

SHSB1102	GENERAL ENGLISH– I	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

### COURSE OBJECTIVES

- To provide opportunities for students to read and respond to representations of current issues
- To prepare the students to effectively communicate by applying reflective thinking practices
- To provide an opportunity to the students to improve their vocabulary
- To create and apply lateral and critical thinking
- To learn academic writing strategies

### UNIT 1

**9 Hrs**

Listening to identify vocabularies- Self Introduction - Developing dialogue between characters -Talking about neighbours, family members, likes and dislikes, Reading Comprehension strategies- Parts of Speech- Kinds of Sentences Connectives and Discourse markers - Rearranging the Jumbled sentences, E-Mail Writing.

### UNIT 2

**9 Hrs**

Listening for Inference- Just a Minute speech- Types of words- Compound words, abbreviations and acronyms, Word Association- Tenses and its Types- Voice- Impersonal Passive- Rules of Passive voice formation - Transcoding - Encoding and Decoding- Bar chart, Pie Chart

### UNIT 3

**9 Hrs**

Listening to telephonic talk to fill blanks- Giving information- travel, hotel booking, making enquiries about availability of seats for admission, asking about courses - Question Tags – Open ended and Close ended questions, Concord, Single - Line Definition - Note Making - Preparing checklists

### UNIT 4

**9 Hrs**

Listening to summarise the information- Reading and identifying the topic sentence, - Editing - Punctuation- Error Corrections, 'If 'Conditionals, Idioms & Phrases, Instructions & Recommendations – Drafting a brochure/Advertisement.

### UNIT 5

**9 Hrs**

Listening to Movie reviews and book reviews, Listening and summarizing- Giving impromptu talks - Reading and Summarizing -Types of words- Homonyms, Homophones, eponyms, acronyms- Writing a Paragraph, Descriptive Essay, Dialogue Writing.

**Max. 45 Hrs.**

### COURSE OUTCOMES

On the completion of the course, the student will be able to

- CO1** - Remember knowledge of linking words related to both spoken and written discourse
- CO2** - Understand collocations, words to express one's point of view in both writing and speaking
- CO3** - Apply the rules for writing compare and contrast paragraphs by using cohesive devices based on prompts given
- CO4** - Analyse critical thinking skills by framing questions related to elements of reasoning
- CO5** - Evaluate written pieces to self-correct in the topic areas of verbs, reported speech, and punctuation
- CO6** - Equip the students with the required Professional Skills

**TEXT / REFERENCE BOOKS**

1. Sen S, Mahendra et al. (2015) Communication and Language Skills. Foundation books. Chennai
2. Strunk, William Jr., and E.B. White. The Elements of Style. Allyn and Bacon, 2000.
3. Murphy, Raymond. English Grammar in Use. Cambridge University Press, 2012.
4. Thomson, A.J., and A.V. Martinet. A Practical English Grammar. Oxford University Press, 1986.
5. Straus, Jane. The Blue Book of Grammar and Punctuation. John Wiley & Sons, 2014.
6. O'Conner, Patricia T. Woe is I: The Grammarphoebe's Guide to Better English in Plain English. Riverhead Books, 2019

**END SEMESTER EXAM QUESTION PAPER PATTERN****Max. Marks : 100****Exam Duration : 3 Hrs.****PART A : 10 Questions of 2 marks each-No choice****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 16 marks****80 Marks**

SMBB1101	GENERAL MICROBIOLOGY	L	T	P	EL	Credits	Total Marks
		3	0	0	2	3	100

**COURSE OBJECTIVES**

- This course is aimed give an understanding about the basics of microbiology dealing types of microbes, classification & characterization

**UNIT 1 HISTORY AND CLASSIFICATION****9 Hrs**

History and scope of Microbiology, Spontaneous generation - Biogenesis theory - Contribution of Leeuwenhoek, Louis Pasteur, Robert Koch, Edward Jenner, Paul Ehrlich and Sir Alexander Flemming. Binomial Nomenclature, Whittaker's five kingdom and Carl Woese's three kingdom classification systems and their utility. Difference between prokaryotic and eukaryotic microorganisms

**UNIT 2 MICROSCOPY AND STAINING****9 Hrs**

Microscope- Principles, working mechanism and application - Simple and compound microscope -Dark field -Phase contrast, Fluorescence, SEM and TEM. Types of Staining - Simple, Differential (Gram's, AFB), Special - Capsular and Spore staining. LPCB, KOH mount

**UNIT 3 ULTRASTRUCTURE OF BACTERIA****9 Hrs**

Structure and organization of bacterial cell - Gram positive and Gram negative bacterial cell wall. Biosynthesis of bacterial cell wall, cell membrane – Bio-membrane, liposomes – membrane transport – diffusion, active and passive transport and osmoregulation.

**UNIT 4 STERILIZATION****9 Hrs**

Sterilization and Disinfection- principles and methods of sterilization- physical methods - Dry heat- Moist heat- Radiation and Filtration. Chemical sterilization- Chemical agents- mode of action- phenol coefficient test- sterility testing.

**UNIT 5 MEDIA AND TECHNIQUES****9 Hrs**

Culture and media preparation - solid and liquid. Types of media- Semi synthetic, Synthetic, Enriched, Enrichment, Selective and Differential media. Pure culture techniques – Tube dilution, Pour, Spread, Streak plate. Anaerobic culture technique - Wright's Tube, Roll tube method, Anaerobic Jar.

**Max. 45 Hrs.****COURSE OUTCOMES**

On completion of the course, student will be able to

**CO1** – Describe the basic concepts of microbiology.

**CO2** – Summarize the principle and working mechanism of simple and compound microscopes.

**CO3** – Describe the various staining techniques used in microbiology

**CO4** – Explain cellular organization of various microorganisms

**CO5** – Discuss various sterilization methods.

**CO6** – Execute preparation of various culture media and plating techniques for growing the microorganisms

**TEXT / REFERENCE BOOKS**

1. Prescott, Harley, Klein. 2003. Microbiology. 5th Edition. McGraw Hill Publ.
2. Bernard R. Glick & Jack J. Pasternak. 2002. Molecular Biotechnology. Indian edition. Panima Publishing Corporation.
3. Pelzer, Chan and Kreig. 1986. Microbiology. 5th Edition. McGraw-Hill.
4. Tortora, G.J., Funke, B.R. and Case, C.L. 2012. Microbiology - An Introduction. 11th Edition. Pearson Education.

**END SEMESTER EXAM QUESTION PAPER PATTERN****Max. Marks : 100****Exam Duration : 3 Hrs.****PART A : 10 Questions of 2 marks each-No choice****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 16 marks****80 Marks**

SMBB2101	GENERAL MICROBIOLOGY LAB	L	T	P	EL	Credits	Total Marks
		0	0	4	0	2	100

**COURSE OBJECTIVE**

- To study the basic laboratory techniques of microbiology

**SUGGESTED LIST OF EXPERIMENTS**

1. Handling of Instruments and Laboratory safety measures
2. Cleaning of Glassware and preparation of cleaning solutions
3. Preparation of culture media: Nutrient Broth and Nutrient agar
4. Isolation of pure cultures of bacteria by Serial dilution, Spread plate and Pour plate technique
5. Streak plate method.
6. Simple staining
7. Gram's staining
8. Negative staining (Capsular Staining)
9. Endospore staining.
10. Motility by hanging drop method
11. Preservation of bacterial cultures by various techniques.
12. Antibiotic sensitivity test.

**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1** - Perform cleaning, sterilization of glass wares and handling of laboratory instruments.
- CO2** - Demonstrate practical skills in microscopy, their handling techniques and staining procedures.
- CO3** - Competently prepare the different types of media.
- CO4** - Differentiate different types of plating methods.
- CO5** - Execute series of dilutions to reduce a dense culture of bacterial cells
- CO6** - Report the results of antibiotic sensitivity tests

SHSB1201	GENERAL ENGLISH- II	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

### COURSE OBJECTIVES

- To provide opportunities for students to read and respond to representations of current issues through texts that present themes and topics that are familiar, insightful and informative.
- To provide an opportunity to the students to improve their vocabulary
- To develop skills relating to creative writing.
- To provide an opportunity to the students to improve their Spoken Language.
- To comprehend the overall idea of a written and oral context.

### UNIT I

**9 Hrs**

Listening for details, Speaking - making a presentation, reading for details and Global Comprehension Vocabulary Binomials, Types of Words- Synonyms, Antonyms that describe people, things and their actions - Paired Expressions -Letter Writing - Informal Letters- Letter to a Friend / Family Members - Creating blogs to post written materials.

### UNIT 2

**9 Hrs**

Listening for details - Speaking: Giving Interview, Public Speech based on specific topics given. Reading for Comprehension and for overall idea - Vocabulary: phrases - Sentence Pattern – Contextual guessing of words– Singular, Plural– Letter writing- Formal letters- Inviting dignitary for a function, Application for job with resume.

### UNIT 3

**9 Hrs**

Listening for details - Telephonic conversation – Speaking: Narrating a Story - Vocabulary: positive and negative connotations - Language Focus: Adjective- Degrees of Comparison, Direct and Indirect Speech - Types of Sentences (simple, compound, complex) - Collocations -Letter to the Editor (Social Issues) – Hints Development.

### UNIT 4

**9 Hrs**

Listening for Overall information - Making requests and suggestions - Speaking: Group Discussion - Vocabulary: Homonyms and Homophones - Language Focus: Transitive and Intransitive verbs - Writing: Precis writing, Story Writing - Process description (Flow chart)

### UNIT 5

**9 Hrs**

Listening for specific details - Speaking using imagination. Reading to identify facts - Language focus: Modal Auxiliary Verbs Writing: Imaginative writing by predicting, Argumentative Essay, Writing a Book or Film review. Vocabulary: Countable and Uncountable Nouns, foreign nouns and framing of plurals.

**Max. 45 Hrs.**

**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1** - Remember knowledge of linking words related to both spoken and written discourse
- CO2** - Understand collocations, words to express one's point of view in both writing and speaking
- CO3** - Apply the rules for writing compare and contrast paragraphs by using cohesive devices based on prompts given
- CO4** - Analyse critical thinking skills by framing questions related to elements of reasoning
- CO5** - Evaluate written pieces to self-correct in the topic areas of verbs, reported speech, and punctuation
- CO6** - Equip the students with the required Professional Skills

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1. Sen S, Mahendra et al. (2015) *Communication and Language Skills*. Foundation books. Chennai
2. Strunk Jr., William, and E.B. White. *The Elements of Style*. Allyn and Bacon, 2000.
3. Murphy, Raymond. *English Grammar in Use*. Cambridge University Press, 2019.
4. Thomson, A.J., and A.V. Martinet. *A Practical English Grammar*. Oxford University Press, 2013.
5. Straus, Jane. *The Blue Book of Grammar and Punctuation*. John Wiley & Sons, 2014.
6. Swan, Michael. *Practical English Usage*. Oxford University Press, 2016

**END SEMESTER EXAM QUESTION PAPER PATTERN**

**Max. Marks : 100**

**Exam Duration : 3 Hrs.**

**PART A** : 10 Questions of 2 marks each-No choice

**20 Marks**

**PART B** : 2 Questions from each unit with internal choice, each carrying 16 marks

**80 Marks**

SBBB1302	IMMUNOLOGY	L	T	P	EL	Credits	Total Marks
		3	0	0	2	3	100

**COURSE OBJECTIVE**

- To know the fundamentals of Immunity and understand how immune system fights and combats the infection and diseases

**UNIT 1 IMMUNITY****9 Hrs**

History of Immunology – Host-parasite relationship – Immunity – Innate and acquired Immunity – Humoral and Cell mediated Immunity

**UNIT 2 CELLS AND ORGANS OF THE IMMUNE SYSTEM****9 Hrs**

Structure, Functions and Properties of Immune Cells – Stem cell, T cell, B cell, NK cell, Macrophage, Neutrophil, Eosinophil, Basophil, Mast cell, Dendritic cell; and Immune Organs – Bone marrow, Bursa of Fabricius, Thymus, Lymph Node, Spleen, GALT, MALT, CALT

**UNIT 3 ANTIGENS & ANTIBODIES****9 Hrs**

Antigens – Types, properties, Immunoglobulins – Structure, types and functions, Monoclonal Antibodies, Complement pathways - Classical and alternative

**UNIT 4 ANTIGEN – ANTIBODY REACTIONS****9 Hrs**

Agglutination, Precipitation, Complement fixation, Immunofluorescence – ELISA, RIA

**UNIT 5 AUTOIMMUNITY, HYPERSENSITIVITY AND TRANSPLANTATION****9 Hrs**

Autoimmunity, Hypersensitivity, Immunohaematology, Transplantation immunology, Tumor immunology

**Max 45 Hrs****COURSE OUTCOMES**

On completion of the course, the student will be able to

- CO1** - Understand the principles and mechanism of immunity
- CO2** - Discuss the immune cells and organs alongside their structure and functions
- CO3** - Distinguish antigens and antibodies, their basic structure and functions
- CO4** - Summarize the various clinically important antigen antibody reactions
- CO5** - Discuss the various medically important immunological disorders
- CO6** - Apply the knowledge of immunology behind transplantations and tumors

**TEXT / REFERENCE BOOKS**

- Text book of Microbiology - Ananthanarayan & Jayaram Panicker
- Kuby Immunology – Kindt, Goldsby and Osborne
- Roitt's Essential Immunology - Peter J. Delves, Seamus J. Martin, Dennis R. Burton, Ivan M. Roitt.

**END SEMESTER EXAM QUESTION PAPER PATTERN****Max. Marks : 100****Exam Duration : 3 Hrs.****PART A : 10 Questions of 2 marks each-No choice****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 16 marks****80 Marks**



SMBB2201	IMMUNOLOGY LAB	L	T	P	EL	Credits	Total Marks
		0	0	4	0	2	100

**COURSE OBJECTIVE**

- To understand experimental immunotechniques with a problem-oriented approach

**SUGGESTED LIST OF EXPERIMENTS**

1. Identification of human blood groups.
2. To perform Total Leukocyte Count of the given blood sample.
3. To perform Differential Leukocyte Count of the given blood sample.
4. Agglutination reaction
5. Widal test
6. ASO test
7. RA test
8. CRP test
9. Pregnancy test (Direct/Indirect)
10. To perform immunodiffusion by
11. Single Radial Immunodiffusion
12. Ouchterlony double diffusion.
13. To perform DOT ELISA.
14. To perform immunoelectrophoresis.

