

Swami Ramanand Teerth Marathwada University Nanded
Choice Based Credit System (CBCS) Course Structure (New scheme)
Faculty of Science and Technology
Subject: Microbiology
B. Sc. Third year (Semester- V & VI)
Semester Pattern effective from June -2018

Semester/ Annual	Course No.	Name of the Course	Instruction Hrs./ Week	Total Periods	Internal Evaluation (CA)	End Semester Examination (ESE)	Total Marks	Credits
V Semester	DSEMBI (Section A)	Microbial Genetics (P – XII)	03	45	10	40	50	2
	DSEMB I[Section B I] OR DSEMB I[Section B II]	Microbial Metabolism (P – XIII A) OR Nitrogen Metabolism (P – XIII B)	03	45	10	40	50	2
VI Semester	DSEMBII (Section A)	Molecular Biology (P-XIV)	03	45	10	40	50	2
	DSEMB II [Section B I] OR DSEMB II [Section B II]	Industrial Microbiology (P – XVA) OR Pharmaceutical Microbiology (P – XVB)	03	45	10	40	50	2
Annual Practicals / Skill	DSEMBP I [DSEMB I & II Section A]	Practicals Based on P – XII & P -XIV (P -XVI)	04	10 Practical	10	40	50	2
	SECMB III (A OR B)	Enzyme Technology (A) OR Molecular Biology Techniques (B)	03	45	25	25	50	(02) *
Annual Practicals / Skill	DSEMBP II [DSEMB I & II (Section B I & II)]	Practicals based on P -XIII A & B & P – XV A & B (P -XVII)	04	10 Practical	10	40	50	2
	SECMB IV (A OR B)	Bioprocess Technology (A) OR Good Manufacturing Practices (B)	03	45	25	25	50	(02) *
Total Credits Semester V & VI								12 (04*)

DSEMB – Discipline Specific Elective Microbiology
DSEMBP – Discipline Specific Elective Microbiology Practical
SECMB – Skill Enhancement Course Microbiology
ESE – End Semester Examination
CA – Continuous Assessment

Outline and Salient Feature:

B. Sc. Third year Microbiology syllabus is crafted to serve the need of choice based credit system course structure to orient and practically train students in the field of Microbiology. The course is specifically bringing discipline elective and skilled enhanced courses together dealing additional domain of knowledge in this field of study where in DSE course based on microbial genetics and molecular biology is concerned with genes, mutation, recombination, DNA replication, transcription, translation, associated phenomena and their manipulation and techniques of such manipulation.

Another DSE course (with choice) provide an option to learn diverse metabolic events occurring in view of the particular microorganisms and its environment and agriculture and to relate this information to a biology as a whole. This course is giving emphasis on enzymology, microbial metabolism, nitrogen metabolism and also offer industrial microbiology or pharmaceutical Microbiology as DSE courses is an area of applied microbiology which deals production of various useful end products on large scale.

Skill enhanced courses on enzyme, bioprocess technology, GMP and molecular biology techniques is well suited to understand application of scientific and engineering skills to the processing of materials by microorganisms.

Utility:

The syllabus of B. Sc. Third year microbiology course will orient and train the students in view of microbial genetics and molecular biology, occurrence of metabolic events and its relation to environment and agriculture, Industrial and Pharmaceutical Microbiology to understand and apply this knowledge for carrier orientation.

SE Course will provide additional opportunity for a student to develop skills of interest in this field of study.

Learning Objectives:

The learning or training objectives of SEC has been mentioned below the skill of the course.

Prerequisite:

The course is offered for a student registered for undergraduate programme in the faculty of Science and technology who had primary training in the field of microbial sciences and also likes to gain additional advanced knowledge in this field of science.

Swami Ramanand Teerth Marathwada University Nanded
Choice Based Credit System (CBCS) Course Structure (New scheme)
Faculty of Science and Technology
Subject: Microbiology
Paper Name: Microbial Genetics DSEMB I (Section A)]
Paper Number: XII

Credits: 02 (Marks: 50)

Periods: 45

Unit – I The Genetic Material

09

- a) Evidences for DNA as genetic material
 - i. Griffith Experiment, Avery *et al* Experiments,
 - ii. Hershey and Chase Experiment
- b) Discovery of RNA as viral genetic material
 - i. Gierer and Schramm Experiment (TMV)
- c) Properties of DNA as Genetic Material
- d) Chemical stability of DNA and its information content
- e) Structure of prokaryotic Chromosomes
 - i. *E. coli*- The model genetic organism

