DEPARTMENT OF BOTANY AND MICROBIOLOGY

Syllabus for Microbiology

Approved in B.O.S. for the Academic Year 2019-2020

PITHAPUR RAJAHS GOVT. COLLEGE

(AUTONOMOUS Institute ACCREDITED WITH A Grade (3.17 CGPA) by NAAC)

KAKINADA – 533 001, A.P., INDIA

P.R.GOVERMENT COLLEGE (AUTONOMOUS), KAKINADA – 533 001, A.P.

Department of Botany & Microbiology

MICROBIOLOGY

Semester wise papers

Year	Semester	Paper Title	Marks E+I	Credits
IYEAR	I	INTRODUCTION TO MICROBIOLOGY AND MICROBIAL DIVERSITY	60+40	03
	I	PRACTICAL	35+15	02
	II	INTRODUCTION TO MICROBIAL BIOCHEMISTRY AND METABOLISM	60+40	03
	II	PRACTICAL	35+15	02
II YEAR	III	MICROBIAL GENETICS AND MOLECULAR BIOLOGY	60+40	03
	III	PRACTICAL	35+15	02
	IV	IMMUNOLOGY AND MEDICAL MICROBIOLOGY	60+40	03
	IV	PRACTICAL	35+15	02
III YEAR *	V	ENVIRONMENTAL&AGRICULTURAL MICROBIOLOGY	60+40	03
		PRACTICAL	35+15	02
	V	FOOD & INDUSTRIAL MICROBIOLOGY	60+40	03
		PRACTICAL	35+15	02
	VI ELCTIVE	MICROBIAL BIOTECHNOLOGY	60+40	03
	VI	PRACTICAL	35+15	02
	VI CI	MICROBIAL DIAGNOSIS IN HEALTH CLINICS	60+40	03
	VI	PRACTICAL	35+15	02
	VI C2	MICROBIAL QUALITY CONTROL IN FOOD AND PHARMACEUTICAL INDUSTRIES	60+40	03
	VI	PRACTICAL	35+15	02
	VI C3	BIOFERTILIZERS & BIOPESTICIDES	60+40	03
	VI	PRACTICAL	35+15	02

C.B.C.S. pattern effective from Academic Year
Microbiology Model Blue Print for the Question paper
And choice for I year (w.e.f.2018-19 Academic Year)

S.No.	Type of Questions	To be given in the Question paper			To be answered		
		No. of Questions	Marks allotted to each question	Total marks	No. of Questions	Marks allotted to each question	Total marks
1	**SECTION - A** Very Short Answer Questions	05	02	10	05	02	10
2	**SECTION - B** Short Answer Questions	08	05	40	04	02	20
3	**SECTION - C** Essay Questions (Either-or)	05	10	50	03	10	30
Total questions & Total marks		**18**	**-**	**100**	**12**	**-**	**60**

Percentage of choice given = $\frac{100 - 60}{100} \times 100 = \frac{40}{100} \times 100 =$ **40.00%**

P.R.GOVERNMENT COLLEGE (A), KAKINADA
DEPARTMENT OF BOTANY AND MICROBIOLOGY

Objectives of Department of Microbiology

- To teach the historical events in Microbiology
- To provide knowledge on diversity of microorganisms.
- To instill students on laboratory techniques like microscopy, sterilization and culture of microbes.
- To give thorough knowledge on biomolecules and their characterization/quantification.
- To endow with basics of Enzymology and nutrition and metabolism in microbes.
- To give thorough knowledge on Microbial genetics and applications
- To impart the knowledge of Molecular biology.
- To acquaint to understand the importance of different types immunity, lymphoid organs cells of immune system it also deals with types of antigen and antibody and its interaction
- To impart knowledge to learn about on human pathogens, etilogy and epidemiology of diseases caused by them.
- To gain knowledge on the role on normal microbial flora and general principles of diagnostic microbiology.
- To acquaint to understand the concept of plant diseases and sol microorganisms
- To impart knowledge of importance of microbes in different fields
- To inculcate knowledge in diagnosing bacteriological disease

B.Sc Microbiology, Botany and Chemistry Course

PROGRAMME OUTCOMES

For every degree program expectations are listed out by the institution under the Program Outcomes. For B.Sc Microbiogy, Botany and Chemistry Stream the following are set as Programme Outcomes.

Course	PROGRAMME OUTCOMES	
Microbiology	**Knowledge and understanding of:**	1. Students to be able to acquire, articulate, retain and apply specialized language and knowledge relevant to microbiology. 2. Students will acquire and demonstrate competency in laboratory safety and in routine and specialized microbiological laboratory skills applicable to microbiological research or clinical methods, including accurately reporting observations and analysis. 3. Students will communicate scientific concepts, experimental results and analytical arguments clearly and concisely, both verbally and in writing. 4. Students will demonstrate engagement in the Microbiology discipline through involvement in research or internship activities
	Intellectual skills – be able to	1. Think logically and organize tasks into a structured form. 2. Assimilate knowledge and ideas based on wide reading and through the internet. 3. Transfer of appropriate knowledge and methods from one topic to another within the subject. 4. Understand the evolving state of knowledge in a rapidly developing field. 5. Construct and test hypothesis. 6. Plan, conduct and write a report on an independent term project.
	Practical skills	1. Understand the importance of laboratory security as it applies to working with hazardous chemicals, biohazards, recombinant material, and general Microbiology laboratory rules and regulations 2. Students will evaluate the accuracy of different types of measuring devices to accurate Measure a solution. They will statistically analyze their data to determine the best measuring device to use. 3. Students will evaluate to learn isolation and identification different microbes from different samples. 4. Students evaluate different products of commercial production by using different raw materials 5. Characterize isolated DNA and RNA using agarose gel electrophoresis and analyze agarose gel data 6. Perform basic microbiological techniques such as sterile plating and isolation of single colonies, culturing bacteria in liquid broth. 7. PCR amplify target genomic DNA and ligate into vector and transform bacteria with rDNA.
	Transferable	1. Use of IT (word-processing, use of internet,

	skills	statistical packages and databases). 2. Communication of scientific ideas in writing and orally. 3. Ability to work as part of a team. 4. Ability to use library resources/Equipment. 5. Time management.
	Problem analysis	1. Identify the taxonomic position of plants 2. Design solutions from medicinal plants for health problems, disorders and disease of human beings /animals which meet the specified needs 3. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data,
	Ethics	**1.** Apply ethical principles and commit to environmental ethics and responsibilities and norms of the environment
	Individual and team work	1. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings. 2. Elicit views of others, mediate disagreements and help reach conclusions in group settings.
	Communication	1. Communicate effectively on complex group activities and with society at large. Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language Manage projects and in multidisciplinary environments.
	Critical Thinking:	1. Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.
	Effective Citizenship	1. Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

B.Sc Microbiology, Botany and Chemistry Course

Semester No.	Title	Programme specific outcomes	Course outcomes
I	**Introduction to Microbiology and Microbial Diversity**	1.Acquire skills and competency in microbiological laboratory practices applicable to microbiological research or clinical methods. 2.Focus on different attributes of living cells.	1.Explain relationship and apply appropriate terminology relating to the structure, Genetics, metabolism and Ecology of prokaryotic microorganisms, Algae, Viruses and Fungi. 2. Demonstrate appropriate laboratory skill and techniques related to isolation, staining, identification and control of microorganisms
II	**Introduction to Microbial Biochemistry and Metabolism**	1. Impart knowledge on structure and biological functions of macromolecules. 2. Impart knowledge on mechanism of enzyme catalysis. 3.Impart knowledge on various metabolic pathways.	1. Explain working principle and applications of Colorimetry, Chromatography, Spectrophotometry, Centrifugation and Gel Electrophoresis. 2. Knowledge on Microbial nutrition, bacterial growth, metabolism and Respiration. 3. The student will get first-hand experience on separation methods
III	**Microbial Genetics and Molecular biology**	1. Understand the concept of replication, gene expression and regulation. 2. Acquire knowledge on different gene mutations and their causative agents.	1. Develop knowledge on microbial genetics and molecular biology and instrumentation.
IV	**Immunology and Medical Microbiology**	1.Understand the concept of immune mechanism. 2. Develop knowledge on different clinical immunological techniques. 3.Provides knowledge on the role normal microbial flora and general principles diagnostic microbiology.	1.Explain No-specific body defenses and the immune response 2. Develop knowledge on disease transmission and control 3. Demonstrate on collection and handling of laboratory specimens
V	**Environmental and Agricultural Microbiology**	1. To impart knowledge on soil microorganisms and role in nutrient cycles. 2.To inculcate knowledge on plant diseases and their control.	1.The student will have fundamental concepts in soil microbiology, soil microbial diversity, basic concept of nitrogen fixation and plant growth promotion. 2. Understands the role of microorganisms in treatment of solid and liquid waste. 3. The student will acquire knowledge on application of microorganisms in agro – environmental fields.

