

# College of Computer, Science & Information Technology - Junagadh

AFFILIATED TO BHAKTA KAVI NARSINH MEHTA UNIVERSITY



♦ Syllabus ♦

## Master of Science

in

[ MICROBIOLOGY ]

[ Semester – III & IV ]

Academic Year : 2024 – 25

( Effective from June – 2024 )



◀ **ADDRESS : C.C.S.I.T. - JUNAGADH** ▶

Green City, Bypass Road, Nr. Chobari Railway Crossing, Junagadh.

Website : <http://ccsit.co.in>, Email : [ccsit\\_junagadh@yahoo.co.in](mailto:ccsit_junagadh@yahoo.co.in)

Phone : 79906 61530, 92280 06940

( SEMESTER-III )					
Subject code	Subject Name	Credit	Int. Marks	Ext. Marks	Total Marks
Mic-313	Genetic Engineering and Protein Engineering (Core)	4	30	70	100
Mic-314	Bioprocess Engineering and Fermentation Microbiology (Core)	4	30	70	100
Mic-315	Pharmaceutical and Medical Microbiology (Core)	4	30	70	100
Mic-316B	Ecology and Environmental Microbiology (Elective)	4	30	70	100
Mic-317	Combined Practicals	12	-	200	200
Mic-419	Dissertation / Project	-	-	-	-
Total Credits		28	Total Marks		600

( SEMESTER-IV )					
Subject code	Subject Name	Credit	Int. Marks	Ext. Marks	Total Marks
Mic-418	Dissertation / Project	20	-	500	500
Mic-419	Seminar Course	4	50	-	50
Mic-420	Submission		50	-	50
Total Credits		24	Total Marks		600

#### General Instructions:

1. Time duration of each theory paper will be of Two and Half hours.
2. Total marks of each theory paper will be 70 marks.
3. There will be five questions.
4. All questions are compulsory.

#### Instructions to the candidates for Practical Examination:-

1. Practical Exam. would be conducted for 1 ½ days, All the students have to remain present at the examination center 15 minutes before the scheduled time for examination.
2. Students have to carry with them certified Journal, I – card, Examination Receipt, and other necessary requirements for examination.
3. Student should not leave the laboratory without the permission of examiner.
4. Use of calculator is allowed but the use of mobile phones is strictly prohibited.
5. The candidate has to leave the laboratory only after the submission of all the answer sheets of the exercises performed.

# **M.Sc.(Microbiology) SEMESTER – III**

## **Micro – 313 : Genetic Engineering and Protein Engineering (Core)**

### **Unit-1:**

1. Concepts and application: Introduction to gene cloning; Application of Recombinant microorganisms.
2. Enzyme used in genetic engineering: Restriction endonuclease; DNA Polymerase: Reverse transcriptase; RNA polymerase; Alkaline Phosphatase; Polynucleotide Kinase; DNA ligase; Deoxyribonuclease; Ribonuclease; Phosphodiesterase;  $\beta$  Agarase; Uracil - DNA Glycoylase; Proteinase K; Lysosome; Topoisomerase
3. Cutting of DNA: Host Controlled Restriction Modification system; Nomenclature of Restriction Endonuclease; Types of Restriction Endonuclease; Recognition sites; Cleavage by Restriction endonuclease; variants of Restriction Endonuclease; Application of Restriction Endonuclease
4. Joining of DNA Fragments: Introduction; Ligation of DNA fragment using DNA ligase; ligation using homopolymer Tailing; Increasing versatility and Efficiency of ligation by modification of the Ends of Restriction Fragments; Ligation of PCR products

### **Unit-2:**

1. Plasmid as a vector: pSC101; pSF124; Col E1; pBR 322 series; pUCSeries; pGEM series; pET,pBAD,
2. Bacteriophage as a vector: lambda phage; M13; Cosmid; Phagemids; Phasmids; Fosmid;
3. Advanced vector: Shuttle vector; Expression vector; Advanced gene trapping vector; Specialized vector for making SS DNA; facilitate Purification of cloned product; promotes solubilization of expressed product; promotes export of cloned product; PAC, YAC, BAC, HAC;
4. Other vectors : Chimeric vector; Gram negative bacteria other than *E. coli* as cloning vector; Gram positive bacteria as cloning vector; Plant and Animal Vectors; Fungi system other than yeast.