Unit – II Prokaryotic DNA replication

12

- a) General Concepts of DNA Replication
- b) Semi Conservative DNA Replication
- c) Replicon Model (Cairns Model), Precursors and Enzymes of DNA Replication
- d) Mechanism of DNA Replication: Initiation, Elongation (Beta Clamp and Progressive Polymerases) and Termination
- e) Replication in *E. coli* (In Short)

Unit – III Molecular Recombination in Bacteria

12

- a) General Perspective of Genetic Recombination (with Holliday Model as example)
- b) Homologous Recombination in *E. coli* (Initiation, Synapsis, Branch Migration and resolution)
- c) Types of Recombination
 - i. Site Specific Recombination (Integrative and Excessive Recombination)
 - ii. Illegitimate Recombination (Non-Homologous Recombination)
 - iii. Transposition:
 - a. Transposable elements in Prokaryotes
 - b. Insertion Sequence

- a) Transformation
 - i. Introduction and History
 - ii. Mechanism of transformation
 - iii. Competence, Binding, Penetration, Synapsis and Integration.
- b) Conjugation
 - i. Discovery of conjugation in bacteria
 - ii. Properties of F plasmid/Sex factor
 - iii. Hfr strains and their formation
 - iv. Mechanism of Conjugation
 - v. F 'factor and Sexduction
- c) Transduction
 - i. Introduction and discovery
 - ii. Generalized and Specialized transduction
 - iii. Abortive transduction

References:

1. **Biochemistry** by Jeremy M Berg, John L Tymoczko, and Lubert Stryer International 5th Edition, Publisher: W. H. Freeman & Company
2. **Essentials of Molecular Biology** by David Freifelder (2002), Publisher: Narosa Publishing House.
3. **Fundamental Bacterial Genetics** by Nancy Trun and Jenanine Trumphy (2003), Publisher: Blackwell Publishing
4. **General Microbiology** (5th edn.) Stanier R. Y., Ingraham, J.L., Wheelis, M. L., Painter, P.R. (2008), Publisher: Macmillan Press Ltd, London
5. **General Microbiology (Vol. I and II)** Powar, C.B. and Dagainawala, H.F. (2008), Publisher: Himalaya publishing house
6. **Genetics a conceptual approach** (3rd ed.) by Benjamin A. Pierce (2008) Publisher: W.H. Freeman and Company.
7. **Genetics-A molecular approach** (2nd /3rd ed.) by Peter J. Russell (2006)
8. **Modern Microbial Genetics**, Second Edition. Edited by Uldis N. Streips, Ronald E. Yasbin. Publisher: Wiley-Liss, Inc.
9. **Principles of Genetics** by R. H. Tamarin, (2004) Publisher: Tata McGraw Hill.
10. **Willey, Joanne M. Prescott, Harley, and Klein's Microbiology** / Joanne M. Willey, Linda M. Sherwood, Christopher J. Woolverton. — 7th ed. Published by McGraw-Hill, a business unit of The McGraw-Hill Companies, Inc., 1221 Avenue of the Americas, New York, NY 10020.
11. **Brock Biology of Microorganisms**, Thirteenth Edition by Michael T. Madigan, John M. Martinko, David A. Stahl, David P. Clark, Benjamin Cummings, 1301 Sansome Street, San Francisco, CA 94111.
12. **Manual of Methods for Pure Culture Study**, by A. B. Solunke, P. S. Wakte, V. D. Hamde, and R. S. Awasthi, Nirmal Publication Delhi (India)

Swami Ramanand Teerth Marathwada University Nanded
Choice Based Credit System (CBCS) Course Structure (New scheme)
Faculty of Science and Technology
Subject: Microbiology
Paper Name: Microbial Metabolism DSEMB I (Section B I)
Paper Number: XIII A

Credits: 02 (Marks: 50)

Periods: 45

Unit – I Enzymes

15

- a) Definition, Physicochemical properties of enzymes
- b) Coenzymes and Cofactors
- c) Nomenclature and Classification of enzymes
- d) Mechanisms of enzyme action
- e) Specificity of enzymes
- f) Enzyme kinetics: Michaelis-Menten equation
- g) Factors affecting enzyme activity
- h) Inhibition of enzyme activity: Competitive, Non-competitive and Uncompetitive inhibition.
- i) Regulation of enzyme activity: Allosteric enzymes, Multienzyme system and Isoenzymes.