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V	**Food and Industrial Microbiology**	1.To impart knowledge on microorganisms involved in food spoilage and their sources. 2.To impart knowledge on isolation and screening of industrially important microorganisms.	1.The course aim to provide general principles of food microbiology. 2. It is assumed that students will have got basic information on spoilage, principle of food preservation and Single cell proteins.
VI	**Microbial Biotechnology**	1. Understand about crop development, callus culture, biotechnological applications of plants, Animal tissue culture, Animal products and their production. 2.To understand concepts of IPR.	1. Student should be able to demonstrate with the wide diversity of microbes and their potential for use in microbial biotechnology 2. It is assumed that students will have get outlines of intellectual property rights.
VI	**Microbial diagnosis in Health clinics**	1.To acquire knowledge on human pathogens. 2. Course will provide practical knowledge about different types of bacteria, virus and fungi found in environment	1. Develop knowledge and skills on microbiological laboratory safety- General rules and regulations
VI	**Microbial quality control in Food and Pharmaceutical Industries**	1.To impart knowledge on different culture techniques. 2.To learn the process of PCR. 3.To learn Microbial Standards for Different Foods and Water.	1. Develop skills on disinfection of instruments and equipments in laboratory and Hospitals
VI	**Biofertilizers and biopesticides**	1.To impart knowledge on microbes involved in nitrogen fixation process. 2.to impart knowledge different plant growth promoting microbes. 3. to impart knowledge on cultivation and field applications of different biofertilizes.	1. Develop knowledge and skills on mass multiplication and field application of bio fertilizers and bio pesticides.

P.R. Government College (Autonomous), Kakinada

I.Bsc., - Microbiology / I semester End (W.E.F. 2018-2019)

Introduction to Microbiology and microbial diversity (course: MBT 1209)

Total Hrs. of Teaching- Learning: 60 @ 4h/ Week Total Credits: 03

UNIT-I 12 Hrs

a. History and mile stones in microbiology. Contributions of Anton von Leeuwenhoek, Edward Jenner, Louis Pasteur, Robert Koch, Ivanowsky.
b. Importance and applications of microbiology.
c. Classification of microorganisms – Haeckel's three Kingdom concept, Whittaker's five kingdom, concept, of three domain concept of Carl Woese.

UNIT – II 10 Hrs

a. Outline classification of bacteria as per the second edition of Bergey's Manual of Systematic Bacteriology.
b. General characteristics of Bacteria, Archaea, Mycoplasma and Cyanobacteria.
c. Ultra structure of Prokaryotic cell- Variant components and invariant components.
d. General characteristics of viruses. Morphology, Structure and replication of TMV and HIV.

UNIT-III 10 Hrs

a. General characteristics and outline classification of Fungi, Algae and Protozoa.
b. Principles of microscopy - Bright field and Electron microscopy (SEM and TEM).

UNIT-IV 8 Hrs

a. Staining Techniques –Simple and Differential (Gram Staining and Spore Staining).
b. Sterilization and disinfection techniques - Physical methods – autoclave, hot- air oven, pressure cooker, laminar air flow, filter sterilization, Radiation methods – UV rays, Gamma rays.
c. Chemical methods – alcohols, aldehydes, fumigants, phenols, halogens and hypochlorite's

UNIT –V 12 Hrs

a. Isolation of Microorganisms from natural habitats.
b. Pure culture techniques – dilution-plating, Streak-plate, Spread-plate, Pour-Plate and micromanipulator. Enrichment culturing.
c. Preservation of microbial cultures – sub culturing, overlaying cultures with mineral oils, lyophilization, sand cultures, storage at low temperature

P.R. Government College (Autonomous), Kakinada

I.Bsc., - Microbiology / I semester End (W.E.F. 2018-2019)

Introduction to Microbiology and microbial diversity (course : MB 1209P)

Total Hrs. of Teaching- Learning:48 @ 4h/ Week Total credits :02

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1. Microbiology Good Laboratory Practices and Biosafety.
2. Preparation of culture media for cultivation of bacteria
3. Preparation of culture media for cultivation of fungi
4. Sterilization of medium using Autoclave
5. Sterilization of glassware using Hot Air Oven
6. Light compound microscope and its handling
7. Microscopic observation of bacteria (Gram +ve bacilli and cocci, Gram -ve bacilli), Cyanobacteria, Algae and Fungi.
8. Simple staining
9. Gram's staining
10. Hanging-drop method.
11. Isolation of pure cultures of bacteria by streaking method.
12. Preservation of bacterial cultures by various techniques.
13. Diagrammatic or Electron photo micrographic observation of TMV, HIV, T4 phage and Adenovirus

SUGGESTED READINGS

- Alexopoulos, C.J., Mims, C.W. and Blackwell, M. (1996). Introductory Mycology, Wiley, New York.
- Atlas, R.A. and Bartha, R. (2000). Microbial Ecology . Fundamentals and Application, Benjamin Cummings, New York.
- Dimmock, N.J., Easton, A.J. and Leppard, K.N. (2001). Introduction to Modern Virology, Blackwell Science Ltd, U.K.
- Dube, R.C. and Maheswari, D.K. (2000) General Microbiology. S Chand, New Delhi. Edition), Himalaya Publishing House, Mumbai.
- Madigan, M.T., Martinkl, J.M. and Parker, J. (2010). Brock Biology of Microorganisms, 9th Edition, MacMillan Press, England.
- Pelczar, M.J., Chan, E.C.S. and Kreig, N.R. (1993). Microbiology. 5th Edition, Tata Mc Graw Hill Publishing Co., Ltd., New Delhi.
- Prescott, M.J., Harley, J.P. and Klein, D.A. (2010). Microbiology. 5th Edition, WCB Mc GrawHill, New York.

P.R. Government College (Autonomous), Kakinada

I Year B.Sc., Program I Semester End

Microbiology I A: Introduction to Microbiology and microbial diversity

(Course Code MB1209 w.e.f.2017-2018)

Time :21/2 Hours Max Marks :60M

SECTION - A

Answer all the following questions **5x2=10 Marks**

1. Iwanowsky
2. Mycoplasma
3. SEM
4. Spore Staining
5. Streak plate

SECTION - B

Answer Four questions **4x5 =20 Marks**

6. Robert Koch
7. Gram staining
8. U.VRays
9. Spread plate method
10. Cell membrane
11. HIV
12. Spore Staining
13. Lyophilization

SECTION - C

Answer ANY THREE of the following questions. Draw labeled diagrams wherever necessary **3x10=30 Marks**

14. Discuss the various contributions of Louis Pasteur and Edward Jenner
15. Write in detail about the structure of Prokaryotic cell
16. General characters and classification of Algae
17. Explain different staining techniques
18. Write an essay on various methods of microbial preservation techniques

Course MB1209: Introduction to Microbiology and microbial diversity

Model paper blue print for the Question Paper setter

Max.marks = 60 **Time: 21/2 Hrs**

Module No./Title	Very short answer Questions	Short answer Questions	Essay Questions	Marks allotted to the Module
History of Microbiology	**1**	**2**	**1**	**22**
Bacteria and Viruses	**1**	**2**	**1**	**22**
Other microbes and microscopy	**1**	**2**	**1**	**22**
Staining and Sterilization techniques	**1**	**1**	**1**	**17**
Culture techniques	**1**	**1**	**1**	**17**
Total marks allotted to all questions including choice =				**100**

Note: Question paper setters are requested to adhere strictly to the above blue print while preparing the said paper.

P.R. Government College (Autonomous), Kakinada

I B.Sc., Microbiology - Practical Examinations

Paper I model at the end of I Semester (w.e.f. 2017-18)

Introduction to Microbiology and microbial diversity (MB1209P)

Time: 2 Hrs. Max. Marks: 35

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1. Identify the given organism 'A' by Gram staining technique. 10 M

Scheme for valuation: Preparation of slide (05M) + Description (3M) + Result (2M)

2. Dilution and isolation technique 'C'. 05 M

Scheme for valuation: Practical work (3M) + Description (2M)

3. Identify and write notes on the following 5 x 2 = 10 M

D. Virus/Protozoa
E. Bacteria/Cyanobacteria
F. Algae
G. Fungi
H. Apparatus

Scheme for valuation: Identification (1M) + Reasons (2M)

4. Record + Viva voce 6 +4 = 10 M

Total = 35 M

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15 marks for CCA

P.R. Government College (Autonomous), Kakinada

I B.Sc., – Microbiology / II Semester End (W.E.F. 2017-2018)

Introduction to Microbial Biochemistry and Metabolism (Course: MBT2209)

Total Hrs. of Teaching-Learning: 60 @ 4 h / Week Total Credits : 03

Learning objectives: 1. To give thorough knowledge on biomolecules and their characterization/quantification.
2. To endow with basics of Enzymology and nutrition and Metabolism in microbes.

Learning out-comes: 1. Student can characterize different biomolecules and and estimation them through instrumentation.
2. Leaner will be able to explain nutrition and metabolism in microbes.

UNIT-I Biomolecules **12 Hrs**

a. Outline classification and general characteristics of carbohydrates (monosaccharides, disaccharides and polysaccharides).
b. General characteristics of amino acids and proteins.
c. Structure of nitrogenous bases, nucleotides, nucleic acids.
d. Fatty acids (saturated and unsaturated). Lipids (sphingolipds, sterols and phospholipids).

UNIT-II Instrumentation techniques **08 Hrs**

a. Principle and applications of - Colorimerty
b. Chromatography (paper, thin-layer and affinity chromatography)
c. Spectrophotometry (UV & visible). Centrifugation

UNIT-III Basics of Enzymology **12 Hrs.**

a. Properties and classification of Enzymes. Biocatalysis- induced fit and lock and key models.
b. Role of Coenzymes and Cofactors in enzyme activity. Factors affecting catalytic activity of enzymes.
c. Inhibition of enzyme activity- competitive, noncompetitive, uncompetitive and allosteric.

UNIT-IV Nutrition and growth of microbes **14 Hrs.**

a. Microbial Nutrition –Nutritional requirements and uptake of nutrients by cells. Nutritional groups of microorganisms- autotrophs, heterotrophs, mixotrophs.
b. Outlines of oxygenic and anoxygenic photosynthesis in bacteria
c. Growth media- synthetic, complex, selective, enrichment and differential media.
d. Microbial Growth- different phases of growth in batch cultures, Synchronous, continuous, biphasic growth. Factors influencing microbial growth.
e. Methods for measuring microbial growth – Direct microscopy, viable count estimates, turbidometry and biomass.

