Estd. 1962
"A++" Accredited by NAAC (2021)
With CGPA 3.52

SHIVAJI UNIVERSITY, KOLHAPUR - 416004, MAHARASHTRA
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शिवाजी विद्यापीठ, कोल्हापूर -४१६००४,महाराष्ट्र
दूरध्वनी-ईपीएबीएक्स -२६०९०००, अभ्यासमंडळे विभाग दुरध्वनी ०२३१—२६०९०९४
०२३१—२६०९४८७

SU/BOS/Science/06 **Date: 01/01/2024**

To,

The Principal, All Concerned Affiliated Colleges/Institutions Shivaji University, Kolhapur	The Head/Co-ordinator/Director All Concerned Department (Science) Shivaji University, Kolhapur.

Subject: Regarding syllabi of B.Sc. Part-III (Sem. V & VI) as per NEP-2020 (1.0) degree programme under the Faculty of Science and Technology.

Sir/Madam,

With reference to the subject mentioned above, I am directed to inform you that the university authorities have accepted and granted approval to the revised syllabi, nature of question paper and equivalence of B.Sc. Part-III (Sem. V & VI) as per NEP-2020 (1.0) degree programme under the Faculty of Science and Technology.

B.Sc.-III (Sem. V & VI) as per NEP-2020 (1.0)			
1.	Mathematics	12.	Computer Science (Opt)
2.	Statistics	13.	Computer Science (Entire)
3.	Physics	14.	Information Technology (Entire)
4.	Microbiology	15.	Food Science and Technology (Entire)
5.	Industrial Microbiology	16.	Food Science
6.	Electronics	17.	Food Science and Quality Control (Entire)
7.	Chemistry	18.	Food Technology &Management (Entire)
8.	Sugar Technology (Entire)	19.	Biochemistry
9.	Geology	20.	Biotechnology (Optional/Vocational)
10.	Zoology	21.	Biotechnology (Entire)
11.	Botany	22.	Environmental Science (Entire)

This syllabus, nature of question and equivalence shall be implemented from the academic year 2024-2025 onwards. A soft copy containing the syllabus is attached herewith and it is also available on university website www.unishivaji.ac.in NEP-2020(Online Syllabus)

The question papers on the pre-revised syllabi of above-mentioned course will be set for the examinations to be held in October /November 2024 & March/April 2025. These chances are available for repeater students, if any.

You are, therefore, requested to bring this to the notice of all students and teachers concerned.

Thanking you,

Dy Registrar
Dr. S. M. Kubal

Copy to:

SHIVAJI UNIVERSITY, KOLHAPUR

Established: 1962

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Structure and Syllabus in Accordance with

Choice Based Credit System with Multiple Entry and Multiple Exit options as per NEP-2020

B. Sc. Part III

Microbiology

Programme Structure

Under Faculty of Science & Technology

(To Be Implemented From Academic Year 2024-25)

Structure of B.Sc. III Microbiology Programme Sem V&VI

SEMESTER–V (Duration–6 Months)																	
Sr. No.	Subject Title	TEACHING SCHEME						EXAMINATION SCHEME									
		THEORY			PRACTICAL			THEORY					PRACTICAL				
								Internal		University							
		Credits	No. of lectures	Hours	Credits	No. of lectures	Hours	Max Marks	Min Marks	Hours	Max Marks	Min Marks	Hours	Max Marks	Min Marks
1	DSE-E 49 Course IX Virology	**2**	3	2.4				10	4	2	40	**14**	**PRACTICAL EXAMINATION IS ANNUAL**		
2	DSE-E 50 Course X Immunology	**2**	3	2.4				10	4	2	40	**14**			
3	DSE-E 51 Course XI Food and Industrial Microbiology	**2**	3	2.4	**8**	**20**	**16**	10	4	2	40	**14**			
4	DSE-E 52 Course XII Agricultural Microbiology	**2**	3	2.4				10	4	2	40	**14**			
5	AECC-E	**4**	4	3.2				10	4	2	40	**14**			
6	SEC-V	Any one from pool of courses			**2**	---	---	---	---				**2**	**50**	**18**
	TOTAL	**12**	**16**	**12.8**	**10**	**20**	**16**	**50**			**200**				

SEMESTER–VI (Duration–6 Months)																	
Sr. No.	Subject Title	TEACHING SCHEME						EXAMINATION SCHEME									
		THEORY			PRACTICAL			THEORY						PRACTICAL			
								Internal		University							
		Credits	No. of lectures	Hours	Credits	No. of lectures	Hours	Max Marks	Min Marks	Hours	Max Marks	Min Marks		Hours	Max Marks	Min Marks	
1	DSE-F 49 Course XIII Microbial Genetics	**2**	3	2.4				10	4	2	40	**14**					
2	DSE-F 50 Course XIV Microbial Biochemistry	**2**	3	2.4				10	4	2	40	**14**					
3	DSE-F 51 Course XV Environmental Microbiology	**2**	3	2.4	**8**	**20**	**16**	10	4	2	40	**14**		**As per BOS Guide- Lines**			
4	DSE-F 52 Course XVI Medical Microbiology	**2**	3	2.4				10	4	2	40	**14**					
5	AECC-E	**4**	4	3.2				10	4	2	40	**14**					
6	SEC-VI	Any one from pool of courses			**2**	---	---							**2**	**50**	**18**	
	TOTAL	**12**	**16**	**12.8**	**10**	**20**	**16**	**50**			**200**						
	GRAND TOTAL	**24**	**32**	**25.6**	**20**	**40**	**32**			**400**	**800**						

