

॥ सा विद्या या विमुक्तये ॥



स्वामी रामानंद तीर्थ मराठवाडा विद्यापीठ, नांदेड

“ज्ञानतीर्थ” परिसर, विष्णुपुरी, नांदेड - ४३१६०६ (महाराष्ट्र)

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY NANDED

“Dnyanteerth”, Vishnupuri, Nanded - 431606 Maharashtra State (INDIA)

Established on 17th September 1994 – Recognized by the UGC U/s 2(f) and 12(B), NAAC Re-accredited with 'A' Grade



ACADEMIC (1-BOARD OF STUDIES) SECTION

Phone: (02462) 229542

Website: www.srtmun.ac.in

E-mail: bos.srtmun@gmail.com

Fax : (02462) 229574

संलग्नित महाविद्यालयांतील विज्ञान व तंत्रज्ञान विद्याशाखेतील पदव्युत्तर स्तरावरील प्रथम वर्षाचे CBCS Pattern नुसारचे अभ्यासक्रम शैक्षणिक वर्ष २०१९-२० पासून लागू करण्याबाबत.

प रि प त्र क

या परिपत्रकान्वये सर्व संबंधितांना कळविण्यात येते की, दिनांक ०८ जून २०१९ रोजी संपन्न झालेल्या ४४व्या मा. विद्या परिषद बैठकीतील ऐनवेळचा विषय क्र.११/४४-२०१९ च्या ठरावानुसार प्रस्तुत विद्यापीठाच्या संलग्नित महाविद्यालयांतील विज्ञान व तंत्रज्ञान विद्याशाखेतील पदव्युत्तर स्तरावरील प्रथम वर्षाचे खालील विषयांचे **C.B.C.S. (Choice Based Credit System) Pattern** नुसारचे अभ्यासक्रम शैक्षणिक वर्ष २०१९-२० पासून लागू करण्यात येत आहेत.

1. Bioinformatics
2. Biotechnology
3. Biochemistry
4. Botany
5. Chemistry
6. Computer Management
7. Computer Science
8. Dairy Science
9. Environmental Science
10. Herbal Medicine
11. Information Technology
12. M.C.A.
13. Microbiology
14. Physics
15. Software Engineering
16. System Administration & Networking
17. Zoology

सदरील परिपत्रक व अभ्यासक्रम प्रस्तुत विद्यापीठाच्या www.srtmun.ac.in या संकेतस्थळावर उपलब्ध आहेत. तरी सदरील बाब ही सर्व संबंधितांच्या निदर्शनास आणून द्यावी.

‘ज्ञानतीर्थ’ परिसर,

विष्णुपुरी, नांदेड - ४३१ ६०६.

जा.क्र.: शैक्षणिक-१/परिपत्रक/पदव्युत्तर-सीबीसीएस
अभ्यासक्रम/२०१९-२०/४६४

दिनांक : ११.०७.२०१९.

प्रत माहिती व पुढील कार्यवाहीस्तव :

- १) मा. कुलसचिव यांचे कार्यालय, प्रस्तुत विद्यापीठ.
- २) मा. संचालक, परीक्षा व मूल्यमापन मंडळ यांचे कार्यालय, प्रस्तुत विद्यापीठ.
- ३) प्राचार्य, सर्व संबंधित संलग्नित महाविद्यालये, प्रस्तुत विद्यापीठ.
- ४) साहाय्यक कुलसचिव, पदव्युत्तर विभाग, प्रस्तुत विद्यापीठ.
- ५) उपकुलसचिव, पात्रता विभाग, प्रस्तुत विद्यापीठ.
- ६) सिस्टम एक्सपर्ट, शैक्षणिक विभाग, प्रस्तुत विद्यापीठ.

स्वाक्षरित/—

उपकुलसचिव

शैक्षणिक (१-अभ्यासमंडळ) विभाग

Swami Ramanand Teerth Marathwada University Nanded

CBCS Syllabus for M.Sc. First Year

Faculty of Science and Technology

Semester – I & II

Subject: Microbiology

(Affiliated Collegesw.e.f. JUNE – 2019)

Name of the Faculty	Total credit	Average credits per semester
Scienceand Technology	100	25

Note:

- Assessment shall consist of Continuous assessment (**CA**) and End of Semester Examination (**ESE**).
- **Weightage:** 75% for ESE & 25% for CA
- **Paper- (Elective):** Transfer of Credit as per Student choice

Eligibility conditions:

- Admission to M. Sc. Microbiology shall be made on the basis of aggregate percentage of three years Microbiology as an optional subject at graduate level (B. Sc).
- B. Sc. Microbiology as one of the optional subject only shall eligible for the admission to M. Sc. Microbiology.

**Distribution of Credits for M.Sc. Microbiology under Science faculty(All
Affiliated Colleges)**

Semester	Paper No. & Code	Title of the subject	External (ESE)	Internal (CA)	Total
Sem. I	Paper-I: MB-101	Microbial Physiology	(75 marks)	(25 marks) (2Test : 15 marks+ Assignments:10marks)	Credit: 4 (100 marks)
	Paper-II: MB-102	Advances in Virology	(75 marks)	(25 marks) (2Test : 15 marks+ Assignments :10 marks)	Credit: 4 (100 marks)
	Paper-III: MB-103	Food and Dairy Microbiology	(75 marks)	(25 marks) (2Test : 15 marks+ Assignments :10 marks)	Credit: 4 (100 marks)
	*Paper-IV (Elective): MB-104	Bioinstrumentation	(75 marks)	(25 marks) (2Test : 15 marks+ Assignments :10 marks)	Credit: 4 (100 marks)
	Paper –V (Seminar) MB-105	Based on theory paper MB101 – 104&LAB: I & II	Credit: 1 (25 marks)		Credit: 1
				Total for Sem: I	Credit: 17
Sem. II	Paper-VI: MB-201	Microbial Metabolism	(75 marks)	(25 marks) (2Test : 15 marks+ Assignments :10 marks)	Credit: 4 (100 marks)
	Paper-VII: MB-202	ModernMicrobial Genetics	(75 marks)	(25 marks) (2Test : 15 marks+ Assignments :10 marks)	Credit: 4 (100 marks)
	Paper-VIII: MB-203	Bioprocess Engineering	(75 marks)	(25 marks) (2Test : 15 marks+ Assignments :10 marks)	Credit: 4 (100 marks)
	*Paper-IX (Elective): MB-204	Enzyme Technology	(75 marks)	(25 marks) (2Test : 15 marks+ Assignments :10 marks)	Credit: 4 (100 marks)
	Paper –X (Seminar) MB-205	Based on theory paper MB- 201 – 204&LAB: III & IV	Credit: 1 (25 marks)		Credit: 1
				Total for Sem: II	Credit: 17
Lab Course Work (Annual Practical)	LAB –I	Based on theory paper MB-101 & MB-102	(75 marks)	(25 marks)	Credit: 4 (100 marks)
	LAB –II	Based on theory paper MB-103 & MB-104	(75 marks)	(25 marks)	Credit: 4 (100 marks)
	LAB –III	Based on theory paper MB-201 & MB-202	(75 marks)	(25 marks)	Credit: 4 (100 marks)
	LAB –IV	Based on theory paper MB-203 & MB-204	(75 marks)	(25 marks)	Credit: 4 (100 marks)
				Total for Lab Course work(Annual)	Credit: 16
				Total for M.Sc. I Year: Sem. I + Sem. II + Lab Course work (Annual)	Credit: 50