UNIT-V Metabolism **12 Hrs.**

a. Aerobic respiration - Glycolysis, HMP path way, ED path way, TCA cycle, Electron transport, oxidative and substrate level phosphorylation. Anaerobic respiration (Nitrate).
b. Fermentation - Alcohol and lactic acid fermentations.

I B.Sc., – I Semester - Microbiology Practical Syllabus (W.E.F. 2017-2018)

Introduction to Microbial Biochemistry and Metabolism **(Course : MB2209P)**

Total Hrs. of Practical's : 30 @ 2 h / Week Total Credits : 02

1. Qualitative Analysis of Carbohydrates
2. Qualitative Analysis of Amino acids
3. Colorimetric estimation DNA by diphenylamine method
4. Colorimetric estimation of proteins by Biuret/Lowry method
5. Paper chromatographic separation of sugars / amino acids
6. Preparation of different media- Synthetic and Complex Media
7. Setting and observation of Winogradsky column.
8. Estimation of CFU count by spread plate method/pour plate method.
9. Bacterial growth curve.
10. Factors affecting bacterial growth – pH.
11. Factors affecting bacterial growth – Temperature.
12. Factors affecting bacterial growth –Salts

Suggested readings:

Lehninger, A.L., Nelson, D.L. and Cox, M.M. (1993). **Principles of Biochemistry**, 2 nd Edition, CBS Publishers and Distributors, New Delhi.

Prescott, M.J., Harley, J.P. and Klein, D.A. (2010). **Microbiology.** 5th Edition, WCB Mc GrawHill, NewYork.

Reddy, S.R. and Reddy, S.M. (2004). **Microbial Physiology**, Scientific Publishers, Jodhpur, India.

Sashidhara Rao, B. and Deshpande, V. (2007). **Experimental Biochemistry**: A student Companion. I.K.International Pvt. Ltd. India Pvt. Ltd., New Delhi.

Tymoczko JL, Berg JM and Stryer L (2012) **Biochemistry:** A short course, 2nd ed., W.H.Freeman

Voet,D. and Voet J.G (2004) **Biochemistry** 3rd edition, John Wiley and Sons

White, D. (1995). **The Physiology and Biochemistry of Prokaryotes**, Oxford University Press, New York.

Willey MJ, Sherwood, LM & Woolverton C J (2013) Prescott, Harley and Klein's **Microbiology** by.9th Ed., McGrawHill

P.R.Government College (Autonomous), Kakinada

I year B.Sc., Program II Semester End

Microbiology I B: Introduction to Microbial Biochemistry and Metabolism

(Course Code MBT 2209 w.e.f.2017-2018)

Time : 2½ hours Max marks: 60M

SECTION – A

Answer all the following questions **5 x 2= 10 M**

1. Sterols
2. Centrifugation
3. Coenzyme
4. Turbidometry
5. Streak plate

SECTION – B

Answer any four questions **4x 5 = 20 M**

6. Phospholipids
7. Paper chromatography
8. Cofactors
9. Factors influencing microbial growth
10. ED path way
11. Amino acids
12. Allosteric inhibition
13. Substrate level phosphorylation

SECTION – B

Answer ANY THREE of the following questions. Draw labeled diagrams wherever necessary **3x10=30 Marks**

14. Write an essay on general characteristics of carbohydrates.
15. Write in detail about the principle and applications of colorimerty.
16. Discuss the properties and classification of Enzymes.
17. Explain in detail about nutritional groups of microorganisms.
18. Write an essay on Glycolysis.

Course MB2209: Introduction to Microbial Biochemistry and Metabolism

Model paper blue print for the Question Paper setter

Max.marks = 60 **Time: 21/2 Hrs**

Module No./Title	Very short answer Questions	Short answer Questions	Essay Questions	Marks allotted to the Module
Unit -I	**1**	**2**	**1**	**22**
Unit –II	**1**	**2**	**1**	**22**
Unit –III	**1**	**2**	**1**	**22**
Unit –IV	**1**	**1**	**1**	**17**
Unit -V	**1**	**1**	**1**	**17**
Total marks allotted to all questions including choice =				**100**

Note: Question paper setters are requested to adhere strictly to the above blue print while preparing the said paper.

P.R. Government College (Autonomous), Kakinada

I B.Sc., Microbiology - Practical Examinations

Paper I model at the end of II Semester (w.e.f. 2017-18)

Introduction to Microbial Biochemistry and Metabolism (MB2209P)

Time: 2 Hrs. Max. Marks: 35

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1. Qualitative analysis of chemical 'A'. 10 M

Scheme for valuation: Conduct of experiment (05M) + procedure (3M) + Result (2M)

2. Estimation of microbial growth 'B'. 05 M

Scheme for valuation: Practical work (3M) + Description (2M)

3. Identify and write notes on the following 5 x 2 = 10 M

D. Biochemical test
E. Biochemical test
F. Medium
G. Isolation technique
H. Instrument

Scheme for valuation: Identification (1M) + Reasons (2M)

4. Record + Viva voce 6 +4 = 10 M

Total = 35 M

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15 marks for CCA

P.R. Government College (Autonomous), Kakinada

II B.Sc., – Microbiology / III Semester End (W.E.F. 2017-2018)

Microbial Genetics and Molecular biology (Course: MBT3209)

Total Hrs. of Teaching-Learning: 60 @ 4 h / Week Total Credits : 03

UNIT-I **No. of hours: 12**

DNA and RNA as genetic material.

Structure and organization of prokaryotic DNA.

Extra chromosomal genetic elements – Plasmids and Transposons in bacteria.

Replication of DNA – Semi conservative mechanism, Enzymes involved in replication.

UNIT-II **No. of hours: 10**

Mutations – spontaneous and induced, base pair changes, frame shifts, deletions, inversions, tandem duplications, insertions.

Mutagens - Physical and Chemical mutagens. Outlines of DNA damage and repair mechanisms.

Genetic recombination in bacteria – Conjugation, Transformation and Transduction.

UNIT-III **No. of hours: 10**

Types of RNA and their functions.

Genetic code.

Structure of ribosomes.

UNIT-IV **No. of hours: 8**

Types of genes – structural, constitutive, regulatory

Protein synthesis – Transcription and translation.

Regulation of gene expression in bacteria – lac operon.

UNIT-V **No. of hours: 10**

Basic principles of genetic engineering.

Restriction endonucleases, DNA polymerases and ligases. Vectors like Pbr 322, M13.

Outlines of gene cloning methods.

Polymerase chain reaction. Genomic and cDNA libraries.

General account on application of genetic engineering in industry, agriculture and medicine.

P.R. Government College (Autonomous), Kakinada

II Year B.Sc., Program III Semester End

Microbiology II A: Microbial Genetics and Molecular biology

(Course Code MB3209 w.e.f.2017-2018)

Time :21/2 Hours Max Marks :60M

SECTION - A

Answer all the following questions **5x2=10 Marks**

1. Topoisomerases
2. Base analogue
3. Monocistronic RNA
4. Pribnow box
5. Ligase

SECTION - B

Answer Four questions **4x5 =20 Marks**

6. Transposons
7. RNA as genetic material
8. Physical mutagens
9. DNA damage
10. Regulatory genes
11. Transcriptional factors
12. DNA polymerases
13. Genomic libraries

SECTION - C

Answer ANY THREE of the following questions. Draw labeled diagrams wherever necessary **3x10=30 Marks**

14. Briefly describe the structure of Prokaryotic DNA
15. Write about DNA repair mechanisms
16. Explain the properties of Genetic code
17. Give a brief note on Translation mechanism in Prokaryotes
18. Write about the steps in gene cloning

P.R.Government College (Autonomous), Kakinada

II year B.Sc., Program III Semester End

Course MB-3209: Microbial genetics and Molecular Biology

Model blue print for the Question Paper setter

Max. Marks = 60 **Time: 2½ Hrs.**

Module No. / Title	Very Short Answer Questions	Short Answer Questions	Essay Questions	Marks allotted to the Module
UNIT-I	1	2	1	22
UNIT-II	1	2	1	22
UNIT-III	1	1	1	17
UNIT-IV	1	1	1	17
UNIT-V	1	2	1	22
Total marks allotted to all questions including choice =				100

Note : Question paper setters are requested to adhere strictly to the above blue print While preparing the said paper

P.R.Government College (Autonomous), Kakinada

II year B.Sc., Program III Semester End Practical Syllabus

MBP- 3209 MICROBIAL GENETICS AND MOLECULAR BIOLOGY
TOTAL HOURS: 48 CREDITS: 2

1. Study of different types of DNA and RNA using micrographs and model / schematic representations
2. Study of semi-conservative replication of DNA through micrographs / schematic representations
3. Isolation of genomic DNA from *E. coli*
4. Estimation of DNA using UV spectrophotometer.
5. Resolution and visualization of DNA by Agarose Gel Electrophoresis.
6. Resolution and visualization of proteins by Polyacrylamide Gel Electrophoresis (SDS-PAGE).
7. Problems related to DNA and RNA characteristics, Transcription and Translation.
8. Induction of mutations in bacteria by UV light.
9. Instrumentation in molecular biology – Ultra centrifuge, Transilluminator, PCR

Microbiology BOS – 2019-20

P.R.Government College (Autonomous), Kakinada

II year B.Sc., Program III Semester End

II B.Sc., Microbiology - Practical Examinations

Paper II model at the end of III Semester (w.e.f. 2018-19)

Microbial genetics and Molecular biology (MB3209P)

Time: 2 Hrs. Max. Marks: 35

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1. Isolation of Genomic DNA of E.coli 'A' **10 M**

Scheme for valuation: Conduct of experiment (05M) + procedure (3M) + Result (2M)

2. Description of the Instrument 'B' **05 M**

Scheme for valuation: Principle (2M) + Description (3M)

4. Identify and write notes on the following **5 x 2 = 10 M**

C-

D-

E-

F-

G-

Scheme for valuation: Identification (1M) + Reasons (2M)

5. Record + Viva voce **6 +4 = 10 M**

Total = 35 M

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15 marks for CCA

REFERENCES

Crueger, W. and Crueger, A. (2000). **Biotechnology: A Text Book of Industrial Microbiology,** PrenticeHall of India Pvt. Ltd., New Delhi.