**COURSE OUTCOMES**

On completion of the course, the student will be able to

- CO1** – Build a strong foundation on basic techniques in identifying immune reactions  
**CO2** – Determine various parameters affecting an antigen-antibody reaction  
**CO3** – Breakdown the fundamentals of handling laboratory equipments and reagents  
**CO4** – Apply the concepts of antigen-antibody interaction in experiments  
**CO5** – Discuss the use of identification of immune reaction  
**CO6** – Recognize the applications of techniques to identify a particular infection

SMBB1301	BACTERIOLOGY	L	T	P	EL	Credits	Total Marks
		3	0	0	2	3	100

**COURSE OBJECTIVES**

- This course aims at understanding medically important bacteria and the diseases caused by them

**UNIT 1 INFECTION****9 Hrs**

Infection - Sources of infection, methods of transmission, factors predisposing to microbial pathogenicity. Types of infectious diseases. Normal Microbial flora of human body

**UNIT 2 GRAM POSITIVE PATHOGENS****9 Hrs**

*Staphylococcus, Streptococcus, Corynebacterium, Clostridium, Bacillus*

**UNIT 3 GRAM NEGATIVE PATHOGENS****9 Hrs**

*E.coli, Salmonella, Neisseria, Shigella, Vibrio, Yersinia, Pseudomonas, Proteus, Klebsiella*

**UNIT 4 ACID FAST BACTERIA & SPIROCHETES****9 Hrs**

*Mycobacterium, Treponemes, Leptospirae*

**UNIT 5 OTHER MEDICALLY IMPORTANT ORGANISMS****9 Hrs**

*Chlamydia, Helicobacter, Actinomycetes, Rickettsiae, Borrelia*

**Max 45 Hrs****COURSE OUTCOMES**

On completion of the course, the student will be able to

- CO1** - Understand infections, their sources, and modes of transmission
- CO2** - Classify gram positive and negative pathogens and the diseases they cause
- CO3** - Differentiate acid fast and non acid fast organisms and explain them
- CO4** - Understand the pathogenesis, prophylaxis and treatment of every disease causing bacteria
- CO5** - Discuss the medically important organisms causing dreadful diseases
- CO6** - Describe the pathogens causing sexually transmitted diseases

**TEXT / REFERENCE BOOKS**

- Text book of Microbiology - Ananthanarayan & Jayaram Panicker
- Medical Microbiology - David Green wood
- Jawetz-Medical Microbiology - Geo F.Brooks, Janet S Butel.

**END SEMESTER EXAM QUESTION PAPER PATTERN****Max. Marks : 100****Exam Duration : 3 Hrs.****PART A : 10 Questions of 2 marks each-No choice****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 16 marks****80 Marks**

SMBB1302	VIOLOGY	L	T	P	EL	Credits	Total Marks
		3	0	0	2	3	100

**COURSE OBJECTIVES**

- This course aims at understanding important medically important virus its mode of infection, pathogenesis prophylaxis and treatment

**UNIT 1 GENERAL CONCEPTS****9 Hrs**

General Concepts: Virus history, Diversity, virus structures and components of genomes. Isolation and purification of viruses and components

**UNIT 2 INFECTION****9 Hrs**

Consequences of virus infection to animals and human. Viral infection: affect on host macromolecules. Viral infection: establishment of the antiviral state. Viruses counter attack mechanisms.

**UNIT 3 CLASSIFICATION****9 Hrs**

Classification of viruses and nomenclatures. Positive strand RNA viruses- Picornaviruses. Flaviviruses- West Nile virus and Dengue virus. Coronaviruses SARS pathogenesis. Negative strand RNA viruses Paramyxoviruses. Orthomyxoviruses: Influenza pathogenesis and Bird flu. Rhabdoviruses: Rabies pathogenesis.

**UNIT 4 RNA VIRUS****9 Hrs**

dsRNA viruses- Reoviruses. Retroviruses: structure, classification, life cycle; reverse transcription. Retroviruses: HIV, viral pathogenesis and AIDS.

**UNIT 5 DNA VIRUS****9 Hrs**

Small DNA viruses: parvo- and polyomaviruses. Large DNA viruses: Herpes-adeno-, and poxviruses. Miscellaneous viruses.

**Max. 45 Hours****COURSE OUTCOMES**

On completion of the course, the student will be able to

- CO1** – Explain the basic concepts of virology
- CO2** – Understand the viral infections and factors associated to it
- CO3** – Outline the classification of viruses
- CO4** – Discuss in detail about the RNA viruses
- CO5** – Understand DNA viruses
- CO6** – Demonstrate various viruses and disease caused by it.

**TEXT / REFERENCE BOOKS**

- Principles of Virology 2nd edition by S.J.Flint, L.W.Enquist,R.M.Krug,V.R. Racaniello, and A.M.Skalka.
- Fields Virology 5th Edition by Bernard Fields, David Knipeand Peter Howley.
- Medical Virology 4th edition by David O.White and FrankJ. Fenner.

**END SEMESTER EXAMINATION QUESTION PAPER PATTERN****END SEMESTER EXAM QUESTION PAPER PATTERN****Max. Marks : 100****Exam Duration : 3 Hrs.****PART A** : 10 Questions of 2 marks each-No choice**20 Marks****PART B** : 2 Questions from each unit with internal choice, each carrying 16 marks**80 Marks**

SMBB2301	BACTERIOLOGY AND VIROLOGY LAB	L	T	P	EL	Credits	Total Marks
		0	0	4	0	2	100

### COURSE OBJECTIVE

- This course aims at imparting knowledge about the experiments and procedures involving bacterial and viral organisms of medical importance, their isolation, preservation and detection

### SUGGESTED LIST OF EXPERIMENTS

- Isolation and identification of microorganisms from urine sample (E.coli, Proteus, Pseudomonas)
- Biochemical tests for bacterial identification (IMViC, TSI, nitrate reduction, urease production, coagulase and catalase tests.)
- Determination of MIC & MBC.
- Preservation of bacterial cultures by various techniques
- Studying isolation and propagation of animal viruses by chick embryo technique
- Isolation and enumeration of bacteriophages (PFU) from water/sewage sample using double agar layer technique
- To perform HBsAg by ELISA
- To perform HIV Tridot method.

### COURSE OUTCOMES

On completion of the course, the student will be able to

- CO1** – Isolate medically significant bacteria and viruses from different clinical samples  
**CO2** – Understand and perform various microbial staining methods  
**CO3** – Competently perform various biochemical tests for microbes  
**CO4** – Isolate different bacteria and bacteriophages by various methods  
**CO5** – Perform analysing methods for antigens and antibodies  
**CO6** – Perform MIC and MBC assays

SMBB1401	MYCOLOGY	L	T	P	EL	Credits	Total Marks
		3	0	0	2	3	100

**COURSE OBJECTIVES**

- This course aims at understanding important medically important fungi its mode of infection, pathogenesis prophylaxis and treatment.

**UNIT 1 CLASSIFICATION****9 Hrs.**

General characteristics and classification of fungi - Morphology & reproduction of fungi – Pathogenesis of fungal infections- Isolation & identification of fungi

**UNIT 2 YEAST AND FILAMENTOUS FUNGI****9 Hrs.**

Yeasts and yeast like fungi of medical importance including Candida. - Cryptococcus, Malassezia, Trichosporon, Geotrichum, Saccharomyces.

Mycelial fungi of medical importance including Aspergillus, Zygomycetes, Fusarium, Piedra and other dematiaceous hyphomycetes.

**UNIT 3 DIMORPHIC FUNGI****9 Hrs.**

Dimorphic fungi including Histoplasma, Blastomyces, Coccidioides, Paracoccidioides, Sporothrix and Dermatophytes

**UNIT 4 FUNGI DISEASES****9 Hrs.**

Fungi causing mycetoma, keratomycosis & otomycosis.- Pneumocystis jirovecii infection - Rhinosporidium seberi & Loboia loboia.

**UNIT 5 COMMON LAB CONTAMINANTS****9 Hrs.**

Common laboratory fungal contaminants- Mycetism & mycotoxicosis - Antifungal agents & in vitro antifungal susceptibility tests. - Hypersensitivity to fungi.

**Max. 45 Hours****COURSE OUTCOMES**

On completion of the course, the student will be able to

**CO1** – Understand the fungal classification and infections caused by them

**CO2** – Explain Yeasts and their medical importance

**CO3** – Explain the concept of fungal dimorphism and organisms that exhibit it

**CO4** – Describe various fungal diseases and the organisms responsible for that

**CO5** – Discuss about the fungal contaminants that are seen in laboratories

**CO6** – Demonstrate the use of various antifungal agents

**TEXT / REFERENCE BOOKS**

- Patel A.H. (1996). Industrial Microbiology. 1st edition, Macmillan India Limited
- Okafor N. (2007). Modern Industrial Microbiology and Biotechnology. 1st edition. Bios Scientific Publishers Limited. USA
- Glaze A.N. and Nikaido H. (1995). Microbial Biotechnology: Fundamentals of Applied Microbiology. 1st edition. W.H. Freeman and CompanyS
- Casida LE. (1991). Industrial Microbiology. 1st edition. Wiley Eastern Limited.
- Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology. 2nd edition. Panima Publishing Co. New Delhi.

**END SEMESTER EXAM QUESTION PAPER PATTERN****Max. Marks : 100****Exam Duration : 3 Hrs.****PART A :** 10 Questions of 2 marks each-No choice**20 Marks****PART B :** 2 Questions from each unit with internal choice, each carrying 16 marks**80 Marks**

SMBB1402	PHYCOLOGY AND PARASITOLOGY	L	T	P	EL	Credits	Total Marks
		3	0	0	2	3	100

**COURSE OBJECTIVE**

- This course aims at understanding the algal biodiversity and their applications, and also the medically important parasites their mode of infection, pathogenesis, prophylaxis and treatment.

**UNIT 1 CLASSIFICATION OF ALGAE****9 Hrs.**

Basic characteristics of the algae: Structure of the algal cell. Nutrition. Gene sequencing and algal systematics. Classification. Algae and the fossil record. Taxonomy, structure, reproduction and life-cycles of the members of: Cyanobacteria, Glaucophyta, Rhodophyta, Chlorophyta, Euglenophyta, Dinophyta, and Cryptophyta. Heterocontophyta: Chrysophyceae, Synurophyceae, Eustigmatophyceae, Bacillariophyceae, Raphidophyceae, Xanthophyceae, Phaeophyceae, and Prymnesiophyta.

**UNIT 2 APPLICATIONS OF ALGAE****9 Hrs.**

Algal Biomass: Culture and cultivation of economically important algae. Continuous algal production using waste water. Biofuels and Biofertilizer: Methane and Hydrogen fuel cells and hydrogen gas production by algae, Liquid seaweed fertilizer and seaweed compost. Algal Polysaccharides (Agar Agar; carraginin and alginic acid); algae in Pharmaceutical industries. Algae and Pollution: Toxic algae. Cooling of the Earth, cloud condensation nuclei, and DMSP. Chemical defense mechanisms of algae. Ultraviolet radiation, the ozone hole and sunscreens produced by algae.

**UNIT 3 INTRODUCTION TO PARASITES AND LAB TECHNIQUES****9 Hrs.**

Parasitology – General Concepts – Introduction to Parasitology, Classification – Host parasite relationship. Laboratory techniques in parasitology- Blood: Thick and thin smear. Faeces: Examination for ova and cyst.

**UNIT 4 PROTOZOAN PARASITES****9 Hrs.**

Protozoology: Pathogenic mechanisms, Disease transmissions, their life cycles and Lab Diagnosis of the following protozoan parasites: Entamoeba histolytica, Plasmodium vivax, Plasmodium falciparum, Leishmania donovani, Giardia lamblia, Trichomonas vaginalis, Balantidium coli, Toxoplasma gondii and Cryptosporidium parvum.

**UNIT 5 HELMINTH PARASITES****9 Hrs.**

Helminthology: Classification, their life cycle, transmission, pathogenicity and Lab Diagnosis of the following helminth parasites. Cestodes: Taenia solium, T. saginata, T. echinococcus. Trematodes: Schistosoma haematobium, Fasciola hepatica. Nematodes: Ascaris, Anchylostoma, Trichuris, Enterobius and Wuchereria.

**Max.45 Hours****COURSE OUTCOMES**

On successful completion of the course students will be able to

- CO1** - Gain knowledge on various algal species.
- CO2** - Understand their applications in various field.
- CO3** - Explain host parasite interactions.
- CO4** - Gain knowledge on protozoan parasites and their diseases.
- CO5** - Analyze the ill effect of helminth parasites.
- CO6** - Plan the diagnosis, treatment of various human parasites scientifically.

**TEXT / REFERENCE BOOKS**

1. Barsanti, Laura and Paolo Gualtieri 2005 Algae-Anatomy, Biochemistry and Biotechnology. Taylor & Francis, London, New York
2. Trivedi, P.C. (Ed.) 2001 Algal Biotechnology. Pointer Publishers, Jaipur, India.
3. Text Book of Medical Parasitology by P. Chakraborty
4. Text Book of Parasitology By Jayaram Panicker
5. Text Book of Medical Parasitology by Parija S.C.

**END SEMESTER EXAM QUESTION PAPER PATTERN****Max. Marks : 100****Exam Duration : 3 Hrs.****PART A : 10 Questions of 2 marks each-No choice****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 16 marks****80 Marks**



SMBB2401	MYCOLOGY AND PARASITOLOGY LAB	L	T	P	EL	Credits	Total Marks
		0	0	4	0	2	100

### COURSE OBJECTIVES

- This course aims at imparting knowledge about the experiments and procedures involving fungal and protozoan organisms of medical importance, their isolation, preservation and detection

### SUGGESTED LIST OF EXPERIMENTS

- Preparation of fungal media and Isolation and Cultivation of fungi.
- Identification of common fungus like Mucor, Rhizopus, Penicillium, Aspergillus by Lactophenol cotton blue staining method.
- Leishman staining for malarial parasites
- Saline wet mount for observing ova and eggs of parasites.
- Iodine wet mount for observing ova and eggs of parasites.
- Concentration of stool samples by floatation method
- Concentration of stool samples by sedimentation method
- Zinc sulphate conc. Method for stool sample
- Demonstration of various parasites by permanent slides.