Unit – II Microbial Metabolism

15

- a) Introduction to metabolism, catabolism and anabolism with examples.
- b) **Role of nucleotides in metabolism: Nucleotides as building blocks of nucleic acids; ATP as currency of cell; Pyridine and Flavin nucleotides.**
- c) Basic pathways of carbohydrate catabolism: EMP, HMP, ED, and PKP, TCA cycle.
- d) **β -Oxidation of saturated and unsaturated fatty acids**

Unit – III Mechanisms of Energy Transformations in Microorganisms

08

- a) Respiration, Photosynthesis and Fermentation (Basic concepts).
- b) Generation of ATP: Oxidative Phosphorylation, Photophosphorylation and Substrate level Phosphorylation.
- c) **Biochemical mechanisms of respiration in Heterotrophs and Chemoautotrophs.**
- d) Respiratory electron transport chain in bacteria.
- e) Characteristics of Bacterial RETC and It's Components.

Unit – IV Microbial Fermentations

07

- a) Ethanol fermentation by yeasts and bacteria.
- b) Lactic acid fermentation: Homo and Heterolacta fermentation.
- c) Mixed acid fermentation.
- d) Acetone-Butanol fermentation.
- e) Butanediol fermentation.
- f) Succinic acid fermentation.

References:

1. D. L. Nelson and M. M. Cox. '*Lehninger Principles of Biochemistry*', Macmillan Int.
2. J. M. Berg, J. L. Tymoczko and L. Stryer. '*Biochemistry*' 6th edition, W. H Freeman and Company.
3. S. C. Rastogi. '*Biochemistry*'. Tata McGraw Hill Publishing Company, New Delhi.
4. Gottschalk G. '*Bacterial Metabolism*'. Springer, New York.
5. Doelle H. W. '*Bacterial Metabolism*'. Elsevier, New Delhi.
6. Sandikar B. M. '*Basic Biochemistry and Microbial Metabolism*'. Himalaya Publishing House, Mumbai.
7. Moat A. G., Foster J. W. and Spector M. P. '*Microbial Physiology*'. Wiley-India.
8. Conn E. E. and Stmph P. K. '*Outlines of Biochemistry*' John Wiley & Sons, New Delhi.
9. **Brock Biology of Microorganisms**, Thirteenth Edition by Michael T. Madigan, John M. Martinko, David A. Stahl, David P. Clark, Benjamin Cummings, 1301 Sansome Street, San Francisco, CA 94111.

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Choice Based Credit System (CBCS) Course Structure (New scheme)
Faculty of Science and Technology
Subject: Microbiology
Paper Name: Nitrogen Metabolism DSEMB I (Section B II)
Paper Number: XIII B

Credits: 02 (Marks: 50)

Periods: 45

Unit – I Fixation of Molecular Nitrogen	10
a) Nitrogen Fixing Organisms	
b) Biochemical mechanism of Nitrogen Fixation	
c) Structure and properties of Nitrogenase	
d) Regulation of Nitrogenase	
Unit – II Biochemistry of Bacterial Nitrification/Denitrification	12
a) Microbiology and Biochemistry of	
i. Oxidation of Ammonia and Hydroxyl amine	
ii. Electron transport pathway coupled to oxidation of Ammonia	
iii. Oxidation of Nitrite	
iv. Denitrification	
Unit – III Nucleotide Metabolism	11
a) Biosynthesis of Purine	
b) Biosynthesis of Pyrimidine	
c) Catabolism of Nucleotides	
Unit – IV Biosynthesis of Amino acids	12
a) Biosynthesis of	
i. Oxaloacetate and Pyruvate families of amino acids	
ii. Phosphoglyecrate family of amino acids	
iii. α – oxoglutaratefamily of amino acids	
iv. Aromatic amino acids	
v. Histidine Synthesis	

References:

1. D. L. Nelson and M. M. Cox. '*Lehninger Principles of Biochemistry*', Macmillan Int.
2. J. M. Berg, J. L. Tymoczko and L. Stryer. '*Biochemistry*' 6th edition, W. H Freeman and Company.
3. S. C. Rastogi. '*Biochemistry*'. Tata McGraw Hill Publishing Company, New Delhi.
4. Gottschalk G. '*Bacterial Metabolism*'. Springer, New York.
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Faculty of Science and Technology
Subject: Microbiology
Paper Name: Molecular Biology DSEMB II (Section A)
Paper Number: XIV