Semester	Paper No. & Code	Title of the subject	External (ESE)	Internal (CA)	Total
Sem. III	Paper-XI: MB-301	Molecular Immunology	(75 marks)	(25 marks) (2Test : 15 marks+Assignments :10 marks)	Credit: 4 (100 marks)
	Paper-XII: MB-302	Recombinant DNA Technology	(75 marks)	(25 marks) (2Test : 15 marks+ Assignments :10 marks)	Credit: 4 (100 marks)
	Paper-XIII: MB-303	Microbial Diversity and Extremophiles	(75 marks)	(25 marks) (2Test : 15 marks+Assignments :10 marks)	Credit: 4 (100 marks)
	*Paper-XIV (Elective): MB-304	Biostatistics, Computer Applications and Research Methodology	(75 marks)	(25 marks) (2Test : 15 marks+ Assignments :10 marks)	Credit: 4 (100 marks)
	Paper –XV (Seminar) MB-305	Based on theory paper MB301, 302, 303 & 304	Credit: 1 (25marks)		Credit: 1
				Total for Sem: III	Credit: 17
Sem. IV	Paper-XVI: MB-401	Fermentation Technology	(75 marks)	(25 marks) (2Test : 15 marks+ Assignments :10 marks)	Credit: 4 (100 marks)
	Paper-XVII: MB-402	Medical and Pharmaceutical Microbiology	(75 marks)	(25 marks) (2Test : 15 marks+ Assignments :10 marks)	Credit: 4 (100 marks)
	Paper-XVIII: MB-403	Environmental Microbiology	(75 marks)	(25 marks) (2Test : 15 marks+ Assignments :10 marks)	Credit: 4 (100 marks)
	*Paper-XIX (Elective): MB-404	Bioinformatics, Proteomics and Genomics	(75 marks)	(25 marks) (2Test : 15 marks+ Assignments :10 marks)	Credit: 4 (100 marks)
	Paper –XX (Seminar) MB-405	Based on theory paper MB401, 402, 403 & 404	Credit: 1 (25 marks)		Credit: 1
				Total for Sem: IV	Credit: 17
Lab Course Work (Annual Practical)	LAB –V	Based on theory paper MB-301 & MB-302	(75 marks)	(25 marks)	Credit: 4 (100 marks)
	LAB –VI	Based on theory paper MB-303 & MB-304	(75 marks)	(25 marks)	Credit: 4 (100 marks)
	LAB –VII	Based on theory paper MB-401, 402, 403 & 404	(75 marks)	(25 marks)	Credit: 4 (100 marks)
	LAB –VIII (Dissertation) *(Elective)	----	(75 marks)	(25 marks)	Credit: 4 (100 marks)
				Total for Lab Course work(Annual)	Credit: 16
				Total for M.Sc. II Year: Sem. III + Sem. IV + Lab Course work (Annual)	Credit: 50
				Total for M.Sc.(I Year + II Year):	Credit: 100

Outline and Salient Feature:

M. Sc. FirstYear Microbiology syllabus is designed 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 Core coursesdealing additional domain of knowledge in this field of study including microbial physiology,advances in virology, food and dairy microbiology, microbial metabolism, modern microbial genetics, and bioprocessing engineeringwhere in elective course based on bioinstrumentation is concerned with laboratory techniques, chromatography techniques, Electrophoretic techniques and Spectroscopic and Radio – isotopic techniques while enzyme technology as elective course gives additional knowledge of extraction and purification of microbial enzyme, enzyme kinetic and inhibition, enzyme as biocatalyst and enzyme engineering and immobilization and microbial enzymes.

The seminar based on these syllabi gives boost to the student to face the interviews which help them to get placements in different industries.

Utility:

The syllabus of M. Sc. First 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, to understand and apply this knowledge for carrier orientation.

Learning Objectives:

The learning objectives of lab course plays essential role for students to have handling knowledge and practice of different instruments through various practicals included in lab course I, II, III and IV.

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.

Practical Examination:

The outline of the distribution of maximum marks for various aspects/mechanisms towards ESE is as follows:

- Journal – **10 marks**

- Experimental Performance – **50 marks**
- Viva-voce & Group discussion of 5/6 students for testing the understanding level of a student – **15 marks**
- At least three experiments should be asked for the full course of 4/5 credits and at least two for 2/3 credits.
- Certified Journal would be compulsory to appear for the ESE practical course.
- There shall be two experts from the parent Department and two examiners (one of which will be external) per batch.
- If a student failed to obtain a grade other than F in a course then such a course will not be taken into account for calculating (C) GPA and overall grade. In fact, all the courses in which a student has passed will be taken into account for calculating the (C) GPA and overall grade.

INFRASTRUCTURE, INSTRUMENTAL, LIBRARY AND OTHER FACILITES REQUIRED FOR M.Sc. COURSE IN MICROBIOLOGY

(For 30 Students INTAKE CAPACITY).

1. Two Laboratories (For Part I and II) each measuring at least 1000 sq.ft with sufficient number of tables and stools. Labs should be provided with basic instruments, such as autoclave, Incubator, oven, pH meter, hot plates, Cyclo-mixers, water bath shakers, colorimeter, fridge, distillation plant, etc.
2. A culture room with a laminar air- flow measuring 300 sq. ft
3. An instrumentation room with double door, air conditioner and inverter, power generator for sophisticated instruments measuring 500 sq. ft.
4. Two lecture halls (For Part I and Part II) with overhead projector facility and measuring 400 sq. ft with tables and chairs.
5. A media preparation and storeroom measuring at least 400 sq. ft.
6. A computer and Bioinformatics laboratory with four to five computers (PIV) with printer and Internet facility.

LIST OF BASIC INSTRUMENTS REQUIRED FOR M.Sc. PRACTICALS.