• Student contact hours per week: 28.8 Hours (Min)	• Total Marks for B.Sc.-III (Including English): **800**
• Theory and Practical Lectures: 48 Min. Each	• Total Credits for B.Sc.-III (Semester V&VI): **44**
• **DSE-Discipline Specific Elective.** A candidate shall select one course (subject) from the three Courses (Subjects) selected at B.Sc.–II. Select any 4 pairs of papers from DSE-E1 to DSE-E84 for Sem –V and DSE- F1 to DSE-F84 for Sem-VI	
• **AECC**-Ability Enhancement Compulsory Course (E & F): English for communication	
• ***There shall be separatee passing for internal, theory and practical examinations.***	
• ***Practical Examination shall be conducted annually for 200 marks, and minimum 70 marks are required forpassing.***	
• ***University semester end exam shall be of 40 marks per paper and minimum 14 marks are required for passing.***	
• ***Minimum 4 marks are required for passing out of 10 for Internal Examination of each paper.*** • ***Examination of SEC shall be either theory or practical depending upon type of SEC.***	

Class	B. Sc. - I	B. Sc. - II	B. Sc. - III	Total
Marks	1200	1100	800	3100
No. of Credits	60	56	44	160

SHIVAJI UNIVERSITY, KOLHAPUR

REVISED SYLLABUS FOR BACHELOR OF SCIENCE PART III: MICROBIOLOGY AS PER NEP 2020

1. TITLE: Microbiology
2. YEAR OF IMPLEMENTATION: Revised Syllabus will be implemented from June 2024 onwards.
3. PREAMBLE:

This syllabus is framed to give sound knowledge with understanding of Microbiology to undergraduate students at first year of three years of B.Sc. degree course. Students learn Microbiology as a separate subject from B.Sc. I. The goal of the syllabus is to make the study of Microbiology popular, interesting and encouraging to the students for higher studies including research. The new and updated syllabus is based on a basic and applied approach with vigor and depth. At the same time precaution is taken to make the syllabus comparable to the syllabi of other universities and the needs of industries and research.

The syllabus is prepared after discussion at length with number of faculty members of the subject and experts from industries and research fields. The units of the syllabus are well defined, taking into consideration the level and capacity of students.

4. GENERAL OBJECTIVES OF THE PROGRAMME:
   1) To make the students knowledgeable with respect to the subject and its practicable applicability.
   2) To promote understanding of basic and advanced concepts in microbiology.
   3) To expose the students to various emerging areas of Microbiology.
   4) To prepare students for further studies helping in their bright career in the subject
   5) To expose the students to different processes used in industries and in research field
   6) To develop their ability to apply the knowledge of microbiology in day-to-day life.
   7) To prepare the students to accept the challenges in life sciences.
   8) To develop skills required in various industries, research labs and in the field of human health.

7. DURATION: The course shall be a full-time course.

8. PATTERN: Pattern of Examination will be Semester.

9. MEDIUM OF INSTRUCTION: The medium of instruction shall be in English.

8. STRUCTURE OF COURSE -

1) B. Sc. III: Total Number of Courses - 8

Sr. No.	Subjects	Marks
	SEMESTER V	
1.	Course – IX	40+10
2.	Course – X	40+10
3.	Course – XI	40+10
4.	Course – XII	40+10
	SEMISTER VI	
5.	Course – XIII	40+10
6.	Course – XIV	40+10
7.	Course – XV	40+10
8.	Course – XVI	40+10
	PRACTICAL COURSE	
9	Practical – I	50
10	Practical – II	50
11	Practical – III	50
12	Practical – IV	50
Total		600

2) Structure and Titles of Papers of B.Sc. III Course:

SEMESTER V	
Course IX (DSE-E 49)	Virology
Course X (DSE-E 50)	Immunology
Course XI (DSE-E 51)	Food and Industrial Microbiology
Course XII (DSE-E 52)	Agricultural Microbiology

SEMESTER VI	
Course XIII (DSE-F 49)	Microbial Genetics
Course XIV (DSE-F 50)	Microbial Biochemistry
Course XV (DSE-F 51)	Environmental Microbiology
Course XVI (DSE-F 52)	Medical Microbiology

9. SCHEME OF TEACHING AND EXAMINATION:

[The scheme of teaching and examination should be given as applicable to the course/paper concerned.]

Sr. No.	**Subject/Paper**	**Teaching Scheme (Lectures/week)**		
		L	**P**	**Total**
1	Course – IX and XIII (DSE E 49 and F 49)	3		
2	Course – X and XIV (DSE E 50 and F 50)	3		
3	Course – XI and XV (DSE E 51 and F 51)	3		12
4	Course – XII and XVI (DSE E 52 and F 52)	3		
5	Practical I		5	
6	Practical II		5	20
7	Practical III		5	
8	Practical IV		5	
	Total	**12**	**20**	**32**

10. SCHEME OF EXAMINATION:

- The theory examination shall be conducted at the end of each semester of academic year.
- Each theory paper shall carry 40 marks.
- The evaluation of the performance of the students in theory papers shall be on the basis of Semester Examination of 600 marks.
- Question Paper will be set in view of the / in accordance with the entire Syllabus and preferably covering each unit of syllabi.