Credits: 02 (Marks: 50)

Periods: 45

Unit – I Gene Expression **10**

- a) Genetic code
- b) Characteristics of Genetic code: Triplet code, comma free, non-overlapping, degenerate, start and stop signals and wobble hypothesis
- c) Structure of RNA Polymerase (RNAP)
- d) Process of transcription
- e) Structure of Ribosome
- f) Process of Translation
- g) Bacterial Transcriptional and Translational Cycle

Unit – II Mutagenesis and DNA Repair **10**

- a) Concept of Mutation
- b) Types of Mutations: Silent, Missense, base pair substitutions or switches and frameshift mutations, induced and spontaneous mutation
- c) Mechanism of Spontaneous Mutation: Mispairing of Bases due to Tautomerism, Deamination, Depurination and Damage due to Oxidative Metabolism
- d) Mechanism of Induced Mutation: Physical and Chemical Mutagenic agents
- e) Repair of DNA by
 - i. Photo-reactivation
 - ii. Nucleotide Excision Repair (NER)
 - iii. Base Excision Repair (BER)
 - iv. Mismatch Excision Repair (MER)

Unit – III Regulation of Gene expression in Prokaryotes **11**

- a) Gene regulation at Transcription level: Repressors, Activators, Sigma factor and Attenuation
- b) Gene regulation at Translation level
- c) The *lac* Operon of *E. coli*
- d) The *trp* Operon of *E. coli*

Unit – IV Molecular Techniques and Applications **14**

- a) Introduction, Definition and purpose of Cloning
- b) Tools for molecular cloning
 - i. **ENZYMES:** Restriction endonucleases, DNA ligases, alkaline phosphatase, DNA Modifying enzymes
 - ii. **VECTORS:** Plasmids- pBR322, Bacteriophage- Phage λ , Cosmids
- c) Methods of Gene Transfer

- i. Transformation
 - ii. Electroporation
 - iii. Liposome Fusion
 - iv. Transduction
- d) Screening Strategies (In short)
 - i. Insertional Inactivation
 - ii. Immunochemical Methods
 - iii. Colony hybridization
- e) Application:
 - i. Expression of Human insulin gene in *E. coli*

References:

1. **Genetics-A molecular approach (2nd /3rd ed.)** by Peter J. Russell (2006)
2. **Genetics a conceptual approach (3rd ed.)** by Benjamin A. Pierce (2008) Publisher: W.H. Freeman and Company.
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7. **Biotechnology** by Satyanarayana U. (2007), Publisher: Books and Allied Pvt. Ltd.Kolkata.
8. **Molecular Biology and Genetic Engineering** by Narayanan, Moni, Selvaraj, Singh, Arumugam (2004) Publisher: SarasPublication, Nagercoil, Kanyakumari.
9. **Modern Microbial Genetics**, Second Edition. Edited by Uldis N. Streips, Ronald E. Yasbin. Publisher: Wiley-Liss, Inc.
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11. **Willey, Joanne M. Prescott, Harley, and Klein's Microbiology** / Joanne M. Willey, Linda M. Sherwood, Christopher J. Woolverton. — 7th ed. Published by McGraw-Hill, a business unit of The McGraw-Hill Companies, Inc., 1221 Avenue of the Americas, New York, NY 10020.
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Faculty of Science and Technology
Subject: Microbiology
Paper Name: Industrial Microbiology DSEMB II (Section B I)
Paper Number: XV A

Credits: 02 (Marks: 50)

Periods: 45

UNIT I: Definition and Scope of Industrial Microbiology **08**

- a) Introduction, Definition, Scope and Development of Industrial Microbiology
- b) Role of Microbiologist in Industrial Microbiology
- c) Bioreactor (Definition, Ideal Design and characteristics, Working of Auxiliary equipment)
- d) Types of Fermenter: laboratory fermenter, pilot plant fermenter, industrial fermenter, Horton sphere. Batch, continuous, Tubular, fed batch, fluidised bed reactor, tower fermenter (In brief)
- e) Computer application in fermentation technology

UNIT II: Microbes in Industrial Microbiology **09**

- a) Introduction, Screening Techniques (Primary and Secondary)
- b) Strain improvement
- c) Stock culture and its maintenance (serial subculture, overlaying with mineral oil, lyophilization, liquid nitrogen, soil stock)
- d) Inoculum development, Fermentation media (substances used as raw materials for formulation of fermentation media) and its sterilization (batch and continuous)

UNIT III: Downstream processing **14**

- a) Introduction, Extraction of fermentation products, solids (Insoluble) removal (Filtration, centrifugation, coagulation and flocculation, foam fractionation,)
- b) Primary isolation of product (Cell disruption, liquid extraction, ion exchange adsorption, precipitation)
- c) Purification (Chromatography, carbon decolorization, crystallization), Product Isolation(Crystalline processing, drying, packing etc).