### **Unit-3:**

1. Introduction of DNA in to Host: Introduction; Introduction of DNA in to bacterial cells; Introduction of DNA in to yeast cells; Genetic transformation of Plants; Introduction DNA in to insects.
2. Construction of Genomic and c DNA Libraries: Introduction; Genomic Library; cDNA Library; PCR as an alternative to library Construction; Functional cloning; Positional cloning; Differential cloning
3. Techniques for Selection, Screening and characterization of trans formants: Introduction; Selectable Marker gene; Reporter genes; Screening of clone(s) of interest.
4. Nucleic Acid Blotting and Hybridization; Protein structure/ Function Fusion- based techniques

### **Unit-4:**

1. Site directed mutagenesis; Concept tools, technique of and application
2. Concept of protein engineering; Evolutionary Methods for Protein Engineering; Phage Display Systems for Protein Engineering; Cell Surface Display Systems for Protein Engineering; Cell-Free Display Systems for Protein Engineering;
3. Protein engineering in basic and applied biotechnology; Enhanced recovery and folding of recombinant proteins using Fusion protein strategies; Protein engineering for affinity purification; Stabilization of industrial enzymes by protein engineering; Engineering of Therapeutic Proteins
4. DNA Microarray technology: Concepts, tools and techniques, data generation and analysis, application; Microarrays for Bacterial Typing; Overview of protein Microarray technology

### **Suggested Practical**

1. Isolation of genomic DNA from Bacteria
2. Isolation of genomic DNA from Plant
3. Isolation of genomic DNA from Blood
4. Isolation of genomic from fungi
5. Agarose gel electrophoresis and recovery of DNA from gel
6. Isolation of plasmid
7. Separation of protein by Native and SDS-PAGE
8. Isolation and extraction of RNA from bacteria
9. RFLP
10. RAPD
11. PCR amplification
12. Cloning in bacteria
13. Transformation of plants
14. Protein denaturation and in vitro Protein folding
15. BT cotton testing

**Reference Books:**

1. Nicholl, An Introduction to Genetic Engineering
2. Reece, Analysis of Genes and Genomes
3. Primrose, Principle of gene Manipulation
4. Brown, Gene cloning and DNA Analysis
5. Howe , Gene Cloning and Manipulation
6. Wong , The ABC of gene cloning
7. Watson, Recombinant DNA genes and genomics
8. Budisa, Engineering the Genetic Code
9. Sheldon J. Park, Protein Engineering and Design
10. Allan Svendsen Enzyme Functionality Design, Engineering, and Screening
11. Lilia Alberghina Protein engineering in industrial Biotechnology by Lilia Alberghina
12. Joanna S. Albala, Protein Arrays, Biochips, and Proteomics The Next Phase of Genomic
13. Isaac, Discovery by Microarrays for an Integrative Genomics

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## **Micro – 314 : Bioprocess Engineering and Fermentation** **Microbiology (Core)**

**Unit-1:**

1. The Basic Nutrient Requirements of Industrial Media; Criteria for the Choice of Raw Materials Used in Industrial Media; Some Raw Materials Used in Compounding Industrial media;
2. Growth Factors; Water; Some Potential Sources of Components of Industrial media, Carbohydrate sources, Protein sources; The use of plant waste materials in Industrial
3. Microbiology media: Saccharification of Polysaccharides, Starch, Cellulose, hemi-celluloses and lignin in plant materials
4. Growth Kinetics : Introduction; Kinetics of batch culture; Disadvantages of batch culture ; Advantages of continuous culture ; Growth kinetics for continuous culture;

**Unit-2:**

1. Introduction; The basis of loss by contaminants; Physical and Chemical Methods of Achieving Sterility : Hot plates; High temperature sterilization; Dry heat sterilization; Sterilisation with filtration; Microwave sterilization; Chemical sterilization;
2. Batch sterilization; Continuous sterilization; The sterilization of the fermentor and its accessories; Media sterilization; Viruses (Phages) in Industrial Microbiology
3. Bioprocess Scale-up: Introduction; Scale-up procedure from laboratory scale to plant scale; Dynamic model and oxygen transfer rate in activated sludge; Aerobic wastewater treatment
4. Bioreactor : Introduction; Background; Bioreactor for batch type fermentation : The Aerated Stirred Tank, Anerobic Batch, Airlift bioreactors, Bubble column, Surface or Solid State; Bioreactor Configurations for Fedbatch Cultivation and Continuous fermentations

**Unit-3:**

1. Amino Acids: Introduction, Microbial strain employed in aminoacid production, process control in amino acid fermentation, Production of Glutamic Acid by Wild Type Bacteria.
2. Production of Amino Acids Using Metabolically Engineered Organisms; Vitamin: Vitamin B12, Riboflavin, Carotenodis.
3. Production of Fermented Foods: Introduction; Fermented Food from Wheat: Bread; Fermented Foods Made from Milk; Fermented Foods from Corn; Fermented Vegetables;
4. Fermentations for the Production of the Stimulant Beverages: Coffee, and Cocoa; Production of Beer, Wines and Spirits.

