks**

(Turbidity test/Methylene blue reductase test/Resazurin test/H_2S strip test)

Demonstration-2 marks, Principle-1 mark, Procedure-1 mark, Result-1 mark)

III. Write critical notes on **C, D, E & F** **4X 2 = 08 marks**

(Fermented food products(Yoghurt, Cheese), Molasses, *Spirulina* culture, *Aspergillus* sp. on groundnut(Wet blotter test), *Penicillium* on orange, Air samplers, diseased specimen of food crops, biofertilizer and biopesticide samples, photographs of Mushroom cultivation, water purification process)

IV. Viva **04 marks**

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VI Semester B.Sc. (MICROBIOLOGY)

Core Course Content

Course Title: **IMMUNOLOGY AND MEDICAL MICROBIOLOGY (Paper VII)**	Course Credits: **4**
Course Code: **MIBDSC601**	L-T-P per week: 4-0-4
Total Contact Hours**: 60**	
Formative Assessment Marks:40	Summative Assessment Marks:60
Pedagogy: Written Assignment/Presentation/Project / Term Papers/Seminar/Field studies	

Formative Assessment

Assessment Occasion	Assessment type	Weightage in Marks
C1 First component	Test-20 marks test for 60 minutes	10
C1 Second Component	Assignment	10
C2 First component	Test-20 marks test for 60 minutes	10
C2 Second Component	Quiz	10
Total		**40**

Note: Any two different activities for C2 First component and C2 Second component can be selected from the below **Quiz/Project/Class room exercise/Practice exercise/Educational (industry/ institutes/ NGOs) visit/ field trip/ Field work/Viva voce/Role Play/Charts/ Models/Case study/Group discussion/Crosswords/Presentation/seminar/Review – movie / Book/Research articles/e – content preparation**

Course Objectives:

1: To study of the structure and function of the immune system, and its response towards foreign and self –antigens 2. To study the nature of antigen and antibody; role of antigen-antibody reactions in immunity, autoimmune disorders, hypersensitivity.
3. To learn the applications of antigen-antibody reactions in sero-diagnosis of diseases and understand the application of Immunology in prophylaxis of diseases using vaccines.
4. To study of the role of microorganisms in human health, concepts of infection, pathogenicity, pathogenesis, virulence, some examples of pathogenic microbes and the diseases they cause, treatment of diseases using antibiotics, antibiotic resistance development.

Course Outcomes (COs)

After the successful completion of the course, the student will be able to:

CO1: Define immunity and its types and explain the structure and function of the immune system

CO2: Explain antigen – antigen body reactions, immunological techniques and sero-diagnosis of infectious diseases

CO3: Identify and describe bacterial infections, symptoms, diagnosis and treatment

CO4: Identify and describe viral, protozoal, fungal infections and antibiotics

VI Sem Content of Course 7: Immunology and Medical Microbiology	**60 Hrs**

Unit 1 : Introduction to Immunology, Structure and function of the Immune system	**15 Hrs.**

Immune system: Historical perspective of Immunology. Immunity-Definition and types. Cells and organs of immune system: 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 Lymph nodes. Lymphoid tissues- MALT and GALT.

Antigen and Antibody: Antigen- Definition, properties and types. Immunogenicity and antigenicity, epitopes, haptens. Degree of foreignness, molecular weight, degradability. Adjuvants and their importance. Antibody: Definition, Basic structure of antibody, Structure and functions of different classes of antibodies (IgG, IgA, IgM, IgD and IgE). Antigenic determinants on immunoglobulins: Isotype, allotype and idiotype.

Unit 2: Antigen-antibody interactions and Hypersensitivity	**15 Hrs.**

Antigen-antibody reactions: Definition, salient features, antibody affinity and avidity, cross reaction. Neutralization, Opsonization.

Agglutination reactions: Hemagglutination- blood grouping, Widal test, VDRL/RPR test

Immunoprecipitation: Radial (Mancini) and double (Ouchterlony) immunodiffusion and Immunoelectrophoresis.

Complement system: Definition, Classical and properdin pathways, complement fixation test.

Immunotechniques: ELISA, Radioimmunoassay (RIA) and Immunofluorescence.