UNIT IV: Typical Fermentative production **14**

- a. Production strain, Fermentation media, Fermentation conditions, Metabolic pathway involved in synthesis of the product, Product recovery operations, and uses of following:
 - i. Beverages: Wine
 - ii. Organic acid: Citric acid
 - iii. Antibiotics: Penicillin
 - iv. Biofertilizers: Legume inoculants
 - v. Bioinsecticide: Thuricide
 - vi. Amino acids: Glutamic acid
 - vii. Enzymes: Fungal Amylase

REFERENCES:

- 1. Industrial Microbiology** by A.H. Patel.
- 2. Industrial Microbiology** by Prescott & Dunn.
- 3. Industrial Microbiology** by Casida
- 4. Biotechnology: A text book of Industrial Microbiology** by Cruger and Cruger
- 5. Modern Industrial Microbiology and Biotechnology** by Nduka Okafor
- 6. Industrial Microbiology: An Introduction by Wastes, Morgan, Rockey and Higten**
- 7. Practical Microbiology** by Maheshwari and Dubey

Swami Ramanand Teerth Marathwada University Nanded
Choice Based Credit System (CBCS) Course Structure (New scheme)
Faculty of Science and Technology
Subject: Microbiology
Paper Name: Pharmaceutical Microbiology DSEMB II (Section B II)
Paper Number: XV B

Credits: 02 (Marks: 50)

Periods: 45

UNIT I: Microbiology and Pharmaceuticals **10**

- a. Introduction, Overview and application of Pharmaceutical Microbiology
- b. Microbiological tests useful for Pharmaceutical sector
- c. Role of microbiologist in Laboratory Management and Design

UNIT II: Good Laboratory Practice and Safety techniques **11**

- a. Introduction to Good Laboratory Practice and safety, Pharmacopeia and microbiological test
- b. Bioburden determination – Total microbial count, units of Measurement, Non sterile products and microbial limit testing, In-process material assessment Presterilization bioburden assessment, alternative methods of bioburden Assessment
- c. Specified and objectionable microorganisms- indicator microorganisms
- d. Determining which microorganism are objectionable and assessing risk

UNIT III: Contamination and infection control **12**

- a. Microbial spoilage, infection risk and contamination control
- b. Laboratory evaluation of non-antibiotic and antimicrobial agents
- c. Chemical disinfectants, antiseptics and preservatives
- d. Non-antibiotics, antimicrobial agents, mode of action and resistance
- e. Sterilization procedures and sterility assurance

UNIT IV: Pharmaceutical production **12**

- a. Pharma products microbial origin:
 - i. Dextran
 - ii. Vitamin (riboflavin) fermentation
 - iii. Enzyme – Streptokinase
- b. Sterile Pharmaceutical Products
 - i. Injections, non-injectionable sterile fluids
 - ii. Ophthalmic preparation
 - iii. Absorbable haemostatics
 - iv. Surgical ligatures and sutures
- c. The manufacture and quality control of immunological products
 - i. Vaccines
 - ii. Immunsera
 - iii. Human immunoglobulin
- d. Recombinant DNA techniques
 - i. Somatostatin

- ii. Insulin
- iii. Interferon

References:

1. **Good Manufacturing Practices for Pharmaceuticals** by Sydney H. Willing, Murray. M. Tuckerman, Willam S. Hitching IV. Second edition Mercel Dekker NC New York
2. **Pharmaceutical Biotechnology** by S. P. Vyas & V. K. Dixit. CBS publishers& distributors, New Delhi
3. **Pharmaceutical Microbiology** by W. B. Hugo & A. R. Russel Sixth Edition. Blackwell Scientific Publications
4. **Pharmacognosy** by Gokhle S. D., Kokate C.K. Edition: 18 Nirali Publication
5. **Biotechnology – Expanding Horizon** by B. D. Singh, First Edition, Kalyani Publication, Delhi.

