Punyashlok Ahilyadevi Holkar Solapur University, Solapur

NAAC Accredited 2022
'B^{++}' Grade (CGPA 2.96)

Name of the Faculty: Science & Technology

National Education Policy (NEP) 2020

Syllabus: Microbiology

Name of the Course: M. Sc. II (Sem.– III & IV)

(Syllabus to be implemented June 2024)

M.Sc. II (Sem. III & IV)

The internal assessment will be based on Unit tests, Home assignment, viva, practical, Project Work etc. as given below. Practical examination of 150 marks for 3 practical courses and research project (60+40) shall be conducted at the end of III & 2 practical courses and research project (90+60) shall be conducted at the end of IV semester. The practical examination of 150 marks shall consist of 90 marks for University practical assessment and 60 marks for college internal assessment for IV semester. For University practical examination, there shall be appointment of four examiners two examiners shall be external and two shall be internal appointed by the University. The internal practical assessment shall be done as per scheme given below.

Scheme of evaluation:

As per the norms of the Credit System of evaluation, out of 100 Marks, the candidates have to appear for College internal assessment of 40 marks and external evaluation (University Assessment) of 60 marks. Assessment scheme is given below.

Semester - III:

Theory: (100 marks)

University Examination (60 Marks): Number of Theory papers: 3 Papers, out of which two papers DSC1-5, DSC1-6 are mandatory & paper no. DSE1- 3 is elective.

Research Project- 100 Marks (UA 60+CA 40)

Semester - IV:

Theory: (100 marks)

University Examination (60 Marks): Number of Theory papers: 3, out of which two papers DSC1-7, DSC1-8 are mandatory & paper no. DSE1- 4 is elective.

Research Project- 150 Marks (UA 90+CA 60)

Practical Examination: University Examination (150 Marks):

The university practical examination shall be of three days per batch per semester (at least of six hours duration each day. 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, a practical course on the lines laid down from time to time by Academic Council on the recommendations of Board of Studies and that the laboratory journals have been properly maintained. Every candidate must have recorded his/her observations in the laboratory journal and a written report on each exercise performed. Every journal is to be checked and signed periodically by a member of teaching staff and certified by the Head of the Department at the end of each semester. Candidates are to produce their journals at the time of semester practical examination.

Students shall have to undertake an academic tour for the period of 1 to 2 days to visit places of academic interest like industries, research institutions, R & D departments during semesters II and IV each. The students should submit the tour report at the time of practical examination. The tour report should be duly certified by Head of the department.

Project Work*/Industrial Training**

Project Work Student has to undertake a separate research projects (as part of the semester III and IV) during respective semester. The student should prepare and present dissertation as a report of project in the format of research methodology (Introduction, Aimsand Objectives, Material and Methods, Results and Discussions, Conclusion and Bibliography) and the prepared dissertation of the project shall be submitted to the department within 10 (ten) days at the end of semester III as well as IV examination.

Seminar shall be conducted on research project for each semester (40% CA evaluation)

Each student shall present a seminar of at least half an hour at every semester which is to be attended by all the faculty members of the department and a detailed copy of the seminar presentation shall be submitted to the department. The topic of the seminar shall preferably be research orientated so as to inculcate development of research aptitude and independent thinking among the students.

The overall structure of the course to be implemented from 2024 onwards is as follow

Level	Semester	Major	OE	SEC/VSC	AEC/ IKS/ VEC	Marks	Credits	Cumulative Credits
		Mandatory/ Elective						
6.5/400	III	DSC 1-5 (Theory) Principles of Bioinstrumentation and techniques	-	-	-	100 (60UA+40 CA)	04	22
		DSC 1-6 (Theory) Bioprocess technology				100 (60UA+40 CA)	04	
		DSE 1-3 (Theory) Immunology OR r-DNA technology				100 (60UA+40 CA)	04	
		DSC 1-5 (Practical) Principles of Bioinstrumentation and techniques				50 (30 UA + 20 CA)	02	
		DSC 1-6 (Practical)				50 (30 UA + 20 CA)	02	

		Bioprocess technology						
		DSE 1-3 **(Practical)** **Immunology** **OR** **r-DNA technology**				**50** **(30 UA + 20 CA)**	**02**	
		Research Project				**100** **(60UA +40 CA)**	**04**	
		SEM III				**550**	**22**	
6.5/400	**IV**	**DSC 1-7 (Theory)** **Food and Dairy Microbiology**	**-**	**-**	**-**	**100** **(60UA +40 CA)**	**04**	**22**
		DSC 1-8 **(Theory)** **Molecular Biology and genetic engineering**				**100** **(60UA +40 CA)**	**04**	
		DSE 1-4 **(Theory)** **Agricultural Microbiology** **OR** **Environmental Microbiology**				**100** **(60UA +40 CA)**	**04**	
		DSC 1-7 **(Practical)** **Food and Dairy Microbiology**				**50** **(30 UA + 20 CA)**	**02**	
		DSE 1-4 **(Practical)**				**50** **(30 UA + 20**	**02**	

		Agricultural Microbiology **OR** **Environmental Microbiology**				**CA)**		
		Research Project				**150** **(90UA +60 CA)**	**06**	
	SEM IV					**550**	**22**	
	SEM III + SEM IV					**1100**	**44**	**4** **4**

Total marks for M.Sc. Course – 2200 (Semester I to IV 550 marks each)

Semester III

DSC1-5 Principles of Bioinstrumentation and Techniques

After completing this course students will be able to:
CO 1 Define and describe chromatographic techniques.