1. Laminar Air Flow
2. Compound Microscope

3. Autoclave
4. Incubator
5. Hot Air ovens
6. BOD incubator
7. pH meter
8. Water bath incubator shaker
9. Colorimeter
10. Spectrophotometer
11. Hot plates
12. Cyclomixer
13. Electrophoretic Apparatus
14. Orbital Incubator Shaker
15. High Speed centrifuge (10,000rpm)
16. Distillation Apparatus (single and Double)
17. Refrigerators
18. Paper Chromatography cabinet
19. Rough Balances
20. Bacterial filter assembly
21. General purpose centrifuge
22. Vortex mixers.
23. Magnetic stirrers
24. UV cabinet
25. TLC apparatus
26. Dissolved oxygen meter
27. Mettler balance
28. Digital balances
29. Water bath shaker
30. Colony counter
31. Rotary shaker
32. Columns for chromatography
33. Fraction collector
34. Gas Burners

35. LPG cylinders
36. Distillation apparatus

LIST OF SOPHISTICATED INSTRUMENTS REQUIRED FOR THE PRACTICALS

1. UV Visible spectrophotometer
2. Gas chromatography
3. Sonicator
4. High speed refrigerated centrifuge
5. Microprocessor based pH analyser
6. Horizontal paper electrophoresis unit
7. Vertical electrophoresis
8. Submarine electrophoresis
9. Immuno-electrophoresis
10. Power pack with constant voltage/current adjustment
11. PAGE electrophoresis unit
12. DNA sequencer
13. ELIZA reader
14. PCR (Thermal cycler)
15. Gel documentation unit
16. Semidry transfer apparatus
17. Deep freezer (-30 °c)
18. Fermenter
19. Atomic absorption spectrophotometer
20. COD and BOD analyser
21. Phase contrast microscope
22. Binocular microscope
23. HPLC
24. Lyophilizer
25. Pentium IV computer with printer
26. Micropipettes
27. CO₂ incubator

OTHER REQUIREMENTS:

The Department should have required **chemicals, Dehydrated Media, Stains, Acids, Solvents, Fine Chemicals, Enzymes, Antisera, Immunodiagnostic Kits, Specific Microbial Cultures With Known Genetic Markers and Glassware** to conduct the prescribed syllabus. Cold room facility is preferred.

LIBRARY FACILITY

The Library should have ample number of prescribed textbooks, reference books, recommended in the prescribed syllabus and the library should also subscribe national and international journals and scientific magazines.

Swami Ramanand Teerth Marathwada University Nanded

CBCS Syllabus for M.Sc. First Year

Faculty of Science and Technology

Semester – I

Subject: Microbiology

Paper Name: MICROBIAL PHYSIOLOGY

Paper Number: MB-101

Credits: 04

Periods: 45

Unit I: Bacterial Chemolithotrophs and Phototrophs

(12)

Physiological groups of Chemolithotrophs, Ammonia oxidation by membrane of genus Nitro groups, Nitrate oxidation by nitro group of genera, Oxidation of molecular hydrogen by *Hydrogenomonas* species, Ferrous and sulfur/sulfide oxidation by *Thiobacillus* species.

Photosynthetic microorganisms, Photosynthetic pigments and generation of reducing power by cyclic and non cyclic photophosphorylation, Electron transport chain in photosynthetic Bacteria, Carbon dioxide fixation pathways.

Unit II: Bacterial Respiration

(12)

Bacterial aerobic respiration: Components of electron transport chain free energy changes and electron transport, Oxidative phosphorylation and its theories of ATP formation, Inhibition of electron transport chain, Electron transport chain in some heterotrophic bacteria, Mechanism of oxygen toxicity, Catalase, Super oxide dismutase.

Bacterial anaerobic respiration: Introduction, Electron transport chain in some anaerobic bacteria, Nitrate, Carbonate and Sulfate as electron acceptors.

Unit III: Bacterial Permeation

(11)

Structure and organization of membrane (Glyco-conjugants and Proteins in membranesystem), Methods to study diffusion of solutes in bacteria (Passive diffusion, Facilitated diffusion, Different mechanisms of active diffusion).

Proton motive force, PTS, Role of permeases in transport, Different permeases in *E. coli*, Transport of amino acids and Inorganic ions in microorganisms and their mechanisms.

Unit IV: Bacterial Sporulation

(10)

Sporulating bacteria, Molecular architecture of spores, Induction and stages of Sporulation, Influence of different factors on sporulation.

Cytological and macromolecular changes during sporulation, Heat resistance and sporulation.

Swami Ramanand Teerth Marathwada University Nanded

CBCS Syllabus for M.Sc. First Year

Faculty of Science and Technology

Semester – I

Subject: Microbiology

Practical Paper Name: MICROBIAL PHYSIOLOGY

Paper Number: PRACTICAL LAB-I MB-101

Credits: 02

1. Isolation of photosynthetic bacteria.
2. Glucose uptake by *E. coli* / *Saccharomyces cerevisiae* [Active and Passive diffusion].
3. Effect of UV, pH, disinfectants, chemicals and heavy metal ions on spore germination of *Bacillus* sp.
4. Determination of Iron Oxidation Rate of *Thiobacillusferrooxidans*.
5. Determination of Sulfur Oxidation Rate of *Thiobacillusthiooxidans*.
6. Enrichment and cultivation of Chemolithotrophic bacteria.
7. Estimation of calcium ions present in sporulating bacteria by EDTA method.
8. Demonstration of utilization of sugars by oxidation and fermentation techniques.

REFERENCES

1. *Advances in Microbial Physiology*, by A. H. Rose. Academic Press. New York.
2. *Applied microbial physiology: A practical Approach* by P. Rhodes & P. Stansbury(1997), IRL Press, New York.
3. *Bacterial physiology and Metabolism* by Byung Hong Kim & Geoffrey Michael Gadd(2008), Cambridge University Press.
4. *Brocks Biology of Microorganisms* (Eleventh Edition) by Michael T. Madigan, John M.Martinko (2006), Pearson Prentice Hall.
5. *Microbial physiology and metabolism* by D. R. Caldwell (1995) Brown Publisher.
6. *Microbial physiology* by A. G. Moat, J. W. Foster & M. P. Spector (1999), Wiley.
7. *Prokaryotic Development* by V. W. Burn & I. J. Shimkots (2000). ASM. Press.
8. *The Bacteria*. Volume by I.C. Gunsalus and RogeryStainer. Academic Press.

Swami Ramanand Teerth Marathwada University Nanded

CBCS Syllabus for M.Sc. First Year

Faculty of Science and Technology

Semester – I

Subject: Microbiology

Paper Name: ADVANCES IN VIROLOGY

Paper Number: MB-102

Credits: 04

Periods: 45

Unit I: Classification, Cultivation and Detection of Viruses (12)

Definitive properties of viruses, Cataloguing of Viruses-International Committee on Taxonomy of viruses (ICTV), Structure based classification, Baltimore classification and Homes classification, LHT system of classification, Morphology and Ultra structure of Viruses.

Cultivation of Viruses: Introduction, Cell culture, Embryonated egg and Laboratory animals.

Detection of viruses in the host, Measurement of infectious units, Measurement of virus particles and their components, One step growth cycle, Assay of viruses, Physical (Electron microscopy) and Chemical methods (Protein and Nucleic acid studies), Infectivity assay.

Unit II: Multiplication of Viruses (11)

Introduction, Architecture of cell surfaces, Interaction of viruses with cell receptors, Uptake of macromolecules by cells, Mechanism of virus entry into cells, Transport of viral genome into the cell nucleus.

Genomic replication of Viruses (DNA/RNA), mRNA production by animal viruses, Mechanism of RNA synthesis, Transcription mechanism and Post transcriptional processing, Translation of viral protein, Assembly, Exit and Maturation of progeny virions.

Multiplication of bacteriophages.