Hypersensitivity: Definition, Classification: antibody- mediated hypersensitivity; Type I (IgE), Type II (IgG and IgM- ADCC), Type III (Antigen-antibody complex), and Cell mediated hypersensitivity- Type IV (DTH). Autoimmune diseases and Transplantation Immunology in brief.

Immunoprophylaxis- Vaccines- Types- Killed, Live attenuated, Toxoid, subunit vaccine, recombinant vaccine, DNA vaccine with an example each. National Immunization Schedule and Mission Indradhanush.

Unit 3: Host-pathogen interaction and Medical Bacteriology	**15 Hrs.**

Host- pathogen interaction: Normal microflora of human body and their importance. Infection – definition, types, sources, modes of transmission, and portals of entry of pathogen. Pathogenicity & Virulence – Definition, virulence factors, attenuation and exaltation. Sample collection, transport and diagnosis

Medical Bacteriology: Symptoms, epidemiology, laboratory diagnosis, prophylaxis and treatment of the following- **respiratory diseases** caused by *Streptococcus pyogenes, Haemophilus influenzae, Mycobacterium tuberculosis*; **gastro-intestinal diseases** caused by: *Escherichia coli, Salmonella typhi, Vibrio cholera*; **Sexually transmitted diseases**: *Treponema pallidum*; and diseases caused by *Staphylococcus aureus, Clostridium tetani.*

Unit 4: Medical Virology, Parasitology ,Mycology and Chemotherapy	**15 Hrs.**

Medical Virology, Parasitology and Mycology:
Symptoms, mode of transmission, prophylaxis and control of **Viral diseases:** Polio, Hepatitis-B, Rabies, Dengue, AIDS, CoVid.; **Protozoal diseases**: Malaria, Kala- azar, Amoebic dysentery
Fungal infections: Cutaneous mycoses- Tinea infections; Systemic mycoses- Histoplasmosis; Opportunistic mycoses- Candidiasis.
Chemotherapy:
Antimicrobial agents: Definition, General characteristics.
Antibacterial agents: Sources, spectrum of activity and mode of action(Inhibitor of nucleic acid synthesis; Inhibitor of cell wall synthesis; Inhibitor of cell membrane function; Inhibitor of protein synthesis; Inhibitor of metabolism with an example each).
Antifungal agents: Source and mode of action of Amphotericin B, Griseofulvin;
Antiviral agents: Acyclovir, Azidothymidine.
Antibiotic resistance-causes, mechanism of development, antibiotic resistant pathogens(MDR,XDR, MRSA, NDM-1)

Course Title	**IMMUNOLOGY AND MEDICAL MICROBIOLOGY (Practical)**		
Course Code	**MIBDSCP601**	**No. of Credits**	**02**
Contact Hours	**60 (4 Hrs. per session)**	**Duration of SEA/Exam (Hrs.)**	**03**
Formative Assessment Marks	**25**	**Summative Assessment Marks**	**25**

Content

1. Determination of human blood groups (ABO & Rh).
2. Total leukocyte count of the given blood sample using haemocytometer.
3. Differential Leukocyte Count of the given blood sample.
4. Separation of serum from the blood sample.
5. Demonstration of precipitation reaction –Double diffusion in two dimensions (Ouchterlony procedure).
6. Demonstration of Single Radial Immunodiffusion (Mancini technique).
7. Demonstration of Widal test / HCG test using test kits

8. Demonstration of RPR test / VDRL test using test kits.
9. 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.
10. Study of bacterial flora of skin by swab method
11. Study of microbial flora of oral cavity (teeth and mouth)
12. Identification of bacteria (*E. coli*, *Staphylococcus*) using laboratory strains on the basis of cultural, morphological and biochemical characteristics: Sugar fermentation, IMViC, TSI, nitrate reduction, urease production and catalase tests.
13. Study of various stages of Malarial parasite in RBCs using permanent mounts
14. Antibiotic sensitivity test by Kirby-Bauer method
15. Microscopic observation/ display of photographs of human pathogens mentioned in the theory syllabus, ELISA,RIA, antibodies, lymphoid organs and cells