CO 2 Study principles and working of various spectroscopic techniques.

CO 3 Learn different immunochemical techniques.

CO 4 Compare and contrast different chromatographic techniques.

CO 5 Analyze electrophoretic separation of by different electrophoresis techniques.

CO 6 Evaluate the significance of various techniques.

UNIT I: Electrochemistry and Electrophoresis **15L**

A) Electrochemistry

a) Ionization of water, weak acid, and weak bases
b) pH, pOH
c) Titration curve reveals the pKa of weak Acid
d) Buffer concept and examples
e) Derivation of Handerson and- Hasselbach equation and
f) Concept of Potentiometric and Conductometric titration.

B) **Electrophoresis**

Types of electrophoresis

a) Zone electrophoresis

i) Gel electrophoresis (Agarose, SDS, and 2D)

ii) Cellulose acetate electrophoresis

b) Moving boundary electrophoresis

i) Capillary electrophoresis

ii) Isotachophoresis

iii) Isoelectric focusing

iv) Immuno-electrophoresis

UNIT II: Chromatography and Centrifugation

15L

A) Chromatography: - Column Chromatography

a) Gel filtration,

b) Ion exchange

c) Affinity chromatography

d) Gas chromatography,

e) High-performance liquid chromatography

B) Centrifugation:

a) Differential centrifugation

b) Density gradient

c) ULTRA centrifugation.

d) Isopycnic

UNIT III: Spectroscopy (Biophysical Methods) 15L

Principle, working, and applications of

a) X-ray diffraction,

b) UV visible spectroscopy

c) IR Spectroscopy

d) CD/ORD Spectroscopy

e) NMR Spectroscopy

f) ESR spectroscopy

g) Atomic absorption spectroscopy

h) Plasma emission spectroscopy

i) Mass Spectroscopy

j) MALDI -TOF

UNIT IV: Microscopy - 15L

a) Optics

i) Refractive index

ii) Focal length

iii) Microscopic resolution

iv) Numerical Aperture

v) Types and properties of microscopic objectives.

vi) Oculars, Illumination.

b) Types of light microscopes:

i) Bright field

ii) Darkfield

iii) Fluorescence

iv) Phase contrast

v) The Differential Interference Contrast Microscope

c) Electron Microscopy:

i) Basic components of electron microscopes.

ii) Types of electron microscopes: TEM, SEM**,**

References:

1. Sharma BK, Instrumental method of chemical analysis
2. DA Skoog. Instrumental methods of analysis
3. Plummer, An introduction to practical Biochemistry
4. Chatwal and Anand, Instrumentation Boyer, Modern experimental Biology
5. Biochemistry by Lubert Stryer
6. Plummer, An introduction to practical Biochemistry
7. Boyer, Modern Experimental Biology
8. Principles and Techniques of Biochemistry and Molecular Biology, Keith Wilson, John Walker. Cambridge University Press India Pvt. Ltd.
9. Biochemistry and Molecular Biology, Keith Wilson, John Walker. Cambridge University Press India Pvt. Ltd.
10. Principles of Physical Biochemistry – Van Holde, et al., Prentice Hall.
11. Crystallography made crystal clear – G. Rhodes, Academic Press.
12. Introduction to Protein Structure – Branden and Tooze, Garland Publishing Co
13. Principles of Protein X-Ray Crystallography - Jan Drenth Third Edition.

DSC 1-6 Bioprocess Technology

CO1: Recall the bioreactor design and monitor its different process variables.

CO2: Discuss downstream processes like Centrifugation, Filtration, Precipitation, Solvent extraction, Chromatography, Ultra Filtration, Crystallization, and whole broth processing for different products.

CO3: Modify the growth of microorganisms by improving the strain for enhanced product fermentation.

CO4: Explain and analyze biosafety, bioethics, and IPR.

CO5: Validate different quality control tests like assay testing, sterility testing, pyrogenicity testing, toxicity and allergy, and carcinogenicity testing for various products.

CO6: Adapt and design guidelines for microbiological practices and quality assurance tests.