11. EQUIVALENCE IN ACCORDANCE WITH TITLES AND CONTENTS OF PAPERS FOR REVISED SYLLABUS

Sr. No.	TITLE OF OLD PAPER	TITLE OF NEW PAPER
1	Course IX (DSE E 49): Virology	Course IX (DSE E 49): Virology
2	Course X (DSE E 50): Immunology	Course X (DSE E 50): Immunology
3	Course XI (DSE E 51): Food and Industrial Microbiology	Course XI (DSE E 51): Food and Industrial Microbiology
4	Course XII (DSE E 52): Agricultural Microbiology	Course XII (DSE E 52): Agricultural Microbiology
5	Course XIII (DSE F 49): Microbial Genetics	Course XIII (DSE F 49): Microbial Genetics
6	Course XIV (DSE F 50): Microbial Biochemistry	Course XIV (DSE F 50): Microbial Biochemistry
7	Course XV (DSE F 51): Environmental Microbiology	Course XV (DSE F 51): Environmental Microbiology
8	Course XVI (DSE F 52): Medical Microbiology	Course XVI (DSE F 52): Medical Microbiology
9	Practical – I, II, III, IV	Practical – I, II, III, IV

12. OTHER FEATURES:

A. LIBRARY: Reference and Text Books, Journals and Periodicals, Reference Books for Advanced studies. - List Attached

B. SPECIFIC EQUIPMENTS: Necessary to run the Course - OHP, Computer, L.C.D., Projector

C. LABORATORY SAFETY EQUIPMENTS:
- Fire extinguisher
- First aid kit
- Fumigation chamber
- Stabilized power supply
- Insulated wiring for electric supply.
- Good valves, distribution pipes & regulators for gas supply.
- Operational manuals for instruments.
- Emergency exits.

Nature of Question Papers (Theory)

Maximum Marks: 40
Duration: 2 hrs

Q. 1 Select the most correct alternate from the following **[8]**

i) to viii) MCQ one mark each with four options
A)
B)
C)
D)

Q.2 Attempt any TWO of the following **[16]**
A)
B)
C)

Q. 3 Attempt any FOUR of the following **[16]**
a)
b)
c)
d)
e)
f)

B. SC. Part III MICROBIOLOGY

SEMESTER V

COURSE IX (DSE E 49) VIROLOGY

(Credit-2, Total Lectures- 30)

Learning Objectives:

1. Gives basics concepts on animal & plant virus isolation, purifications and cultivation.
2. Provides in depth knowledge on reproduction of bacteriophages.
3. Give in depth knowledge on methods of enumeration of viruses.
4. Give in-depth understanding on viral replication.

Learning Outcomes:

1. Be able to explain about bacteria and viruses cultivation method.
2. Be able to describe properties of viruses and bacteria
3. Be able to explain methods of enumeration of viruses
4. Be able to conversant with viral replication lytic cycles and lysogeny.

UNIT – I / CREDIT - I Lectures - 15

1) The Structural properties of viruses: Capsids, Nucleic acids and envelope. Structure of T4 bacteriophage, TMV and HIV, Viroids and prions.
2) Reproduction of Bacteriophages:
    a) One step growth experiment.
    b) Reproduction of T4 phage.
3) Isolation, cultivation and Purification of viruses
    a) Isolation and cultivation of viruses:
        i) Animal virus - Tissue culture, chick embryo and live animals
        ii) Plant virus – Whole plant, Protoplasts, Insect cell culture
        iii) Bacteriophages - Plaque method
    b) Purification of viruses based on physico-chemical properties:
        i) Density gradient centrifugation
        ii) Precipitation
4) Methods of Enumeration of viruses
        i) Latex droplet method (Direct electron microscopic count)
        ii) Plaque and pock assay method.

UNIT – II / CREDIT - II Lectures - 15

1) Lysogeny
    a) Introduction
        - Definition of lysogeny
        - Temperate phages
    b) Lysogeny by lambda phage
        - Adsorption and penetration of λ phage
        - Circularization of lambda genome
        - Genetic map for lysogenic interaction
        - Expression of λ genes
        - Establishment of repression
        - Maintenance of repression
        - Integration of λ genome into host genome
2) Reproduction of animal virus - Adenovirus.
3) Reproduction of plant virus - TMV
4) Oncogenesis:
    a) Definition of oncogenesis
    b) Types of cancers
    c) Characteristics of cancer cells.
    d) Genetic basis of cancer- Oncogene, Tumor suppressor gene, DNA repair genes
    e) Hypothesis about cancer.
        i) Somatic mutation hypothesis
        ii) Defective immunity hypothesis
        iii) Viral gene hypothesis
            - Provirus theory
            - Protovirus theory
            - Oncogene theory

BOOKS RECOMMENDED

1. General Microbiology - Stanier
2. Microbiology - Prescott, Klein
3. Microbiology - Davis
4. General Virology - Luria
5. Genetics of Bacteria and their Viruses - William Hayes.
6. General Microbiology Vol. II - Powar and Daginawala
7. Virology - Biswas and Biswas
8. Virology Vol. 4- Toply and Wilson
9. Principals of virology- S.J. Flint
10. Bacterial and Phage Genetics – Birge

COURSE X (DSE E 50) IMMUNOLOGY

(Credit-2, Total Lectures- 30)

UNIT – I / CREDIT - I Lectures – 15

Learning Objectives:

1. Gives a detailed information on cells and organs of the immune system.
2. Gives in depth knowledge about molecular mechanism of antibody production.
3. Provides the details on complement and monoclonal antibodies.
4. Gives central concepts in cytokines and hypersensitivity and autoimmunity

Learning Outcomes:

1. Be able to describe immunology basics of cells and organs involved in immune system.
2. Be able to understand the theoretical principles of in monoclonal antibodies.
3. Be able to explain allergic reactions.
4. Be able to explain immunization procedure and immunization programmes.