Swami Ramanand Teerth Marathwada University Nanded
Choice Based Credit System (CBCS) Course Structure (New scheme)
Faculty of Science and Technology

Subject: Microbiology

**Paper Name: Practicals Based on P – XII & P – XIV (DSEMBP I [DSEMB I & II
Section A])**

Paper Number: XVI

Credits: 02

Marks: 50

(Annual practical Based on [DSEMB I& II (Section A)] (Practical syllabus requires four periods per batch per week for 2 consecutive days B.Sc. Third year practical includes studies of growth of microorganisms and life activities of Microorganisms. These studies need two consecutive days for completion of practical.)

1. Purification of chromosomal/plasmid DNA and study of DNA profile.
 - i. Confirmation of nucleic acid by spectral study.
 - ii. Quantitative estimation by diphenylamine test.
 - iii. DNA denaturation and determination of T_m and G + C contents.
 - iv. Agarose gel electrophoresis of DNA.
2. Effect of UV radiations
 - i. To study the survival pattern of *E.coli*/yeast
 - ii. Repair mechanisms in *E.coli* / yeast (Dark and Photo reactivation).
3. Isolation of antibiotics resistant Bacterial Mutants by Physical/ Chemical agents.
4. Ampicillin selection method for isolation of auxotrophic mutants.
5. Extraction and purification of RNA from *S. cerevisiae*.
6. Studies on gene expression in *E. coli* with reference to Lac operon.
7. Study of Conjugation in *E. coli*.
8. Restriction digestion and Agarose gel electrophoresis of DNA.
9. Generalized Transduction in *E. coli* using p1 phage
10. Determination of MIC and LD50 of Streptomycin

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Faculty of Science and Technology

Subject: Microbiology

**Paper Name: Practicals Based on P – XIII A & B & P – XVA & B (DSEMBP II
[DSEMB I & II Section B I& II])**

Paper Number: XVII

Credits: 02

Marks: 50

(Annual practical Based on [DSEMB I& II (Section B)] (Practical syllabus requires four periods per batch per week for 2 consecutive days B.Sc. Third year practical includes studies of growth of microorganisms and life activities of Microorganisms. These studies need two consecutive days for completion of practical.)

1. Estimation of reducing sugar by Sumner's method.
2. Estimation of Amino acids by Rosen's method
3. Study of enzymes (Lecithinase, Gelatinase, Urease, Caseinase, Catalase)
4. Fermentative production of Production of amylase
5. Effect of various physicochemical parameters on amylase activity (pH, Temp)
6. Primary screening of antibiotic producers, amylase producers, organic acid producers
7. Production of Penicillin (Surface / submerged)
8. Fermentative production of Wine & and its estimation by Titrable acidity
9. Production of Citric acid (Surface / submerged) & its estimation by Titrable acidity
10. Production of Biofertilizer (*Azotobacter*)
11. Bioassay of Penicillin
12. Bioassay of therapeutic enzyme glucose oxidase
13. Determination of antimicrobial activity of chemical compound (Phenol)
14. Sterility testing by using *Bacillus stearothermophilus* / *Bacillus subtilis*

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Choice Based Credit System (CBCS) Course Structure (New scheme)
Faculty of Science and Technology
B. Sc. Third (V and VI Semester)
Pattern of Theory Question Paper and Scheme of Marking
Subject: Microbiology

Paper:

Title of Paper:

Time: 2Hrs

Marks: 40

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- N.B. i) Attempt All Questions.
ii) All Questions carry equal Marks
iii) Illustrate your answers with suitable labelled diagrams wherever necessary.

Q.1 Attempt Any Four of the followings: (Each of Two Marks) [Based on UNIT I, II, III, IV] 08

- a)
- b)
- c)
- d)
- e)
- f)

(Minimum one and Maximum two from each Unit)

Q. 2 Attempt Any Two of the followings: (Each of Four Marks) [Based on Unit I & Unit II] 08

- a)
- b)
- c)

(Minimum one and Maximum two from each Unit)

Q. 3 Attempt Any One of the followings: (Each of Eight Marks) [Based on Unit I & Unit II] 08

- a)
- b)

Q. 4 Attempt Any Two of the followings:(Each of Four Marks) [Based on Unit III & Unit IV] 08

- a)
- b)
- c) M

Q. 5 Attempt Any One of the following: (Each of Eight Marks) [Based on Unit III & Unit IV] 08

- a)
- b)