Unit III: Viral Pathogenesis (11)

Host and virus factors involved in pathogenesis, Patterns of infection, Pathogenesis of animal viruses (Adenovirus, Herpes virus, Hepatitis virus, Picorna virus, Poxivirus and Orthomyxovirus), Pathogenesis of plant viruses (TMV) and Insect viruses (NPV).

Host cell transformation by viruses and oncogenesis of DNA and RNA viruses.

Unit IV: Prevention and Control of Viruses (11)

Introduction, Viral vaccines, Preparation of viral vaccines, New vaccine technology, Antiviral drugs, Virus evolution and Emergence of new viruses.

Swami Ramanand Teerth Marathwada University Nanded

CBCS Syllabus for M.Sc. First Year

Faculty of Science and Technology

Semester – I

Subject: Microbiology

Practical Paper Name: ADVANCES IN VIROLOGY

Paper Number: PRACTICAL LAB-I MB-102

Credits: 02

1. Isolation of coliphage by plaque formation assay.
2. One-step growth curve for determination of virus titre.
3. Induction of lambda lysogeny by UV radiations.
4. Studies on Specialized transduction.
5. Isolation of lambda DNA and their characterization.
6. Amplification of lambda DNA by PCR.
7. Cultivation and assay of virus using embryonated eggs and tissue culture Technique.
8. Study of symptoms of plant viruses by simple detached leaf technique.

REFERENCE:

1. *An Introduction to Viruses* by S. B. Biswas & Amita Biswas (2009), Vikas Publishing House PVT LTD.
2. *Applied Virology Research: New Diagnostic Procedures* by Edouard Kurstak, R. G. Marusyk, F. A. Murphy (1984), Academic press Inc.
3. *Brocks Biology of Microorganisms* (Eleventh Edition) by Michael T. Madigan, John M. Martinko (2006), Pearson Prentice Hall.
4. *Clinical Virology Manual* by Steven C. Specter, Richard L. Hodinka, Danny L. Wiedbrauk, Stephen A. Young (2009), ASM Press.
5. *Introduction to Modern Virology 4th Edition* by N. J. Dimmock & S. B. Primrose (1994), Blackwell Scientific publications, Oxford.
6. *Notes on Medical Virology, 10th Edition* by Morag C. Timbury (1994).
7. *Principles of Virology: Molecular Biology, Pathogenesis and Control* by S. J. Flint, L. W. Enquist, V. R. Racaniello, A. M. Skalkaj (2009), ASM Press, Washington.
8. *Principles of Molecular Virology (4th edn.)*, Edward Arnold & A. J. Cann (2005). Academic Press, London.
9. *Text Book on principles of bacteriology, Virology and Immunology* by Topley and Wilsons (1995).
10. *Virology 3rd Edition* by H. F. Conrat, P. C. Kimball and J. A. Levy (1994). Prentice Hall, Englewood Cliff, New Jersey.

11. *Compendium of Immunology and Virology* by A.B. Solunke, S.C. Aithal, V.S. Hamde, R.S. Awasthi (2018) Published by Notion Press, India, ISBN 978-1-64249-611-0
Pages 360

Swami Ramanand Teerth Marathwada University Nanded

CBCS Syllabus for M.Sc. First Year

Faculty of Science and Technology

Semester – I

Subject: Microbiology

Paper Name: FOOD AND DAIRY MICROBIOLOGY

Paper Number: MB-103

Credits: 04

Periods: 45

Unit I: Food and Dairy Fermentations

(10)

Starter culture, Biochemical activities production and preservation of following:

i) Soy Sauce ii) Saurkraut iii) Sausages iv) Vinegar v) Cheese vi) Fermented milk products

vii) Tea and Coffee viii) Indian fermented foods (Indigenous and Traditional).

Unit II: Preservation and Spoilage of Food

(12)

Principles of food preservation, Heat processing, Irradiation, High-pressure processing- Pascalization, Low-temperature storage, Chemical preservatives and Naturally occurring antimicrobials, Traditional methods of food preservation, Food packaging, Minimal processing technology for preservation of fresh foods, Use of antioxidants, Use of natural preservatives.

General types of Microbial spoilage, Factors affecting kind and rate of spoilage, Spoilage of Fruits, Vegetables and Juices, Microbial spoilage of Milk products (Butter and frozen desserts).

General principles underlying Meat spoilage, Microbial spoilage of Fish, Poultry, Sea foods and Fresh Egg.

Unit III: Quality Assurance in Foods

(12)

Food borne bacterial infections and intoxications: i) *Clostridium*, ii) *Salmonella*,

iii) *Shigella*, iv) *Staphylococcus*, v) *Campylobacter*, vi) *Listeria*.

Mycotoxin (Rubratoxin and Alfa Toxins), Phycotoxins in foods.

Quality assurance: Microbiological quality standards of food, Government regulatory practices and policies- FSSAI, FDA, EPA, HACCP, ISI, FPO, MFPO, MMPO, Codex Alimentarius, BIS, AGMARK.

Unit IV: Advances in Food Microbiology

(11)

Microbial enzymes in food and dairy industry (Proteases, Lipases, Amylases and Pectinase), Molecular diagnostic techniques for detection of food borne pathogens [Biosensors, Nucleic Acid-based Tests (NAT) and Different PCR-based techniques].

Probiotic foods and their applications, Genetically Modified Foods- Applications, Health and Safety aspects, SCP as food, Utilization of by-products i) Whey ii) Molasses.

Swami Ramanand Teerth Marathwada University Nanded

CBCS Syllabus for M.Sc. First Year

Faculty of Science and Technology

Semester – I

Subject: Microbiology

Practical Paper Name: FOOD AND DAIRY MICROBIOLOGY

Paper Number: PRACTICAL LAB-II MB-103

Credits: 02

1. Production and estimation of lactic acid by *Lactobacillus sp.*
2. Extraction and estimation of Diacetyl.
3. Isolation of food poisoning microorganisms from contaminated food products.
4. Extraction and detection of Aflatoxin from infected foods.
5. Preservation of Potato/Onion by UV radiation.
6. Production of fermented milk by *Lactobacillus acidophilus*.
7. Rapid analytical technique in food quality.
8. Isolation and Characterization of Casein from milk.
9. Detection of quality of meat products:
 - i. Estimation of tyrosine value to measure deteriorative changes
 - ii. Isolation of *Salmonella* from meat/food sample

REFERENCES

1. *Food Microbiology (2nd Edition)* by M. R. Adams & M. O. Moss, (2008) RSCPublishing.
2. *Basic Food Microbiology* by George J. Banwart (1979) Avi Publishing.
3. *Food Microbiology: Fundamentals and Frontiers* by Dolle
4. *Biotechnology: Food Fermentation Microbiology, Biochemistry and Technology*. Volume 2 by Joshi.
5. *Fundamentals of Dairy Microbiology* by J. B. Prajapati (1995), AktaPrakashan.
6. *Essentials of Food Microbiology* Edited by John Garbult, Arnold International StudentsEdition.
7. *Microbiology of Fermented Foods*. Volume I & II by Brain J. Wood. Elsevier AppliedScience Publication.
8. *Microbiology of Foods* by John C. Aryes, OrwinMundt, William E. Sandinee , W.H.Freemen and Co.