A) Cells and organs of the immune system:

I) Cells of the immunesystem

i. Hematopoiesis- Characteristics and Types of stem cells
ii. Classification of cells of immune system-Lymphoid and myeloid cells
iii. Structure and functions of Lymphoid cells- T cells and T cell subsets, NK cells, B cells and dendritic cells
iv. Structure and functions of myeloid cells – Granulocytes, Monocytes and macrophages

II) Organs of the immune system

Primary and secondary lymphoid organs - Structure and functions of Thymus, bone marrow, spleen , lymph node and Mucosa associated lymphoid tissue(MALT)

B) Molecular mechanism of antibody production:

i. Processing and presentation of antigen by Antigen presenting cell.
ii. Interaction of APC with T_H cell
iii. Interaction of B cell and T_H cell
iv. Proliferation and differentiation of activated B cells
v. Role of follicular dendritic cells in selection of high affinity B cells
vi. Role of cytokines in proliferation and differentiation

C) Complement:

i. Nature, Properties, Complement activation by classical and alternate pathway.
ii. Biological consequences of complementactivation

D) Monoclonal antibodies:

i. Concepts of Polyclonal and monoclonal antibodies
ii. Production of mouse monoclonal antibodies by hybridoma technology.
iii. Types of monoclonal antibodies- Mouse, Chimeric, Humanized and Human antibodies
iv. Applications of monoclonal antibodies.

UNIT – II / CREDIT - II Lectures - 15

A) Cytokines:

i. General characters of cytokines
ii. Cytokines produced by different T_H cells and Macrophages.
iii. Effects of cytokines
iv. Interferon–properties- types, inducers of Interferon, Mechanism of action- antiviral and immunoregulatory

B) Hypersensitivity:

i. Basic concept ,Gell and Coombs classification
ii. Type I-Anaphylaxis
iii. Type II-Blood transfusion reactions
iv. Type III-Serum sickness.
v. Type IV- Delayed type hypersensitivity –Allergy of infection, Allograftrejection.

C) Immunological tolerance and Autoimmunity:

i. Immunological tolerance
   a) Natural or self tolerance and induced tolerance
   b) Cellular mechanism of immunological tolerance- Central tolerance and peripheral tolerance
   c) Termination of tolerance
ii. Autoimmunity :
   a) Concept
   b) Autoimmune diseases: Types, Immunopathological mechanisms-Rheumatoid arthritis, Treatment of autoimmunediseases

Books Recommended :

1) Immunology - 6th edition - Kubay ,Kindt, Goldsby & Osborne.
2) Essential Immunology - 11th edition - Delves, Martin, Burton and Roitt.
3) Immunology - An Introduction, 4th edition – Tizzard.
4) Basic and Clinical Immunology 5th edition- Stites, Stobo, H. H. Fudenberg.
5) Essentials of Immunology - S. K. Gupta
6) Immunology – M. P. Arora
7) Textbook of Basic and clinical Immunology- Sudha Gangal, Shubhangi Sontakke University Press
8) The elements of Immunology- Fahim Khan, Pearson Publication 2009
9) Immunology Second Edition- Vaman Rao.

COURSE XI (DSE E 51) FOOD AND INDUSTRIAL MICROBIOLOGY

(Credit-2, Total Lectures- 30)

UNIT – I / CREDIT - I Lectures – 15

Learning Objectives:

1. To give information on industrial applications of microorganisms
2. To know about industrial production of various fermented food products
3. To provide information on downstream processing of the products
4. To provide in depth information on strain improvement and quantification of products

Learning Outcomes:

1. Be able to know about food microbiology
2. Be able to understand the process economics and down stream processing
3. Be able to understand food infections and food poisoning
4. Be able to gain in depth idea about strain improvement and quantification of products

1) Food Microbiology

a) Food as a substrate for microorganisms: Intrinsic and extrinsic factors
b) Sources of microorganisms to food
c) Food spoilage: spoilage wine and beer, spoilage of vinegar
d) General Principles and methods of food preservation
e) Determination of: TDP, TDT, D, F, and Z values
f) Food poisoning:
    a. Role of microorganisms in food poisoning
    b. Food poisoning: i) Staphylococcal
       ii) Fungal (aflatoxin)
g) Food infections: food infection: Salmonellosis.
h) Probiotics: Concept and applications

2) Industrial Microbiology

A) Strain Improvement
B) Scale up of fermentations
C) Microbiological assays

UNIT – II / CREDIT - II Lectures - 15

1) Industrial Microbiology

A. Preservation of industrially important microorganisms: Methods & Culture collection centers.
B. Industrial production of:
    a. Alcohol: - Organisms used, Inoculum preparation, Fermentation media, Fermentation conditions, Extraction and Recovery.
    b. Grape wine: - Definition, types, production of table wine (Red and White) and microbial defects of wine
    c. Penicillin: - Organisms used, Inoculum preparation, Fermentation media, Fermentation conditions, Extraction and Recovery. Concept of semi synthetic penicillin
C. Down stream processing & product recovery :
   Centrifugation, flocculation, filtration, solvent extraction, distillation, precipitation, crystallization and chromatography.
D. Testing of sterility, pyrogen, carcinogenicity, toxicity and allergens

Books Recommended:

1. Principles of fermentation technology- Peter F. Stanbury & Allan Whitaker (Pergamon Press).
2. Principles of Microbial technology - Peppler, Vol. I & II.
3. Industrial Microbiology - Casida
4. Industrial Microbiology - A. H. Patel
5. Industrial Microbiology - Prescott & Dnn
6. Industrial Microbiology - Miller
7. Pharmaceutical Microbiology - Huggo & Russel
8. Modern food Microbiology - Jay & Jay
9. Food Microbiology - Frazier
10. Industrial Microbiology- Cruger.
11. Fermentation Technology- A.H.Modi - Vol. I and II

COURSE XII (DSE E 52) AGRICULTURAL MICROBIOLOGY

(Credit-2, Total Lectures- 30)

Learning Objectives:

1. To provide in-depth information about soil microbiology
2. To give information on role of microorganisms in elemental cycles and soil reclamation.
3. To give knowledge on production, methods of application of biofertilizers and biopesticides.
4. To provide in-depth knowledge about various organisms for practical applications.