Note: *Visit to pharmaceutical industry and pathology laboratory*

Text Books / References

1. Ananthanarayan, R. and Paniker C. K. J. (2009). **Textbook of Microbiology**, 8th Edition, University Press,Publication.
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. Goering, R., Dockrell, H., Zuckerman, M. and Wakelin, D. (2007). Mims' **Medical Microbiology**. 4th edition. Elsevier
4. Willey, J. M., Sherwood, L. M., and Woolverton, C. J. (2013) Prescott, Harley and Klein's **Microbiology**.9th edition. McGraw Hill Higher Education
5. Madigan, M. T., Martinko, J. M., Dunlap, P. V. and Clark, D. P. (2014). Brock **Biology of Microorganisms.**14thedition. Pearson International Edition
6. Delves, P., Martin, S., Burton, D., Roitt, I. M. (2006). Roitt's **Essential Immunology**.11th edition Wiley-Blackwell Scientific Publication, Oxford.
7. Goldsby, R. A., Kindt, T. J., Osborne, B. A. (2007). Kuby's **Immunology**. 6th edition W. H. Freeman andCompany, New York.
8. Murphy, K., Travers, P., Walport, M. (2008). Janeway's **Immunobiology**. 7th edition Garland Science, Publishers, New York.
9. Peakman, M. and Vergani, D. (2009). **Basic and Clinical Immunology**, 2nd edition Churchill, Livingstone Publishers, Edinberg.
10. Richard, C. and Geiffrey, S. (2009). **Immunology**. 6th edition. Wiley Blackwell Publication.

Blueprint of End semester examination

B. Sc. MICROBIOLOGY

Duration: 2 $^{1}/_{2}$ Hours **Maximum: 60 Marks**

All questions are compulsory

Draw neat labeled diagrams wherever necessary

Q. No. I **Define/Expand any EIGHT of the following** **2X8=16**

(1) **(2)**

(3) **(4)**

(5) **(6)**

(7) **(8)**

(9) **(10)**

Q. No. II **Write short notes on any SIX of the following** **4X6=24**

(11) **(12)**

(13) **(14)**

(15) **(16)**

(17) **(18)**

Q. No. III **Answer any TWO of the following** **10X2=20**

(19) **(21)**

(20) **(22)**

ST.PHILOMENA'S COLLEGE (AUTONOMOUS), MYSURU

VI SEM (NEP) SCHEME OF PRACTICAL EXAMINATION

Practical VII: Immunology & Medical Microbiology (MIBDSCP601)

Duration: 3 hours **Max. Marks: 25**

I. Demonstrate / perform the experiment **A** giving principle and procedure. Record the result. **08 marks**

(Bacterial flora of skin by swab method / Antibiotic sensitivity test by Kirby-Bauer method / Total Leukocyte Count/Differential Leukocyte Count)

Demonstration-2 marks, Principle-2 marks, Procedure-2 marks, Result-2 marks

II. Demonstrate the given experiment **'B'.** Write the principle and procedure**. 05 marks**

(Blood grouping/ WIDAL/ RPR/ Ouchterlony Double Diffusion/ Radial

Immunodiffusion) Demostration-2 marks,Principle-1 mark,Procedure-1 mark,Result-1

mark)

III. Write critical notes on **C, D, E** & **F** **4 X 2 = 08 marks**

(Photographs of - Polio, Rabies, Chikungunya and AIDS viruses, Histoplasmosis, Candidiasis and Athlete's foot, Malarial parasite, *Salmonella typhi*, *Vibrio cholerae*, *Streptococcus pyogenes*, *Haemophilus influenzae*, *Mycobacterium tuberculosis*, *Treponema pallidum*, *Staphylococcus aureus*, *Clostridium tetani*,/ EMB Agar, MacConkey agar, Mannitol salt agar, Deoxycholate citrate agar, TCBS agar/results of experiment performed)

IV. Viva **04 marks**

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VI Semester B.Sc. (MICROBIOLOGY)

Core Course Content

Course Title: **INDUSTRIAL MICROBIOLOGY AND GENETIC ENGINEERING (Paper VIII)**	Course Credits: **4**
Course Code: **MIBDSC602**	L-T-P per week: 4-0-4
Total Contact Hours**: 60**	
Formative Assessment Marks:40	Summative Assessment Marks: 60
Pedagogy: Written Assignment/Presentation/Project / Term Papers/Seminar/Field studies	