### COURSE OUTCOMES

On completion of the course, the student will be able to

**CO1** – Identify various genus of fungi from different samples by staining

**CO2** – Perform fungal cultivation using various media

**CO3** – Perform staining techniques for malarial parasites

**CO4** – Analyse stool samples and organisms associated with infections

**CO5** – Explain different techniques of analysis of stool sample

**CO6** – Demonstrate different parasites with permanent slides

SMBB1501	INDUSTRIAL MICROBIOLOGY	L	T	P	EL	Credits	Total Marks
		3	0	0	2	3	100

**COURSE OBJECTIVES**

- To learn basic knowledge in Industrial Microbiology.
- To gain knowledge in antibiotics, enzyme and beverages production process.

**UNIT 1 INTRODUCTION****9 Hrs**

Industrial important microorganism, Exploitation of microorganisms and their products, screening, strain development strategies, immobilization methods, fermentation media: raw material used in media production, Types of media, antifoaming agents, buffers, downstream processing steps.

**UNIT 2 DESIGN OF FERMENTOR****9 Hrs**

Fermentation equipment and its uses, fermentor design, Types of fermentors and fermentations- single, batch, continuous, multiple, surface, submerged and solid-state fermentation and its applications.

**UNIT 3 ANTIBIOTIC PRODUCTION****9 Hrs**

Antibiotics: production of penicillin, streptomycin. Interferons, vaccines: Diphtheria, Whooping cough, Tetanus, meningitis and rabies vaccine, streptokinase, vitamins: vitamin B12, Vitamin C, and xanthan gum.

**UNIT 4 ENZYMES PRODUCTION****9 Hrs**

Enzymes from microbes: amylase, protease. Organic acids: citric acid, acetic acid, amino acids: glutamic acid, lysine, Biofertilizer production: Rhizobium, Phosphobacterium, Azospirillum.

**UNIT 5 BEVARAGES PRODUCTION****9 Hrs**

Production of alcoholic beverages: beer and wine, butanol biofuels: biodiesel, ethanol and biogas. Single cell production: Spirulina, Saccharomyces cerevisiae, Fusarium venenatum.

**Max 45 Hrs****COURSE OUTCOMES**

On completion of the course the student will be able to

- CO1** - Understand basic skills about strain development.
- CO2** - Learn basic steps involved in downstream Processing
- CO3** - Design a fermentor for desired products.
- CO4** - Compare antibiotics and vaccines.
- CO5** - Evaluate various enzyme activity and its applications
- CO6** - Execute the production of industrially important biotechnological products

**TEXT / REFERENCE BOOKS**

1. Whitaker and Stanbury. Principles of Fermentation Technology.
2. Casida. Industrial Microbiology. Tata McGraw Hill.

**END SEMESTER EXAM QUESTION PAPER PATTERN****Max. Marks : 100****Exam Duration : 3 Hrs.****PART A : 10 Questions of 2 marks each-No choice****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 16 marks****80 Marks**

SMBB1502	FOOD AND DAIRY MICROBIOLOGY	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

**COURSE OBJECTIVES**

- This course aims on studying interaction of microorganisms and food in relation to food-borne diseases, food spoilage and bio-processing of food and dairy products and to make students learn about technologies to render foods and dairy products safe and analytical techniques for monitoring of food biological safety.

**UNIT 1 FACTORS****9 Hrs**

Intrinsic and extrinsic factors that affect growth and survival of microbes in foods, natural flora of food and source of contamination of foods in general.

**UNIT 2 SPOILAGE****9 Hrs**

Principles, Spoilage of vegetables, fruits, meat, eggs, milk and milk products, bread and canned Foods.

**UNIT 3 PRESERVATION****9 Hrs**

Principles of food preservation. Physical methods of food preservation: temperature (low, high, canning, drying), irradiation, hydrostatic pressure, high voltage pulse, microwave processing and aseptic packaging. Chemical methods of food preservation: salt, sugar, organic acids, SO<sub>2</sub>, nitrite and nitrates, ethylene oxide, antibiotics and bacteriocins

**UNIT 4 FERMENTATION****9 Hrs**

Dairy starter cultures, fermented dairy products: yogurt, acidophilus milk, kumiss, kefir, dahi and cheese, other fermented foods: dosa, sauerkraut, soy sauce and tempeh, Probiotics: Health benefits, types of microorganisms used, probiotic foods available in market. Prebiotics.

**UNIT 5 MICROBIAL DISEASES****9 Hrs**

Food intoxications: Staphylococcus aureus, Clostridium botulinum and mycotoxins; Food infections: Bacillus cereus, Vibrio parahaemolyticus, Escherichia coli, Salmonellosis, Shigellosis, Yersinia enterocolitica, Listeria monocytogenes and Campylobacter jejuni. HACCP, Indices of food sanitary quality and sanitizers.

**Max 45 Hrs****COURSE OUTCOMES**

On completion of the course, the student will be able to

- CO1** – Build a strong foundation on basic analytic techniques
- CO2** – Understand the operating mechanisms of sterilizing instruments in labs
- CO3** – Understand the operating mechanisms of analytic instruments
- CO4** – Perform quantitative analysis of various molecules
- CO5** – Perform Electrophoretic methods
- CO6** – Outline various food borne pathogens

**TEXT / REFERENCE BOOKS**

1. Adams MR and Moss MO. (1995). Food Microbiology. 4th edition, New Age International (P) Limited Publishers, New Delhi, India.
2. Banwart JM. (1987). Basic Food Microbiology. 1st edition. CBS Publishers and Distributors, Delhi, India.
3. Davidson PM and Brannen AL. (1993). Antimicrobials in Foods. Marcel Dekker, New York.
4. Dillion VM and Board RG. (1996). Natural Antimicrobial Systems and Food Preservation. CAB International, Wallingford, Oxon.

**END SEMESTER EXAM QUESTION PAPER PATTERN****Max. Marks : 100****Exam Duration : 3 Hrs.****PART A : 10 Questions of 2 marks each-No choice****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 16 marks****80 Marks**

SMBA1503	ENVIRONMENTAL MICROBIOLOGY	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

## COURSE OBJECTIVES

- This course will provide students with the ability to demonstrate their knowledge of prokaryotic biodiversity and function, and to apply this understanding to solve problems and find solutions related to current environmental issues.

### UNIT 1 MICROORGANISMS IN THE ENVIRONMENT 9 Hrs.

Microbial evolution and diversity - A historical perspective - Overview of functions and applications of microorganisms - Interconnectivity of ecosystems. Microbial metabolism and activity - Range of conditions that support life and how microorganisms are adapted to that - Extremophiles.

### UNIT 2 BIOGEOCHEMICAL CYCLING, SOIL FORMATION 9 Hrs.

Influence of microbes on carbon, nitrogen, and sulphur cycles - Influence of microorganisms on soil formation and quality - Biodegradation of different substrates by microbes - Organic matter. Microbial diversity: DNA, genome, and metagenome. DNA sequencing: methods and examples of data/current findings - OMICS.

### UNIT 3 AGRICULTURE AND SOIL MICROBIOME 9 Hrs.

Soil microbial biodiversity and abundance; - Soil and plant microbiomes; - Soil pathogenic and beneficial microbes; - Influence of biotic and abiotic factors on food production. Plant microbiome: Benefits, function, and biotechnological applications: Importance of microorganisms for agriculture: beneficial and pathogenic; - Microbial inoculants; - Biotechnological solutions for agriculture.

### UNIT 4 BIOREMEDIATION OF CONTAMINATED SOILS 9 Hrs.

*In situ*, *ex situ* - Natural attenuation, biostimulation, bioaugmentation - Bioprospection of microorganisms Biodegradation of plastics: Antibiotic-resistant bacteria - Conventional plastics - Bioplastics; - The biology of plastics biodegradation - Mechanisms of antibiotic-resistance

### UNIT 5 BIOTECHNOLOGICAL APPLICATIONS OF MICROORGANISMS 9 Hrs.

Synthetic biology - Biomining - Microbes and production of pharmaceuticals - Microbes on food production. Microbial Control of Crop Pests and Diseases. Microbes in human welfare: biofuel production - Microbial fermentation - Microbes role in Vermicomposting. Reclamation of waste land by microorganisms.

**Max. 45 Hours**

## COURSE OUTCOMES

On completion of the course, students will be able to

- CO1** - Recognize the importance of microbial communities to the functioning of diverse ecosystems.
- CO2** - Compare and evaluate microbial communities based on their DNA sequences.
- CO3** - Predict changes in microbial community structure according changes in biotic and abiotic factors
- CO4** - Understand how plants, soil, and human microbiomes are interconnected and how they can influence each other
- CO5** - Integrate their knowledge in environmental microbiology and ecosystems management to find out solutions for environmental issues
- CO6** - Solve problems and find solutions related to current environmental issues such as antibiotic resistance, pollution, and global warming.

**TEXT / REFERENCE BOOKS**

1. Manual of environmental Microbiology. Cindy H. Nakatsu, Robert V. Miller, Suresh D. Pillai. 4th edition. 2016.
2. Environmental Microbiology. Ian L. Pepper, Charles P. Gerba, Terry J. Gentry, 2014.
3. Brock Biology of Microorganisms. Madigan, M., Martinko, J.M. and Parker, J. (14 Ed.) 2015. Prentice Hall of India Pvt. Ltd., New Delhi
4. Microbiology. Prescott, L.M, Harley, J.P. and Klein, D.A. (9th Ed.) 2014. McGraw Hill Publishing Ltd., New York.
5. Soil Microbiology: Subba Rao, N.S. (4th Ed.) 2014. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.

**END SEMESTER EXAM QUESTION PAPER PATTERN****Max. Marks : 100****Exam Duration : 3 Hrs.****PART A : 10 Questions of 2 marks each-No choice****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 16 marks****80 Marks**

<b>S77BPB51</b>	<b>RESEARCH METHODOLOGY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>EL</b>	<b>Credits</b>	<b>Total Marks</b>
		<b>3</b>	<b>0</b>	<b>2</b>	<b>2</b>	<b>4</b>	<b>100</b>

**COURSE OBJECTIVES**

- This course addresses the issues inherent in selecting a research problem and discuss the techniques and tools to be employed in completing a research project.

**UNIT 1 FOUNDATIONS OF RESEARCH 12 Hrs**

Meaning, Objectives, Motivation, Utility. Concept of theory, empiricism, deductive and inductive theory. Characteristics of scientific method: Understanding the language of research – Concept, Construct, Definition, Variable. Research Process. Problem Identification & Formulation: Research Question, Investigation Question, Measurement Issues. Hypothesis: Qualities of a good Hypothesis, Null Hypothesis & Alternative Hypothesis; Hypothesis Testing – Logic & Importance  
Practical component: Writing an abstract, articulation of null hypothesis and alternate hypothesis

**UNIT 2 RESEARCH 12 Hrs**

Concept and Importance in Research; Features of a good research design, Exploratory Research Design and Descriptive Research Designs – concept, types and uses. Experimental Design: Concept of Independent & Dependent variables. Qualitative and Quantitative Research  
Practical component: writing a review paper

**UNIT 3 MEASUREMENT 12 Hrs**

Concept of measurement– what is measured? Problems in measurement in research – Validity and Reliability. Levels of measurement – Nominal, Ordinal, Interval, Ratio. Sampling: Concepts of Statistical Population, Sample, Sampling Frame, Sampling Error, Sample Size, Non Response. Characteristics of a good sample. Probability Sample – Simple Random Sample, Systematic Sample, Stratified Random Sample & Multi-stage sampling. Determining size of the sample – Practical considerations in sampling and sample size.  
Practical component: calculation of mean, median and mode in excel.

**UNIT 4 DATA ANALYSIS 12 Hrs**

Data Preparation – Univariate analysis (frequency tables, bar charts, pie charts, percentages), Bivariate analysis – Cross tabulations and Chi-square test including testing hypothesis of association.  
Practical component: generation of graph in excel, testing hypothesis in excel

**UNIT 5 INTERPRETATION OF DATA AND PAPER WRITING 12 Hrs**

Layout of a Research Paper, Journals in Computer Science, Impact factor of Journals, When and where to publish? Ethical issues related to publishing, Plagiarism and Self-Plagiarism.  
Practical component: plagiarism checking

**Max 60 Hrs****COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1** - Discuss some basic concepts of research and techniques used in research works
- CO2** - Explain how a research should be designed
- CO3** - Understand measurements and sampling
- CO4** - Analyse given research data through various techniques
- CO5** - Understand how to interpret a data through publications
- CO6** - Apply the knowledge of scientific writing

**TEXT / REFERENCE BOOKS**

1. Business Research Methods – Donald Cooper & Pamela Schindler, TMGH, 9th edition
2. Business Research Methods – Alan Bryman & Emma Bell, Oxford University Press.
3. Research Methodology – C.R.Kothari

**END SEMESTER EXAM QUESTION PAPER PATTERN****Max. Marks : 100****Exam Duration : 3 Hrs.****PART A : 10 Questions of 2 marks each-No choice****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 16 marks****80 Marks**



SMBB2501	INDUSTRIAL MICROBIOLOGY LAB	L	T	P	EL	Credits	Total Marks
		0	0	4	0	2	100

**COURSE OBJECTIVES**

- To learn how to isolate industrial important microorganisms
- To learn how to produce industrial important products

**SUGGESTED LIST OF EXPERIMENTS**

1. Isolation of Protease producing microorganism
2. Isolation of Amylase Producing microorganism.
3. Isolation of Antibiotics producing microorganism.
4. Production of Oyster Mushrooms.
5. Production of Spirulina.
6. Production of Wine and estimation of Alcoholic content.
7. Production of Citric acid by solid-state fermentation.
8. Optimization of Medium by Plackett Burman Model.

**COURSE OUTCOMES**

On completion of the course the student will be able to

- CO1** - Understand basic knowledge in isolation of microorganisms.
- CO2** - Learn to produce industrial important products.
- CO3** - Determine alcoholic content from wine.
- CO4** - Distinguish the difference between submerged and solid-state fermentation.
- CO5** - Apply knowledge in start-up industry.
- CO6** - Design a medium by placket burman model.

SMBB2502	FOOD AND DAIRY MICROBIOLOGY LAB	L	T	P	EL	Credits	Total Marks
		0	0	4	0	2	100

### COURSE OBJECTIVE

- This course aims at imparting knowledge about the experiments and procedures involved with food related microbes and develop practical skills in handling them.