Freifelder, D. (1990). **Microbial Genetics**. Narosa Publishing House, New Delhi.

Freifelder, D. (1997). **Essentials of Molecular Biology**. Narosa Publishing House, New Delhi.

Glazer, A.N. and Nikaido, H. (1995). **Microbial Biotechnology – Fundamentals of Applied**

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Glick, B.P. and Pasternack, J. (1998). **Molecular Biotechnology**, ASM Press, Washington D.C., USA.

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P.R.Government College (Autonomous), Kakinada
II year B.Sc., Program IV Semester End
IV SEMESTER: B.Sc., MICROBIOLOGY
MBT- 4209 IMMUNOLOGY AND MEDICAL MICROBIOLOGY
TOTAL HOURS: 60 CREDITS: 3

UNIT-I IMMUNOLOGY BASICS NO. OF HOURS: 12

Types of immunity – innate and acquired; active and passive; humoral and cell-mediated immunity.
Primary and secondary organs of immune system – thymus, bursa fabricus, bone marrow, spleen and lymph nodes.
Cells of immune system.
Identification and function of B and T lymphocytes, null cells, monocytes, macrophages, neutrophils, basophils and eosinophils.

UNIT-II ANTIGEN & ANTIBODIES NO. OF HOURS: 12

Antigens – types, chemical nature, antigenic determinants, haptens. Factors affecting antigenicity.
Antibodies – basic structure, types, properties and functions of immunoglobulin's.
Types of antigen-antibody reactions - Agglutinations, Precipitation, Neutralization, complement fixation, blood groups.
Labeled antibody based techniques – ELISA, RIA and Immunofluroscence.
Monoclonal antibodies – production and applications.

UNIT-III MICROBIOLOGY CONCEPTS NO. OF HOURS: 12

Normal flora of human body.
Host pathogen interactions: infection, invasion, pathogen, pathogenicity, virulence and opportunistic infection, General account on nosocomial infection.
General principles of diagnostic microbiology- collection, transport and processing of clinical samples.
General methods of laboratory diagnosis - cultural, biochemical, serological and molecular methods.

UNIT-IV MICROBIOLGY- APPLICATIONS NO. OF HOURS: 12

Antibacterial Agents- Penicillin, Streptomycin and Tetracycline.
Antifungal agents – Amphotericin B, Griseofulvin
Antiviral substances - Amantadine and Acyclovir
Tests for antimicrobial susceptibility.
Brief account on antibiotic resistance in bacteria - Methicillin-resistant Staphylococcus aureus (MRSA).
Vaccines – Natural and recombinant.

UNIT-V MICROBES AND DISEASES NO. OF HOURS: 12

General account on microbial diseases – causal organism, pathogenesis, epidemiology, diagnosis, prevention and control
Bacterial diseases – Tuberculosis and Typhoid
Fungal diseases – Candidiasis. Protozoal diseases – Malaria.
Viral Diseases - Hepatitis- A and AIDS

P.R.Government College (Autonomous), Kakinada

II year B.Sc., Program IV Semester End

Microbiology IIB: **Immunology and Medical microbiology**

(Course Code MB 4209 w.e.f. 2018-19)

Time : 2½ hours Max. Marks:60

SECTION – A

Answer all the following questions 5 x 2 = 10 Marks

1. Basophils
2. Hapten
3. Nosocomial infection
4. Acyclovir
5. Typhoid antigen

SECTION – B

Answer any **FOUR** questions 4X 5 = 20 Marks

6. Cell Mediated Immunity
7. Macrophages and its function
8. Factors affecting antigenicity
9. Applications of Monoclonal antibodies
10. Serological methods
11. Tests for antimicrobial susceptibility
12. MRSA
13. Malaria

SECTION – C

Answer ANY **THREE** of the following Questions. Draw labeled diagrams wherever necessary 3 x 10 = 30 Marks

14. Describe about Primary organs of Immune system.
15. Explain about any two antigen and antibody reactions
16. Write about the general methods laboratory diagnosis.
17. Briefly describe about antibacterial substances with its mode of action.
18. Give an account on causative organism, pathogenesis, diagnosis, prevention of Tuberculosis

Course MB-4209 : Immunology and Medical Microbiology
Model blue print for the Question Paper setter
Max. Marks = 60 **Time : 2½ Hrs.**

Module No. / Title	Very Short Answer Questions	Short Answer Questions	Essay Questions	Marks allotted to the Module
UNIT- **IMMUNOLOGY BASICS**	1	2	1	22
UNIT-II **ANTIGEN & ANTIBODIES**	1	2	1	22
UNIT-III **MICROBIOLOGY CONCEPTS**	1	1	1	17
UNIT-IV **MICROBIOLGY-APPLICATIONS**	1	2	1	22
UNIT-V **MICROBES AND DISEASES**	1	1	1	17
Total marks allotted to all questions including choice =				100

Note : Question paper setters are requested to adhere strictly to the above blue print while preparing the said paper

P.R.Government College (Autonomous), Kakinada

II year B.Sc., Program III Semester End Practical Syllabus

MBP- 4209P IMMUNOLOGY AND MEDICAL MICROBIOLOGY

TOTAL HOURS: 48 CREDITS: 2

1. Identification of human blood groups.
2. Separate serum from the blood sample (demonstration).
3. Estimation of blood hemoglobin.
4. Total Leukocyte Count of the given blood sample.
5. Differential Leukocyte Count of the given blood sample.
6. Immunodiffusion by Ouchterlony method.

7. Identify bacteria (*E. coli, Pseudomonas, Staphylococcus, Bacillus*) using laboratory strains on the basis of cultural, morphological and biochemical characteristics: IMViC, urease production and catalase tests

8. Isolation of bacterial flora of skin by swab method.

9. Antibacterial sensitivity by Kirby-Bauer method
10. Study of various stages of malaria parasite in RBCs using permanent mounts.

II B.Sc., Microbiology - Practical Examinations
Paper II model at the end of IV Semester (w.e.f. 2018-19)
Immunology and Medical microbiology (MB4209P)

Time: 2 Hrs. Max. Marks: 35

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1. Major Experiment-'A'(Immunology/Medical microbiology) 10 M

Scheme for valuation: Conduct of experiment (05M) + procedure (3M) + Result (2M)

2. Major Experiment-'B' (Immunology/Medical microbiology) 05 M

Scheme for valuation: Principle (2M) + Description (3M)

4. Identify and write notes on the following 5 x 2 = 10 M

C-
D-
E-
F-
G-

Scheme for valuation: Identification (1M) + Reasons (2M)

5. Record + Viva voce 6 +4 = 10 M

Total = 35 M

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15 marks for CCA

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Abbas AK, Lichtman AH, Pillai S. (2007). Cellular and Molecular Immunology. 6th edition Saunders Publication, Philadelphia.

Ananthanarayan R. and Paniker C.K.J. (2009) Textbook of Microbiology. 8th edition, University Press Publication

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Goldsby RA, Kindt TJ, Osborne BA. (2007). Kuby's Immunology. 6th edition W.H. Freeman and Company, New York.

P.R.Government College (Autonomous), Kakinada
III year B.Sc., Program V Semester End
V SEMESTER: B.Sc., MICROBIOLOGY
MBT- 5209 Environmental & Agricultural Microbiology

TOTAL HOURS: 60@ 3h/Week **CREDITS: 3**

UNIT - I **No. of hours: 8**

Terrestrial Environment: Soil profile and soil micro flora
Aquatic Environment: Micro flora of fresh water and marine habitats
Atmosphere: Aeromicroflora and dispersal of microbes

UNIT – II **No. of hours: 8**

Role of microorganisms in nutrient cycling (Carbon, nitrogen, phosphorus).
Treatment and safety of drinking (potable) water, methods to detect potability of water samples: (a) standard qualitative procedure: presumptive test/MPN test, confirmed and completed tests for faecal coliforms (b) Membrane filter technique. Microbial interactions – mutualism, commensalism, antagonism, competition, parasitism, predation.

UNIT – III **No. of hours: 6**

Outlines of Solid Waste management: Sources and types of solid waste, Methods of solid waste disposal
(Composting and sanitary landfill).
Liquid waste management: Composition and strength of sewage (BOD and COD), Primary, secondary
(Oxidation ponds, trickling filter, activated sludge process and septic tank) and tertiary sewage treatment.

UNIT – IV **No. of hours: 7**

Plant Growth Promoting Microorganisms - Mycorrhizae, Rhizobia, *Azospirillum, Azotobacter, Frankia,*
phosphate-solubilizers and Cyanobacteria.
Outlines of biological nitrogen fixation (symbiotic, non-symbiotic). Biofertilizers - *Rhizobium*.