Formative Assessment		
Assessment Occasion	**Assessment type**	**Weightage in Marks**
C1 First component	Test-20 marks test for 60 minutes	10
C1 Second Component	Assignment	10
C2 First component	Test-20 marks test for 60 minutes	10
C2 Second Component	Quiz	10
Total		**40**

Note: Any two different activities for C2 First component and C2 Second component can be selected from the below **Quiz/Project/Class room exercise/Practice exercise/Educational (industry/ institutes/ NGOs) visit/ field trip/ Field work/Viva voce/Role Play/Charts/ Models/Case study/Group discussion/Crosswords/Presentation/seminar/Review – movie / Book/Research articles/e – content preparation**

Course objectives:

1. To study the applications of microorganisms in industry and their industrial scale cultivation
2. To study the microbial production of industrial products and downstream processing
3. To learn the tools and techniques of genetic engineering
4. To study genetic engineering in relation to Industrial Microbiology, applications and limitations of genetic engineering.

Course Outcomes (COs)

After the successful completion of the course, the student will be able to:

CO1: Explain the scope and importance of industrially important microbes.

CO2 :Describe the different types of fermentation processes, equipment and effluent treatment

CO3: Explain the purification and uses of microbe-based industrial products

CO4: Describe the tools, techniques and products of genetic engineering.

VI Sem Content of Course 8: INDUSTRIAL MICROBIOLOGY AND GENETIC ENGINEERING	**60 hrs.**

Unit 1: Introduction to Industrial Microbiology:	**15 hrs.**

Scope and concepts. Microorganisms of industrial importance: Selection criteria, Strain improvement and Preservation.

Fermentor: Design and components of a bioreactor. Specialized bioreactors: Airlift bioreactors, fluidized bed reactor, packed bed reactors, Photo-bioreactors and membrane bioreactors. Sterilization of fermentor. Control of air, temperature and pH. Aseptic inoculation and sampling methods.

Fermentation media and fermentation processes: Strategies for media formulation, Natural and synthetic media. Production medium and Inoculum medium. Raw materials (Molasses and its types, corn steep liquor, sulphite waste liquor and whey). Buffers, Precursors, Inhibitors and Antifoam agents. Types of fermentation processes: Submerged fermentation, Solid state fermentation (Koji), Batch fermentation and continuous fermentation.

Unit 2: Downstream processing, General production strategies of microbial products and Enzyme immobilization, disposal of wastewater from industries	**15 hrs.**

Microbial production of industrial products: Industrial production and uses of Ethyl alcohol, Penicillin, Glutamic acid, Citric acid, Amylase, Wine

Downstream processing- Definition, Stages in downstream processing. Methods of downstream processing: Precipitation, filtration, centrifugation, distillation, cell disruption, , solvent recovery, drying and crystallization

Enzyme immobilization: Immobilized enzymes, Reversible immobilization- Adsorption, Irreversible immobilization- covalent coupling, entrapment, and copolymerization. Applications of enzyme immobilization, Advantages and disadvantages of immobilized enzymes

Disposal of wastewater in industries: Physical, chemical and microbiological characteristics of wastewater. Wastewater treatment in Effluent treatment plants (ETP) in industries - primary (screening, coagulation and sedimentation), secondary (trickling filter, oxidation pond, activated sludge process) tertiary (reverse osmosis, ion exchange, disinfection). Methods of solid waste disposal (composting and biogas production)

Unit 3: Genetic Engineering tools used in strain improvement of microbes of industrial importance	**15 hrs.**

Introduction to genetic engineering: Definition, milestones in genetic engineering.
Tools in genetic engineering:
Restriction enzymes- Types, Mode of action, nomenclature, applications.
DNA modifying enzymes and their applications: DNA polymerases, Methylases, Terminal deoxynucleotidyl transferase, Kinases, Phosphatases and Ligases.
Cloning Vectors - Definition and Properties. Characteristics of cloning vectors. Plasmid vectors: pBR and pUC series. Bacteriophage lambda, Cosmids, BACs, YACs. Use of linkers and adaptors.