### SUGGESTED LIST OF EXPERIMENTS

- Detection of number of bacteria in milk by Standard Plate Count method.
- Determination of quality of milk sample by methylene blue reductase test.
- To demonstrate role of yeast in bread-making
- Isolation of spoilage and pathogenic microorganisms from spoiled food
- Detection of adulterants in spices, pulses, sugar, tea, milk and milk products
- Detection of arsenic by microbiological methods
- Detection of nicotinic acid by bioassay
- Detection of coliforms by MPN method for checking the quality of water sample.

### COURSE OUTCOMES

On completion of the course, the student will be able to

- CO1** – Analyse various adulterants in different food products
- CO2** – Detect chemicals and vitamins by bioassays
- CO3** – Analyse milk quality and enumerate bacterial count in milk
- CO4** – Isolate harmful pathogens from different food products
- CO5** – Demonstrate how yeast is involved in bread making
- CO6** – Execute the methods to isolate food borne pathogens

SBBB1601	BIOSAFETY, BIOETHICS AND IPR	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

**COURSE OBJECTIVES**

- To understand biosafety and the importance of bioethics
- To be able to distinguish the different IPR and biotechnological patent

**UNIT 1 INTRODUCTION TO BIOSAFETY 9 Hrs**

Biosafety – definition, need, importance, applications, levels of biosafety and criteria for biosafety levels. NIH guidelines for biosafety. Regulations specific to biotechnology companies and research institutions. Biosafety guidelines in India. Role of institutional biosafety committee.

**UNIT 2 IMPLICATIONS OF BIOSAFETY 9 Hrs**

Guidelines for research with transgenic organisms. Environmental impact of genetically modified organisms (beneficial and hazardous impact), Field trials with GMO, Containment levels. Biosafety protocol, Cartagena Biosafety protocol, Mechanism of implementation of biosafety guidelines. Biosafety and politics. Biosafety database

**UNIT 3 INTRODUCTION TO BIOETHICS 9 Hrs**

Bioethics – need, applications. Impact of bioethics to the environment and society. Bioethical issues pertaining to various aspects of Biotechnology. Bioengineering ethics, responsible researchers, research ethics, ethical decision making. Biowarfare and biopiracy

**UNIT 4 INTELLECTUAL PROPERTY RIGHTS 9 Hr.**

Forms of Intellectual property – patent, copyright, trademark, design, trade secret, domain name and geographical indications. WTO treaties, GATT articles, main features of TRIPS agreement, practical aspects of WIPO. IPR related legislatures in India.

**UNIT 5 PATENT 9 Hrs**

History of Indian patent system and law. Patenting authority. Different types of patent. Requirements and procedure for patenting. Patentable and Non-patentable things. Patent search and patent co-operation treaty (PCT). Farmer's right and plant breeders right. Importance, social consequences and controversies on biotechnology patents.

**Max.45 Hrs.****COURSE OUTCOMES**

On completion of course, student will able to

- CO1** - Describe biosafety, bioethics and intellectual property rights.
- CO2** - Discuss the different regulations pertaining to biosafety.
- CO3** - Categorize the various forms of IPR.
- CO4** - Appraise the importance of bioethics in biotechnology.
- CO5** - Elaborate the different patents and the process of patenting.
- CO6** - Interpret biotechnological novelty as patents.

**TEXT / REFERENCE BOOKS**

1. Sateesh M.K., Bioethics and Biosafety, I.K. International Publishing House Pvt. Ltd., 2013.
2. Fleming D.O. and Hunt D.L., Biological Safety: Principles and Practices, ASM Press, 2006.
3. Goel D. and Parashar S., IPR Biosafety and Bioethics, Pearson Education India, 2013.
4. Pandey N. and Dharni K., Intellectual Property Rights, PHI Learning, 2014.
5. Singh K.K., Biotechnology and Intellectual Property Rights: Legal and Social Implications, Springer India, 2014.
6. Young T.R., Policy I. and Group G.C., Genetically Modified Organisms and Biosafety: A Background Paper for Decision-makers and Others to Assist in Consideration of GMO Issues. IUCN, 2004.

**END SEMESTER EXAM QUESTION PAPER PATTERN****Max. Marks : 100****Exam Duration : 3 Hrs.****PART A : 10 Questions of 2 marks each-No choice****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 16 marks****80 Marks**

<b>S77BLH61</b>	<b>BIOSTATISTICS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>EL</b>	<b>Credits</b>	<b>Total Marks</b>
		<b>3</b>	<b>0</b>	<b>2</b>	<b>2</b>	<b>4</b>	<b>100</b>

**COURSE OBJECTIVES**

- This course aim to use and interpret results of, descriptive statistical methods effectively
- Demonstrate an understanding of the central concepts of basic biomathematics and biostatistical theory

**UNIT 1 INTRODUCTION TO BIOSTATISTICS****12 Hrs.**

Definitions in Statistics, Sample and Population, Variables: Discrete and Continuous, Collection, Classification and Tabulation of data, Bar diagrams and Pie diagrams, Histogram, Frequency curve and frequency polygon, Ogives.

Practical component: Generation of different graph in excel

**UNIT 2 SAMPLING AND MEASURES OF DEVIATION****12 Hrs.**

Concept of Sampling and Sampling Distribution. Measures of Central tendency (Mean, Median, Mode), Measures of deviation (Standard deviation, variance and coefficient of variation).

Practical component: measures of central tendency and deviation in R

**UNIT 3 TEST AND LEVEL OF SIGNIFICANCE****12 Hrs.**

Test of significance, Hypothesis Testing, Null and Alternate Hypothesis, Level of significance, Confidence Limit Student, T and F Test, Chi-square test

Practical component: test of significance in excel

**UNIT 4 PROBABILITY AND DISTRIBUTION****12 Hrs.**

Probability and Distribution, Concepts and problems on probability, Binomial, Poisson, Normal Distribution and their applications

Practical component: Distribution analysis in excel

**UNIT 5 ANALYTICAL METHODS****12 Hrs.**

Simple Regression and Correlation, Concept of analysis of variance (one-way classification)

Practical component: regression line in excel, Correlation in excel and ANOVA in excel

**Max. 60 Hours****COURSE OUTCOME**

On completion of the course, student will be able to

**CO1** – Familiarize students about the principal concepts of biostatistics

**CO2** – Provide the knowledge of sampling and sample analysis

**CO3** – Identify distribution form relating to the variable/variables

**CO4** – Discuss the test of significance and ANOVA

**CO5** – Explain different types of probability distribution

**CO6** – Apply hypothesis testing via some of the statistical distributions

**TEXT / REFERENCE BOOKS**

1. Fundamentals of Biostatistics. by Irfan A Khan.
2. An introduction to Biostatistics. by PSS Sunder Rao.
3. Introduction to the Practice of Statistics by Moore and McCabe

**END SEMESTER EXAM QUESTION PAPER PATTERN****Max. Marks : 100****Exam Duration : 3 Hrs.****PART A : 10 Questions of 2 marks each-No choice****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 16 marks****80 Marks**

SBBB1303	ANCILLARY BIOCHEMISTRY I	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

**COURSE OBJECTIVE**

- To give an insight into the basics of Biochemistry highlighting biomolecules and their significance.

**UNIT 1 CARBOHYDRATES****9 Hrs**

Monosaccharides-Definition, classification, structure and properties. Disaccharides-Definition, types, structure and biological importance. Polysaccharides-types and properties.

**UNIT 2 AMINOACIDS AND PROTEINS****9 Hrs**

Amino acids: Structures and Classifications, Essential and Non-essential amino acids, amphoteric nature, isoelectric point, zwitter ion. Protein: Classification - shape, solubility and composition; biological functions of proteins, bonds involved in protein structure, structural levels of organization: - primary, secondary, tertiary and quaternary structures with examples.

**UNIT 3 LIPIDS****9 Hrs**

Definition, Classification and properties of lipids. Types of fatty acids -saturated, unsaturated and essential fatty acids.

Classification and significance of lipoproteins and phospholipids. Importance of steroids, structure and biological significance of cholesterol.

**UNIT 4 NUCLEIC ACIDS****9 Hrs**

Nucleic acids: Nitrogenous bases, structures of Ribonucleotides and deoxyribonucleotides, structure, types and functions of DNA and RNA.

**UNIT 5 VITAMINS AND MINERALS****9 Hrs**

Vitamins: fat soluble and water-soluble vitamins. Deficiency disorders. Minerals: Micro and Macro minerals. Biological importance of vitamins and minerals

**Max.45 Hrs****COURSE OUTCOMES**

On completion of the course, students will be able to

**CO1** - Understand the basic classification and biological significance of carbohydrates

**CO2** - Elucidate the impact of structure and properties of amino acids on organizing the structure of proteins

**CO3** - Apply knowledge on lipids to their biological significance

**CO4** - Identify the structural and functional significance of nucleic acids

**CO5** - Analyze the requirement of vitamins

**CO6** - Interpret the vital role of minerals

**TEXT / REFERENCE BOOKS**

1. Jain J.L, Fundamentals of biochemistry, S.Chand Publication 7th Edition, 2005
2. Textbook of Medical Biochemistry – Rana Shindae and Chatterjee, 8th Edition, 2012
3. Deb, A.C., Fundamentals of Biochemistry, New Central Agency, Calcutta, 2016.
4. Ambika Shanmugam, Fundamentals of Biochemistry for Medical Students, Eighth Edition, Lippincott Williams and Wilkins Publications, 2016
5. Lehninger, A.L., Nelson, D.L., Cox, M.M., Principles of Biochemistry, CBS Publishers, 7th Edition, 2017
6. Harper's Biochemistry: R.K. Murray, D.K Granner, P.A. Mayes and U.W.Rodwell – Lange Medical publications, 31<sup>st</sup> edition, 2018

**END SEMESTER EXAM QUESTION PAPER PATTERN****Max. Marks : 100****Exam Duration : 3 Hrs.****PART A : 10 Questions of 2 marks each-No choice****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 16 marks****80 Marks**



SBBB1403	ANCILLARY BIOCHEMISTRY II	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

**COURSE OBJECTIVES**

- To give an insight into the basics of enzymes, metabolic cycles of biomolecules and energy production.

**UNIT 1 ENZYMES****9 Hrs**

Classification of enzymes with examples, coenzymes and cofactors (structures not needed). Active site: Lock and Key model, Induced fit hypothesis. Factors affecting enzyme activity. Types of enzyme inhibition. Chemical and industrial applications of enzymes.

**UNIT 2 CARBOHYDRATE METABOLISM****9 Hrs**

Glycolysis, TCA cycle and its energy production. Glycogen metabolism: Glycogenesis and Glycogenolysis, Alternative pathways: HMP pathway, gluconeogenesis

**UNIT 3 LIPID METABOLISM****9 Hrs**

Fatty acid oxidation –  $\alpha$ ,  $\beta$ ,  $\omega$  oxidation. Biosynthesis of saturated and unsaturated fatty acids. Metabolism of cholesterol, triglycerides.

**UNIT 4 PROTEIN METABOLISM****9 Hrs**

Ketogenic and Glucogenic amino acids metabolism. Deamination, Transamination and Decarboxylation, Urea cycle.

**UNIT 5 NUCLEIC ACID METABOLISM & ENERGY PRODUCTION****9 Hrs**

Biosynthesis and degradation of purine and pyrimidine nucleotides. Mitochondrial Electron Transport Chain: Oxidative phosphorylation

**Max.45 Hrs****COURSE OUTCOMES**

On completion of the course, students will be able to

- CO1** - Apply the concept of enzymes and their importance
- CO2** - Elucidate the role of various pathways in carbohydrate metabolism
- CO3** - Analyze the types and process of lipid metabolism
- CO4** - Categorize the reaction involved and nature of protein metabolism
- CO5** - Identify the metabolism of nucleotides
- CO6** - Interpret the mechanism of energy production

**TEXT / REFERENCE BOOKS**

- Jain J.L, Fundamentals of biochemistry, S.Chand Publication 7th Edition, 2005
- Textbook of Medical Biochemistry – Rana Shindae and Chatterjee, 8th Edition, 2012
- Deb, A.C., Fundamentals of Biochemistry, New Central Agency, Calcutta, 2016.
- Ambika Shanmugam, Fundamentals of Biochemistry for Medical Students, Eighth Edition, Lippincott Williams and Wilkins Publications, 2016
- Lehninger, A.L., Nelson, D.L., Cox, M.M., Principles of Biochemistry, CBS Publishers, 7th Edition, 2017
- Harper's Biochemistry: R.K. Murray, D.K Granner, P.A. Mayes and U.W.Rodwell – Lange Medical publications, 31st edition, 2018
- Fundamentals of Biochemistry, Donald Voet, Judith G.Voet and Charlotte W Pratt, John Wiley & Sons, NY, 3rd Edition, 2011

**END SEMESTER EXAM QUESTION PAPER PATTERN****Max. Marks : 100****Exam Duration : 3 Hrs.****PART A :** 10 Questions of 2 marks each-No choice**20 Marks****PART B :** 2 Questions from each unit with internal choice, each carrying 16 marks**80 Marks**

SMBB1303	ANCILLARY BIOTECHNOLOGY I	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

**COURSE OBJECTIVES**

- This course provides you with further knowledge associated with molecular biology and inheritance at the molecular, cellular and phenotypic levels.

**UNIT 1 MENDELIAN GENETICS****9 Hrs.**

Mendel's work on transmission of traits, Genetic Variation, Molecular basis of Genetic Information. Interrelation between the cell structure and the genetics function, Mitosis, Meiosis (explaining Mendel's ratios).

**UNIT 2 INHERITANCE****9 Hrs.**

Principles of Inheritance, Chromosome theory of inheritance, Laws of Probability, Pedigree analysis, Incomplete dominance and codominance, Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, sex-linked inheritance. Linkage and crossing over, Recombination frequency as a measure of linkage intensity, two factor and three factor crosses, Interference and coincidence, Somatic cell genetics –an alternative approach to gene mapping.

**UNIT 3 GENETIC MATERIAL****9 Hrs.**

Introduction and History of Microbial Genetics. DNA as a Genetic material. Physical structure and Chemical composition of DNA – RNA and its types RNA as a Genetic material. DNA Replication – Types and Experimental proof of replication – Enzymes involved in DNA replication

**UNIT 4 GENE EXPRESSIONS****9 Hrs.**

Prokaryotic Transcription, Translation. Genetic code – Regulation of gene expression in prokaryotes – lac Operon. Gene transfer mechanisms – Transformation, conjugation and Transduction. Plasmid – Characteristics and types.