**Unit-4:**

1. Microbial Polysaccharides and Polyesters : Polysaccharides, Xanthan Gum, Polyesters.
2. Production of Organic Acids: Citric, acetic lactic, Gluconic and Itaconic acid.
3. Single Cell Protein (SCP): Substrates for Single Cell Protein Production; Microorganisms Used in SCP Production; Use of Autotrophic Microorganisms in SCP Production; Safety of Single Cell Protein; Nutritional Value of Single Cell Protein;
4. Production of Ergot Alkaloids: Nature of Ergot Alkaloids, Uses of Ergot Alkaloids and their Derivates

## **Suggested Practical**

1. Amino acid Production
2. Wine Production
3. Production of extra-cellular polysaccharide
4. Production of Vitamin B12/Vitamin B2
5. production of Alcohol
6. Lab scale production and estimation of citric acid.
7. Isolation and Screening of citric acid producers
8. Isolation and Screening of Antibiotic producing microorganism
9. Production of Antibiotics streptomycin
10. Sterility testing of pharmaceutical product
11. Isolation, screening and optimization of Amylase producer
12. Isolation, screening and optimization of Protease
13. Purification of Amylase and protease
14. Immobilization of enzyme

### **Reference Books:**

1. Okafor, Modern Industrial Microbiology and biotechnology.
2. Najafpour, Biochemical Engineering and Biotechnology.
3. Shigeo, Biochemical engineering.
4. Whittaker, Principles of fermentation technology.
5. Alexander, Microbial Biotechnology.
6. Sikyta, Techniques in Applied Microbiology.
7. Vogel, Fermentation and Biochemical Engineering Handbook.
8. Mcneil, Practical Fermentation Technology.
9. Doran, Bioprocess engineering Principle.
10. Nathan, Modern Biotechnology.
11. Mansi, Fermentation microbiology and Biotechnology, Taylor and Francis
12. Waites, Industrial Microbiology: An Introduction, Blackwell publication
13. Michal, Bioprocess Engineering Basic Concept, Prentice Hall of India
14. Crueger, A text book of Industrial microbiology.
15. Volkmar, Microbial Fundamentals of Biotechnology
16. Peppler, Microbial technology: fermentation technology
17. Mansi, Fermentation microbiology and Biotechnology, Taylor and Francis
18. Najafpour, Biochemical Engineering And Biotechnology
19. Waites, Industrial Microbiology: An Introduction, Blackwell publication
20. Whittaker, Principles of fermentation technology.
21. Walker, Microbial Processes and Products
22. Michal, Bioprocess Engineering Basic Concept
23. Biotol series, Operational Models for Bioreactor,
24. Biotol series, Product recovery in Bioprocess technology,

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## **Micro - 315 : Pharmaceutical and Medical Microbiology(Core)**

### **Unit-1:**

1. Introduction of the Drug Discovery and Development Process; Drug Discovery: Targets and Receptors;
2. Drug Discovery: Small Molecule Drugs; Drug Discovery: Large Molecule Drugs;
3. Computer aided drug discovery and QSAR
4. Drug Development and Preclinical Studies; Clinical Trial : Overview, Role of microbiologist in CRO

### **Unit-2:**

1. Host-Parasite relationship: Nonspecific host defenses, virulence factors, normal flora and gnotobiology  
Epidemiology : Infectious diseases, disease cycle, epidemiological methods, diagnostic principles, control, prevention, antimicrobial therapy.

2. Bacterial diseases: Pathogenesis, diagnosis, prevention and treatment of diseases caused by Staphylococcus, Streptococcus, Neisseria;
3. Viral diseases: SARS, bird flu, swine flu, Ebola, Zika etc.
4. Pathogenesis, diagnosis, prevention and treatment diseases caused by Shigella, Salmonella, Mycobacteria, Treponema;

### Unit-3:

1. Immune response to infectious diseases: Bacteria, viruses, Intracellular parasites and Helminthes
2. AIDS & other immunodeficiencies: Primary & secondary immunodeficiencies.
3. Transplantation immunity: Immunological basis of graft rejection, clinical manifestations of graft rejection, immunosuppressive therapies, immune tolerance to allograft, clinical transplants.
4. Cancer and immune system: Malignant transformation of cells, oncogenes and cancer induction, tumour antigens, cancer immunotherapy.