Expression vectors: Baculovirus based vectors, mammalian SV40-based expression vectors.
Cloning host- Cloning in *Escherichia coli* and *Saccharomyces cerevisiae.*

Unit 4: Genetic engineering techniques in industrial production of recombinant products	**15 hrs.**

Techniques in genetic engineering:
Isolation of DNA, restriction digestion and ligation of DNA, Agarose gel electrophoresis, Blotting techniques, DNA sequencing- Sanger's method. PCR technique and applications. **DNA transfer methods:** Microinjection, Biolistic device, Electroporation, Calcium phosphate mediated DNA transfer. Identification and selection of recombinants: DNA hybridization, blue white selection, colony and plaque hybridization. DNA library: Construction and application of cDNA and genomic libraries.
Industrial production of recombinant products and applications of recombinant microorganisms in basic research, industry, medicine (insulin, hGH, antisense molecules. Gene therapy, recombinant vaccines), agriculture (Bt Cotton, Bt Brinjal), environment.
Biological, ethical and social issues of gene cloning and IPR.

Course Title	**INDUSTRIAL MICROBIOLOGY AND GENETIC ENGINEERING (Practical)**		
Course Code	**MIBDSCP602**	**No. of Credits**	**02**
Contact Hours	**60 (4 Hrs. per session)**	**Duration of SEA/Exam(Hrs.)**	**03**
Formative Assessment marks	**25**	**Summative Assessment marks**	**25**

CONTENT

1. Preparation of natural and synthetic media used in industry.
2. Production of amylase by solid substrate fermentation.
3. Preservation of industrial important microbes with glycerol/soil.
4. Preparation of alcohol using jaggery /molasses.
5. Isolation and identification of indigenous wine yeast and its use in wine preparation
6. Estimation of citric acid produced from *Aspergillus niger* by titrimetric method
7. Estimation of % alcohol in a given sample by specific gravity bottle method
8. Measurement of Biochemical Oxygen Demand (BOD) of industrial wastewater
9. Estimation of total solids of industrial wastewater

10. Isolation of plasmid DNA from *Escherichia coli.*
11. Digestion of DNA with restriction enzymes and separation by agarose gel electrophoresis.
12. Demonstration of amplification of DNA by PCR.
13. Demonstration of Southern blotting.
14. Demonstration of cloning of DNA inserts and Blue white screening of recombinants.
15. Study of specialized bioreactors, raw materials and microbial production of industrial products, Cloning vectors, techniques in genetic engineering and recombinant products, and wastewater treatment as per theory syllabus.

Note: *Visit to Alcohol distillery, Effluent Treatment plant*

Text Books / References

1. Arindam Kuila and Vinay Sharma (2018). **Principles and Applications of Fermentation Technology,**Wiley.
2. Casida, L. (2016). **Industrial Microbiology**, 2nd edition, New Age International Publisher.
3. Crueger, W. and A Crueger. (2017). Cruegers **Biotechnology: A Text Book of Industrial Microbiology.** Edited by K.R. Aneja. Panima Publishing Corporation.
4. Michael, J. W., Neil, L. Morgan. (2013). **Industrial Microbiology: an Introduction**. Blackwell science
5. Nduka Okafor and Benedict Okeke (2017). **Modern Industrial Microbiology and Biotechnology.** 2ndEdition :CRC Press Publishers
6. Stanbury P. F., W. Whitaker and S. J. Hall (2016). **Principles of Fermentation Technology.** 3rd edition. Elsevier Publication
7. Alexander, N. Glazer, Hiroshi Nikaido (2014). **Microbial Biotechnology: Fundamentals of Applied Microbiology**, 2nd Edition, Cambridge University Press
8. Rao, M. N. and Datta , A. K. (1987).**Waste Water Treatment**. Oxford and I.B.H.
9. Brown, T. A. (2010). **Gene Cloning and DNA Analysis**. 6th edition. Blackwell Publishing, Oxford, U.K.
10. Clark, D. P. and Pazdernik, N. J. (2009). **Biotechnology: Applying the Genetic Revolution.** Elsevier Academic Press, USA
11. Krebs, J., Goldstein, E., Kilpatrick, S. (2013). **Lewin's Essential Genes**, 3rd Ed., Jones and Bartlett Learning
12. Primrose, S. B. and Twyman, R. M. (2006). **Principles of Gene Manipulation and Genomics**, 7thedition. Blackwell Publishing, Oxford, U.K.
13. Primrose, S. B. and Twyman, R. M. (2008). **Genomics: Applications in human biology**. Blackwell Publishing, Oxford, U.K.
14. Russell, P. J. (2009). **Genetics- A Molecular Approach**. 3rd Ed, Benjamin Cummings
15. Sambrook, J. and Russell, D. (2001). **Molecular Cloning-A Laboratory Manual**. 3rd edition. Cold Spring Harbor Laboratory Press
15. Sambrook, J. and Russell, D. W. (2001). **Molecular Cloning: A Laboratory Manual**. 4th Edition, Cold Spring Harbor Laboratory press.
16. Watson, J. D., Baker, T. A., Bell, S. P. et al. (2008). **Molecular Biology of the Gene**, 6th Ed., Benjamin Cummings Wiley
17. Sherwood, L. M. and Woolverton, C. J. (2008). Prescott, Harley and Klein's **Microbiology.**McGraw Hill Higher Education.