9. *Dairy Microbiology* Volume I & II by R. K. Robinson (2005), Academic Press London.
10. *Modern food Microbiology* by James M Jay, Martin J Loessner & David A Golden (2005), Springer.
11. *Food Microbiology: Fundamentals and Frontiers*. 2nd Edition by Michael P. Doyle, Larry R. Beuchat and Thomas I. Montville. (Eds.) ASM Publication.
12. *Bacterial Pathogenesis. A Molecular Approach*. 2nd Edition by 2001 by Abigail A. Salyers and Dixie D. Whitt. ASM Publications.
13. *Advances in Applied Microbiology* by D. Pearlman, Academic Press.
14. *Modern concepts of Microbiology*, 2nd edition by Kumar, HD and Kumar, S (2004), Vikas Publishing House Pvt. Ltd., New Delhi (ISBN: 81-259-1000-X).
15. Thomas Ohlsson (Nov. 1994), Minimal processing-preservation methods of the future: an overview In: *Trends in Food Science & Technology*. 5 (11) Pages 340-377, ISSN: 0924-2244. Elsevier Ltd
16. *Emerging technologies for food processing*. 2nd Edition by Sun Da-Wen 2015, ISBN: 978-0-12-411479-1, Academic Press, Elsevier Ltd.

Swami Ramanand Teerth Marathwada University Nanded

CBCS Syllabus for M.Sc. First Year

Faculty of Science and Technology

Semester – I

Subject: Microbiology

Paper Name: BIOINSTRUMENTATION

Paper Number: MB-104 (ELECTIVE)

Credits: 04

Periods: 45

Unit I: Laboratory techniques

(10)

Biosafety in microbiological laboratories: General safety measures, Personal protection, Chemical and Biological hazards, Spillage and Waste disposal, First aid.

Theory, Principle, Working and Applications of: pH meter and Laminar Air Flow.

Efficacy testing protocols for Autoclave, pH meter and Laminar Air Flow.

Centrifuge machine types and Centrifugation: Differential, Rate zonal, Isopycnic, Density gradient, Rotor types and Ultra centrifugation.

Unit II: Chromatography Techniques

(12)

Theory, Principle, Apparatus, Methods and Applications of Paper Chromatography, TLC, HPTLC, Gel Filtration Chromatography, Ion Exchange Chromatography, Affinity Chromatography, Gas Chromatography, and HPLC.

Unit III: Electrophoretic Techniques

(11)

Theory, Principle, Apparatus, Methods and Applications of Paper Electrophoresis, PolyAcrylamide Gel Electrophoresis (PAGE), Agarose Gel Electrophoresis.

Principle and Applications of: Iso-electric Focusing, Immuno Electrophoresis, Enzyme-Linked Immunosorbant Assay (ELISA), Southern, Northern and Western Blotting.

Unit IV: Spectroscopic and Radio-isotopic Techniques

(12)

Principle, Working, Instrumentation and Applications of: UV/Vis spectroscopy, IR spectroscopy, Atomic absorption spectroscopy, NMR spectroscopy, Mass spectroscopy, Raman spectroscopy.

Introduction to radioisotopes and their biological applications, Principles and Applications of Geiger Muller (GM) counter, Solid and Liquid scintillation counter, Autoradiography, Radioimmunoassay (RIA) and Radiation Dosimeters.

Swami Ramanand Teerth Marathwada University Nanded

CBCS Syllabus for M.Sc. First Year

Faculty of Science and Technology

Semester – I

Subject: Microbiology

Practical Paper Name: BIOINSTRUMENTATION

Paper Number: PRACTICAL LAB-II MB-104

Credits: 04

1. Efficacy testing of autoclave employing chemical and biological autoclave indicators.
2. Standardization of pH meter using standard buffers.
3. Studies on pH titration curves of amino acids/acetic acid and determination of pKa values and Handerson-Hasselbach equation.
4. Separation of bacterial lipids/amino acids/sugars/organic acids by TLC and Paper Chromatography.
5. Study of UV absorption spectra of macromolecules (protein, nucleic acid, bacterial pigments).
6. Paper Electrophoresis of proteins.
7. Separation of Proteins/Nucleic acids by gel electrophoresis.
8. Density gradient centrifugation.

REERENCES

1. *Biochemistry*. 6th Edition by Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006).Freeman, New York.
2. *Biophysics: An Introduction* by Cotterill, R. M. J. (2002). John Wiley & Sons, England.
3. *Principles of protein X-ray crystallography* by Drenth, J. (2007). 3rd Ed.Springer, Germany.
4. *Biochemistry*. 3rd edition by Garrett, R. H. and Grisham, C. M. (2004). Brooks/Cole,Publishing Company, California.
5. *Understanding NMR Spectroscopy* by Keeler, J. (2002). John Wiley & Sons, England.
6. *Bioinformatics: sequence and genome analysis* by Mount, D. W. (2001). ColdSpringHarbor Laboratory Press, New York.
7. *Methods in Modern Biophysics*. Second Edition by Nölting, B. (2006). Springer,Germany.
8. *Biophysics* by Pattabhi, V. and Gautham, N. (2002). Kluwer Academic Publishers,NewYork and Narosa Publishing House, Delhi.
9. *Principles and Techniques of Biochemistry and Molecular Biology* by Wilson Keith andWalker John (2005), 6th Ed. Cambridge University Press, New York.
10. *Proteins NMR Spectroscopy: Principles and Practice* by Cavanagh John *et.al.* (1995),Academic Press

11. *Molecular Biophysics: Structures in Motion* by Daune M. and W. J. Duffin (1999), Oxford University Press.
12. *Methods in Modern Biophysics* by Nalting B. and B. Nalting (2003) Springer Verlag
13. *Computational Analysis of Biochemical Systems* by Voit E. O. (2000) Cambridge University Press.
14. *Physical Biochemistry: Applications to Biochemistry and Molecular Biology* by Freilder, D. Freeman, San. Francisco, 1976
15. *Biochemical Techniques: Theory and Practice* by Robyt, John F.; White, Bernard J.
16. Waveland Press, Inc., U.S.A. Published: 1990.
17. *Principles of Instrumental Analysis* by Douglas A. Skoog, F. James Holler, Timothy A. Nieman: (Saunders Golden Sunburst Series) published by Wadsworth Pub Co. 2007
18. *Biophysical chemistry. Principles and techniques* by Upadhyay A, Upadhyay K, Nath N.: Himalaya Publishing House, Mumbai. 1997.
19. *Introduction to Radiological Physics and Radiation Dosimetry* by Attix, F.H., Wiley, New York (1986).
20. *An Introduction to Centrifugation*, by TC. Ford and J.M. Graham (1991). 118 pages. BIOS Scientific Publishers, Ltd. ISBN 1 872748 40 6
21. *Biological Centrifugation* by D. Rickwood, J.M. Graham (2001), Springer Verlag; ISBN:0387915761
22. *Paper Electrophoresis as a Quantitative Method for serum proteins* by W. P. Jencks, Mera r. Jetton and E. L. Durrum. *Biochemistry (Journal)* 1955 Vol:60pp 205-215
23. *Electrophoresis of proteins on filter paper* by Henry G. Kunkel and Arne Tiselius. *The Journ. of Gen. Physiol.* (1951) pp 89-118.
24. *Brocks Biology of Microorganisms* (Eleventh Edition) by Michael T. Madigan, John M. Martinko (2006), Pearson Prentice Hall.