UNIT – V **No. of hours: 7**

Concept of disease in plants. Symptoms of plant diseases caused by fungi, bacteria, and viruses. Plant diseases - groundnut rust, Citrus canker and tomato leaf curl.
Principles of plant disease control.

P.R.Government College (Autonomous), Kakinada
III year B.Sc., Program V Semester End
Microbiology V: **MBT- 5209 Environmental & Agricultural Microbiology**

Time : 2½ hours Max. Marks:60M

SECTION – A

Answer all the following questions **5 x 2 = 10 Marks**

1. Soil Profile
2. Predation
3. Sewage sludge
4. Leg Hemoglobin
5. Necrosis

SECTION – B

Answer any FOUR questions **4X 5 = 20 Marks**

6. Micro flora of marine habitats
7. Aeromicroflora
8. Phosphorus Cycle
9. Mutualism
10. BOD
11. Sanitary land fills
12. Cyanobacteria
13. Citrus Canker

SECTION – C

Answer ANY THREE of the following Questions.

Draw labeled diagrams wherever necessary **3 x 10 = 30 Marks**

14. Write an account on Soil micro flora
15. Write an essay on role of microorganisms in carbon
16. Explain about methods of solid waste disposal
17. Write an essay on phosphate Solubilizing Microorganism.
18. Describe about symptoms of plant diseases caused by fungi

Course MB-5209: Environment and Agricultural Microbiology
Model blue print for the Question Paper setter
Max. marks - 60 **Time : 2½ Hrs.**

Module No. / Title	Very Short Answer Questions	Short Answer Questions	Essay Questions	Marks allotted to the Module
UNIT-**I**	1	2	1	22
UNIT-II	1	2	1	22
UNIT-III	1	1	1	17
UNIT-IV	1	2	1	22
UNIT-V	1	1	1	17
Total marks allotted to all questions including choice =				100

Note : Question paper setters are requested to adhere strictly to the above blue print while preparing the said paper

P.R.Government College (Autonomous), Kakinada
III year B.Sc., Program V Semester End Practical syllabus

MBP- 5209 Environment and Agricultural Microbiology
TOTAL HOURS: 48 CREDITS: 2

1. Preparation of soil extract agar and any one culture media for algal growth
2. Isolation of microbes (bacteria and fungi) from soil.
3. Study of air micro flora by petriplate exposure method.
4. Microbiological Analysis of potable water Standard Plate Count

5. Determination of Dissolved Oxygen (DO) of water samples.
6. Isolation of *Rhizobium* from root nodules.
7. Isolation of actinomycetes on I.S.P. media (International Streptomyces project media)
8. Observation of photo micrographs of plant diseases of local importance - Citrus canker, Tikka disease of Groundnut, Bhendi yellow vein mosaic, Rusts, Smuts, Powdery mildews, Tomato leaf curl.

III B.Sc., Microbiology - Practical Examinations
Paper III model at the end of V Semester (w.e.f. 2018-19)
Environment and Agricultural microbiology (MB5209P)

Time: 2 Hrs. Max. Marks: 35

1. Major Experiment-'A' 10 M

Scheme for valuation: Conduct of experiment (05M) + procedure (3M) + Result (2M)

2. Major Experiment-'B' 05 M

Scheme for valuation: Principle (2M) + Description (3M)

4. Identify and write notes on the following 5 x 2 = 10 M

C-
D-
E-
F-
G-

Scheme for valuation: Identification (1M) + Reasons (2M)

5. Record + Viva voce 6 +4 = 10 M

Total = 35 M

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15 marks for CCA

SUGGESTED READINGS

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Barton LL & Northup DE (2011). **Microbial Ecology**. 1st edition, Wiley Blackwell, USA

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Willey JM, Sherwood LM, and Woolverton CJ. (2013). **Prescott's Microbiology**. 9th edition. McGraw Hill Higher Education.

P.R.Government College (Autonomous), Kakinada
III year B.Sc., Program V Semester End
V SEMESTER: B.Sc., MICROBIOLOGY
MBT-6209 Food and Industrial Microbiology

TOTAL HOURS: 60@ 3h/Week **CREDITS: 3**

UNIT- I **No. of hours: 8**

Intrinsic and extrinsic parameters that affect microbial growth in food
Microbial spoilage of food - fruits, vegetables, milk, meat, egg, bread and canned foods
Food intoxication (botulism).
Food-borne diseases (salmonellosis) and their detection.

UNIT – II **No. of hours: 7**

Principles of food preservation - Physical and chemical methods.
Fermented Dairy foods – cheese and yogurt.
Microorganisms as food – SCP, edible mushrooms (white button, oyster and paddy straw).
Probiotics and their benefits.

UNIT – III **No. of hours: 6**

Microorganisms of industrial importance – yeasts,(Saccharomyces cerevisiae) moulds,(Aspergillus niger) Bacteria(E.coli), actinomycetes (Streptomyces griseus).
Outlines of Isolation and Screening and strain improvement of industrially-important microorganisms.
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UNIT – IV **No. of hours: 8**

Types of fermentation processes – solid state, liquid state, batch, fed-batch,
continuous. Basic concepts of Design of fermentor.
Ingredients of Fermentation media
Downstream processing - filtration, centrifugation, cell disruption, solvent extraction.

UNIT – V **No. of hours: 7**

Microbial production of Industrial products - Citric acid, Ethanol, amylases, penicillin, glutamic acid and vitamin B12.

P.R.Government College (Autonomous), Kakinada
III year B.Sc., Program V Semester End
Microbiology V: **MBT- 6209 Food and Industrial Microbiology**

Time : 2½ hours Max. Marks:60

SECTION – A

Answer all the following questions **5 x 2 = 10 Marks**

1. Food Intoxication
2. Drying
3. Yeast
4. Impellor
5. Uses of vitamin B12

SECTION – B

Answer any FOUR questions **4X 5 = 20 Marks**

6. Intrinsic Parameters
7. Botulism
8. Yoghurt
9. Edible Mushrooms
10. Strain improvement
11. Moulds
12. Solvent Extraction
13. Glutamic Acid

SECTION – C

Answer ANY THREE of the following Questions.

Draw labeled diagrams wherever necessary **3 x 10 = 30 Marks**

14. Write an account on Food Spoilage
15. Explain about Probiotics
16. Describe briefly about Industrial Important Microorganisms
17. Write an essay on Types of Fermentation
18. Write an essay on production of Penicillin

Course MB-6209 : Food and Industrial Microbiology
Model blue print for the Question Paper setter
Max. Marks = 60 **Time : 2½ Hrs.**

Module No. / Title	Very Short Answer Questions	Short Answer Questions	Essay Questions	Marks allotted to the Module
UNIT-**I**	1	2	1	22
UNIT-II	1	2	1	22
UNIT-III	1	1	1	17
UNIT-IV	1	2	1	22
UNIT-V	1	1	1	17
Total marks allotted to all questions including choice =				100

Note : Question paper setters are requested to adhere strictly to the above blue print while preparing the said paper

P.R.Government College (Autonomous), Kakinada
III year B.Sc., Program V Semester End Practical syllabus

MBP- 6209 Food and Industrial Microbiology
TOTAL HOURS: 48 CREDITS: 2

1. Isolation of bacteria and fungi from spoiled bread/fruits/vegetables
2. Preparation of Yogurt/Dahi
3. Determination of the microbiological quality of milk sample by MBRT
4. Isolation of antagonistic microorganisms by crowded plate technique
5. Design of Fermentor (identification of diagrams of various types of Fermentors and labeling of parts)
6. Microbial fermentation for the production and estimation of ethanol from Grapes.
7. Microbial fermentation for the production and estimation of citric acid.

P.R. Government College (Autonomous), Kakinada

III B.Sc., Microbiology - Practical Examinations

Paper III model at the end of V Semester (w.e.f. 2018-19)

Food and Industrial Microbiology (MB6209P)

Time: 2 Hrs. Max. Marks: 35

1. Major Experiment-'A' 10 M

Scheme for valuation: Conduct of experiment (05M) + procedure (3M) + Result (2M)

2. Major Experiment-'B' 05 M

Scheme for valuation: Principle (2M) + Description (3M)

4. Identify and write notes on the following 5 x 2 = 10 M

C-

D-

E-

F-

G-

Scheme for valuation: Identification (1M) + Reasons (2M)

5. Record + Viva voce 6 +4 = 10 M

Total = 35 M

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15 marks for CCA

SUGGESTED READING

Adams MR and Moss MO. (1995). **Food Microbiology**. 4th edition, New Age International (P) Limited Publishers, New Delhi, India.

Banwart JM. (1987). **Basic Food Microbiology**. 1st edition. CBS Publishers and Distributors, Delhi, India.

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Tortora GJ, Funke BR, and Case CL. (2008). **Microbiology: An introduction**. 9th Edition. Pearson Education

Willey JM, Sherwood LM AND Woolverton CJ (2013), Prescott, Harley and Klein's **Microbiology**. 9th Edition. McGraw Hill Higher education

P.R.Government College (Autonomous), Kakinada
III year B.Sc., Program VI Semester End
VI SEMESTER: B.Sc., MICROBIOLOGY
MBT- 7209 MICROBIAL BIOTECHNOLOGY

TOTAL HOURS: 60@ 3h/Week **CREDITS: 3**

UNIT- I **No. of Hours: 8**

Microbial biotechnology: Scope and its applications in human therapeutics, agriculture
(Biofertilizers, PGPR, Mycorrhizae), environmental, and food technology.
Genetically engineered microbes for industrial application: Bacteria and yeast

UNIT- II **No. of Hours: 7**

Recombinant microbial production processes in pharmaceutical industries - Streptokinase, recombinant vaccines (Hepatitis B vaccine).
Over view of production and applications of Microbial polysaccharides, Bioplastics and Microbial biosensors

UNIT- III **No. of Hours: 10**

Microbial based transformation of steroids and sterols.
Bio-catalytic processes and their industrial applications: Production of high fructose syrup and production of cocoa butter substitute.
Immobilization methods and their application: Whole cell immobilization

UNIT- IV **No. of Hours: 7**

Bio-ethanol and bio-diesel production: commercial production from lignocellulosic waste and algal biomass.
Biogas production: Methane and hydrogen production using microbial culture.
Microorganisms in bioremediation: Degradation of xenobiotics.
Mineral recovery, removal of heavy metals from aqueous effluents.