Unit-I Bioreactor **15L**

A) Design and Operation.

a) Design aspects, the dimensional ratio of the outer shell, and operational aspects such as working volume, baffles, and impellers. The configuration (placement) of impellers in the vessel and different types of impellers.

b) Facilitation for maintaining all parameters during fermentation. Aeration, Agitation.

c)Sterilization of fermenter and other mechanical systems of fermenter

d) Different types of fermenters. (batch, feed batch, continuous)

B) Monitoring of process variables.

a) Use of various types of sensors and biosensors for maintaining environmental parameters (Foam, pH, temperature, and DO)

b) Computer applications and Automation in the fermentation industry.

Unit-II Upstream and Downstream processes and Quality control. **15L**

A) Upstream Process

a) Screening, strain improvement, Fermentation Media, Optimization of Media

b) Scale up, inoculums preparation, stock culturemaintenance, contamination problems.

B) Downstream Process

a) Product recovery and purification. Solvent extraction, Liquid-liquid extraction, Distillation, Ultra Filtration, Crystallization, and whole broth processing.

C) Quality control and |Fermentation economics

a) Quality control in the fermentation industry. Assay testing, Sterility testing,

Pyrogenicity testing, Toxicity and Allergy, Carcinogenicity testing.

b) Fermentation economics.

Unit-III Industrial production of products **15L**

a) Production of Streptomycin, Amylase, Vitamin B12, and L-Lysine,

b) Production and applications of biopolymers, Xanthan gum, dextran, pullulan, and Alginate.

c) Production of mushrooms, production steps, harvesting and preservation, nutritive value

d) Industrial production of distilled alcoholic beverages. Whisky and Brandy.

Unit-IV Biosafety, Bioethics and IPR **15L**

a) Guidelines for safety in microbiological processes, good manufacturing practices, and biosafety levels of infectious agents.

b) Regulatory practices, process validation, and Quality assurance.

c) Bioethics: concept, case study, GM foods.

d) Intellectual property rights. Basic concepts, patents, trade secrets, Copyrights, and Trademarks. Patent regulatory bodies at the National and International level.

References:

1. Principles of Fermentation Technology by Stanbury, P.F., Whitekar A. and Hall.1995., Pergamon. Mc Neuland Harvey.
2. Fermentations - A practical approach. IRL.
3. Bioprocess Technology: Fundamentals and Applications. Stockholm KTH.
4. Biochemical Reactors by Atkinson B., Pion, Ltd. London.
5. Biotechnology - A Text Book of Industrial Microbiology by Cruger.
6. Fermentation Biotechnology: Industrial Perspectives by Chand.
7. Biochemical Engineering Fundamentals by Bailey and Ollis, Tata McGraw Hill, N.Y.
8. Biotechnology. Volume 3. Edited by H. J. Rehm and G. Reed. Verlag Chemie 1983.
9. Advances in Biochemical Engineering by T.K. Bhosh, A. Fiechter and N.Blakebrough.
10. Springer Verlag Publications, New York.
11. Bioprocess Engineering Kinetics, Mass Transport, Reactors, and Gene Expression by Veith, W. F., John Wiley and Sons.
12. Applied Microbiology Series.
13. Industrial Microbiology by L.E. Casida, Wiley Eastern
14. 10Bioseparation: Downstream processing for Biotechnology by Belter, P. A. Cussler,E.L. and Hu, W.S., John Wiley and Sons, N.Y.
15. Separation process in Biotechnology by Asenjo, J.A. Eds. Marcel Dekkar, N.Y.
16. Bioprocess Engineering Principles by Doran, Acad. Press, London.

17. Bioreaction Engineering Principles by Nielsen, J. and Villadsen, plenum Press, N.Y.
18. Fermentation, Biocatalysis and bioseparation, Encyclopedia of Bioprocess
19. Technology by Chisti, Y., Vol. 5, John Wiley and Sons, N, Y

DSE1-3 Immunology

CO1: Define the innate and acquired immunity.
CO2: Describe immune response for different infectious diseases.
CO3: Explain major histocompatibility complex.
CO4: Classify and differentiate primary and secondary immunodeficiency disorders.
CO5: Summarize transplantation immunology.
CO6: Generalize the different immunological techniques like agglutination, ELISA, RIA etc.

UNIT- I: Immunity- Innate and acquired immunity, immune system **15 L**

A] Lymphoid organs: Types, structure & function

B] Cells of the immune system: Structure, types, and functions

C] Lymphatic system

UNIT – II: Immune Response **15 L**

A] Immune Cells- B, T and APC

B] Major histocompatibility systems:

The H2 and HLA complex, MHC and antigen presentation, structure of class I and class II molecules and HLA typing

C] Cytokines: general properties & their role

D] Immunoglobulins: types, properties

UNIT –III: Auto Immunity and Immunological Tolerance **15L**

A] Autoimmunity

a. Mechanism

b. Classification: Autoimmune Hemolytic, Organ specific [Graves, myasthenia Gravis, pernicious anemia Non organ specific: Systemic lupus erythematosus, Rheumatoid arthritis, Multiple myeloma.