Swami Ramanand Teerth Marathwada University Nanded

CBCS Syllabus for M.Sc. First Year

Faculty of Science and Technology

Semester – I

Subject: Microbiology

Paper Name: Seminar

Paper Number: MB-105

Credits: 01

MB - 105: Seminar

(Based on theory paper MB – 101 – 104 & LAB: I & II)

Swami Ramanand Teerth Marathwada University Nanded

CBCS Syllabus for M.Sc. First Year

Faculty of Science and Technology

Semester – II

Subject: Microbiology

Paper Name: MICROBIAL METABOLISM

Paper Number: MB – 201

Credits: 04

Periods: 45

Unit I: Thermodynamics and Bioenergy Transduction (11)

Basic aspects of bioenergetics: Entropy, Enthalpy, Modes of ATP generation, Hypothesis of phosphorylation. Chemiosmotic energy transduction, Chemiosmotic theory fundamentals.

Basic morphology of Energy transduction membrane: Mitochondria and Sub mitochondrial particles, Respiratory bacteria and derived preparation, Chloroplast and thylakoids, Photosynthetic bacteria and Chromatophore.

Unit II: Carbohydrate Metabolism (12)

Major Carbohydrate catabolic pathways, their regulation and significance: EMP, HMP, ED, PKP, TCA, Methyl glyoxal bypass, Anaplerotic Sequences, Glycerol metabolism, Catabolism of different carbohydrate.

Fermentations: Ethanol, Lactate, Butyrate and Butanol-acetone, Mixed Acid, 2, 3-butandiol, Propionate, Succinate, Acetate, Methane and Sulphate.

Unit III: Metabolism of Organic Nitrogenous Compounds (12)

Biosynthesis of Amino acid: Oxaloacetate and Pyruvate families, Phosphoglycerate family, α -Oxoglutarate family, Aromatic amino acids and L-histidine synthesis.

Nucleic acid metabolism: Biosynthesis and Catabolism of purine and pyrimidine nucleotide.

Unit IV: Hydrocarbon Metabolism, Endogenous Metabolism and Microbial growth on C₁ compounds(10)

Microbial degradation of aliphatic hydrocarbon (Monoterminal, Biterminal oxidation), Microbial degradation of aromatic hydrocarbon via Catechol, Protocatachuate, Metaclevage of Catachol, Protocatachuate, Homogentisate pathway.

Microbial synthesis, Degradation and regulation of glycogen, Poly-phosphate, Poly β hydroxybutyrate (PHB) production. Microbial growth on C₁ compound.

Swami Ramanand Teerth Marathwada University Nanded

CBCS Syllabus for M.Sc. First Year

Faculty of Science and Technology

Semester – II

Subject: Microbiology

Practical Paper Name: MICROBIAL METABOLISM

Paper Number: PRACTICAL LAB-III MB-201

Credits: 02

1. Isolation and identification of Reserve food material (Glycogen / Polyphosphate/ PHB) of *B. megaterium*.
2. Demonstration of endogenous metabolism in *B. megaterium* or *E. coli* and their survival under saturation condition.
3. Quantitative estimation of amino acid by Rosen's method.
4. Quantitative estimation of sugar by Sumners method.
5. Quantitative estimation of protein by Folin Lowry/Biuret method.
6. Preparation and analysis of polar lipids from *S. aureus* and *E. coli*.
7. Isolation of hydrocarbon degraders.

REFERENCES:

1. *Bacterial metabolism* by Gerhard Gottschalk (second edition), (1986) Springer Verlag New York Inc.
2. *Bacterial metabolism* by H. W. Doelle (Second edition), (2005), Academic press, Inc.
3. *Biochemistry, Seventh Edition* by Jeremy M. Berg, John L. Tymoczko and Lubert Stryer (Dec 24, 2010), W.H. Freeman & Company.
4. *Chemolithoautotrophic bacteria: Biochemistry and environmental biology* by Tateo Yamanaka, (Jan. 2008). Springer.
5. *Lehninger: Principles of Biochemistry* by Albert L. Lehninger, Michael Cox and David L. Nelson (4 May 2004), W. H. Freeman.
6. *Microbial Biochemistry (Second Edition)* by G.N. Cohen, (2011) Springer Dordrecht Heidelberg London New York.
7. *Principles of Biochemistry (Lehninger Principles of Biochemistry)* by Albert L. Lehninger, Michael M. Cox and David L. Nelson (February 2008), W. H. Freeman.
8. *Microbial Catabolism-A Review* (2010) by Dr. Shiva C. Aithal and Abhay Solunke. Pub. Cinnamonteal Print and Publishing, Dogears Print Media Pvt. Ltd. Edition 1st, Year of Publication: 2010. ISBN [978-93-80151-19-1].

Swami Ramanand Teerth Marathwada University Nanded

CBCS Syllabus for M.Sc. First Year

Faculty of Science and Technology

Semester – II

Subject: Microbiology

Paper Name: MODERN MICROBIAL GENETICS

Paper Number: MB – 202

Credits: 04

Periods: 45

Unit I: Bacterial DNA Replication, Damage and Repair (10)

Unit of replication, Enzymes involved in replication origin and replication fork, Fidelity of replication, Extrachromosomal replicon.

Types of damage: Spontaneous damage, Thermal damage, Damage due to radiation, Oxidative damage, Hydrolytic damage, Alkylation, DNA damaging agents.

DNA repair pathways: Damage reversal, Base Excision repair, Nucleotide excision repair, Methyl directed mismatch repair, Very short patch repair, Recombination repair, SOS system.

Unit II: Bacterial Transcription and Translation Process (12)

Structure of RNA polymerase (RNAP), Transcription factors, Structure and Functions of different types of RNA, Promoter structure, Transcription cycle and Fidelity of transcription.

Structure of ribosomes, Genetic code, Initiation complex, Activation and functioning of tRNA, Translation cycle, Polysomes, Post-translational modifications (PTMs) and Recycling.

Unit III: Regulation of Gene Expression in Bacteria (12)

Common modes of regulation: Co-ordinate regulation, Auto regulation, Negative and Positive regulation, stringent response, Lac operon, Trp operon, Arabinose operon.

Transcriptional regulation: Regulation by repressors and activators, Alternative sigma factors, Regulation of RNAP activity, Regulation of transcription termination (regulation by attenuation).

Translational regulation: Regulation at the level of initiation, Elongation and Termination.

Regulation of gene expression in bacteriophages

Introduction to Quorum-sensing Regulation of Gene Expression in bacteria.