### Unit-4:

1. Vaccines: Designing vaccines for active immunization, purified macromolecules as vaccines, recombinant vaccines, DNA vaccines and multivalent vaccines.
2. Immunodiagnostics : Immunofiltration and Immunochromatography based rapid diagnostic methods
3. Introduction to Molecular Diagnostic Technology; Immunological Diagnostic Procedure; Monoclonal Antibodies; DNA diagnosis systems; Molecular Diagnosis of genetic disease
4. Overview and Current status of Anti HIV, Anti Malaria, Anti Tuberculosis and Anti-Cancer treatment; Multidrug resistance : Introduction, development, detection and treatment

## Suggested Practical

1. Identification of Gm- and Gm+ (medically important) bacteria according to Bergey's manual.
2. Antibiotic sensitivity test
3. Immunology and Serology :
4. Single radial diffusion
5. Ouchterlony and immunoelectrophoresis
6. Widal
7. Hematology; RBC Count; Total WBC Count; Differential WBC Count; E.S.R. determination; Hb estimation
8. Blood Grouping: Slide technique and Tube technique;
9. Reverse and forward grouping/ Cross matching
10. Isolation and identification of Pathogens
11. VDRL test
12. Enzyme Linked Immuno Sorbent assay (ELISA)
13. Bleeding time and clotting time

### Reference Books:

1. Immunology; Roitt et al, Mosby Publications
2. Cellular and Molecular Immunology; Abbas and Litchman, Saunders Publication.
3. Kuby Immunology; Tizard RI, Saunders College Publishing.
4. Roitt's Essential Immunology; Roitt I, Blackwell Publishing.
5. Essential haematology A.V.Hoffbrand Black well
6. De Gruchy's Clinical Haematology in medical practice Frank Firkin, C ChesterMan Black well
7. Principles of haematology Peter Haen WCB
8. Haematology EmamanuelBesaHarwal
9. Abbas, A.K., Litchman, A.H., Pober. J.S, Cellular and Molecular Immunology. Second Edition. W.B.Saunders, USA, 1994.
10. Bellanti. J.A, Immunology III Ed, 1985.
11. C.V. Rao, An Introduction to Immunology. NarosaPublihng House, India, 2002.
12. Chapel, H. and Halbey, Essentials of clinical Immunology ELBS London, 1986.
13. Coleman, R.M. Lambard, M. F. and Siccard, Fundamental of Immunology II Ed, 1992
14. Donald M. Weir, John Steward, Immunology VII Ed. ELBS, London, 1993.
15. Hue Davis, Introductory Immunology Champman and Hall Publisher, 1997.
16. Janeway, C, Immunology VI ED, Garland Science. New York, 2004.



17. K. R. Joshi, N.O. Osama, Immunology, Agrobios Ltd, India, 2000.
18. Kuby, J, Immunology VI Ed. W.H. Freeman and Company New York, 2004.
19. Poul, W.E, Fundamental of Immunology II Ed. Ravar Press, New York, 1990.
20. Riot. M.Ivan, Essential Immunology, VII Ed. ELBS and Black well Scientific Pub., 1998.
21. Tizarrd. I.R, Immunology an Introduction II Ed. Thomson Asia Pvt. Ltd, 2004.
22. Tom Parker, M.Lesline, H.Collier, Principles of Bacteriology, Virology and Immunity.VII Ed, 1990.
23. Unani and Benacerraf, Text Book of Immunology.
24. Weir, Hand Book of experimental Immunology, Vol I,II.
25. <http://www-immuno.path.cam.ac.uk/-immuno/part1.html>
26. <http://www.lclark.edu/-reiness/immuno/lectures.html>
27. <http://www.hhmi.org/biointeractive/immunology/lectures.html>
28. <http://www.immuneweb.xxmc.edu.cn/immunology/immunology.html>

## **Micro – 316B : Ecology and Environmental Microbiology (Elective)**

### **UNIT-1**

1. Ecosystem Ecology: Ecosystem structure; ecosystem function; energy flow and mineral cycling (C, N, and P); primary production and decomposition; structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, eustarine).
2. Biogeography: Major terrestrial biomes; theory of island biogeography; biogeographical zones of India.
3. Applied Ecology: Environmental pollution; global environmental change; biodiversity: status, monitoring and documentation; major drivers of biodiversity change; biodiversity management approaches.
4. Conservation Biology: Principles of conservation, major approaches to management, Indian case studies on conservation/management strategy (Project Tiger, Biosphere reserves)..