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Faculty of Science and Technology
Subject: Microbiology
Paper Name: Enzyme Technology (SECMBIII A)
Paper Number: Skill - III

Credits: 02

Marks: 50

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1. Introduction
 - i. Sources of enzymes and their classes
 - ii. Application of enzymes in
 - a. Industrial paper and textile
 - b. Biomedical and in drug design
 - c. Dairy, food and brewing industry
 - d. Artificial enzymes and Recombinant enzymes
 - e. Enzymes as biosensors
 2. Methods of enzyme isolation
 - i. Cell lysis methods –
 - a. Osmotic shock
 - b. Enzyme lysis
 - c. Homogenization
 - d. Ultra centrifugation
 - ii. Concentration of enzymes by
 - a. Precipitation (Ammonium sulphate)
 - b. Dialysis of protein
 - c. Heat treatment
 - d. Nucleic acid removal
 3. Enzyme purification, characterization based on
 - i. Size and mass (centrifugation, GPC Gel Permeation chromatography, Dialysis and ultracentrifugation)
 - ii. Polarity (ion exchange electrophoresis)
 - iii. Changes in solubility (change in pH, Change in ionic strength, salting in or salting out)
 - iv. Change in dielectric strength by isoelectric focusing and adding organic solvent, hydrophobic interaction chromatography
 - v. Specific binding sites (Affinity chromatography, Affinity elution, Dye – ligand chromatography, immune adsorption chromatography, co – valent chromatography)
 4. Immobilization of enzymes methods
 - i. Adsorption
 - ii. Covalent bonding
 - iii. Entrapment and membrane confinement
 - iv. Application in - analytical, therapeutic, industrial

Practices:

Fungal Amylase

1. Production
2. Isolation methods
3. Purification methods
4. Assay and activity procedure
5. Immobilization techniques of fungal amylase

Training Objectives:

1. To understand the importance of enzymes in day today life
2. To practically isolate and purify particular enzyme.

Swami Ramanand Teerth Marathwada University Nanded
Choice Based Credit System (CBCS) Course Structure (New scheme)
Faculty of Science and Technology
Subject: Microbiology
Paper Name: Molecular Biology Techniques (SECMB III B)
Paper Number: Skill - III

Credits: 02

Marks: 50

1. Enzymes involved in genetic engineering
 - a. Restriction endonucleases type I, II, and III (Nomenclature and Classification, activity)
 - b. DNA ligase –
 - i. properties and specificities
 - ii. Activity and mode of Action
 - a. S Nuclease
 - b. DNA Polymerase
 - c. Phosphatase
 - d. Reverse transcriptase
2. Hybridization techniques
 - a. Northern, Southern & colony hybridization
 - b. Fluorescence in situ hybridization
 - c. Restriction map and mapping technique
 - d. DNA Finger printing
3. Cloning vector
 - a. Plasmids and their properties (pBR322, PUC18, its derivatives and construction)
 - b. Bacteriophage – λ gt, 10/11
 - c. Cosmid vectors
 - d. Artificial chromosome vectors – YAC, BACS
 - e. Animal virus derived vector – SV40
4. Cloning methodologies
 - a. Insertion of Foreign DNA into the host cells – transformation
 - b. Plant transformation technology
 - i. Basic of tumour formation
 - ii. Features of Ti and Ri plasmids
 - iii. Mechanism of DNA transfer
 - iv. Use of Ti & Ri as plasmid vector

Practice:

1. Extraction and isolation of DNA
2. Confirmation of DNA by spectral studies
3. Agarose gel electrophoresis of DNA

OR

Industrial training on molecular biology techniques

Training Objectives:

1. To understand the importance of enzymes involved in genetic engineering.
2. To study the procedure of genetic engineering.

Swami Ramanand Teerth Marathwada University Nanded
Choice Based Credit System (CBCS) Course Structure (New scheme)
Faculty of Science and Technology
Subject: Microbiology
Paper Name: Bioprocess Technology (SECMB IV A)
Paper Number: Skill - IV

Credits: 02

Marks: 50

1. Agro based Bioprocesses involved in manufacture of
 - a. Biocompost
 - b. Biofertilizers
 - c. Bioinsecticides
 - d. Biogas
 - e. Biofuel
2. Food and Dairy bioprocesses
Bioprocesses involved in production of
 - a. Bread
 - b. Idli, Dhokla, Dosa
 - c. Pickles
 - d. Yoghurt (curd) & buttermilk
 - e. Cheese
3. Industrial effluent Treatment
 - a. Physical, chemical
 - b. Biological treatment
 - i. Aerobic treatment processes – Trickling filters, biologically aerated filters, rotating biological contactors, rotating drums, fluidized – bed systems, activated sludge processes.
4. Anaerobic treatment process – anaerobic digestion, anaerobic digester, anaerobic filters, up – flow anaerobic sludge blankets (UASD)