**UNIT 5 MUTATIONS****9 Hrs.**

Mutation – types of mutation – Molecular basis of mutation –Mutagenesis, Detection of mutants – Ames test, DNA repair mechanisms. Molecular basis of Mutations in relation to UV light and chemical mutagens, Detection of mutations: CLB method, Attached X method, DNA repair mechanisms.

**Max. 45 Hours****COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1** - Study the detail of genetic material of our living system-DNA replication, transcription and translation and explain how they relate to each other.
- CO2** - Understand the Basic of DNA replication in prokaryotes and eukaryotes.
- CO3** - Study the details of gene organization and mechanisms of control the gene expression in various organisms.
- CO4** - Understand the applications of molecular biology in the modern world.
- CO5** - Through this course the students are exposed to importance of biological macromolecules
- CO6** - Apply the molecular aspects of the biology in research

**TEXT / REFERENCE BOOKS**

1. David Freifelder (1995). Molecular Biology. Narosa Publishing House, New Delhi.
2. Peter Snustad D and Michael J Simmons (2003). Principles of Genetics. 3<sup>rd</sup> Edition, John Wiley & Sons, Inc., Publication, New Delhi.
3. Peter J Russel (2002). Genetics. Benjamin Cummings.

**END SEMESTER EXAM QUESTION PAPER PATTERN****Max. Marks : 100****Exam Duration : 3 Hrs.****PART A : 10 Questions of 2 marks each-No choice****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 16 marks****80 Marks**

SMBB1403	ANCILLARY BIOTECHNOLOGY II	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

### COURSE OBJECTIVES

- By the end of the course, students should be able to critically analyze and apply biotechnological techniques and concepts in various industrial and environmental settings, assess the potential benefits and risks associated with these technologies, and contribute to the development of innovative solutions in ancillary biotechnology.

#### UNIT 1 INTRODUCTION

9 Hrs

Overview of ancillary biotechnology and its applications in various industries, Historical development and milestones in ancillary biotechnology, Ethical and regulatory considerations in ancillary biotechnology, Biotechnological techniques and tools used in ancillary biotechnology

#### UNIT 2 INDUSTRIAL ENZYMES AND BIOCATALYSIS

9 Hrs

Introduction to industrial enzymes and their role in biocatalysis, Enzyme production and optimization techniques, Applications of enzymes in various industries, such as food, textile, and detergent industries, Immobilized enzymes and their industrial application

#### UNIT 3 BIOSENSORS AND BIOELECTRONICS

9 Hrs

Principles and working mechanisms of biosensors, Types of biosensors and their applications in healthcare, environmental monitoring, and food safety, Bioelectronic devices and their role in medical diagnostics and therapeutics, Integration of biosensors and bioelectronics for advanced applications

#### UNIT 4 BIOREMEDIATION AND ENVIRONMENTAL BIOTECHNOLOGY

9 Hrs

Introduction to bioremediation and its significance in environmental protection, Microorganisms and their role in bioremediation of pollutants, Biotechnological approaches for wastewater treatment and solid waste management, Genetic engineering for enhancing bioremediation capabilities

#### UNIT 5 AGRICULTURAL BIOTECHNOLOGY AND CROP IMPROVEMENT

9 Hrs

Applications of biotechnology in crop improvement and agricultural practices, Genetic modification of crops for enhanced yield, disease resistance, and nutritional value, Biotechnological methods for plant tissue culture and micropropagation, Biosafety considerations and regulations in agricultural biotechnology

**Max 45 Hrs**

### COURSE OUTCOMES

On completion of the course, the students will be able to

- CO1** - Understand the fundamental principles and concepts of ancillary biotechnology, including its applications in various industries and its role in addressing societal challenges.
- CO2** - Demonstrate knowledge of the different biotechnological techniques and tools used in ancillary biotechnology, and apply them effectively in practical applications.
- CO3** - Analyze the production, optimization, and industrial applications of enzymes in biocatalysis, and evaluate their significance in different sectors such as food, textile, and detergent industries.
- CO4** - Evaluate the principles and working mechanisms of biosensors, and apply them in the design and development of biosensing systems for healthcare, environmental monitoring, and food safety.

- C05 -** Assess the applications of bioremediation and environmental biotechnology in the remediation of pollutants, wastewater treatment, and solid waste management, and evaluate the potential of genetic engineering in enhancing bioremediation capabilities.
- C06 -** Execute the applications of biotechnology in crop improvement and agricultural practices, and evaluate the impact of genetic modification on crop yield, disease resistance, and nutritional value

### TEXT BOOKS/ REFERENCES

1. "Industrial Biotechnology: Sustainable Production and Bioresource Utilization" by Christian Stevens and Wim Soetaert (Latest Edition: 2021)
2. "Biocatalysis: Fundamentals and Applications" by Andreas S. Bommarius and Bettina R. Riebel (Latest Edition: 2019)
3. "Biosensors: Introduction and Trends" by Francisco J. Andrade and Antonio F. Silva (Latest Edition: 2020)
4. "Environmental Biotechnology: Principles and Applications" by Bruce Rittmann and Perry L. McCarty (Latest Edition: 2019)
5. "Agricultural Biotechnology: Challenges and Prospects" by Gurbachan Miglani and Surinder Kumar Gupta (Latest Edition: 2020)
6. "Bioremediation: Principles and Applications" by Ronald L. Crawford and Don L. Crawford (Latest Edition: 2019)
7. "Industrial Enzymes: Structure, Function and Applications" by Julio Polaina and Andrew P. MacCabe (Latest Edition: 2019)
8. "Plant Biotechnology: Principles and Applications" by Chittaranjan Koley (Latest Edition: 2019)

### END SEMESTER EXAM QUESTION PAPER PATTERN

**Max. Marks : 100**

**Exam Duration : 3 Hrs.**

**PART A :** 10 Questions of 2 marks each-No choice

**20 Marks**

**PART B :** 2 Questions from each unit with internal choice, each carrying 16 marks

**80 Marks**

SBBB2301	ANCILLARY BIOCHEMISTRY LAB I	L	T	P	EL	Credits	Total Marks
		0	0	4	0	2	100

**COURSE OBJECTIVE**

- To develop basic laboratory skills essential for biochemical analysis

**SUGGESTED LIST OF EXPERIMENTS**

1. Preparation of Normal, Molar and Percentage solutions
2. Preparation of stock standard and working standard solutions
3. Working of pH meter
4. pH and buffers - preparation of buffers
5. Estimation of Ascorbic acid
6. Qualitative analysis of Carbohydrates: Glucose, fructose, maltose and lactose
7. Qualitative analysis of Amino acids: Arginine, cysteine, tryptophan and tyrosine

**COURSE OUTCOMES**

On completion of the course, students will be able to

**CO1** - Apply the concept of concentration calculations in the preparation of solutions

**CO2** - Identify the role of stock standard and working standard solutions

**CO3** - Understand the measurement and importance of Ph

**CO4** - Evaluate the vitamin C content in various sources

**CO5** - Identify the presence of various sugars

**CO6** - Interpret the amino acids in biological sources

SB BB2402	ANCILLARY BIOCHEMISTRY LAB II	L	T	P	EL	Credits	Total Marks
		0	0	4	0	2	100

**COURSE OBJECTIVE**

- To understand biochemical methods for the preparation and analysis of biomolecules

**SUGGESTED LIST OF EXPERIMENTS**

1. Isolation & estimation of starch from potato
2. Isolation & estimation of caesin from milk
3. Determination of saponification value of lipid
4. Working of colorimeter
5. Colorimetric estimation of proteins
6. Determination of achromatic point of salivary amylase
7. Qualitative analysis of phytochemicals

**COURSE OUTCOMES**

On completion of the course, students will be able to

- CO1** - Demonstrate the isolation and preparation of biomolecules
- CO2** - Identify the properties of lipids related to their uses
- CO3** - Understand the measurement of coloured samples
- CO4** - Evaluate protein content based on absorbance
- CO5** - Identify the mechanism of enzyme action
- CO6** - Interpret the presence of secondary metabolites in plants



SMBB2302	ANCILLARY BIOTECHNOLOGY LAB I	L	T	P	EL	Credits	Total Marks
		0	0	4	0	2	100

**COURSE OBJECTIVE**

- The experiments provide hands-on experience in performing basic molecular biology techniques thereby developing skill in performing molecular biology experiments. This will facilitate the students to take up specialized projects in Molecular biology and will be a pre-requisite for research work.

**SUGGESTED LIST OF EXPERIMENTS**

1. Isolation of DNA from E. coli/ liver/ plant
2. Agarose gel electrophoresis of DNA
3. Restriction digests of DNA.
4. Isolation of plasmid
5. Separation of serum protein by SDS -PAGE
6. Western blotting

**COURSE OUTCOMES**

On completion of the course, the student will be able to

- CO1** – Build a strong foundation on basic molecular techniques  
**CO2** – Determine the amount of nucleic acids present in a given sample  
**CO3** – Perform DNA and plasmid isolation, SDS-PAGE  
**CO4** – Perform analytic techniques for DNA and proteins  
**CO5** – Perform analytic techniques for proteins  
**CO6** – Recognize the principle behind the quantification of nucleic acids

SMBB2402	ANCILLARY BIOTECHNOLOGY LAB II	L	T	P	EL	Credits	Total Marks
		0	0	4	0	2	100

### COURSE OBJECTIVES

- By the end of the course, students should be able to get a deeper understanding of the applications and implications of industrial enzyme production, enzyme activity assays, bioremediation, plant tissue culture, antibiotic resistance evaluation, and data analysis.

### LIST OF EXPERIMENTS

- Industrial Enzyme Production and Optimization
- Enzyme Activity Assay
- Bioremediation of Contaminated Soil
- Plant Tissue Culture and Micropropagation
- Evaluation of Antibiotic Resistance in Bacterial Isolates

### COURSE OUTCOMES

- C01** - Understand the principles and techniques of industrial enzyme production, including fermentation, strain selection, and Analyse and interpret data to assess the effectiveness of different parameters, such as pH, temperature, and substrate concentration, on enzyme production.
- C02** - Apply appropriate assay techniques to measure and compare the activity of different enzymes.
- C03** - Demonstrate proficiency in setting up and monitoring bioremediation experiments in soil samples.
- C04** - Apply aseptic techniques to culture plant tissues and establish and maintain in vitro plant cultures.
- C05** - Apply appropriate techniques, such as disk diffusion assays, to evaluate antibiotic resistance in bacterial isolates.
- C06** - Apply data analysis methods to interpret experimental results and draw valid conclusions.

SMBB3001	DESIGN AND OPERATION OF BIOREACTORS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

**COURSE OBJECTIVES**

- To develop knowledge in bioreactors and its types
- To make understand the knowledge in microbial growth parameters

**UNIT 1 INTRODUCTION****9 Hrs**

Concept of Bioreactors, Overview of SLF and SSF. Medium optimization-Plackett Burman method. Introduction to bioreactor configuration.

**UNIT 2 DESIGN AND OPERATION****9 Hrs**

Basic mode of operation batch, fed-batch and continuous reactor, Kinetics of batch and continuous culture.

**UNIT 3 IDEAL CONTINUOUS STIRRED TANK BIOREACTOR****9 Hrs**

Material balance-Evaluation of Monod Kinetic parameter, Alternatives to Monod equation-Blackman, Tessier, Moser, Contois equation -Comparison of batch and CSTB-Multiple CSTB connected in series-CSTB with cell recycling.

**UNIT 4 GENERAL CHARACTERISTIC OF MODELS****9 Hrs**

Unstructured and structured models. Models with growth inhibitors- Substrate inhibition, Product Inhibition-Competitive and Noncompetitive product inhibition. Rate. Mass transfer and rheology: Rheology of broths - impact on transfer processes Oxygen transport from the bubble to the cell.

**UNIT 5 DESIGN CONSIDERATIONS****9 Hrs**

Animal and plant cell bioreactors. Determination of  $k_La$  - Correlation for  $k_La$ . Introduction to Single Use, Bioreactors (SUBs),

**Max.45 Hrs****COURSE OUTCOMES**

On completion of course, student will able to

- CO1** - Learn basic working principle of bioreactors
- CO2** - Design and operation of industrial bioreactors
- CO3** - Evaluate the various microbial growth kinetics
- CO4** - Discuss the microbial growth kinetics using models
- CO5** - Critique on the validity of experimental data and measurements of mass transfer rate
- CO6** - Analyse various economical important products

**TEXT / REFERENCE BOOKS**

1. Shuler.M.L. and Kargi.F, Bioprocess Engineering Basic concepts, Pearson Education India, 1<sup>st</sup> Edition, 2003.
2. Stanbury P.F., Whitaker A. and Hall S.J., Principles of Fermentation Technology, 2nd Edition, 1997.
3. Pauline M. Doran, Bioprocess Engineering Principles.2012.

**END SEMESTER EXAM QUESTION PAPER PATTERN****Max. Marks : 100****Exam Duration : 3 Hrs.****PART A : 10 Questions of 2 marks each-No choice****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 16 marks****80 Marks**

SMBB3002	FERMENTATION TECHNOLOGY AND DOWNSTREAM PROCESSING	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

**COURSE OBJECTIVES**

- To understand and improve the knowledge in fermentation technology
- To gain knowledge in growth kinetics, fermenter control process and various downstream process techniques

**UNIT 1 INTRODUCTION TO FERMENTATION PROCESS****9 Hrs.**

The range of fermentation processes, culture collection management, Inoculum preparation: Scale up of the inoculum for Bacteria and fungi. Sterilization: Batch and Continuous sterilization of medium, Filter sterilization.

**UNIT 2 MICROBIAL GROWTH KINETICS****9 Hrs.**

Bacterial growth kinetics, Monod model, Comparison of Continuous Batch and continuous culture. Design of a fermenter – ancillary equipment fermenter and Bioreactor types.

**UNIT 3 INSTRUMENTATION AND CONTROL****9 Hrs.**

Fermentation control systems – manual and automatic control in fermentation processes. temperature measurement and control, flow measurement and control, pressure measurement and control, measurement of pH and dissolved oxygen, Computer applications in fermentation technology: Artificial neural network.

**UNIT 4 DOWNSTREAM PROCESSING****9 Hrs.**

Separation and recovery of fermented products- precipitation, filtration, centrifugation, flocculation, coagulation- cell disruption –physical and chemical methods, Solvent extraction: liquid – liquid, aqueous two phase extraction, supercritical fluid extraction.