### **UNIT-2**

1. Environmental Pollution; Types, Detection and Measurement of Pollutants; Environmental monitoring techniques
2. Water Pollution: sources, measurement and management;
3. Waste Water Treatment systems: primary, secondary and tertiary treatments; Biological Treatment Processes, Biochemistry and Microbiology of Aerobic and Anaerobic Treatment, Bioreactors for waste water treatment, Disinfection and Disposal
4. Global environmental problems: Ozone depletion, UV-B and greenhouse gases

### **UNIT-3**

1. Environmental Pollution control: concepts of bioaugmentation, biostimulation, biodegradation, biosorption,
2. Bioremediation of xenobiotics, petroleum hydrocarbons, pesticides and heavy metals, elucidation of biodegradative pathways.
3. Treatment of industrial effluents: Dairy, Distillery, Sugar, and pharmaceutical Industries.
4. Management of municipal, biomedical and agricultural solid waste

### **UNIT-4**

1. Environment friendly technologies: Biosurfactants, biofertilizers, biopesticides, microbially enhanced oil recovery, resource management, integrated waste management;
2. Production of biomass, biogas and biofuel from waste.
3. Pollution monitoring: chemical, biological and molecular methods;
1. Environmental impact assessment, Biodiversity and its conservation, GMOs and Biosafety.

### **Suggested Practical**

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|--|------------------------------------|
| 1. Biodegradation of oil                 | 6. Estimation of phosphorus        |
| 2. Biodegradation of industrial effluent | 7. Estimation of sulphate          |
| 3. Biodegradation of textile dye         | 8. Estimation of chloride          |
| 4. Estimation of BOD                     | 9. Study the Lip producers         |
| 5. Estimation of COD                     | 10. Perform the Winogradsky Column |

**Suggested Books:**

1. Eugene Odum, Fundamentals of Ecology, , Cengage
2. Kormondy Edward, Concepts of Ecology, Pearson Education
3. Smith, Elements of Ecology, Pearson Education
4. Santra, Fundamentals of Ecology and Environmental Biology,
5. Rana, Essentials of Ecology and Environmental Science, PHI
6. Ecology: The Experimental Analysis of Distribution and Abundance, Person
7. The Ecology Book (Big Ideas Simply Explained), DK, DK publication
8. M. Dash, Fundamentals of Ecology, McGraw Hill Education
9. Manuel C Molles, Ecology: Concepts and Applications, McGraw-Hill Higher Education
10. Alan, First Ecology, Oxford
11. PD Sharma, Ecology and Environment, Rastogi Publications

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**Structure of Theory Examination Paper – External****SECTION-I**

1. Answer the following (Two short Questions)
  - A. Write a short note..... 07
  - B. Explain ..... 07
- OR**
1. Answer the question (One long Question) 14
2. Answer the following (Two short Questions)
  - A. Write a short note..... 07
  - B. Explain ..... 07
- OR**
2. Answer the question (One long Question) 14  
**Note:** Question 1 and 2 from the unit-1 and 2 respectively.
3. Do as direct (any seven out of eight questions each of one mark) 07  
**Note:** Question 3 from the unit-1 and 2.

**SECTION-II**

1. Answer the following (Two short Questions)
  - A. Write a short note..... 07
  - B. Explain ..... 07
- OR**
1. Answer the question (One long Question) 14
2. Answer the following (Two short Questions)
  - A. Write a short note..... 07
  - B. Explain ..... 07
- OR**
2. Answer the question (One long Question) 14  
**Note:** Question 1 and 2 from the unit-3 and 4 respectively.
3. Do as direct (any seven out of eight questions each of one mark) 07  
**Note:** Question 3 from the unit-3 and 4.



## **M.Sc.(Microbiology) SEMESTER – IV**

### **Micro – 418 : Dissertation/Project**

- Selection of the dissertation topic should be new and not repeated amongst the class students.
- Any reported case study will not be considered as a dissertation report.
- Dissertation carried out from other than the affiliated university/college will be liable to produce the attendance and work carried out certificate from the respected university/institute/industries. The original certificate should be attached to the dissertation report.

### **MICR 419: Seminar Course**

- Seminar course includes the topic selection for dissertation.
- Seminar course covers the presentation of selected topic and intermediate evaluation of dissertation.

### **MICR 420: Submission (Research Proposal & Review Article)**

- Preparation of research proposal prescribe format of state and nation funding agency such as GUJCOST, DST-SERB, DBT, ICMR etc. download from portal.
- Research paper and review article writing from the national and international publisher such as Current Sciences, Elsevier, Springer, Taylor and Francis, Wiley etc. download the instruction from selected journal.