UNIT- V **No. of Hours: 4**

Outlines of Intellectual Property Rights: Patents, Copyrights, Trademarks

P.R.Government College (Autonomous), Kakinada
III year B.Sc., Program VI Semester End
Microbiology: **MBT- 7209 Microbial Biotechnology**

Time: 2½ hours Max. Marks:60

SECTION – A

Answer all the following questions **5 x 2 = 10 Marks**

1. PGPR
2. Bioplastics
3. Sterols
4. Xenobiotics
5. Copyrights

SECTION – B

Answer any FOUR questions **4X 5 = 20 Marks**

6. Biofertilizers
7. Yeast
8. Biosensors
9. Hepatitis B Vaccine
10. Whole cell Immobilization
11. Bioremediation
12. Copy rights
13. Algal biomass production

SECTION – C

Answer ANY THREE of the following Questions.

Draw labeled diagrams wherever necessary **3 x 10 = 30 Marks**

14. Write an account on genetically engineered microorganisms.
15. Explain about production and application microbial polysaccharides
16. Give an account on production of fructose syrup
17. Write an essay on degradation of xenobiotics
18. Write an essay on Trademarks

P.R. Government College (Autonomous), Kakinada

Course MB-7209: Microbial Biotechnology

Model blue print for the Question Paper setter

Max. Marks = 60 **Time : 2½ Hrs.**

Module No. / Title	Very Short Answer Questions	Short Answer Questions	Essay Questions	Marks allotted to the Module
UNIT-**I**	1	2	1	22
UNIT-II	1	2	1	22
UNIT-III	1	1	1	17
UNIT-IV	1	2	1	22
UNIT-V	1	1	1	17
Total marks allotted to all questions including choice =				100

Note : Question paper setters are requested to adhere strictly to the above blue print while preparing the said paper

P.R.Government College (Autonomous), Kakinada
III year B.Sc., Program VI Semester End Practical Syllabus

MBP- 7209 Microbial Biotechnology

TOTAL HOURS: 48 **CREDITS: 2**

1. Yeast cell immobilization in calcium alginate gels
2. Enzyme immobilization by sodium alginate method
3. Pigment production from fungi (*Trichoderma* / *Aspergillus* / *Penicillium*)
4. Isolation of xylanase or lipase producing bacteria
5. Study of algal Single Cell Proteins

III B.Sc., Microbiology - Practical Examinations
Paper Elective model at the end of VI Semester (w.e.f. 2018-19)
Microbial Biotechnology (MB7209P)

Time: 2 Hrs. Max. Marks: 35

1. Major Experiment-'A' 10 M

Scheme for valuation: Conduct of experiment (05M) + procedure (3M) + Result (2M)

2. Major Experiment-'B' 05 M

Scheme for valuation: Principle (2M) + Description (3M)

4. Identify and write notes on the following 5 x 2 = 10 M

C-
D-
E-
F-
G-

Scheme for valuation: Identification (1M) + Reasons (2M)

5. Record + Viva voce 6 +4 = 10 M

Total = 35 M

---

15 marks for CCA

SUGGESTED READING

Crueger W, Crueger A (1990) Biotechnology: **A text Book of Industrial Microbiology** 2nd edition Sinauer associates, Inc.

Demain, A. L and Davies, J. E. (1999). **Manual of Industrial Microbiology and Biotechnology**, 2nd Edition, ASM Press.

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Glick BR, Pasternak JJ, and Patten CL (2010) **Molecular Biotechnology** 4th edition, ASM Press

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P.R.Government College (Autonomous), Kakinada

THIRD YEAR – SEMESTER- VI

CLUSTER PAPERS UNDER ELECTIVE 8209 (8209A, 8209B & 8209C)

MBT- 8209 A1: MICROBIAL DIAGNOSIS IN HEALTH CLINICS

TOTAL HOURS: 60hrs@3hrs per week **CREDITS: 3**

UNIT- I **No. of hours: 8**

Study of Bacterial,(Tuberculosis and Typhoid) Viral,(Influenza and HIV) Fungal (Aspergillosis and

Candidiasis)and Protozoan Malaria and Amebiasis)Diseases affecting humans.

UNIT- II **No. of hours: 8**

Collection of clinical samples (oral cavity, throat, skin, blood, CSF, urine and faeces) and precautions required.
Method of transport of clinical samples to laboratory and storage.

UNIT- III **No. of hours: 8**

Examination of sample by staining - Gram stain, 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- IV **No. of hours: 6**

Serological Methods - Agglutination, ELISA, immunofluorescence, Nucleic acid based methods - PCR, Nucleic acid probes.
Typhoid, Dengue and HIV, Swine flu.

UNIT- V **No. of hours: 6**

Importance, Determination of resistance/sensitivity of bacteria using disc diffusion method, Determination of minimal inhibitory concentration (MIC) of an antibiotic by serial double dilution method

P.R.Government College (Autonomous), Kakinada
III year B.Sc., Program VI Semester End
Microbiology :MBT- **8209 A1: MICROBIAL DIAGNOSIS IN HEALTH CLINICS**

Time : 2½ hours Max. Marks:60

SECTION – A

Answer all the following questions **5 x 2 = 10 Marks**

1. Typhoid antigen
2. CSF
3. Blood agar
4. Agglutination
5. MIC

SECTION – B

Answer any FOUR questions **4X 5 = 20 Marks**

6. Candidiasis
7. Throat samples
8. HIV
9. Skin samples
10. Mac conkey agar
11. Swine flu
12. Disc diffusion method
13. Dengue

SECTION – C

Answer ANY THREE of the following Questions.

Draw labeled diagrams wherever necessary **3 x 10 = 30 Marks**

14. Give a brief note on tuberculosis
15. Write an account on methods of transport of clinical samples
16. Explain about Principle and procedure of Gram staining technique
17. Give an account on Nucleic acid probes
18. Write an essay on sensitivity on bacteria

P.R. Government College (Autonomous), Kakinada

MBT-8209 A1: MICROBIAL DIAGNOSIS IN HEALTH CLINICS

Model blue print for the Question Paper setter

Max. marks = 60 **Time : 2½ Hrs.**

Module No. / Title	Very Short Answer Questions	Short Answer Questions	Essay Questions	Marks allotted to the Module
UNIT-**I**	1	2	1	22
UNIT-II	1	2	1	22
UNIT-III	1	1	1	17
UNIT-IV	1	2	1	22
UNIT-V	1	1	1	17
Total marks allotted to all questions including choice =				100

Note : Question paper setters are requested to adhere strictly to the above blue print while preparing the said paper

P.R.Government College (Autonomous), Kakinada

III year B.Sc., Program VI Semester End Practical Syllabus

Microbiology : **8209 A1: MICROBIAL DIAGNOSIS IN HEALTH CLINICS**

TOTAL HOURS: 36 **CREDITS: 2**

1. Collection transport and processing of any one of the following clinical specimens (Blood/ Urine/ Stool/Sputum). Receipts, Labeling, recording and dispatching clinical specimens.
2. Isolation of bacteria in pure culture and Antibiotic sensitivity.
3. Identification of common bacteria(E.coli, Staphylococus aureus and Streptococus sps) by studying their morphology, cultural character, Biochemical reactions, and other tests.
4. Maintenance and preservation of stock culture.

III B.Sc., Microbiology - Practical Examinations
Paper Cluster model at the end of VI Semester (w.e.f. 2018-19)
Microbiology : **MBT-8209 A1: MICROBIAL DIAGNOSIS IN HEALTH CLINICS**

Time: 2 Hrs. Max. Marks: 35

1. Major Experiment-'A' 10 M

Scheme for valuation: Conduct of experiment (05M) + procedure (3M) + Result (2M)

2. Major Experiment-'B' 05 M

Scheme for valuation: Principle (2M) + Description (3M)

4. Identify and write notes on the following 5 x 2 = 10 M

C-
D-
E-
F-
G-

Scheme for valuation: Identification (1M) + Reasons (2M)

5. Record + Viva voce 6 +4 = 10 M

Total = 35 M

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15 marks for CCA

SUGGESTED READING

Ananthanarayan R and Paniker CKJ (2009) **Textbook of Microbiology**, 8th edition, Universities Press Private Ltd.

Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013) Jawetz, Melnick and Adelberg's **Medical Microbiology**. 26th edition. McGraw Hill Publication

Collee JG, Fraser, AG, Marmion, BP, Simmons A (2007) Mackie and Mccartney Practical **Medical Microbiology**, 14th edition, Elsevier.