**UNIT 5 PURIFICATION PROCESSES****9 Hrs.**

Drying, whole broth processing, Chromatography - Adsorption Chromatography, gel permeation, Affinity Chromatography, High performance liquid. Chromatography. Lyophilization.

**Max.45 Hrs.****COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1** - Understand basic knowledge in range of fermentation process.
- CO2** - Learn the various types of sterilization techniques.
- CO3** - Apply Artificial intelligence in instrument and control system.
- CO4** - Evaluate the product separation by solvent extraction techniques.
- CO5** - Assess a suitable method for downstream processing and its potential applications.
- CO6** - Apply the knowledge to produce various biotechnologically important products

**TEXT / REFERENCE BOOKS**

1. Stanbury P.F., Whitaker A. and Hall S.J., Principles of Fermentation Technology, 2nd Edition, Elsevier Science Publishers, 2003.
2. Belter P.A, Cursler E.L, and Hu W.S., Bioseparation - Downstream Processing for Biotechnology John Wiley & Sons, publishers, 1990.
3. Harrison R.G, Todd P., Rudge S.R and Petrides D.P, Bioseparations Science and Engineering, Oxford Press, 2002.

**END SEMESTER EXAM QUESTION PAPER PATTERN****Max. Marks : 100****Exam Duration : 3 Hrs.****PART A : 10 Questions of 2 marks each-No choice****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 16 marks****80 Marks**

SMBB3003	MICROBIAL PRODUCTS FOR AGRICULTURE AND INDUSTRIES	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

**COURSE OBJECTIVES**

- To make the students to understand role of bio-products and its applications.
- To make the students understand the basic principles of Biofuels and Biopesticides

**UNIT 1 BIOFERTILIZERS****9 Hrs.**

General account about the microbes used as bio-fertilizer – Rhizobium, Azotobacter, Phosphate solubilizing microbes, azospirillum- isolation, identification, mass multiplication, carrier-based inoculants.

**UNIT 2 BIOPESTICIDES****9 Hrs.**

History and concept of biopesticides. Importance, scope and potential of biopesticide. Mass production technology of bio-pesticides. Virulence, pathogenicity and Symptoms of entomopathogenic pathogens and nematodes.

**UNIT 3 BIOSTIMULANTS****9 Hrs.**

Humic acids and Fulvic acids, seaweeds, amino acids, microbial inoculants, plant growth promoters, mycorrhiza- isolation, identification, mass multiplication, carrier-based inoculants.

**UNIT 4 INDUSTRIAL PRODUCTS****9 Hrs.**

Production of Protease, Amylase, lipase and its applications. Production of Citric acid, Lactic acid, Acetic acid. Production of Probiotics, biosurfactant, Microbial fuel cell and its applications.

**UNIT 5 MICROBIAL QUALITY CONTROL****9 Hrs.**

Estimation of nitrogen content by kjeldahl method, MPN test, air sampling procedure, Principles of quality assurance and quality management systems. Good Manufacturing Practices (GMP) and regulatory guidelines. Auditing and documentation in industrial microbiology.

**Max.45 Hrs.****COURSE OUTCOMES**

On the successful completion of the course, student will be able to

- CO1** - Understand the role of microorganism in agriculture
- CO2** - Describe production steps and specific requirements for bio-fertilizers
- CO3** - Learn the importance of bio stimulant in agriculture
- CO4** - Apply the knowledge gained to generate opportunities of self- employability.
- CO5** - Evaluate Auditing and documentation in industrial microbiology
- CO6** - Determine nitrogen content by kjeldahl method

**TEXT / REFERENCE BOOKS**

1. Biostimulants for crop production and sustainable agriculture, 2022
2. Handbook of microbiological quality control in pharmaceuticals and medical devices.
3. Bio-fertilizers and organic \_farming vayas, s.c, vayas, s. And modi, h.a. (1998) akta prakashan, nadiad
4. Biotechnology of biofertilizers kannaiyan, s., (2003), chips, texas.
5. Hand book of microbial biofertilizers rai, m.k., (2005), the haworth press, inc. newyork

**END SEMESTER EXAM QUESTION PAPER PATTERN****Max. Marks : 100****Exam Duration : 3 Hrs.****PART A : 10 Questions of 2 marks each-No choice****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 16 marks****80 Marks**



SMBB3004	MEDICAL LABORATORY TECHNIQUES	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

**COURSE OBJECTIVES**

- The main purpose of the program is to provide the students with the good knowledge of the basic techniques used in the laboratory.

**UNIT 1 CLINICAL LABORATORY****9 Hrs**

Basic laboratory principles – code of conduct – organization of clinical laboratory- safety measures, Common equipments – Glasswares, microscopes, incubators and centrifuges

**UNIT 2 SAMPLES FOR DIAGNOSIS****9 Hrs**

Disease associated clinical samples for diagnosis. Collection of clinical samples (oral cavity, throat, skin, Blood, CSF, urine and faeces). Methods of transport of clinical samples to laboratory and storage procedures.

**UNIT 3 STAINING TECHNIQUES****9 Hrs**

Examination of sample by staining techniques- Bacterial infections- Gram stain, capsule, spore staining and Ziehl-Neelson staining for tuberculosis, Giemsa stained thin blood film for malaria. Preparation and use of culture media - Blood agar, Chocolate agar, Lowenstein-Jensen medium, MacConkey agar, Distinct colony properties of various bacterial pathogens.

**UNIT 4 URINE AND BLOOD ANALYSIS****9 Hrs**

Components of routine urine analysis – color, odour, sugar (Benedict's test), protein (Heller's test), ketones (Rothera's test), bile salts (Hay's test) and blood (Benzidine test). Complete blood count (CBC) – RBC, WBC and platelet count, hemoglobin content, hematocrit and ESR

**UNIT 5 MOLECULAR DIAGNOSTICS****9 Hrs**

Nucleic acid amplification testing (NAAT) – PCR, RT-PCR. Antigen-based Rapid Diagnostic Testing, chip based tests.

**Max. 45 hours****COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1** – Describe the various techniques used in medical laboratories.
- CO2** – Understand the application of laboratory techniques in disease diagnosis
- CO3** – Explore various infectious agents and the diseases caused by it
- CO4** – Explain the protocols for disease diagnosis
- CO5** – Demonstrate each technique and inference of test results
- CO6** – Develop methods to study infectious diseases.

**TEXT/ REFERENCE BOOKS**

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

**END SEMESTER EXAM QUESTION PAPER PATTERN****Max. Marks : 100****Exam Duration : 3 Hrs.****PART A : 10 Questions of 2 marks each-No choice****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 16 marks****80 Marks**

SMBB3005	CLINICAL MICROBIOLOGY	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

**COURSE OBJECTIVES**

- Identify the procedures required for the collection and transportation of the clinical samples
- Describe the diagnostic tests to find out the causative agent of the respective clinical condition

**UNIT 1 COLLECTION, TRANSPORT AND PROCESSING OF SAMPLES 9 Hrs.**

Collection of samples - Blood, Urine, Sputum, CSF, Pus & Faeces. Transport of specimens - transport media and storage. Processing of samples - general identification process of medicinally important pathogens –Molecular diagnostic methods - qPCR. Reporting of results & interpretation.

**UNIT 2 IDENTIFICATION OF BACTERIAL PATHOGENS 9 Hrs.**

Microscopic examination of specimens for Bacterial pathogens – simple, differential staining and motility. Isolation and cultivation of viable pathogens – differential, selective, enrichment media. Identification of pathogens - Biochemical tests – Sugar fermentation test - susceptibility test – MIC

**UNIT 3 IDENTIFICATION OF FUNGAL PATHOGENS 9 Hrs.**

General identification process of medically important fungi. Fungal sample analysis – Direct Microscopic examination, culture media and incubation, Serological tests for fungi – Antifungal susceptibility testing.

**UNIT 4 IDENTIFICATION OF VIRAL PATHOGENS 9 Hrs.**

Laboratory methods in basic virology - Media used – Specimen processing – isolation and identification of viruses. Advanced techniques to detect viral antigens – automated and immuno methods – ELISA, RIA. Viral Serology- Special consideration- Hepatitis and AIDS.

**UNIT 5 IDENTIFICATION OF PROTOZOA AND PARASITES 9 Hrs.**

Identification of Intestinal Protozoa – Amoeba, Blood protozoa – Malaria, Intestinal Helminthes: Ascaris, Taenia, Entrobilus and Blood Helminthes: Wuchereria bancrofti. Laboratory methods for parasitic infections – Diagnostic techniques for faecal, gastrointestinal and urogenital specimen.

**Max. 45 Hours****COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1** – Understand how clinical samples are collected and transported to the lab.
- CO2** – Explain the different methodologies used to identify medicinally important pathogens
- CO3** – Discuss different protozoan parasites and diseases caused by them
- CO4** – Describe theoretical concepts of virology and lab techniques to detect viruses
- CO5** – Compare different media for viral cultivation and methods of viral antigen detection
- CO6** – Demonstrate the role of clinical microbiology techniques in disease diagnosis

**TEXT / REFERENCE BOOKS**

1. Manual of Clinical Microbiology (Vol.1&2)– 8th edn,2003, Patrick R Murray (edn.), ASM Press., Washinton,D.C.
2. Diagnostic Microbiology, Bailey and Scott's., 1990. Eighth edition. The Mosby Company.
3. Medical laboratory techniques, Abdul Khader, 2003, First edition. Frontline Publications, Hyderabad.
4. Virology, Sawant, K.C., 2005, First edition, Dominant Publishers and distributors, Delhi.
5. Medical Parasitology, Rajesh Karykarte, Ajit Damla, 2004. Books and allied publishers Ltd. Kolkata.
6. Textbook of Medical Parasitology, Subash O. Barija , 1996. First edition. All India Publishers and Distributors Regd. 920 Poonamallee High Road, Chennai.
7. Rajesh Karykarte and Ajith Damle (2005)Medical Parasitology, Books and Allied(P)Ltd.

**END SEMESTER EXAM QUESTION PAPER PATTERN****Max. Marks : 100****Exam Duration : 3 Hrs.****PART A : 10 Questions of 2 marks each-No choice****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 16 marks****80 Marks**

SMBB3006	GLOBAL HEALTH AND EPIDEMIOLOGY	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

**COURSE OBJECTIVES**

- Inculcate the ability to understand epidemiological indicators
- Acquisition of the principles of global health, major challenges and global health governance

**UNIT 1 FUNDAMENTALS OF EPIDEMIOLOGY 9Hrs**

Definition, Historical aspects and evolution of Epidemiology, Tools of Epidemiology: measuring disease Frequency (Prevalence, incidence, morbidity rates, attack rates )

**UNIT 2 STUDY DESIGNS 9Hrs**

Observational Studies, Experimental Studies and qualitative research- Mixed designs, Ecological Studies, Space time cluster studies, Familial aggregation studies.

**UNIT 3 THREATENING DISEASES 9Hrs**

Epidemiological aspects of diseases of national importance- Malaria, HIV, Diabetes mellitus, Leprosy, Mental Health. Emerging and Re- Emerging Diseases - Dengue, Swine Flu, Chikungunya, Corona. National Programmes related to Communicable and Non Communicable diseases.

**UNIT 4 GLOBAL HEALTH 9Hrs**

Introduction to Global Public Health: Concepts, Overview Data Used To Monitor Global Health (Morbidity/Mortality). Management and Planning for Global Health.

**UNIT 5 GLOBAL EMERGENCY 9Hrs**

WHO principles for effective global health communication. Major global emergency: Global warming and environmental exposures impacting population health.

**Max.45 Hrs.****COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1** - Explain the role of epidemiology in the field of public health.
- CO2** - Describe the range of epidemiologic study designs used to examine the health status of a population
- CO3** - Identify and describe the impact of bias and confounding in epidemiologic studie
- CO4** - Build understanding around the principles of global health, major challenges and global health governance
- CO5** - Understand global environmental exposures and the impact on population health
- CO6** - Apply their role in self and global health.

**TEXT / REFERENCE BOOKS**

1. Epidemiology: An Introduction. Kenneth J. J. Rothman. 2002. Oxford University Press.
2. Epidemiology. Leon Gordis. 2004. Elsevier Health Sciences.
3. Ethne Barnes. L. Diseases and Human Evolution. March 2005. University of New Mexico Press.
4. Indian Council of Medical Research. Ethical Guidelines for Biomedical Research on Human Subjects. New Delhi: 2000

**END SEMESTER EXAM QUESTION PAPER PATTERN****Max. Marks : 100****Exam Duration : 3 Hrs.****PART A : 10 Questions of 2 marks each-No choice****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 16 marks****80 Marks**

SMBB3007	SOIL AND AGRICULTURAL MICROBIOLOGY	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

**COURSE OBJECTIVES**

- Learners will gain detailed idea on various micro-organisms, its harmful or beneficial effects on Agriculture, how to use them in a safer way for creating a better agriculture.

**UNIT 1 SOIL MICROBE INTERACTION****9 Hrs.**

Introduction to Soil Microbiology - Soil as Habitat - Microbial Metabolism - Microbial Diversity: Bacteria - Cyanobacteria - Archaea - Eukaryotic Algae - Fungi - Fauna. Microbial Ecology: Basics, Communities - Intraspecific Interactions - Interspecific Interactions. Elemental transformation and cycling: Carbon cycling - Nitrogen cycling - phosphorous cycle. Management of Soil Microbes. Factors influencing the microbial density in soil.

**UNIT 2 MICROBIAL ASSOCIATIONS AND THEIR APPLICATIONS****9 Hrs.**

Microbial associations: symbiotic, commensalism, and parasitism with suitable examples. Microorganisms in the decomposition of organic matter: cellulose, Hemi cellulose, lignin, pectin and chitin. Bioconversion of organic wastes - sugarcane wastes - coir pith composition – composting - conversion process.

**UNIT 3 BIOFERTILIZERS****9 Hrs.**

Microorganisms in agriculture: Plant growth promoting rhizobacteria (PGPR). Biofertilizers: Cyanobacteria – Rhizobium, Azospirillum, Azotobacter, Frankia, and Phosphorus solubilizing microorganisms (PSM): fluorescent Pseudomonads - Phosphorus mobilizers - Zinc and Silicate solubilizers. Fungi as biofertilizers: Mycorrhizae - Arbuscular Mycorrhizal (AM) fungi, Ectomycorrhizal (EcM) fungi, Endomycorrhizal Fungi. Types and their application in agriculture and forestry.