Learning Outcomes:

1. Be able to acquaint themselves about soil microbiology
2. Be able to understand role of microorganisms in elemental cycles and soil reclamation.
3. Be able to gain knowledge on various production, methods of application of biofertilizers and biopesticides
4. Be able to know methods of soil reclamation.

UNIT – I / CREDIT - I

Lectures – 15

1) Soil Microbiology
   a. Physical characters- Soil structure, Soil texture, Soil profile, Soil colour, Soil tilth
   b. Chemical characters- pH, Cation exchange capacity, Soil nutrient, Electrical conductivity
   c. Types of microorganisms in soil and their role in soil fertility.
   d. Microbiological interactions - Symbiosis, Commensalism, Amensalism, Parasitism, and Predation.
2) Role of microorganisms in elemental cycles
   a. Carbon cycle.
   b. Nitrogen cycle
   c. Phosphorous cycle
3) Role of Microorganisms in reclamation of soil.
   I) Manure and Compost
      Methods of Production:
      a) Green manure
      b) Vermicompost
   II) Optimal conditions for composting with reference to - Composition of organic waste, Availability of microorganisms, Aeration, C: N:P ratio, Moisture content, Temperature, pH and Time.
   III) Standards of City Compost and Vermicompost as per Fertilizer Control Order.

UNIT – II / CREDIT - II Lectures - 15

1) Types, production, methods of application and uses of:

A) Biofertilizers

i) Nitrogen fixing - Azotobacter, Rhizobium, and Azospirillum.

ii) Phosphate Solubilizing Microorganisms.

B) Biopesticides

a) Bacillus thuringiensis

b) Tricoderma spp.

2) Biodegradation of:

a) Cellulose

b) Pesticides

3) Plant Pathology:

a) Common symptoms produced by plant pathogens

b) Modes of transmission of plant diseases.

c) Plant diseases :

i) Citrus Canker

ii) Tikka disease of groundnut

iii) Bacterial Blight of Pomegranate.

Books Recommended:

1. Soil Microbiology - An exploratory approach - Mark Coyne.
2. Agricultural Microbiology - N. Mukherjee and J. Ghosh.
3. Introduction to Soil Microbiology - Martin Alexander II
4. Edition.
5. Agricultural Microbiology - Rangaswamy and Bhagyaraj II
6. Plant diseases - R. S. Singh.
7. Plant pathology - R. S. Mehrotra.
8. Diseases of crop plants in India - G. Rangaswamy.
9. Principles of Soil Science - M. M. Rai.
10. Soils and Soils Fertility- 6th edition-Frederick R.Troeh (Blackwell publishing Co.)
11. 10.Soil Microbiology- Singh, Purohit, Parihar. (Agrobios India , 2010)
12. Soil Microbiology and Biochemistry – Ghulam Hassan Dar (New India Publishing Agency, 2010)

B.SC.III MICROBIOLOGY

SEMESTER VI

Course XIII (DSE F 49) MICROBIAL GENETICS

(Credit-2, Total Lectures- 30)

Learning Objectives:

1. Gives basic concepts bacterial genome.
2. Provides in depth knowledge on molecular mechanism of gene expression
3. Gives overall picture about DNA mutations
4. Provides in depth information genetic complementation and extrachromosomal inheritance.

Learning Outcomes:

1. Be able to gain knowledge on genome diversity and gene transfer mechanisms,.
2. Capable to gain information on mutations and gene transfer mechanisms
3. Capable to gain in depth-knowledge on DNA and biosynthesis
4. understand about positive and negative gene regulation

UNIT – I/ CREDIT I Lectures - 15

1) Basic concepts of bacterial genome -
   a) Structural organization of *E. coli* chromosome - Folded Fiber model.
   b) One cistron - one polypeptide hypothesis.
2) Molecular mechanism of gene expression
   a) Concept of operon
   b) Pribnow box
   c) Genetic regulation in tryptophan operon
3) Mutations
   a) Expression of mutations -
      i) Time course of phenotypic expression.
      ii) Conditional expression of mutation.
   b) Suppressor mutations (with examples) - Genetic and non-genetic.
4) Methods of isolation and detection of mutants based on -
   a) Relative survival

b) Relative growth
c) Visual detection

UNIT – II / CREDIT II Lectures - 15

1) Genetic complementation - Cis-trans test

2) Extrachromosomal inheritance :
   a) Kappa particles.
   b) Transposable elements - general properties and types.