Randhawa, VS, Mehta G and Sharma KB (2009) **Practicals and Viva in Medical Microbiology** 2nd edition, Elsevier India Pvt Ltd

Tille P (2013) Bailey's and Scott's **Diagnostic Microbiology**, 13th edition, Mosby

ADIKAVINANNAYA UNIVERSITY
B.Sc MICROBIOLOGY (CBCS) SYLLABUS
THIRD YEAR – SEMISTER-VI
P.R.Government College (Autonomous), Kakinada
THIRD YEAR – SEMESTER- VI
CLUSTER PAPERS UNDER ELECTIVE 8209 (8209A, 8209B & 8209C)
MBT- 8209 A3: BIOFERTILIZERS AND BIOPESTICIDES

TOTAL HOURS: 60hrs@3hrs per week **CREDITS: 3**

TOTAL HOURS: 36 **CREDITS: 3**

UNIT – I **No of Hours: 10**

General account of the microbes used as Biofertilizers for various crop plants and their advantages over chemical fertilizers.

Symbiotic N_2 fixers: *Rhizobium* - Isolation, characteristics, types, inoculum production and field application, legume/pulses plants

Frankia from non-legumes and characterization.

Cyanobacteria and *Azolla*, characterization, mass multiplication, Role in rice cultivation, Crop response, field application.

UNIT – II **No of Hours: 6**

Free living *Azospirillum*, *Azotobacter* - isolation, characteristics, mass inoculum production and field application.

UNIT – III **No of Hours: 6**

Phosphate solubilizing microbes - Isolation, characterization, mass inoculum production, field application

UNIT – IV **No of Hours: 7**

Importance of mycorrizal inoculum, types of mycorrhizae and associated plants, Mass inoculum production of VAM, field applications of Ectomycorrhizae and VAM.

UNIT – V **No of Hours: 7**

General account of microbes used as bioinsecticides and their advantages over synthetic pesticides.

Bacillus thuringiensis - production, Field applications.

Viruses – NPV cultivation and field applications.

P.R.Government College (Autonomous), Kakinada
III year B.Sc., Program VI Semester End
Microbiology : **MBT- 8209-A3: BIOFERTILIZERS AND BIOPESTICIDES**

Time : 2½ hours Max. Marks:60

SECTION – A

Answer all the following questions **5 x 2 = 10 Marks**

1. Rhizobium
2. Frankia
3. Azolla
4. Bioinsecticides
5. Ectomycorrhizae

SECTION – B

Answer any FOUR questions **4X 5 = 20 Marks**

6. Cyanobacteria
7. Field applications
8. Azotobacter
9. Azospirillum
10. Isolation of phosphate solubilizing microorganisms
11. VAM
12. NPV
13. Production of bt

SECTION – C

Answer ANY THREE of the following Questions.

Draw labeled diagrams wherever necessary **3 x 10 = 30 Marks**

14. Write an account on symbiotic nitrogen fixers
15. Write an account on Isolation of Azotobacter
16. Explain about production process of PSM
17. Give an account on types of Mycorrhizae
18. Write an essay on Bioinsecticides

P.R. Government College (Autonomous), Kakinad

8209- A3: BIOFERTILIZERS AND BIOPESTICIDES

Model blue print for the Question Paper setter

Max. marks = 60 **Time : 2½ Hrs.**

Module No. / Title	Very Short Answer Questions	Short Answer Questions	Essay Questions	Marks allotted to the Module
UNIT-**I**	1	2	1	22
UNIT-II	1	2	1	22
UNIT-III	1	1	1	17
UNIT-IV	1	2	1	22
UNIT-V	1	1	1	17
Total marks allotted to all questions including choice =				100

Note : Question paper setters are requested to adhere strictly to the above blue print while preparing the said paper

P.R.Government College (Autonomous), Kakinada

III year B.Sc., Program VI Semester End Practical Syllabus

Microbiology : **8209 A3: BIOFERTILIZERS AND BIOPESTICIDES**

TOTAL HOURS: 36 **CREDITS: 2**

1. Isolation of *Rhizobium* from root nodules.
2. Isolation of phosphate solubilizers from soil
3. Staining and observation of VAM
4. A visit to biofertilizer production unit.

III B.Sc., Microbiology - Practical Examinations

Paper Cluster model at the end of VI Semester (w.e.f. 2018-19)

BIOFERTILIZERS AND BIOPESTICIDES (MB8209-A3P)

Time: 2 Hrs. Max. Marks: 35

1. Major Experiment-'A' 10 M

Scheme for valuation: Conduct of experiment (05M) + procedure (3M) + Result (2M)

2. Major Experiment-'B' 05 M

Scheme for valuation: Principle (2M) + Description (3M)

4. Identify and write notes on the following 5 x 2 = 10 M

C-
D-
E-
F-
G-

Scheme for valuation: Identification (1M) + Reasons (2M)

5. Record + Viva voce 6 +4 = 10 M

Total = 35 M

---

15 marks for CCA

SUGGESTED READINGS

Agarwal SK (2005) **Advanced Environmental Biotechnology**, APH publication.

Kannaiyan, S. (2003). **Bioetchnology of Biofertilizers,** CHIPS, Texas.

Mahendra K. Rai (2005). **Hand book of Microbial biofertilizers**, The Haworth Press, Inc. New York.

Reddy, S.M. et. al. (2002). **Bioinoculants for sustainable agriculture and forestry**, Scientific Publishers.

Saleem F and Shakoori AR (2012) **Development of Bioinsecticide,** Lap Lambert Academic Publishing GmbH KG

Subba Rao N.S (1995) **Soil microorganisms and plant growth** Oxford and IBH publishing co. Pvt. Ltd. NewDelhi.

ADIKAVINANNAYA UNIVERSITY

B.Sc MICROBIOLOGY (CBCS) 8121/ABCS

THIRD YEAR – SEMESTER- VI

THIRD YEAR – SEMISTER-VI

CLUSTER PAPERS UNDER ELECTIVE 8209 (8209A, 8209B & 8209C)

MBT- 8209 A2: MICROBIAL QUALITY CONTROL IN FOOD AND PHARMACEUTICAL INDUSTRIES

TOTAL HOURS: 36 **CREDITS: 3**

UNIT – I **No. of Hours: 8**

Good laboratory practices - Good microbiological practices.
Biosafety cabinets – Working of biosafety cabinets, using protective clothing, specification for BSL-1, BSL-2, BSL-3.
Discarding biohazardous waste – Methodology of Disinfection, Autoclaving & Incineration

UNIT – II **No. of Hours: 8**

Culture and microscopic methods - Standard plate count, Most probable numbers, Direct microscopic counts, Biochemical and immunological methods: Limulus lysate test for endotoxin, gel diffusion, sterility testing for pharmaceutical products

UNIT – III **No. of Hours: 8**

Molecular methods - Nucleic acid probes, PCR based detection, biosensors.

UNIT – IV **No. of Hours: 8**

Enrichment culture technique, Detection of specific microorganisms - on XLD agar, *Salmonella Shigella* Agar, Manitol salt agar, EMB agar, McConkey Agar, Saboraud Agar
Ascertaining microbial quality of milk by MBRT, Rapid detection methods of microbiological quality of milk at milk collection centres (COB, 10 min Resazurin assay).

UNIT – V **No. of Hours: 4**

Hazard analysis of critical control point (HACCP) - Principles, flow diagrams, limitations. Microbial Standards for Different Foods and Water – BIS standards for common
foods and drinking water.

P.R.Government College (Autonomous), Kakinada
III year B.Sc., Program VI Semester End
Microbiology : **MBT- 8209-A2: MICROBIAL QUALITY CONTROL IN FOOD AND PHARMACEUTICAL INDUSTRIES**

Time : 2½ hours | Max. Marks:60

SECTION – A

Answer all the following questions **5 x 2 = 10 Marks**

1. Incineration
2. Endotoxin
3. Taq polymerase
4. EMB
5. BIS

SECTION – B

Answer any FOUR questions **4X 5 = 20 Marks**

6. Working of biosafety cabinets
7. Methods of disinfection
8. Culture methods
9. Gel diffusion
10. Biosensors
11. Salmonella Shigella agar
12. MBRT
13. HACCP

SECTION – C

Answer ANY THREE of the following Questions.

Draw labeled diagrams wherever necessary **3 x 10 = 30 Marks**

14. Write an account on good microbiological practices
15. Write an account on direct microscopic counts
16. Explain about PCR technique
17. Give an account on types of culture media
18. Write an essay on flow diagrams of microbial standards

P.R.Government College (Autonomous), Kakinada

III year B.Sc., Program VI Semester End Practical Syllabus

Microbiology : **8209 A2: MICROBIAL QUALITY CONTROL IN FOOD AND PHARMACEUTICAL INDUSTRIES**

TOTAL HOURS: 36 **CREDITS: 2**

1. Microbiological laboratory safety- General rules & Regulations.
2. Sterility tests for Instruments – Autoclave & Hot Air Oven
3. Disinfection of selected instruments & Equipments
4. Sterility of Air and its relationship to Laboratory & Hospital sepsis.
5. Sterility testing of Microbiological media
6. Sterility testing of any one Pharmaceutical product
7. Standard qualitative analysis of water.
8. Microbiological analysis of homogenized food samples by direct microscopic count

P.R. Government College (Autonomous), Kakinada

III B.Sc., Microbiology - Practical Examinations

Paper III Cluster at the end of VI Semester (w.e.f. 2018-19)

MICROBIAL QUALITY CONTROL IN FOOD AND PHARMACEUTICAL INDUSTRIES

(MB8209-A2P)

Time: 2 Hrs. Max. Marks: 35

1. Major Experiment-'A' 10 M

Scheme for valuation: Conduct of experiment (05M) + procedure (3M) + Result (2M)

2. Major Experiment-'B' 05 M

Scheme for valuation: Principle (2M) + Description (3M)

4. Identify and write notes on the following 5 x 2 = 10 M

C-

D-

E-

F-

G-

Scheme for valuation: Identification (1M) + Reasons (2M)

5. Record + Viva voce 6 +4 = 10 M

Total = 35 M

---

15 marks for CCA

SUGGESTED READING

Baird RM, Hodges NA and Denyer SP (2005) Handbook of Microbiological Quality control in Pharmaceutical and Medical Devices, Taylor and Francis Inc.