B] Immunological Tolerance

a. Peripheral and Central Tolerance

b. mechanism of tolerance

Transplantation immunology: types of grafts, transplantation antigens, graft rejection mechanism

UNIT IV: Serological Techniques and Immunoprophylaxis 15L

A] Serological techniques:

Agglutination, precipitation, immune-fluorescence,immunoelectrophoresis, immunoblotting, Immunodiffusion, ELISA, RIA and Flow cytometry

B] Immunoprophylaxis

Classification of common vaccines: whole cell, purified macromolecules, recombinant

antigen vaccines, recombinant vector vaccines, DNA vaccines, synthetic peptide vaccines

References:

1.Chatterji C.C. (1992) Human Physiology Vol. 1 and 2, Medical AlliedAgency, Calcutta,

2.Guyton A.C. and Hall J.E. (1996) Text Book of Medical Physiology, GoelBook Agency, Bangalore.

3. Baron D.N. Shhort Text book on Chemical Pathology, ELBS, London.

4. Austyn J.M. and Wood K.J. (1993) Principles of molecular and cellularImmunology, Oxford University Press.

5. Barrel James D. (1983) Text Book of Immunology, 4th Edition, C.V. Mosby and Co., London.

6. Boyd William C. (1966) Fundamentals of Immunology, Interscience Publishers, NY.

7.Pathak S.S. and Palan V. (1997) Immunology, Essential and Fundamental, Pareer Publications, Mumbai

8.Talwar G.P. (1983) Handbook of Immunology, Vikas Publishing Pvt Ltd, New Delhi.

9.Roitt M. (1984) Essentials of Immunology, P.G. Publishers Pvt. Ltd, New Delhi

10.Roitt M. (1988) Essentials of Immunology, ELBS, London.

11.Kuby J. (1996) Immunology Ed. 3 W.H. and Co

DSE1-3 RECOMBINANT DNA TECHNOLOGY

CO1: List the different enzymes used in recombination.

CO2: Explain the different gene cloning vectors and their expression.

CO3: Establish the genomic and cDNA libraries.

CO4: Write the different screening methods for protein expression.

CO5: Differentiate the different types of PCR.

CO6: Choose the different tools and techniques involved in genetic engineering.

Unit-1 Introduction and Enzymes used in Gene manipulation 15L

1. Concept and approach of genetic engineering, advantages, and limitations
2. Essential enzymes used in rDNA Technology:

a) Restriction endonucleases, type I, II, III, recognition sequences, properties, nomenclature, and mechanism of action of endonucleases,

b) DNA ligases (*T4* & *E. coli* ligase): Properties and specificity,

c) S1 nuclease,

d) DNA polymerase,

e) Polynucleotide kinase,

f) Alkaline Phosphatase,

3. Reverse transcriptase
4. Restriction digestion, ligation and transformation.

Unit-II Gene cloning Vectors 15L

A) Concept and strategies of cloning vectors and expression vectors

B) Vectors of *E. coli:*

a) Plasmid vectors, Properties, PBR 322 – its construction and derivatives, pUC vectors
b) Phage vectors: Lambda, Charon, EMBL and M13.

c) Modified and higher capacity vectors: Cosmids, Phagmid

d) Artificial expression/production cloning vectors: YAC BAC

e) Vectors for yeast: 2 µ plasmid vector, ARS vector, mini chromosome vectors

f) Shuttle vectors: SV 40 plasmid and retrovirus vectors.

g) Vectors of plant: Ti Plasmid vector

Unit-III Gene Cloning and Mapping **15L**

A) Isolation of gene of interest:

a) Physical and Enzymatic using Restriction endonucleases,
b) Modification of cut ends
c) Chemical synthesis of genes and methods of joining the fragments into vectors,
d) Ideal hosts in gene cloning,
e) Different methods of transformation and isolation of recombinant clones.

B) Identification of clone

1. Direct Screening: -
   a) Identification of clones containing recombinant vectors: Selectable markers,
   b) Insertional inactivation of Marker gene
   c) Visual screening methods
   d) Plaque Phenotype
2. Indirect screening method: -
   a) Immunological techniques
   b) Hybrid Arrested Translation
   c) Hybrid- selected Translation
   d) Nucleic Acid Hybridization
   e) Colony Hybridization

Unit- IV Mapping of Genome and Applications of Genetic Engineering **15L**

A) Mapping of Genome

a) Restriction Mapping
b) Chromosome walking
c) Chromosome Jumping

B) Applications of rDNA technology

a) Agricultural biocide preparation (Bt cotton)
b) Production of recombinant Insulin,

c) Hepatitis B surface antigen,

d) Production of monoclonal antibodies,

e) rDNA in gene therapy.

References

1. DNA Cloning: A Practical Approach by D. M. Glower and B. D. Hames, I R L Press, Oxford. 1995.

2.Genetic Engineering and Introduction to Gene Analysis and Exploitation in Eukaryotes by S. M. Kingsman and A. J. Kingsman, Blackwell Scientific Publications, Oxford1998.