3) Techniques in Molecular Biology –

   a) DNA sequencing (Sanger's method)
   b) DNA Finger printing
   c) PCR

4) Genetic engineering
   a) Introduction
   b) Tools of genetic engineering –
      i) Enzymes
      ii) Vectors-phage, plasmid and cosmid
      iii) DNA probe
      iv) Linkers and adaptors
      v) Cloning organisms - (Bacteria and Yeasts)
      vi) Genomic library and cDNA library
   c) Techniques –
      i) Isolation of desired DNA segment- Shotgun Method, cDNA synthesis, Chemical synthesis
      ii) Construction of r-DNA using appropriate vector- Use of restriction enzymes, Linkers, Adaptors, Homopolymer tails
      iii) Transfer to cloning organisms (Bacteria and Yeasts)
      iv) Selection of recombinant bacteria and yeasts – Blue and white screening, Colony hybridization technique.
   d) Application of genetic engineering in –
      i) Medicine-
      ii) Agriculture
      iii) Industry
      iv) Environment

Books Recommended:

1. Genetics - Stickberger.
2. Genes - Benjamin Lewin IX ed.
3. Principles of gene manipulation - Primrose and Old
4. Genetic Engineering - Second Ed. Desmond S. T. Nicholl
5. Recombinant DNA - J. D. Watson
6. Biochemistry - Lehninger
7. Molecular Biology of Gene - J. D. Watson
8. Principles of Genetics - Herskowitz
9. General Microbiology - Stanier

COURSE XIV (DSE F 50) MICROBIAL BIOCHEMISTRY

(Credit-2, Total Lectures- 30)

Learning Objectives:

1. To provide basic concepts of enzymes.

2. To provide in depth information about microbial metabolism.

3. To provide in depth information on biosynthesis of various biomolecules.

4. To provide in depth information regulation of enzyme synthesis and operon concepts.

Learning Outcomes:

1. Be able to understand basic concepts of enzymes.

2.Aquanted with information about microbial metabolism.

3. Be able to explain information on biosynthesis of various biomolecules..

4.Understand regulation of enzyme synthesis and operon concepts.

UNIT – I / CREDIT I Lectures - 15

1) Enzymes -

A) Definition, properties, structure, specificity, mechanism of action (Lock & Key, Induced fit hypothesis), Basics of enzyme classification.

B) Allosteric enzymes - Definition, properties, models explaining mechanism of action (Concerted and sequential models). Patterns of feed back inhibition.

2) Extraction and purification of enzymes.

A) Methods of extraction of intracellular and extracellular enzymes. i) Choice of source and biomass development

B) Methods of homogenization - cell disruption methods

C) Purification of enzymes on the basis of - a) Molecular size, b) Solubility differences c) Electrical charge, d) Adsorption characteristic differences e) Differences in biological activity

3) Assay of enzymes - Based on substrate and product estimation.

4) Ribozymes and Isozymes.

5) Immobilization of enzymes - Methods and applications

UNIT – II / CREDIT II Lectures - 15

1) Factors affecting enzyme activity-

a) Factors affecting catalytic efficiency of enzymes- i) Proximity and orientation, ii) Strain and distortion, iii) Acid base catalysis, iv) Covalent catalysis

b) Environmental factors influencing enzyme activity- i) Substrate concentration,

ii) Temperature, iii) pH, iv) Metal ions

2) Kinetics of single substrate-enzyme catalyzed reactions - Derivation of Michaelis-Menten equation, Lineweaver Burk Plot, Significance of Km and Vmax.

3) Microbial Metabolism

I) Basics in carbohydrate metabolism-

a) PP pathway, ED pathway, Phosphoketolase pathway

b) Pyruvate as a key intermediate

c) Glyoxylate bypass

II) Assimilation of -

a) Carbon

b) Nitrogen with respect to N_2 and NH_3 (GOGAT)

c) Sulphur

4) Biosynthesis of -

a) RNA, b) DNA, c) Proteins, d) Peptidoglycan

5) Regulation of enzyme synthesis. i) Positive control - Ara operon, ii) Negative control - Lac operon iii) Catabolite repression

Books Recommended:

1. Enzymology - Prise & Stevens
2. Enzymes - Biochemistry, Biotechnology, clinical chemistry - Trevor Palmer.
3. Enzymes - Dixon and Webb
4. Nature of Enzymology - R. L. Foster,
5. Lehnigers Principles of Biochemistry by David Nelson & Michale Cox, Fifth edition.
6. General Microbiology - Stanier
7. Principles & techniques of Biochemistry - Wilson & Walker,6th edition.
8. Biochemistry - Lubert Stryer

COURSE XV (DSE F 51) ENVIRONMENTAL MICROBIOLOGY

(Credit-2, Total Lectures- 30)

Learning Objectives:

1. To provide overview of solid and liquid waste.
2. To give in-depth information about sewage microbiology.
3. To give knowledge about wastes of different industries.
4. To provide information about bioremediation and bioleaching methods.

Learning Outcomes:

1. Be able to acquaint with solid and liquid waste.
2. Be able to know about sewage microbiology.
3. Be able to understand the knowledge about wastes of different industries.
4. Be able to understand the solid waste management.

UNIT – I / CREDIT I Lectures - 15

1) General characteristics of waste-
   a) Liquid waste - pH, electrical conductivity, COD, BOD, total solids, total dissolved solids, total suspended solids, total volatile solids, chlorides, sulphates, oil & grease.
   b) Solid waste- pH, electrical conductivity, total volatile solids, ash.
   c) Standards as per MPCB.
2) Sewage Microbiology
   a) Physico-chemical and Biological characteristics
   b) Treatment
      i) Biological treatment: Trickling filter, Activated sludge process, Oxidation ponds, Anaerobic digestion, Septic tank, Root zone technology
      ii) Chemical treatment - Chlorination
3) Characteristics and treatment of waste generated by
   a) Sugar Industry
   b) Distillery
   c) Dairy Industry

d) Hospital

4) Eutrophication
   a) Classification of lakes
   b) Sources
   c) Consequences
   d) Control

UNIT – II / CREDIT II Lectures - 15

1) Biological safety in laboratory
   a) Good Laboratory Practices
   b) Bio safety levels (BSL)