Unit IV: Genetic Recombination and Mapping in Bacteria (11)

Background and perspectives of Genetic Recombination. Introduction to different types of genetic maps.

Molecular mechanism of gene transfer and genetic mapping by:

- i. Co-transformation in Transformation,
- ii. Interrupted Mating and Time-of-Entry in Conjugation,
- iii. Linkage maps by breakage and re-joining in Transduction
- iv. Use of Transposons in Genetic Mapping.

Swami Ramanand Teerth Marathwada University Nanded

CBCS Syllabus for M.Sc. First Year

Faculty of Science and Technology

Semester – II

Subject: Microbiology

Practical Paper Name: MODERN MICROBIAL GENETICS

Paper Number: PRACTICAL LAB-III MB – 202

Credits: 02

1. Purification of chromosomal/plasmid DNA and study of DNA profile. Confirmation of nucleic acid by spectral study.
 - i. Quantitative estimation by diphenylamine test.
 - ii. DNA denaturation and determination of T_m and G+C contents. Agarose gel electrophoresis of DNA.
2. Effect of UV radiations to study the survival pattern of *E. coli* /yeast. Repair mechanisms in
3. Isolation of antibiotics resistant mutants by chemical mutagenesis.
4. Ampicillin selection method for isolation of autotrophic 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.

REFERENCES

1. Gene VIII by Benjamin Lewin (2007), Oxford University Press.
2. Microbial genetics by David Freifelder (1987) Jones and Bartlett.
3. Microbial Genetics by Stanley R. Maloy, John E. Cronan, David Freifelder(1994) Jones and Bartlett Publishers.
4. Modern Microbial Genetics, 2nd Edition. Uldis N. Streips, Ronald E. Yasbin (2002), Wiley.
5. Molecular biology of the gene, 4th Edition, Vol. I, by James D. Watson, Nancy H. Hopkins, Jeffrey W. Roberts, Joan ArgetsingerSteitz and Alan M. Weiner (2005) The Benjamin/Cummings Publ. Co.
6. Molecular Genetics of Bacteria by Jeremy W. Dale, Simon F. Park (2013), John Wiley & Sons, Ltd.
7. Organization of Prokaryotic Genome by Robert Charlebois (1999).
8. Recombinant DNA by James D. Watson (1992), W. H. Freeman.
9. Glossary in Biotechnology and Genetic Engineering and Biographies of Related Scientists Handbook (2008) by Shiva C. Aithal and Nikhilesh S. Kulkarni. Pub.

Swami Ramanand Teerth Marathwada University Nanded

CBCS Syllabus for M.Sc. First Year

Faculty of Science and Technology

Semester – II

Subject: Microbiology

Paper Name: BIOPROCESS ENGINEERING

Paper Number: MB – 203

Credits: 04

Periods: 45

Unit I: Introduction to Industrial Bioprocess Engineering (10)

Definition of bioprocess engineering, Bioprocess engineer, Biotechnology and bioprocess engineering, Approach of biologist and engineers towards research, Regulatory constraints of bioprocess.

Batch growth (growth pattern and kinetics in batch culture, Environmental factors affecting growth kinetics), Monod's equation, Continuous culture, Chemostat and Turbitostat (Construction and Working), Mixed culture in nature, Industrial utilization of mixed culture.

Unit II: Bioreactors (12)

Design of basic bioreactor, Bioreactor configuration, Design features, Individual parts, Baffles, Impellers, Foam separators, Spargers, Culture vessel, Cooling and heating devices, Probes for on-line monitoring, Computer control of fermentation process.

Ideal batch reactor, Ideal continuous flow stirred tank reactor, Packed bed reactor bubble column reactor, Fluidized bed bioreactor, Trickle bed reactor (Their basic construction, Working, and distribution of gases).

Unit III: Mass Transfer and Sterilization (12)

Transport phenomena in bioprocess system: Gas liquid mass transfer in cellular systems, Basic mass transfer concept, Rate of metabolic oxygen utilization, Determination on oxygen transfer rates, Determination of K_{La} , Heat transfer, Aeration/Agitation and its importance.

Unit IV: Upstream processes and Down Stream Process (11)

Upstream processes: Inoculum development, Formulation of production media, Sterilization of bioreactors, Air supply, Media, Maintenance of stock culture, Scale up of the process from shake flask to industrial level, Solid state fermentation process.

Downstream processes: Introduction, Recovery of particulates filtration, Centrifugation, Sedimentation, Emerging technologies for cell recovery, Product isolation, Extraction, Solvent extraction, Aqueous two phase system, sorption, Precipitation, Reverse osmosis, Ultra filtration.

Recent trends in Product recovery: Commercial enzymes, Intracellular foreign proteins from recombinant *E. coli*, Single Cell Protein.

Swami Ramanand Teerth Marathwada University Nanded

CBCS Syllabus for M.Sc. First Year

Faculty of Science and Technology

Semester – II

Subject: Microbiology

Practical Paper Name: BIOPROCESS ENGINEERING

Paper Number: PRACTICAL LAB-IV MB – 203

Credits: 02

1. Isolation of Industrially important microorganisms for microbial processes.
2. Determination of Thermal Death Point (TDP) and Thermal Death Time (TDT) of microorganisms for design of a sterilizer.
3. Cultivation and determination of growth curve of bacteria *E. coli* in batch reactor/flask.
4. Continuous cultivation of bacteria in laboratory (Chemostat)
5. Study of mixed culture and its comparison with the pure culture (growth pattern).
6. Designing of batch bioreactor.
7. Determination of Oxygen Absorption rate as a function of flask size.
8. Determination of Oxygen Absorption rate as a function of RPM on shaker.
9. Determination of KLa.
10. Fermentative production and recovery of amino acid (Glutamic acid).
11. Fermentative production and recovery of alkaline protease.
12. Estimation of amino acids.
13. Estimation of Alkaline protease.

REFERENCES:

1. James E. Bailey and David F Ollis, Biochemical Engineering Fundamentals, McGraw Hill Publication.
2. Shuler and FikretKargi, Bioprocess Engineering basic concepts, 2nd edition, Prentice Hall publication.
3. Stanbury PF, Whitekar, A And Hall S J, Principles of fermentation Technology, Pergamon Press.
4. Pepler and Perlmen, Microbial Technology, Vol I and II, Academic Press.
5. Cruger and Cruger, Biotechnology: A text Book of Industrial Microbiology.

Swami Ramanand Teerth Marathwada University Nanded

CBCS Syllabus for M.Sc. First Year

Faculty of Science and Technology

Semester – II

Subject: Microbiology

Paper Name: ENZYME TECHNOLOGY

Paper Number: MB – 204(ELECTIVE)

Credits: 04

Periods: 45

Unit I: Extraction and Purification of Microbial Enzyme (12)

Importance of Enzyme purification, Different sources of enzyme, Extracellular and Intracellular enzyme, Physical and Chemical methods used for cell disintegration, Enzyme fractionation by precipitation (using Temperature, Salt, Solvent, pH etc.), Liquid-liquid extraction, Ionic Exchange, Gel electrophoresis, Affinity chromatography and other special purification methods, Enzyme crystallization technique, Criteria of purity of enzyme, Pitfalls in working with pure enzyme.