3. PCRTechnology-PrinciplesandApplicationsforDNAAmplificationbyHenryA.Erlich(Ed.) Stockton Press. 1989.

4. Genetic Engineering–2000 by Nicholl.

5. Recombinant DNA and Biotechnology: Guide for Teachers. 2nd Edition by Helen Kreuz.2001.ASM Publications.

6. Molecular Biotechnology: Principles and Applications of Recombinant DNA. 2nd Edition.1998 by Bernard R. Glick and Jack J. Pastemak, ASM Publications.

7. Molecular Biology by David P. Clarke,1stedition; ElsevierAcademicPress;2005.

8. Molecular Cloning: A laboratory manualbyJosephSambrook&DavidRussell,3rdedition; CSHL press; 2001.

9. DNA Technology: The Awesome Skill by I. Edward Alcamo, 2nd edition; Hard court Academic Press; 2001.

10. Molecular Biology of the Gene by James Watson, Tania Baker, Stephen Bell, Alexander Gann, Michael Levine & Richard Losick, 6th Edition; CSHL Press; 2007.

11. Discovering Genomics, Proteomics and Bioinformatics, Malom Campbell and L.J. Heyer 2nd Edn, Pearson Publication, 2009.

12. Lewin's Genes XI, (2014) Jones and Bartelett Publishers Inc.

13. Malom Campbell and L. J. Heyer, Discovering Genomics, Proteomics and Bioinformatics, 2nd Ed., Pearson Publication, 2009.

14. S. B Primrose and RMT wyman 2006 7th edition. Blackwell publishing

15. Molecular Biologyand Biotechnology,4th Ed., 2009, Royal Society Press, U.K.

16. Walker J.M., Rapley R. (eds.) Molecular Biology and Biotechnology, 4th Ed., 2009, Royal Society Press, U.K. 4. S. B Primrose and R M Twyman 20067th edition. Black well publishing

DSC 1-5 - Practical (Principles of bioinstrumentation and Techniques)

1) The pH titration of weak acids and determine the pKa of amino acids glycine and Lysine
2) The separation of biomolecules from a mixture by using centrifugation technique.
3) The separation of amino acids, sugars, dyes, and plant materials by Paper Chromatography/TLC techniques.
4) The separation of biomolecules by column Chromatographic techniques
5) The separation of proteins and nucleic acids by Agarose gel electrophoresis.
6) The separation of proteins and nucleic acids by polyacrylamide gel electrophoresis (PAGE).
7) Studies on the principles of light spectroscopy – Beer and Lambert`s laws, extinction coefficient, and molar extinction coefficient.
8) Determination of the wavelength of maximum absorbance (λ max) of a given sample by using UV- Vis Spectroscopy
9) The determination of various functional groups in the given compound by using FTIR spectroscopy
10) The determine the functional groups of the given compound by using XRD spectroscopy
11) Immunochemical techniques: Immunodiffusion, immunoelectrophoresis, radioimmunoassay.

DSC 1-6 - Practical (Bioprocess Technology)

1. Bioassay of Penicillin
2. Bioassay of Streptomycin
3. Sterility testing of production media
4. Detection of leaky substances from bacterial cells
5. Determination of MIC and MLD50 of antibiotics
6. Study of production of Xanthan and dextran.
7. Production of alcoholic beverages
8. Production of Amylase
9. Amylase assay
10. Vitamin B12 assay
11. Biomass separation from fermented broth.
12. Extraction and Immobilization of Amylase
13. Extraction of enzymes (Proteins) by solvents.

DSC 1-3 -Practical (Immunology)

1. Separation of serum and plasma and its storage
2. Immunoelectrophoresis of serum
3. Perform radial immunodiffusion assay.
4. Perform rocket immunoelectrophoresis.
5. Study of quantitative precipitation assay
6. To perform ELISA and determine Antibody titer by ELISA method.
7. To perform latex agglutination test
8. To perform western blotting.
9. Blood smear identification of leucocytes by Giemsa stain/Leishman method
10. Determination of phagocytic index
11. Immunodiagnostics using commercial kits

DSE1-3 Practical (RECOMBINANT DNA TECHNOLOGY)

1. Isolation of genomic DNA and its confirmation by southern blotting.

2. Isolation of plasmid DNA and its restriction digestion.

3. DNA sequencing by Sangers method

4. DNA cloning using plasmid vectors

5. Screening of recombinants by Blue-white screening

6. RFLP analysis.

7. Isolation of RNA

8. Amplification of DNA by PCR.

9. Identification of recombinants by colony hybridization

10. Study of Restriction Digestion of λ DNA.

Semester IV

DSC1-7 Food and Dairy Microbiology

After completing this course students will be able to:

CO 1- define and memorize food properties, food spoilage, and methods of food preservation
CO 2- understand and compare different fermented food products and their applications.
CO 3- Study about milk-borne diseases and antimicrobial systems in milk.
CO 4- analyze and correlate various pasteurization methods.
CO 5- learn about food adulteration and chemical and microbiological examination of milk. Sanitation and regulation in the food and dairy industry.