2) Environmental monitoring
   a) Definition and purpose
   b) Cleanroom classification
   c) Routine Environmental monitoring programme in pharmaceutical industries- Air monitoring, Surface monitoring and Personnel monitoring.
   d) Bioburden test

3) Environmental Impact Assessment- Concept and Brief introduction

4) Bioremediation and Bioleaching
   a) Bioremediation
      i) Definition
      ii) Types
      iii) Applications.
   b) Bioleaching
      i) Introduction
      ii) Microorganisms involved
      iii) Chemistry of Microbial leaching
      iv) Laboratory scale and pilot scale leaching
      v) In situ leaching - Slope, heap
      vi) Leaching of Copper and Uranium

Books Recommended:

1. Environmental Pollution by Chemicals - Walker, Hulchiason.
2. Biochemistry and Microbiology of Pollution - Higgins and Burns.
3. Environmental Pollution - Laurent Hodge, Holt.
4. Waste Water Treatment - Datta and Rao (Oxford and IBH)
5. Sewage and waste treatment - Hammer

6. Pollution - Kudesia, Pragati Prakashan Meerat.
7. Environment Chemical Hazards - Ram Kumar (Swarup and Sons, New Delhi).
8. Environment and Metal Pollution - Khan (ABD Pub. Jaipur).
9. Environment Pollution - Timmy Katyal (Satke Anmol Pub. New Delhi).
10. Ecology of Polluted Water - Vol. II - Anand Kumar (Aph Pub. Co. New Delhi).
11. Environment Pollution and Management of waste waters by Microbial Techniques - Pathade and Goel (ABD Pub. Jaipur).
12. Current Topics in Environmental Sciences - Tripathi and Pandey (ABD Pub. Jaipur).
13. Environmental Impact Assessment - R. K. Trivedy
14. Microbial Limit and Bioburden Tests, 2nd edition - Lucia Clontz (CRC Press)

COURSE XVI (DSE F 52) MEDICAL MICROBIOLOGY

(Credit-2, Total Lectures- 30)

Learning Objectives:

1. Provides information on infections and pathogenesis.

2. Helps to learn chemotherapy principle.

3. Be able to explain the symptoms of bacterial infections.

4. Be able to explain the symptoms of viral, fungal and parasitic diseases.

Learning Outcomes:

1. Be able to explain about various infections with respect to pathogenesis ,diagnosis and prevention control..

2. Be able to understand the diagnostic methods.

3. Be able to explain the symptoms of bacterial infections, Protozoal, Viral and Fungal infections.

4. Be able to explain the chemotherapy, chemoprophylaxis, immunoprophylaxis of diseases.

UNIT – I / CREDIT I Lectures - 15

BACTERIAL DISEASES

Morphology, cultural and biochemical characteristics, antigenic structure, modes of transmission, pathogenesis, symptoms, laboratory diagnosis, prevention and control of diseases caused by

i) Mycobacterium tuberculosis ii)Clostridium perfringens iii)Treponema pallidum iv)Pseudomonas aeruginosa v)Vibrio cholera vi)Staphylococcus aureus vii)Leptospira interrogans viii)Klebsiella pneumonia

UNIT – II / CREDIT II Lectures- 15

A. Morphology, cultural and biochemical characteristics, antigenic structure, modes of transmission and pathogenesis, symptoms, laboratory diagnosis, prevention and control of diseases caused by-
   1) Protozoa : *Plasmodium falciparum* (malaria)
   2) Viruses : i) Hepatitis A & B virus , ii) Rabies virus iii) Dengue virus
   3) Fungus: *Candida albicans*

B. Chemotherapy
   1) Chemoprophylaxis
   2) General principles of chemotherapy

3) Mode of action of antimicrobial agents:
    a) Antibacterial drugs: Penicillin, Bacitracin, Piperacillin, cycloserine, Streptomycin, Tetracycline, Trimethoprim, Sulphonamides and Quinolones .
    b) Antiviral drug :AZT,
    c) Antifungal drugs: Ketoconazole, Griseofulvin, Nystatin
    d) Antiprotozoal drugs: Metranidazole, Mepacrine
4) Drug resistance: Reasons and Mechanism of drug resistance
5) Immunoprophylaxis: Vaccines and Immune Sera
    a) Vaccines-live attenuated, inactive, subunit, conjugate and DNA vaccines
    b) Immune Sera- examples with applications

Books Recommended:

1. Microbiology–Davis B.D., Delbacco, 4th edition,1990 ,J.B.Lippincott Co. NY
2. Text book of Microbiology-Ananthnarayan R and C.E. Jayaram Panikar 5th edition, 1996, Orient Longman
3. Medical Bacteriology-Dey N .C. & Dey T.K. 17 th edition 1988, Allied Agency, Calcutta
4. Medical Bacteriology including Medical Mycology & AIDS–T. K. Dey, D. Sinha & N. C. Dey,New Central Book Agency (Kolkata)
5. Principals and Practice of Clinical Bacteriology–A.M.Emmerson
6. Antimicrobial chemotherapy- David Greenwood, 5th edition, Oxford university press
7. Medical Laboratory Technology;Vol. III,-Mukharjee K.L. ,10th edition. Tata Mc Graw-Hill Pub Co.
8. Ananthnarayan and Paniker's Textbook of Microbiology –9th edition , Editor Arati Kapil 2013, University Press

PRACTICAL COURSE

Learning Objectives:

1. Gives hands on experience various isolation techniques of viruses, pathogens, PGPR.
2. Provides hands on experience on various separation methods methods.
3. Will gain knowledge in immunehematology.
4. Gives hands on experience on blood related tests.
5. Given knowledge on virus cultivation.
6. Provides hands on experience on various diagnostic tests.
7. To provide hands on experience with the techniques used in molecular cell biology.
8. To give hands on experiments techniques used in Environmental Microbiology.