Unit II: Enzyme Kinetics and Enzyme Inhibition (11)

Enzyme kinetics: Steady state kinetics, Brigs Haldane equation, Michaelis Menten equation, The Monod-Wyman-Changeux (MWC) Model, the Koshland-Nemethy-Filmer (KNF) Model.

Irreversible, Reversible, competitive, Noncompetitive and Uncompetitive Inhibition with suitable examples and their kinetics studies, Allosteric regulation, Types of allosteric regulation and their significance in metabolic regulation and their kinetics study (Hills equation).

Unit III: Enzyme as a biocatalyst and Enzyme Engineering (10)

Structure of active sites, Role of Ionizable group in catalysts, Study on vitamins and co-enzymes: Structure and functions with suitable examples, Metallo enzymes and Metal ions as co-factors and enzyme activators. Chemical modification and site directed mutagenesis to study structure –function relationship of industrially important enzyme.

Unit IV: Immobilization and Applications of Microbial enzymes (12)

Properties of Immobilized enzyme, Methods of immobilisation: Adsorption, Covalent bonding, Entrapment and Membrane confinement. Analytical, Therapeutic and Industrial applications of Immobilised enzymes.

Microbial enzymes in Textiles, Leather, Wood Industries and Detergent, Enzymes in clinical diagnosis, Enzyme sensors for clinical processes and environment analysis, Enzymes as therapeutic agents, Extremozymes, Solventogenic enzymes.

Swami Ramanand Teerth Marathwada University Nanded

CBCS Syllabus for M.Sc. First Year

Faculty of Science and Technology

Semester – II

Subject: Microbiology

Practical Paper Name: ENZYME TECHNOLOGY

Paper Number: PRACTICAL LAB-IV MB – 204 (ELECTIVE)

Credits: 02

1. Microbial production, Extraction, Purification and confirmation of alpha amylase / Lipase.
2. Determination of efficiency of enzyme purification by measuring specific activity at various stages viz. Salt precipitation, dialysis, electrophoresis etc.
3. Effect of pH and Temperature on enzyme activity (amylase/ lipase)
4. Studies on enzyme activation and inhibition of extracted alpha amylase / Lipase. Effect of heavy metal ions, Chelating agents activators and inhibitors.
5. Immobilization of cells and enzyme using sodium alginate and egg albumin and measurement of enzyme activity (amylase / Lipase).
6. Studies on impact of immobilization of enzyme activity in terms of temperature tolerance and V_{max} and K_m using various forms of alpha amylase/ Lipase.
7. Determination of molecular weight of enzyme using PAGE technique.
8. Preparation of biosensors of urease and determination of its activity.

REFERENCES

1. Methods in enzymology. Volume 22-Enzyme purification and related techniques. Edited by William B. Jakoby. Academic press, New York.
2. Allosteric enzymes – kinetic Behaviour. 1982. by B.I Kurganov. John Wiley and Sons Inc., New York.
3. Biotechnology, volume 7 A- enzymes in biotechnology 1983 Edited by H.J. Rehm and G. Reed Verlag Chemie.
4. Hand Book of Enzyme Biotechnology by Wiseman.
5. Enzymes as Drugs Edited by John S. Hoilenberg and Joseph Roberts. John Wiley and Sons New York.
6. Methods of Enzymatic Analysis by Hans Ulrich. Bergmeyer, Academic Press.
7. Methods in enzymology by W. A. Wood. Academic Press.
8. Advances in enzymology by Alton Meister, Interscience Publishers.
9. Topics in enzymes and fermentation biotechnology by L.N. Weisman, John Wiley and Sons.
10. Understanding enzymes by T. Palmer.
11. Enzymes by Dixon and Webb. Academic Press.
12. Enzyme kinetics by Segel. Academic press.

Swami Ramanand Teerth Marathwada University Nanded

CBCS Syllabus for M.Sc. First Year

Faculty of Science and Technology

Semester – II

Subject: Microbiology

Paper Name: Seminar

Paper Number: MB-105

Credits: 01

MB - 205: Seminar

(Based on theory paper MB-201– 204& LAB: III & IV)

Swami Ramanand Teerth Marathwada University, Nanded.

Model Question Paper Pattern (Theory) with effective from 2019

Class: M. Sc. First Year (Semester I & II) CBCS Pattern

Subject: MICROBIOLOGY

Papers: MB – 101to 104 and MB– 201to 204

Time: Three Hrs

Max. Marks: 75 (ESE)

NB: All questions are compulsory.

Q. 1: Essay Type Question (On Unit I)	15 Marks
OR	
a) Short Question	8 Marks
b) Short Question	7 Marks
Q. 2: Essay Type Question (On Unit II)	15 Marks
OR	
a) Short Question	8 Marks
b) Short Question	7 Marks
Q. 3: Essay Type Question (On Unit III)	15 Marks
OR	
a) Short Question	8 Marks
b) Short Question	7 Marks
Q. 4: Essay Type Question (On Unit IV)	15 Marks
OR	
a) Short Question	8 Marks
b) Short Question	7 Marks
Q. 5: Essay Type Question (On Unit V)	15 Marks
OR	
a) Short Question	8 Marks
b) Short Question	7 Marks

Swami Ramanand Teerth Marathwada University, Nanded.

Model Question Paper Pattern (Practical) with effective from 2019

Class: M. Sc. First Year (Semester I&II) CBCS Pattern

Subject: MICROBIOLOGY

Practical Paper LAB-I (Based on theory Papers: MB-101 to 102) (Morning) &

LAB-II (Based on theory papers: MB-103 to 104) (Evening)

For two Consecutive days for each batch

Time: Four Hrs (Morning: 09am To 1pm & Evening: 2 pm To 6 pm) Max. Marks: 75 (ESE)

Q. 1: Long Experiment (MB-101/MB-103)	15
Q. 2: Long Experiment (MB-102/MB-104)	15
Q. 3: Short Experiment (MB-101/MB-103)	10
Q. 4: Short Experiment (MB-102/MB-104)	10
Q. 5: Record Book	10
Q. 6: Viva Voce	15

Swami Ramanand Teerth Marathwada University, Nanded.

Model Question Paper Pattern (Practical) with effective from 2019

Class: M. Sc. First Year (Semester I&II) CBCS Pattern

Subject: MICROBIOLOGY

Practical Paper: LAB-III (Based on theory Papers: MB-201 to 202) (Morning) &

LAB-IV (Based on theory papers: MB-203 to 204) (Evening)

For two Consecutive days for each batch

Time: Four Hrs (Morning: 09am To 1pm & Evening: 2 pm To 6 pm) Max. Marks: 75 (ESE)

Q. 1: Long Experiment (MB-201/MB-203)	15
Q. 2: Long Experiment (MB-202/MB-204)	15
Q. 3: Short Experiment (MB-201/MB-203)	10
Q. 4: Short Experiment (MB-202/MB-204)	10
Q. 5: Record Book	10
Q. 6: Viva Voce	15