Unit-I Food Microbiology **15L**

A) Origin of Human food, Food components& Food as substrates for microorganisms.

B) General mechanism of food spoilage.
i) Meat, fish, and poultry, ii) fruits and vegetables iii) Spoilage of Pack foods.

C) Microbial Food-borne diseases, Food poisoning, and infections, investigation of foodborne outbreaks, prevention and control.

D) General principles and methods of food preservation.

Unit-II Milk Microbiology **15 L**

A) Composition and nutritive value of milk.

B) Sources of contaminations of milk

C) Spoilage of milk and milk products

D) Milk-borne diseases: prevention and control of milk-borne diseases.

E) Preservation of milk and methods of Pasteurization, and phosphatase test.

Unit-III Fermented milk and food products 15 L

A) Fermented milk products:
a) Cheese, Paneer, Kefir, kumiss, yoghurt, Bulgarian sour milk,

B) Fermented food products- Types, Production and Defects in:

a) Jilebi, Idli, Dosa, dhokla,

b) Lime and mango pickles.

C) Probiotic and Prebiotic concept

Unit-IV Food Adulteration and Safety **15 L**

A) Chemical and microbiological examination of food & milk, grading of food &milk.

B) Food adulterations and contamination of foods with harmful microorganisms.

C)Food laws and standards, Indian and international food safety laws.

D)Approved food preservatives and additives.

E) Quality and safety assurance in the food and dairy industry, Sanitation and regulation infood and dairy industry.

REFERENCES:

1) The Technology of Food Preservation: 4thEdi. Norman N. Potter (1987) CBS Public.

2) Milk and Milk Products: 4th Edi. Clasence Hanry. TMH Publications.

3)Food Processing: Biotechnological Applications (2000). S.S. Marwaha and Arora.Asiatech Publications, New Delhi.

4)Food Microbiology: Frazier.

5)Food Microbiology: James De and De.

6)Dairy Technology: Sukumar De. Food Science: 5th Edi, Norman N. Potter (1996).

DSC 1-8 Molecular Biology and Genetic Engineering

CO1 Summarize different techniques like blotting, DNA sequencing, PCR, etc.

CO2 Describe the cell cycle, cancer, cancer markers, mechanism behind cancer, apoptosis as well as treatment of cancer.

CO3 Explain protein and metabolic engineering.

CO4 Designing the tools and vectors required for genetic engineering as well as construction of rDNA.

CO5 Compare the Insertion methods of rDNA like Transformation, transfection, electroporation, lipofection, microinjection, protoplast fusion, biolistic transformation and gene gun.

CO 6 Analyze the screening techniques of rDNA like colony hybridization, phage plaque assay, blue-white screening, immuno screening, direct and indirect screening.

CO7 Establish the genetic engineering techniques in agriculture, industries, human health and in pollution control.

UNIT I **15L**

Molecular Biology Techniques

A) Blotting techniques (Southern, Northern, Western and Eastern blotting)

B) PCR (Reverse transcriptase PCR, Real-time PCR)

C) DNA sequencing, Microsatellite repeats

D) DNA fingerprinting

E) Gene therapy, PCR-ELISA, Fluorescence in situ hybridization (FISH)

F) Microarray, RFLP, RAPD

G) DNA footprinting

UNIT II

Tools and Techniques of GE- **15L**

A) Restriction endonucleases and their types (types, nomenclature, recognition sequences, and cleavage patterns with examples)

B) *E. coli* and *T4* DNA ligase and its action

C) Alkaline phosphatase

D) DNA adaptor and linker

E) Klenow fragments

F) T4 Polynucleotide kinase

G) Terminal deoxynucleotidyl transferase

H) Reverse Transferase

I) DNA Methylase

J) DNA Polymerase-I

UNIT III

Vectors in Genetic Engineering- **15L**

A) Plasmid vectors

a) pBR322,

b) pUC18,

c) Ti plasmid vectors.

B) Bacteriophage vectors-

a) Insertion vectors,

b) replacement vectors,

c) λ- bacteriophage,

d) Cosmid vectors, phagemid vectors,

e) M13 phages,

C) Shuttle vectors,

D) YAC, BAC.

E) Construction and applications of Genomic libraries and cDNA libraries.