Blueprint of End semester examination

B. Sc. MICROBIOLOGY

Duration: 2 $^{1}/_{2}$ Hours **Maximum: 60 Marks**

All questions are compulsory

Draw neat labeled diagrams wherever necessary

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ST.PHILOMENA'S COLLEGE (AUTONOMOUS), MYSURU

VI SEM (NEP) SCHEME OF PRACTICAL EXAMINATION

Practical VIII: Industrial Microbiology and Genetic Engineering (MIBDSCP602)

Duration: 3 hours **Max. Marks: 25**

I. Demonstrate / Perform the experiment **A** giving principle and procedure Record the result**.** **08 marks**

(Estimation of citric acid/ Estimation of % alcohol by specific gravity method/Measurement of BOD of the given wastewater sample/ Estimation of total solids in the given wastewater sample)

Demonstration-2 marks, Principle-2 marks, Procedure-2 marks, Result-2 marks

II. Write the protocol for the experiment **B.** **05 marks**

(Isolation of plasmid DNA/ Digestion of DNA with restriction enzymes/ Amplification of DNA by PCR/ Southern blotting/Cloning of DNA insert and blue white selection / Wine preparation/production of amylase by solid substrate fermentation)

III. Write critical notes on **C, D, E** & **F** **4 X 2 = 08 marks**

(Fermentor, Specialized bioreactors-airlift, fluidized bed reactor, packed bed reactor, photobioreactor, membrane bioreactor, /Molasses/ Wine/alcohol from jaggery/ wastewater treatment (trickling filter, oxidation pond, activated sludge process, reverse osmosis, ion exchange, disinfection, biogas production) / pBR and PUC vectors/ lambda vectors/Cosmids/Agarose gel electrophoresis/Colony and plaque hybridization/PCR/ Blotting techniques/recombinant insulin/ hGH, antisense molecules/ Bt Cotton/Bt Brinjal /recombinant vaccine/Glycerol or Soil stocks/ Blue white colonies)

IV. Viva **04 marks**

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B. Sc. Microbiology 6th Semester Internship for Graduate Programme

Course title	**Internship(Discipline specific)**
No of contact hours	**90**
No of credits	**2**
Method of evaluation	**Presentations and Report submission for 50 marks**

Internship shall be Discipline Specific of 90 hours (2 credits) with duration 4-6 weeks.

- Internship may be full-time/part-time (full-time during semester holidays and part-time in the academic session)
- Internship mentor/supervisor shall avail work allotment during 6th semester for a maximum of 20 hours.
- The student should submit the final internship report (90 hours of Internship) to the mentor for completion of the internship.
- The detailed guidelines and formats shall be formulated by the universities separately as prescribed in accordance to UGC and AICTE guidelines.

UNIVERSITY OF MYSORE, MYSURU

PATTERN OF PRACTICAL EXAMINATION

Practical examination – B. Sc. MICROBIOLOGY

Duration: 3 hours **Max. Marks: 25**

Q.1	Major question Marks	08
Q.2	Minor question Marks	05
Q.3	Identify and comment	2X4 = 08Marks
Q.4	Viva-voce Marks	04

PATTERN OF FORMATIVE ASSESSMENT - PRACTICALS

Max. Marks: 25

1	IA 1(Test)	10 Marks
2	IA 2(Viva)	05 Marks
3	Record+ Field Visit Reports	10 Marks