Practice:

1. Ethanol production from Agri waste
2. Idli & Dosa preparation
3. Determination of COD of industrial effluent
4. Determination of BOD of industrial effluent

Training Objectives:

1. To understand the bioprocesses.
2. To study the role of microorganisms involved in treatment of sewage.

Swami Ramanand Teerth Marathwada University Nanded
Choice Based Credit System (CBCS) Course Structure (New scheme)
Faculty of Science and Technology
Subject: Microbiology
Paper Name: Good Manufacturing Practices (GMP) (SECMB IVB)
Paper Number: Skill - IV

Credits: 02

Marks: 50

1. Quality Assurance & Validation
 - a. GMP & GLP in pharmaceutical industry
 - b. Regulatory aspects of quality control
 - c. Quality assurance & quality management in industry ISO, WHO & US certification
2. Sterilization & sterility testing
 - a. Heat sterilization
 - b. D – value, Z – value, survival curve
 - c. Radiation & Gaseous sterilization
 - d. Filter sterilization
3. Validation & in process monitoring of sterilization
 - a. Physical indicators
 - b. Chemical indicators
 - c. Biological indicators
 - d. Sterility testing
4. Design and layout of sterile product manufacturing unit
 - a. Designing of microbiology laboratory
 - b. Safety in microbiology lab

Practices:

1. Bioassay of Penicillin
2. Bioassay of therapeutic enzyme Glucose Oxidase
3. Determination of MIC & LD 50 of Streptomycin
4. Determination of antimicrobial activity of chemical compounds like Phenol
5. Sterility testing by using *Bacillus stearothermophilus* or *Bacillus subtilis*

Training Objectives:

1. To understand the importance of GMP in Pharmaceutical Industry.
2. To practically carry sterilization of Pharmaceutical Products.

Swami Ramanand Teerth Marathwada University Nanded
Choice Based Credit System (CBCS) Course Structure (New scheme)
Faculty of Science and Technology
Subject: Microbiology
Paper Name: Practicals Based on P – XII & P – XIV (DSEMBP I [DSEMB I & II
Section A])
Paper Number: XVI
PROFORMA FOR PRACTICAL EXAMINATION

Time: Four hours per day per batch for two consecutive days

Marks: 40

- | | |
|---|----|
| 1. Effect of UV Radiation on survival of Yeast/Bacteria and Photo-reactivation | 15 |
| OR | |
| Purification of Chromosomal/Plasmid DNA and its confirmation | |
| 2. Isolation of antibiotic resistant mutants by induced mutation | 10 |
| OR | |
| Restriction digestion of DNA and its Gel Electrophoresis/Estimation of DNA/RNA | |
| 3. Studies on gene expression in <i>E. coli</i> with respect to <i>Lac</i> Operon | 10 |
| OR | |
| Transformation/Conjugation/Transduction in <i>E. coli</i> | |
| 4. Viva- voce | 05 |

Swami Ramanand Teerth Marathwada University Nanded
Choice Based Credit System (CBCS) Course Structure (New scheme)
Faculty of Science and Technology
Subject: Microbiology
Paper Name: Practicals Based on P – XIII A & B & P – XVA & B (DSEMBP II
[DSEMB I & II Section B I])
Paper Number: XVII
PROFORMA FOR PRACTICAL EXAMINATION

Time: Four hours per day per batch for two consecutive days

Marks: 40

- | | | |
|----|---|----|
| 1. | Studies on enzymes Lecithinase/Gelatinase/Urease/Caseinase/Catalase (Any Three) | 15 |
| | OR | |
| | Penicillin Bioassay | |
| 2. | Estimation of Reducing sugar (Sumner's method)/Amino-acid (Rosen's method) | 10 |
| | OR | |
| | Production of Biofertilizer/Legume Inoculants and its characterization | |
| 3. | Estimation of Citric Acid/Wine (Titrable method) | 10 |
| | OR | |
| | Screening of Starch hydrolyser/Antibiotic producer/Organic acid producer | |
| 4. | Viva- voce | 05 |