F) Constructions of recombinant DNA- selection of DNA fragments for cloning,

G) Methods of Gene transformation

Unit- IV **15 L**

Protein and Metabolic Engineering

A) Protein engineering

a) Protein engineering approaches

b) Rational Design

c) Directed evolution

B) Metabolic Engineering

a) Essence of metabolic engineering,

b) Examples of pathway manipulations and metabolic engineering in practice

c) Metabolic flux analysis and its applications, synthesis of low molecular weight compounds

C) Applications of Genetic engineering and Protein engineering

REFERENCES

1) Benjamin Lewin (2008) Genes IX, Jones and Bartelett Publishers Inc.
2) Bruce Alberts, Dennis Bray, Julian Lewis, Martin Raff, Keith Roberts, and James D. Watson (2004), Molecular Biology of the Cell, 4th Edition, Garland Publishing
3) Raff, Keith Roberts, Peter Walter, (2003) Essential Cell Biology, 2nd Edition, Garland Publishing
4) Watson James D., Tania Baker, Stephen P. Bell, Alexander Gann, Michael Levine, Richard Lodwick (2004) Molecular Biology of the Gene, 5th Edition, Pearson Education, Inc. and Dorling Kindersley Publishing, Inc.
5) Weaver R., (2007) Molecular Biology, 4th Edition, McGrew Hill Science.

DSE 1-4 Agricultural Microbiology

After completing this course students will be able to:

CO 1 define and describe soil formation, properties, interactions and soil ecosystem.

CO 2 understand elemental transformations and explain role of microorganisms in elemental cycles.

CO 3 Study about degradation of complex components in soil and apply role of microorganisms in composting and will also extend the knowledge for types of composts.

CO 4 analyze plant pathology concepts and differentiate diseases and learn to act their control.

CO 5 evaluate preparation methods of biofertilizers, compare Biopesticides with examples and will also apply those in agriculture.

UNIT –I Soil as an Ecosystem **15L**

A) Soil environment**:** Physicochemical and biological properties of soil, organic matter decomposition, microorganisms and soil fertility

B) Biogeochemical cycles-C, N, S and P.

C) Rhizosphere and Phyllosphere – Rhizospheric effect, nitrogen fixation in rhizosphere, root exudates, the influence of the rhizosphere on crop productivity, biological control within microbial communities of the rhizosphere, plant growth promoting rhizobacteria, siderophore, the role of antibiotics and siderophore in biocontrol of plant pathogens, Phyllosphere, and microorganisms.

D) Plant growth hormones: Production, Applications of IAA, Gibberellic acid

UNIT –II **15L**

Biofertilizers

A) Historical development, concept, scope, merits, and limitations of Biofertilizer.

Nitrogen-fixing bacteria (*Azotobacter, Rhizobium*), Phosphate solubilizing microbes, blue-green algae, and mycorrhizae.

B) Production of biofertilizers- production of bacterial (*Azotobacter and Rhizobium*), algal and fungal (*Trichoderma*) biofertilizers

C) Different types of carriers and applications.

D) Economical and commercial viability of biofertilizers. Latest developments and future prospects of biofertilizer technology.

UNIT –III **15L**

Biopesticides

A) Biological control, its importance in crop pests and disease management. Biopesticides their use and significance.

B) Pest control for crop protection by using biocontrol agents like bacteria (spore formers and non-spore formers) with special reference to *B. thuringiensis* and *B. sphericus,* mosquito control by fungi,

C) Toxin produced by bacteria and fungi - mode of action

D) Commercial production and applications of *B. thuringiensis*,

E) Economic and future prospects of biopesticides

UNIT –IV **15L**

Organic Farming and Plant Tissue Culture

A) Composting - different methods, anaerobic digestion, merits and the demerits of the processes, saccharification of cellulosic wastes

B) Green manure, organic matter, compost and composting, vermicomposting Production, Development of genetically modified crop plants for control of insect pests, *B. thuringiensis* gene transformation, transgenic crop plants.

C) Plant Tissue Culture – Types, formulation of growth media, techniques and applications.

REFERENCES

1. Subba Rao. 2000. Soil Microbiology.4th Ed. Oxford & IBH
2. Subba Rao. Biofertilizers in Agriculture. Oxford & IBH
3. Subba Rao. Recent Advances in Biological Nitrogen Fixation. Oxford & IBH.
4. Rangaswamy and Bagyraj. Agriculture Microbiology.
5. Smith S E and Read D J. Mycorrhizal symbiosis. 2nd Ed.
6. Alexendra and Bold. 1999. Introduction to Mycology. Academic Press
7. Sundara Rajan S. Practical Manual of Fungi.

DSE 1-4 Environmental Microbiology

After completing this course students will be able to:

CO1: Define environment, ecosystem and eutrophication.

CO2: Examine the different characterization of industrial waste.

CO3: Discus the hazardous waste management.

CO4: Plan and explain different novel methods of pollution control.

CO5: Measure the EIA, EA, water tracing method etc.

CO6: Explain global warming, acid rain and its significance.

UNIT–I Environment as an Ecosystem 15L

A) Environment and Ecosystems: Definitions, biotic and abiotic environment. Environmental segments. Composition and structure of the environment. Concept of biosphere, communities, and ecosystems. Ecosystem characteristics, structure, and function. Food chains, food webs, and trophic structures. Ecological pyramids.