Garg N, Garg KL and Mukerji KG (2010) Laboratory Manual of Food Microbiology I K International Publishing House Pvt. Ltd.

Harrigan WF (1998) Laboratory Methods in Food Microbiology, 3rd ed. Academic Press Jay JM,

Loessner MJ, Golden DA (2005) Modern Food Microbiology, 7th edition. Springer Laboratory

Exercises in Microbiology, George.A.Wistreich & Max.D.Lechtman, 3 rd Ed, Glencoe press, London.
Manual of diagnostic microbiology, Dr.B.J.Wadher & Dr.G.L.Bhoosreddy, Firs.Ed., Himalaya publishing house, Nagpur.
Microbiology - A laboratory manual, Cappuccino & Sherman , 6 th Ed, Pearson Education
Pharmaceutical Microbiology – Purohit
Pharmaceutical Microbiology – W.B. Hugo

Suggested Student Project works

1. Influence of different sugars on the production of ethanol by yeast fermentation.
2. Influence of heavy metals on the growth of microorganisms.
3. Effect of medicinal plants on the bacterial growth.
4. Production of enzymes and influence of different media constituents on the enzyme production.
5. Diversity of microorganisms in water samples of different areas.
6. Conventional methods to decrease the microbial loads.
7. Collection and identification of air born microorganisms in the college campus.
8. Efficacy of seaweed extracts on microbes.
9. Effect of Mangrove plant extracts on microbes.
10. Determination of milk quality by MBRT.
11. Antibiotic sensitivity test against mastitis in cattle.
12. Screening of animals and human beings against Brucellosis by RBPT and STAT.
13. Isolation and identification of Rhizobia from root nodules of some Fabaceae members.
14. Collection and identification of cyanobacteria from Kakinada.
15. Isolation and identification of soil microbes in college campus.
16. A case study on phylloplane microflora of some plants in the college campus.
17. Blood grouping and its analysis in the students of PRGC (A), Kakinada.

P.R.GOVERMENT COLLEGE (AUTONOMOUS), KAKINADA – 533 001, A.P.
Department of Botany & Microbiology

MICROBIOLOGY

Board of Studies Meeting for the academic year 2019-20

The **Board of Studies in Microbiology for** the Academic Year 2019-20 is conducted on at 10:00 A.M. in Dept. of Botany and Microbiology, P.R.G.C. (A), Kakinada.

Agenda

1. Adopting the Affiliating University syllabus for V& VI Semesters.
2. Adopting 60- external evaluation and 40- internal evaluation pattern for V & VI Semesters from the academic year 2019-20.
3. Conduct of semester end practical examinations for the I,& II & III years
4. Approval of Panel of question paper setters and Examiners.
5. Adopting the compulsory project in the VI semester in the cluster.

The members of B.O.S. in Microbiology discussed all the issues kept in the agenda at length and taken following resolutions.

RESOLUTIONS:

1. The chairperson submitted that the Syllabus for Microbiology was adopted form the affiliating University form the academic year 2019-20 onwards with the modifications in V & VI semesters hence.
2. It is resolved to adopt the affiliating University, Adikavinannaya University syllabus for V and VISemesters from the academic year 2019-20

3. Resolve to adopt 60 external evaluations - 40 internal evaluation for the V & VI semesters from the academic year 2019-20.
4. Resolved to conduct the semester end practical examinations for the I& II& III
5. Resolved to approve the panel of Question paper setters
6. Resolved to approve the compulsory project in the VI semester instead of cluster paper.

(**PROF .A.MATTA REDDY**)
School of Life Sciences
ANUR Nominee
Adikavi Nannaya University
Rajamahendravaram

(**DR.SMT.K.ARUNA**)
Lec. in Microbiology & Subject Expert
A.S.D.G.D.C.(Autonomous
Kakinada, East Godavari Dist.

(**SMT.P.SWATHI**)
Assistant Director
Biological Control Laboratory
Dept. of Agriculture
Near R.T.O. Office, Kakinada
Member from Agriculture Department

(DR.**A. SRINIVAS RAO**)
Principal Investigator
AP BIO DIVERSITY PROJECT
Dept. of Botany
Govt. Degree College, Mandapeta, E.G.Dt.
Member from Research Body

(**SMT P.SARA**)
Chairman, BOS in Microbiology
Lecturer. In-Charge
Dept. of Botany & Microbiology
P.R.Govt. College (A), Kakinada

Ms. Y. Anitha
Guest Faculty in Microbiology
Department of Botany & Microbiology
P R Govt. College (A), Kakinada.

Students 1.
2.

PITHAPUR RAJAHS GOVERNMENT COLLEGE (AUTONOMOUS), KAKINADA, E.G.DT., ANDHRA PRADESH

DEPARTMENT OF BOTANY AND MICROBIOLOGY

The Board of Studies meeting for **MICROBIOLOGY** subject for the academic year 2018-19 is conducted at the Dept. of Botany and Microbiology on 09-04-2019 at 11:00 AM with Smt P.Sara, Lecturer in-Charge in the chair along with the following members.

Name, designation and address **Signature**

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1. Chairperson :

Smt P.Sara, Lecturer – In-Charge
Dept. of Botany and Microbiology
P.R.G.C.(A), Kakinada

2. A.K.N.University, Rajahmundry Nominee :

Prof. A.Matta Reddy, Professor
School of Life Sciences, Adikavi Nannaya University
Rajamahendravaram, East Godavari District, A.P.

3. Members nominated by Executive council of the College :

a. Member from Research Domain:

Dr. A. Srinivasa Rao
Principal Investigator
AP Biodiversity Project, EGREE Project
Dept. of Botany, Govt. Degree College
Mandapeta, E.G.Dt., A.P.

b. Subject expert – Local nominee :

Dr. Smt. K. Aruna, Lecturer in Microbiology
A.S.D. Govt. Degree College for Women (A),
Kakinada, E.G.Dt., A.P.

c. Member from Industry :

Smt. P. Swathi, Assistant Director
Biological Control Laboratory
Dept. of **Agriculture**, Near RTO office, Kakinada

4. Members from the College :

a. Faculty members :

Ms. Y. Anita, Guest faculty in Microbiology

b. Student members :

Ms A.Sravani Devi III MBC
Mr B.Vijay Siddardha III MBC

P.R.Government College (Autonomous), Kakinada

THIRD YEAR – SEMESTER- VI

CLUSTER PAPERS UNDER ELECTIVE 8209 (8209A, 8209B & 8209C)

MBT- 8209 A2: MICROBIAL QUALITY CONTROL IN FOOD AND PHARMACEUTICAL INDUSTRIES

TOTAL HOURS: 36 **CREDITS: 3**

UNIT – I **No. of Hours: 8**

Good laboratory practices - Good microbiological practices.
Biosafety cabinets – Working of biosafety cabinets, using protective clothing, specification for BSL-1, BSL-2, BSL-3.
Discarding biohazardous waste – Methodology of Disinfection, Autoclaving & Incineration

UNIT – II **No. of Hours: 8**

Culture and microscopic methods - Standard plate count, Most probable numbers, Direct microscopic counts, Biochemical and immunological methods: Limulus lysate test for endotoxin, gel diffusion, sterility testing for pharmaceutical products

UNIT – III **No. of Hours: 8**

Molecular methods - Nucleic acid probes, PCR based detection, biosensors.

UNIT – IV **No. of Hours: 8**

Enrichment culture technique, Detection of specific microorganisms - on XLD agar, *Salmonella*
Shigella Agar, Manitol salt agar, EMB agar, McConkey Agar, Saboraud Agar
Ascertaining microbial quality of milk by MBRT, Rapid detection methods of microbiological quality of milk at milk collection centres (COB, 10 min Resazurin assay).

UNIT – V **No. of Hours: 4**

Hazard analysis of critical control point (HACCP) - Principles, flow diagrams, limitations. Microbial Standards for Different Foods and Water – BIS standards for common
foods and drinking water.

P.R.Government College (Autonomous), Kakinada

THIRD YEAR – SEMESTER- VI

CLUSTER PAPERS UNDER ELECTIVE 8209 (8209A, 8209B & 8209C)

MBT- 8209 A3: BIOFERTILIZERS AND BIOPESTICIDES

TOTAL HOURS: 36 **CREDITS: 3**

UNIT – I **No of Hours: 10**

General account of the microbes used as Biofertilizers for various crop plants and their advantages over chemical fertilizers.

Symbiotic N_2 fixers: *Rhizobium* - Isolation, characteristics, types, inoculum production and field application, legume/pulses plants

Frankia from non-legumes and characterization.

Cyanobacteria and *Azolla*, characterization, mass multiplication, Role in rice cultivation, Crop response, field application.

UNIT – II **No of Hours: 6**

Free living *Azospirillum*, *Azotobacter* - isolation, characteristics, mass inoculum production and field application.

UNIT – III **No of Hours: 6**

Phosphate solubilizing microbes - Isolation, characterization, mass inoculum production, field application

UNIT – IV **No of Hours: 7**

Importance of mycorrizal inoculum, types of mycorrhizae and associated plants, Mass inoculum production of VAM, field applications of Ectomycorrhizae and VAM.

UNIT – V **No of Hours: 7**

General account of microbes used as bioinsecticides and their advantages over synthetic pesticides.

Bacillus thuringiensis - production, Field

applications. Viruses – NPV cultivation and

field applications.