**UNIT 4 MICROBIAL PESTICIDES AND OTHER USEFUL PRODUCTS****9 Hrs.**

Principles of plant disease control. Microbial Control of Crop Pests and Diseases. Rhizosphere and phyllosphere. Microbes in human welfare: silage production, biofuel production and biodegradation. Food Microbiology, Fermentation Technology, Microbial Management of Organic Wastes, Vermicomposting. Reclamation of waste agricultural land by microorganisms.

**UNIT 5 MICROBIAL DISEASES IN AGRICULTURE****9 Hrs.**

Concept of disease in plants - Symptoms of plant diseases. Fungal diseases of plants: Groundnut rust - Rusts of wheat – Linseeds - Late blight of potato - Red rot of sugarcane. Bacterial diseases of plants: Citrus canker - Blight of rice. Viral diseases of plants: Tomato leaf curl - Leaf curl of Papaya - Vein clearing of lady's finger.

**Max. 45 Hours****COURSE OUTCOMES**

On completion of the course students will be able to

- CO1** - Understand the environmental factors influencing microbial distribution and abundance.
- CO2** - Describe intra-specific interactions of microbes as well as inter-specific relationships with other organismal groups.
- CO3** - Describe the most important microbial roles in elemental cycling and transformation, with a particular focus on carbon, nitrogen, and phosphorus cycling.
- CO4** - Study several beneficial and harmful micro-organisms

**CO5 -** Understand the complex interaction between agriculture system and micro-organism.

**CO6 -** Introduce micro-organism in agricultural system for building a pathway for sustainable agriculture

### **TEXT / REFERENCE BOOKS**

1. Microbiology. Pelczar, J.r., M.J.E.C.S. Chan and Krieg, N.R. (5th Ed.) 2015. McGraw Hill Publishers, New York.
2. Microbiology. Prescott, L.M, Harley, J.P. and Klein, D.A. (9th Ed.) 2014. McGraw Hill Publishing Ltd., New York.
3. Brock Biology of Microorganisms. Madigan, M., Martinko, J.M. and Parker, J. (14 Ed.) 2015. Prentice Hall of India Pvt. Ltd., New Delhi
4. Soil Microbiology: Subba Rao, N.S. (4th Ed.) 2014. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.

### **END SEMESTER EXAM QUESTION PAPER PATTERN**

**Max. Marks : 100**

**Exam Duration : 3 Hrs.**

**PART A :** 10 Questions of 2 marks each-No choice

**20 Marks**

**PART B :** 2 Questions from each unit with internal choice, each carrying 16 marks

**80 Marks**



SMBB3008	BIOREMEDIATION	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

**COURSE OBJECTIVES**

- To understand the environmental contaminants and apply the remediation technologies.

**UNIT 1 ENVIRONMENTAL CONTAMINANTS AND BIOREMEDIATION 9 Hrs.**

Sources and impacts of pesticides, PCBs, PAHs, petroleum hydrocarbons; Explosives: TNT & RDX; Inorganic Pollutants: Sources and impacts of heavy metals on terrestrial and aquatic environments. Bioremediation: Advantages of Bioremediation, types of bioremediation. Monitoring the efficacy of Bioremediation. Bio-augmentation, bio-magnification and Biotransformation Bioventing. Bioremediation for controlling oil spills.

**UNIT 2 REMEDIATION TECHNOLOGIES 9 Hrs.**

Biosorption: Use of bacteria and fungi, Bioreaction for biosorption. Problems associated with disposal of xenobiotic compounds, Hazardous wastes. Biodegradation of xenobiotics: Persistent compounds, Degradation mechanisms, naphthalene, benzene, phenol, PCB's, propanil (Herbicide), urea. Biodegradation of petrochemical effluents.

**UNIT 3 TERRESTRIAL PHYTOTECHNOLOGIES 9 Hrs.**

Phytoremediation of heavy metals in soil - Basic principles of phytoremediation: Uptake and transport, Accumulation and sequestration – Phytoextraction – Phytodegradation - Phytovolatilization - Rhizodegradation - Phytostabilization – Organic and synthetic amendments in multi metal contaminated mine sites - Role of arbuscular mycorrhizal fungi in phytoremediation Aquatic Phytosystems Blastofiltration – Rhizoremediation – Phytofiltration - Constructed wetlands - Algal blooms - Phytohydraulics – Riparian Buffers

**UNIT 4 RECLAMATION OF CONTAMINATED SITES – CASE STUDIES 9 Hrs.**

Scheme of evaluation steps in a project remediation site – Phytoremediation decision tree - Mine site rehabilitation in India - Plants used for dual benefits - Canola case studies for Se phytoremediation and biofortification in California – Phytoremediation and biodiesel production from Jatropha – Phytomining

**UNIT 5 TOLERANCE MECHANISMS 9 Hrs.**

Phyto and bioavailability of heavy metals in soils – Role of hyperaccumulators in phytoextraction – Continuous or Natural phytoextraction, Chelate-induced phytoextraction – Assessing the efficiency of phytoextraction – Transgenic approaches to enhance phytoremediation of metal contaminated soils - Sulphur and nitrogen containing metabolites in metal defense mechanism: Phytochelatins, metallothioneins, polyamines, and amino acids.

**Max.45 Hrs.****COURSE OUTCOMES**

On successful completion of the course students will be able to

- CO1** - Understand about various environmental contaminants.
- CO2** - Explain on remediation technologies.
- CO3** - Understand the concepts of terrestrial phytoremediation.
- CO4** - Gain knowledge on aquatic phytosystems.
- CO5** - Analyze the need of reclamation of contaminated sites
- CO6** - Calculate the tolerance level of plants and other organisms.

**TEXT / REFERENCE BOOKS**

1. Singh SN (2014) Biological Remediation of Explosive Residues, Springer International Publishing, Switzerland.
2. Dhir B (2013) Phytoremediation: Role of Aquatic Plants in Environmental Clean-Up, Springer India.
3. Yin X and Yuan L (2012) Phytoremediation and Biofortification – Two sides of one coin, Springer, Netherlands.
4. Anjum NA, Ahmad I, Pereira ME, Duarte AC, Umar S and Khan NA (2012). The Plant Family Brassicaceae – Contribution Towards Phytoremediation, Springer-Verlag, Berlin Heidelberg.
5. Anjum NA, Pereira ME, Ahmad I, Duarte AC, Umar S and Khan NA (2013) Phytotechnologies – Remediation of Environmental Contaminants, CRC Press, Boca Raton, FL, USA.
6. Gupta DK (2013) Plant-Based Remediation Processes, Springer-Verlag, Berlin Heidelberg.

**END SEMESTER EXAM QUESTION PAPER PATTERN****Max. Marks : 100****Exam Duration : 3 Hrs.****PART A : 10 Questions of 2 marks each-No choice****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 16 marks****80 Marks**

SMBB3009	MARINE MICROBIOLOGY	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

**COURSE OBJECTIVES**

- To understand the characters and distribution of microbes in the Sea.

**UNIT 1 INTRODUCTION TO OCEANOGRAPHY 9 Hrs.**

The world's oceans and seas, properties of seawater, physico-chemical factors in the marine environment such as temperature, density, nutrients, salinity, dissolved gases, waves, tides, oceanic currents, Ekman transport and upwelling; oceanic phenomena such as Coriolis effect, eddies, gyres, El Nino Southern Ocean (ENSO), El Nino, La Nina.

**UNIT 2 MARINE MICROBIAL HABITATS AND DIVERSITY 9 Hrs.**

Marine microbes from Estuaries, mangroves, salt marshes, beach and coastal ecosystems, reef and coral reefs, water column, sediments. Factors that impact marine microbial diversity. Microbes in extreme environments and their significance- thermophiles, psychrophiles, halophiles and barophiles.

**UNIT 3 MARINE VIRUSES 9 Hrs.**

Viruses - Introduction, nature, structure and classification. Metagenomic approaches to study the diversity of marine viruses. Marine phages and their host: Archaea, bacteria and cyanobacteria, phytoplankton, algae. Significance and effect of viruses in marine ecosystem. Marine viruses and global climate change. Viral pathogens of fish: Lymphocystis virus, Infectious pancreatic necrosis virus (IPNV), Nervous necrosis virus (NNV), Infectious haematopoietic necrosis virus (IHNV), viral hemorrhagic septicemia virus (VHSV). Viruses in shell-fish and health hazards: Norwalk virus and Hepatitis virus A

**UNIT 4 MARINE PRODUCTS AND PROCESS DEVELOPMENT 9 Hrs.**

Bioprospecting: Concept of exploiting marine microbial resource and their cellular components from marine environment and marine invertebrates. Bioprospecting and bioremediation: Industrially important enzymes - Natural products – nutraceuticals, antimicrobials, antitumor agents - Secondary metabolites – pigments.

**UNIT 5 MARINE POLLUTION AND CONTROL 9 Hrs.**

Marine Pollution. Human impacts on marine microbial diversity - Red tides: Causative factors and effects on the organisms of marine environment. Usage of marine microbes to ameliorate environmental deterioration. Control of oil spills, biodegradation and bioremediation. Sea food processing, practical aspects of planning and implementing HACCP systems. Hazards in sea foods, risk assessment, FSSAI. Traceability issues in international trade.

**Max. 45 Hours****COURSE OUTCOMES**

On completion of the course students will be able to:

- CO1** - Describe about various marine habitats.
- CO2** - Understand the distribution of microbes in the Sea.
- CO3** - Describe about marine viruses.
- CO4** - Explain various viral pathogens and their diseases.
- CO5** - Analyze the benefits of marine microbial products.
- CO6** - Plan the management of marine pollution and sea food hazards.

**TEXT / REFERENCE BOOKS**

1. Cava, J.H., Karl, D. and Buckley, M. Marine microbial diversity: Key to earth's habitability, ASM.
2. Marine microbiology- Ecology and Applications - Colin Munn, 2011
3. Dhevendaran K. 2008. Aquatic Microbiology. Daya Publ. House.
4. Vernam AH & Evans M. 2000. Environmental Microbiology. Blackwell
5. Viruses manipulate the marine environment (2009) F. Rohwer and R.V. Thurber. Nature 459, 207-212.
6. Viruses of Fish: An Overview of Significant Pathogens (2011) M. Crane and A. Hyatt Viruses 3: 2025–2046.

**END SEMESTER EXAM QUESTION PAPER PATTERN****Max. Marks : 100****Exam Duration : 3 Hrs.****PART A : 10 Questions of 2 marks each-No choice****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 16 marks****80 Marks**

SMBB3010	BASICS OF ENTREPRENEURIAL MICROBIOLOGY	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

**COURSE OBJECTIVES**

- This course aims at understanding the basic of entrepreneur development in microbiology and the other process to initiate self-development in these industries

**UNIT 1 ENTREPRENEURIAL DEVELOPMENT****9 Hrs.**

Entrepreneur development, activity, Institutes involved, Government contributions to entrepreneur, risk assessment. Industrial Microbiology, Definition, scope and historical development.

**UNIT 2 MICROBIAL PRODUCTS****9 Hrs**

Microbial cells as fermentation products- Baker's yeast, food and feed yeasts, Bacterial Insecticides, Legume Inoculants, Mushrooms, Algae. Enzymes as fermentation products- Bacterial and Fungal Amylases, Proteolytic Enzymes, Pectinases, Invertases and other enzymes

**UNIT 3 BIOFERTILIZERS AND BIOPESTICIDES****9 Hrs**

Production of Rhizobium, Azotobacter, Azospirillum, Phosphobacterium, BGA (Anabena, Nostoc); Packing, Quality assurance, Field Application and Crop Response. Bioinsecticide: Mass Production, field Application, and Crop Response of Bacteria (*Bacillus thuringiensis*, *Bacillus papillae*, *Pseudomonas fluorescens*), Fungi (*Verticillium lecanii*, *Coelomyces*) and Viruses (Baculo viruses, NPV, Granulosis virus)

**UNIT 4 COMMERCIAL PRODUCTS****9 Hrs**

Production and Application of TPA, HGH, Cytokines and Monoclonal Antibodies; Production of enzymes – Cellulase, Protease, Amylase and lipase Production of teaching kits-DNA isolation, widal

**UNIT 5 BIOFUELS, BIOPLASTICS AND BIOPIGMENTS****9 Hrs**

Biochemistry, Industrial Production and Application of biogas, bio-diesel, hydrogen fuel, gasoline; Bioplastics - PHB, PHA; Biopigments – Lycopene, Betacarotene, and its applications

**Max 45 Hrs****COURSE OUTCOMES**

On completion of the course, student will be able to

**CO1** - Describe and apply several entrepreneurial ideas and business theories in practical framework

**CO2** - Explain about the various microbial products

**CO3** - Express the mass production of microbial inoculants used as Biofertilisers and Bioinsecticides

**CO4** - Analyze the application and commercial production of Monoclonal antibodies, Cytokines

**CO5** - Decode the significance of industrial production of Biofuels and point out the role of Bioplastics and Biopigments

**CO6** - Develop start ups to be an entrepreneur and produce various products

**TEXT / REFERENCE BOOKS**

1. Industrial Microbiology- L.E.Casida, jr, New age International publication.
2. Entrepreneurial Development in India- By Arora
3. Experiments in Microbiology, Plant pathology, Tissue culture and Mushroom production technology- K.R.Aneja, New age International publication.

**END SEMESTER EXAM QUESTION PAPER PATTERN****Max. Marks : 100****Exam Duration : 3 Hrs.****PART A : 10 Questions of 2 marks each-No choice****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 16 marks****80 Marks**

SMBB3011	BIOFERTILIZER TECHNOLOGY	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

**COURSE OBJECTIVES**

- To make the students to understand role of bio-fertilizers and its mechanism of action in agriculture.
- To make the students understand the basic principles of production of different biofertilizers as per need of agriculture.

**UNIT 1 OVERVIEW OF BIOFERTILIZERS****9 Hrs.**

General account about the microbes used as bio-fertilizer – Rhizobium - isolation, identification, mass multiplication, carrier-based inoculants, Actinorrhizal symbiosis.

**UNIT 2 AZOSPIRILLUM****9 Hrs.**

isolation and mass multiplication – carrier based inoculant, associative effect of different microorganisms. Azotobacter: classification, characteristics – crop response to Azotobacter inoculum, maintenance and mass multiplication.