B) Water pollution and its control: Need for water management. Sources of water pollution. Measurement of water pollution,

Eutrophication: Definition, causes of eutrophication, and microbial changes in eutrophic bodies of water induced by various inorganic pollutants. Effects of eutrophication on the quality of water environment, factors influencing eutrophication. Qualitative characteristics and properties of eutrophic lakes. Measurement of degree of eutrophication. Algae in eutrophication, algal blooms, their effects and toxicity, colored waters, red tides, and cultural eutrophication.

UNIT–II Microbiology of Wastewater Treatment 15L

A)Characterization of Industrial wastes: Types of industrial wastes, General Characteristics of different wastes- pH, Suspended solids, volatile solids, DO, BOD, COD, Organic Carbon etc.

B).Microbiology and biochemistry of waste water treatment:

a. Introduction, basic concepts and methods of waste water treatment, bio-augmentation,

b. Microorganisms in waste water treatment: source of organisms, enrichment and acclimatization, isolation, treatability tests, mass scale production, mixed cultures.

c. Genetically engineered microorganisms, preservation, applications and future prospects

C)Working of treatment systems and their analysis:

a. Critical operation parameters like, HRT, Mean Cell Residence Time (MCRT), F/M ratio, tank volume, flow rate, temperature.

b. Reaction and kinetics, mass balance analysis, reactor types, hydraulic characters of reactor, selection of reactor type

UNIT–III Waste Management and Regulation **15L**

A) Hazardous waste management, low-cost waste treatment systems, and treatment of Dairy, Sugar, Distillery, Textile, Paper, and Pulp wastes.

B) Environmental control Bodies, State, National and International

C) Waste disposal control and regulations:

a) Water pollution control, regulation, and limits for disposal into Lakes, rivers, oceans, and land.

D) Environmental Impact Assessment (EIA), Environmental Audit (EA)

UNIT–IV Environmental Pollution and Control 15L

A) Global warming, acid rains, and significance

B) Enzymes and Pollution–Monooxygenases, aminotransferases, bioenergetic enzymes, other metabolic enzymes, enzymatic Rectifications.

C) Novel Methods of Pollution Control: Vermicomposting, treatment using aquatic plants, root zone process.

REFERENCES:

1. Environmental biotechnology (Industrial pollution Management) Jogdand S.N., Himalaya publishing house.
2. Waste water treatment– Rao M. N. and A. K. Datta
3. Industrial pollution Control,Vol.1,E.Joe,MiddleBrooks.
4. The treatment of industrial wastes, 2ndEd.Edmund D. Besselievere and Max Schwartz.
5. Water and water pollution hand book,Vol.1,Leonard L.,Ciaccio
6. Treatment of Industrial Effluents-A.G. callely, C.F.Foster and D. A. Staffor

Practical Semester IV

DSC 1-7 - Practical (Food and Dairy Microbiology)

1. Detection of adulteration in common foods.
2. Detection of Afla Toxin in food and feeds
3. Chemical analysis of foods- pH, Benzoates, Sorbates and colors.
4. Isolation of common pathogens in food.
5. Isolation of common pathogens in milk.
6. Determination of microbiological Quality of milk, MBRT, Phosphatase test.
7. Study of spoilage of milk
8. Study of spoilage of food.
9. Physical analysis of food and milk- Specific gravity, different solid tests.
10. Platform tests in dairy industry.
11. Estimation of Casein, Fat and lactose in milk.
12. Microbiological study of Cheese, Yogurt and other fermented food.
13. Study of SPC of packed food.

DSE 1-4 Practical (Agricultural Microbiology)

1. isolation of IAA producing bacteria
2.Detection of IAA by *Azospirilium* / *Pseudomonas*.
3. Detection of siderophore production by *Pseudomonas*.
4. Laboratory production of *Bacillus thuringiensis* insecticide and testing of its efficiency.
5. Production of biomass of *Azotobacter,Rhizobium*, *Azolla*, *Azospirilum*, *Blue green algae* and preparation of biofertilizer
6. Production of biogas by using different Agricultural wastes and testing of its efficiency.
7. Enrichment, acclimatization and isolation of organisms from wastes containing recalcitrant, xenobiotic compounds.
8.Biofuel energy –electricity
9. Effect of Plant growth promoting rhizobacteria (PGPR) on plant growth.

DSE 1-4 Practical (Environmental Microbiology)

1)Physical analysis of sewage/industrial effluent by measuring total solids, total dissolved solids and total suspended solids.

2) Determination of indices of pollution by measuring BOD/COD of different effluents**.**

3) Bacterial reduction of nitrate from ground waters

4) Isolation and purification of degradative plasmid of microbes growing in polluted environments.

5) Recovery of toxic metal ions of an industrial effluent by immobilized cells.

6) Utilization of microbial consortium for the treatment of solid waste [Municipal Solid Waste].

7)Tests for the microbial degradation products of aromatic hydrocarbons/aromatic Compounds

8) Reduction of distillery spent wash (or any other industrial effluent) BOD by bacterial cultures.

9) Microbial dye decolorization /adsorption