Learning Outcomes:

.1. Be able to perform techniques in immunology, virology, food microbiology independently.
2. Be able to perform techniques in environmental microbiology, bioassay, BOD/COD estimation.
3. Able to perform isolation of DNA and its separation by electrophoresis
4.Able to produce citric acid amylase and its estimation by different methods.

Practical - I (Virology and Microbial Genetics)

Major:

1. Isolation of coliphages from sewage.
2. Effect of U.V. light on bacteria and graphical presentation of result.
3. Isolation of auxotrophic mutants by replica plate technique
4. Transfer of genetic material by transformation in *E. coli*
5. Isolation of chromosomal DNA from bacteria (J. Marmurs method or by Phenol chloroform method)

Minor:

1. Electrophoretic separation of DNA.
2. Isolation of streptomycin - resistant mutants (gradient plate technique)
3. Testing of carcinogenicity of a substance by Ame's test.

Practical - II (Food and Industrial Microbiology)

Major:

1. Assay of amylase by DNSA method (graphical estimation)
2. Bio-assay of Vitamin B12
3. Bio-assay of Penicillin.

Minor:

1. Production of wine and examination for pH, colour and alcohol content.
2. Citric acid fermentation, recovery and estimation by titration.
3. Amylase production by using *Bacillus* species.
4. Isolation of lactic acid bacteria from fermented food.
5. Examination of milk by Direct microscopic count (DMC)

Practical - III (Agricultural and Environmental Microbiology)

Major:

1. Isolation of Azotobacter from soil.
2. Isolation of Xanthomonas from infected citrus fruit.
3. Isolation of Rhizobium from root nodules.
4. Isolation of phosphate solublising bacteria from soil.
5. Determination of BOD of sewage

Minor :

1. Estimation of Calcium and Magnesium from soil (EDTA method)
2. Determination of organic carbon content of soil (Walkley and Black method)
3. Determination of COD of sewage.

Books recommended for Practical:

1. Medical Lab Technology - Ramnik and Sood, Jaypee brothers (Medical pub. New Delhi)
2. Practical Biochemistry - Plummer
3. APHA (American Public Health Association) Handbook
4. Soil, Plant and Water Analysis - P. C. Jaiswal
5. Biochemical methods - S. Sadasivam, A. Manickam
6. Practical Biochemistry - J. Jayraman
7. Chemical and Biological Analysis of Water - Dr. R. K. Trivedy and P. K. Goel.

Practical - IV Medical Microbiology

Major :

1. Isolation of following pathogens from clinical samples (wherever possible) and identification of the same by morphological, cultural and biochemical characteristics.
   a) Pseudomonas aeruginosa b) *Staphylococcus aureus* *c) Candida albicans*
2. Determination of MIC of streptomycin against *E. coli* by broth method

Minor :

1. Determination of sensitivity of common pathogens to antibiotics by paper disc method.
2. Serological tests:
   a) Widal test -Quantitative
   b) Rapid Diagnostic Test for Malaria
   c) Demonstration of Enzyme Linked Immunosorbent Assay (ELISA)
3. Haematology:
   a) Estimation of haemoglobin by Sahli's method
   b) Determination of ESR of the blood sample (Wintrobe method)
   c) Determination of PCV
   d) Total and differential blood cells count.
4. Urine analysis: Physical and chemical examination of urine.
   a) Microscopic examination of urine-crystals, RBCs, pus cells and bacteria.
   b) Test for protein (Acetic acid test)
   c) Test for ketone bodies (Rothra'stest)
   d) Test for bile salt and bile pigments.
   e) Test for sugar (Benedict's method)

Books recommended for Practical:

1. Medical Lab Technology-Ramnikand Sood,Jaypee brothers(Medical pub. NewDelhi)
2. Practical Biochemistry -Plummer
3. APHA (American Public Health Association) Handbook
4. Soil, Plant and Water Analysis-P. C.J aiswal
5. Biochemical methods-S. Sadasivam, A. Manickam
6. Practical Biochemistry-J. Jayraman
7. Practical Microbiology – R.C. Dubey, D. K. Maheshwari, S. Chand & Co. Ltd.

Practical Examination

A) The practical examination will be conducted on three (3) consecutive days for not less than 6 hours on each day of the practical exanimation.

B) Each candidate must produce a certificate from the Head of the Department in his/her college stating that he/she has completed in a satisfactory manner the practical course on the guidelines laid down from time to time by Academic Council on the recommendation of Board of studies and has been recorded his/her observations in the laboratory journal and written a report on each exercise performed. Every journal is to be checked and signed periodically by a member teaching staff and certified by the Head of the Department at the end of staff and certified by the Head of the Department at the end of the year. Candidates are to produce their journal at the time of practical examination. Candidates have to visit the least

Two (2) places of Microbiological interest (Pharmaceutical industry, Dairy, Research institutes etc.) and submit the report of their visit at the time of examination. The report should be duly certified by the Head of the Department.

Nature of question paper and distribution of marks for B.Sc. Part III Microbiology Practical Examination

Practicals I, II, III & IV

Q.1 Major Experiment	20 Marks
Q. 2 Minor Experiment	15 Marks
Q.3 Journal	05 Marks

SPOTTING **10 Marks**

VIVA-VOCE **10 Marks**

(On Practicals not attempted in the examination)

TOUR REPORT: **20 MARKS**

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