**UNIT 3 ALGAL FERTILIZERS****9 Hrs.**

Cyanobacteria (blue green algae), Azolla and Anabaena azolla association, nitrogen fixation, factors affecting growth, blue green algae and Azolla in rice cultivation.

**UNIT 4 PSB PRODUCTION****9 Hrs.**

Phosphate solubilizing microbes (anyone / consortia) - Isolation, characterization, mass inoculum production, field Application

**UNIT 5 CHEMICAL AND ORGANIC FERTILIZERS****9 Hrs.**

Panchagavya, Chicken litter, vermicompost, seaweed fertilizer and its applications, Urea Production, Potash Fertilizers, Humic acid Productions and its applications.

**Max.45 Hrs****COURSE OUTCOMES**

On the successful completion of the course, student will be able to

- CO1** - Explain isolation and role of various soil bacteria in bio-fertilizer production.
- CO2** - Describe production steps and specific requirements for each bio-fertilizers
- CO3** - Restore the soil fertility by performing the sustainable agriculture practices via organic farming
- CO4** - Apply the knowledge gained to generate opportunities of self-employability
- CO5** - Compare bio and chemical fertilizers and its applications.
- CO6** - Determine humic acid content from lignite.

**TEXT / REFERENCE BOOKS**

1. A Textbook of Biotechnology- Dubey, R.C., (2005) S.Chand & Co, New Delhi.
2. Biotechnology Kumaresan, V. (2005), Saras Publications, New Delhi.
3. Vermiculture and Organic Farming Sathe, T.V., (2004) Daya publishers.
4. Soil Microbiology Subha Rao, N.S. (2000), Oxford & IBH Publishers, New \_Delhi.
5. Bio-fertilizers and organic \_Farming Vayas,S.C, Vayas, S. and Modi, H.A. (1998) Akta Prakashan, Nadiad
6. Biotechnology of Biofertilizers Kannaiyan, S., (2003), CHIPS, Texas.
7. Hand book of Microbial Biofertilizers Rai, M.K., (2005), The Haworth Press, Inc. NewYork

**END SEMESTER EXAM QUESTION PAPER PATTERN****Max. Marks : 100****Exam Duration : 3 Hrs.****PART A : 10 Questions of 2 marks each-No choice****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 16 marks****80 Marks**



SMBB3012	MUSHROOM TECHNOLOGY	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

**COURSE OBJECTIVE**

- This course aims at imparting knowledge about the classification, nutrient profile of mushrooms and their cultivation strategies

**UNIT 1 BIOLOGY AND NUTRIENT PROFILING OF MUSHROOMS 9 Hrs**

Button, Straw & Oyster- General morphology, distinguishing characteristics, spore germination and life cycle. Protein, amino acids, calorific values, carbohydrates, fats, vitamins & minerals. Antiviral value, antibacterial effect, antifungal effect, anti-tumour effect, haematological value cardiovascular & renal effect, in therapeutic diets, adolescence, for aged persons & diabetes mellitus.

**UNIT 2 CULTIVATION SYSTEM 9 Hrs**

Fundamentals of cultivation system- small village unit & larger commercial unit. Principles of mushroom farm layout- location of building plot, design of farm, bulk chamber, composting platform, equipments & facilities, pasteurization room & growing room

**UNIT 3 COMPOSTING 9 Hrs**

Principles of composting, machinery required for compost making, materials for compost preparation. Methods of Composting- Long method of composting (LMC) & Short method of composting.

**UNIT 4 SPAWNING 9 Hrs**

Facilities required for spawn preparation, Preparation of spawn substrate, preparation of pure culture, media used in raising pure culture, culture maintenance, storage of spawn.

**UNIT 5 CULTIVATION 9 Hrs**

Collection of raw materials, compost & composting, spawn & spawning, casing & case run, cropping & crop management, picking & packing

**Max.45 Hrs****COURSE OUTCOMES**

On completion of the course, student will be able to

**CO1** - Understand the classification and proximate composition of mushrooms

**CO2** - Be aware of the various types of mushroom cultivation system

**CO3** - Discuss about composts and composting methods

**CO4** - Explain Spawns and spawning

**CO5** - Learn the technologies to cultivate mushrooms

**CO6** - Execute the process of mushroom cultivation and efficiently grow mushrooms

**TEXT / REFERENCE BOOKS**

- Mushroom Production and Processing Technology, P Y Gour (2010) by Agrobios (India).
- A hand book of edible mushroom, S.Kannaiyan & K.Ramasamy (1980). Today & Tomorrows printers & publishers, New Delhi
- Handbook on Mushrooms, Nita Bahl, oxford & IBH Publishing Co.

**END SEMESTER EXAM QUESTION PAPER PATTERN****Max. Marks : 100****Exam Duration : 3 Hrs.****PART A** : 10 Questions of 2 marks each-No choice**20 Marks****PART B** : 2 Questions from each unit with internal choice, each carrying 16 marks**80 Marks**

SBBB3001	ANIMAL CELL CULTURE – PRINCIPLES AND APPLICATIONS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

**COURSE OBJECTIVES**

- To study about the knowledge in tumour, oncogenes, signals and diagnosis and treatment of Cancer.

**UNIT 1 CELL CULTURE LABORATORY DESIGN AND EQUIPMENT 9 Hrs**

Planning, construction and services; Layout; Sterile handling area; Incubation; Hot room; Air circulation; Service bench; Laminar flow; Sterilizer; Incubator; CO<sub>2</sub> incubator; Refrigerators and freezers; Centrifuge; Inverted stage microscope; Magnetic stirrer; Liquid nitrogen freezers; Slow cooling system for cell freezing; Water bath; Autoclaves and hot air oven; Pipette washers; Water purification system; Fluid handling systems and other equipments; Washing, packing and sterilization of different materials used in animal cell culture; Aseptic concepts; Maintenance of sterility; Cell culture vessels.

**UNIT 2 CELL CULTURE MEDIA AND REAGENT 9 Hrs**

Types of cell culture media; Ingredients of media; Physiochemical properties; CO<sub>2</sub> and bicarbonates; Buffering; Oxygen; Osmolarity; Temperature; Surface tension and foaming; Balance salt solutions; Antibiotics, growth supplements; Foetal bovine serum; Serum free media; Trypsin solution; Selection of medium and serum; Conditioned media; Other cell culture reagents; Preparation and sterilization of cell culture media, serum and other reagents.

**UNIT 3 CELL CULTURE TECHNIQUES 9 Hrs**

History of animal cell culture; Different tissue culture techniques; Types of primary culture; Chicken embryo fibroblast culture; Chicken liver and kidney culture; Secondary culture Trypsinization; Cell separation; Continuous cell lines; Suspension culture; Organ culture etc.; Behavior of cells in culture conditions: division, growth pattern, metabolism of estimation of cell number; Development of cell lines; Characterization and maintenance of cell lines, stem cells; Cryopreservation; Common cell culture contaminants

**UNIT 4 APPLICATIONS OF CELL CULTURE 9 Hrs.**

Cell cloning and selection; Transfection and transformation of cells; Commercial scale production of animal cells, stem cells and their application; Application of animal cell culture for in vitro testing of drugs; Testing of toxicity of environmental pollutants in cell culture; Application of cell culture technology in production of human and animal viral vaccines and pharmaceutical proteins.

**UNIT 5 SCALE UP TECHNIQUE 9 Hrs.**

Cell culture reactors; Scale-up in suspension; Scale and complexity; Mixing and aeration; Rotating chambers; Perfused suspension cultures; Fluidized bed reactors for suspension culture; Scale-up in monolayers; Multisurface propagators; Multiarray disks, spirals and tubes; Roller culture; Microcarriers; Perfused monolayer cultures; Membrane perfusion; Hollow fiber perfusion; Matrix perfusion; Microencapsulation; Growth monitoring Recommended

**Max. 45 Hours****COURSE OUTCOMES**

On the successful completion of the course, students will be able to

**CO1** - Acquaint fundamentals of Animal cell culture.

**CO2** - Utilize skills of cell culture for development of biomolecules of clinical importance

**CO3** - Describe the relevance of cell cycle regulations in reference to cellular metabolism

**CO4** - Understand the mechanism of cellular cytotoxicity

**CO5** - Acquire knowledge on applications of cell culture

**CO6** - Develop methods to scale up animal cell culture

#### **TEXT / REFERENCE BOOKS**

1. Culture of Animal Cells(2005) 5th Edition, Freshney Wiley-Liss,
2. Animal Cell Culture - Practical Approach (2000), 3rd Edition, Ed. John R.W. Masters Oxford University Press
3. Animal Cell Culture Techniques. (1998). Ed. Martin Clynes Springer,

#### **END SEMESTER EXAM QUESTION PAPER PATTERN**

**Max. Marks : 100**

**Exam Duration : 3 Hrs.**

**PART A** : 10 Questions of 2 marks each-No choice

**20 Marks**

**PART B** : 2 Questions from each unit with internal choice, each carrying 16 marks

**80 Marks**

SBBB3002	STEM CELL BIOLOGY	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

**COURSE OBJECTIVES**

- This course is aimed at providing an insight towards culturing of stem cells, its therapeutic uses and the technological advancements in the field of stem cell science

**UNIT 1 STEM CELL BASICS****9 Hrs.**

Introduction to stem cells Definition, properties, proliferation, culture of stem cells, medical applications of stem cells, ethical and legal issues in use of stem cells.

**UNIT 2 EMBRYONIC STEM CELLS AND ETHICAL ISSUES****9 Hrs.**

Types of stem cells. Stem Cell biology and therapy, types embryonic stem cell, Adult stem cell, Stem Cell Biology and Therapy, Embryonic Stem Cells, culture and the potential benefits of stem cell technology

**UNIT 3 ADULT STEM CELLS****9 Hrs.**

Somatic stem cells, Test for identification of adult stem cells, Adult stem cell differentiation – Trans differentiation -Plasticity - Different types of adult stem cells- Isolation of haemopoietic stem cell, Muscle and Cardiac stem cell and their applications.

**UNIT 4 ADVANCEMENT OF STEM CELL IN TISSUE ENGINEERING****9 Hrs.**

Tissue engineering triad, ECM components and their role in tissue development, Tissue engineering application - Production of complete organ - Kidney - Eyes - Heart - Brain.

**UNIT 5 THERAPEUTIC APPLICATION OF STEM CELLS****9 Hrs.**

Gene therapy - genetically engineered stem cells - stem cells and Animal cloning - transgenic animals and stem cells - Therapeutic applications – Parkinson's disease - Neurological disorder - limb amputation - heart disease – spinal cord injuries - diabetes -burns - HLA typing- Alzheimer's disease.

**Max. 45 Hours****COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1** - Explain the basics of stem cell
- CO2** - Appraise the ethical implications in using stem cells
- CO3** - Point out the applications of adult stem cells
- CO4** - Elaborate on the advancement of stem cells in tissue engineering
- CO5** - Compile the therapeutic applications of stem cells
- CO6** - Assess the role of stem cell in gene therapy

**TEXT / REFERENCE BOOKS**

- Kursad and Turksen, Embryonic Stem cells, Humana Press, 2002
- Stem cell and future of regenerative medicine. By committee on the Biological and Biomedical applications of Stem cell Research, 12 National Academic press

**END SEMESTER EXAM QUESTION PAPER PATTERN****Max. Marks : 100****Exam Duration : 3 Hrs.****PART A** : 10 Questions of 2 marks each-No choice**20 Marks****PART B** : 2 Questions from each unit with internal choice, each carrying 16 marks**80 Marks**

SBBB3003	CANCER BIOLOGY	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

**COURSE OBJECTIVES**

- To study about the knowledge in tumour, oncogenes, signals and diagnosis and treatment of Cancer.

**UNIT 1 FUNDAMENTALS OF CANCER BIOLOGY 9 Hrs.**

Regulation of cell cycle, mutations that cause changes in signal molecules, effects on receptor, signal switches, tumour suppressor genes, modulation of cell cycle in cancer, different forms of cancers, diet and cancer. Cancer screening and early detection, Detection using biochemical assays, tumour markers, molecular tools for early diagnosis of cancer.

**UNIT 2 PRINCIPLES OF CARCINOGENESIS 9 Hrs.**

Chemical carcinogenesis, metabolism of carcinogenesis, principles of physical carcinogenesis, X –ray radiation - mechanisms of radiation carcinogenesis.

**UNIT 3 PRINCIPLES OF MOLECULAR CELL BIOLOGY OF CANCER 9 Hrs**

Signal targets and cancer, activation of kinases, Oncogenes, Identification of oncogenes, retroviruses and oncogenes, Oncogenes/protooncogene activity. Growth factors related to transformation, telomerases

**UNIT 4 PRINCIPLES OF CANCER METASTASIS 9 Hrs.**

Clinical significances of invasion, heterogeneity of metastatic phenotype, metastatic cascade, basement membrane disruption, three step theory of invasion, proteinases and tumour cell invasion.

**UNIT 5 NEW MOLECULES FOR CANCER THERAPY 9 Hrs.**

Different forms of therapy, chemotherapy, radiation therapy, detection of cancers, advances in cancer detection. Use of signal targets towards therapy of cancer, Gene therapy.

**Max. 45 Hours****COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1** – Understand the nature of cancer and the processes underlying cancer formation and progression.
- CO2** – Understand the application of radiation carcinogenesis
- CO3** – Explore the molecular biology of cancer cells
- CO4** – Understand the principles of clinical significances
- CO5** – Explain the gene therapy and advances in cancer detection
- CO6** – Apply the knowledge of cancer therapy treatment in research

**TEXT / REFERENCE BOOKS**

1. King, Roger J.B. "Cancer Biology" Addison Wesley Longman, 1996. 2. Ruddon, Raymond W. "Cancer Biology" Illrd Edition . Oxford University Press, 1995.
2. Weinberg RA. The Biology of Cancer, 2nd Edition. Garland Science, 2013.
3. Cellular signal processing , 2nd Edition by Friedrich Marks, Ursula Klingmuller and Karin Muller-Decker, Garland Science

**END SEMESTER EXAM QUESTION PAPER PATTERN****Max. Marks : 100****Exam Duration : 3 Hrs.****PART A : 10 Questions of 2 marks each-No choice****20 Marks****PART B : 2 Questions from each unit with internal choice, each carrying 16 marks****80 Marks**