RAJARSHI SHAHU MAHAVIDYALAYA (AUTONOMOUS), LATUR

M. Sc. (SEMESTER PATTERN)

SUBJECT: MICROBIOLOGY

M. Sc. FIRST YEAR

SEMESTER -II

CURRICULUM (CBCS)

Effective progressively from June 2019

Rajarshi Shahu Mahavidyalaya(Autonomous), Latur

Program: M.Sc Microbiology Curriculum: (CBCS)

M. Sc. Part-I

Semester	Course code	Title of the Course	Hours/ Wk	Marks		Credits
				In Sem	End Sem	
SEM-I	P-MIP-180	Microbial Physiology	04	40	60	4
	P-ADV-181	Advance Virology	04	40	60	4
	P-FDM-182	Food and Dairy Microbiology	04	40	60	4
	P-BIO-183	Bioinstrumentation	04	40	60	4
	P-SEM-188	Seminar based on theory papers	01	25		1
	P-LAC-184	Lab. Course-I (Microbial Physiology)	04	20	30	2
	P- LAC-185	Lab. Course-II (Advance Virology)	04	20	30	2
	P- LAC-186	Lab. Course-III (Food and Dairy Microbiology)	04	20	30	2
	P- LAC-187	Lab. Course-IV(Bioinstrumentation)	04	20	30	2
		TOTAL		625		25
SEM-II	P-MIM-280	Microbial Metabolism	04	40	60	4
	P-MIG-281	Modern Microbial Genetics	04	40	60	4
	P-ENZ-282	Enzymology	04	40	60	4
	P-BIE-283	Bioprocess Engineering **(Elective)**	04	40	60	4
	P-SEM-288	Seminar based on theory Papers	01	25		1
	P-LAC-284	Lab. Course-V(Microbial Metabolism)	04	20	30	2
	P- LAC-285	Lab. Course-VI(Microbial Genetics)	04	20	30	2
	P- LAC-286	Lab. Course-VII(Enzymology)	04	20	30	2
	P- LAC-287	Lab. Course-VIII(Bioprocess Engineering)	04	50	30	2
		TOTAL		625		25

Rajarshi Shahu Mahavidyalaya (Autonomous), Latur

M.Sc . First Year

Microbiology

1. Introduction:

In synchronization with the highly progressing developments in higher education and research, Rajarshi Shahu Mahavidyalaya (Autonomous), Latur has decided to introduce the regular Credit Based Semester System Post-graduate program in Microbiology from academic.

Year 2019-2020. These are stimulating times in microbiology, consequently, a draft of syllabus was designed for M.Sc. microbiology program that will meet the requirements of innovative, skill based and career oriented education. The syllabus also caters for the student's need for various competitive examinations in related fields in India and abroad.

2. Learning Objectives of the Program:

The Board of Studies in Microbiology of this autonomous college designed the programme envisioning the following objectives.

1) To promote a clear, complete and advanced mastery in the discipline of Microbiology.
2) To provide basic ideology of biological sciences with special reference to Microbiology and its related branches. To direct the students to explore the details of life forms at cellular and molecular level.
3) To encourage students' motivation and enthusiasm and to help them not only to appreciate the beauty of microbial life forms, their interactions with biotic and abiotic factors and their varied metabolic capabilities.
4) To inspire the students to explore the wonderful properties of microbial life in goodwill of sustainable development and protection of human life and environment.
5) To develop problem solving skills in students and encourage them to carry out innovative research projects thereby inculcating in them the spirit of knowledge creation.
6) To enable students to develop employable skills concurrently with an understanding of theoretical foundations and practical techniques required in R & D, quality control, regulatory function in various industries

3. Program specific Outcomes:

The Masters in Microbiology Program will address the increasing need for skilled scientific manpower with an understanding of research ethics involving microorganisms to contribute to application, advancement and impartment of knowledge in the field of microbiology and molecular biology globally. The laboratory training will empower them to prepare for careers in broad range fields.

M.Sc. Microbiology student will acquire:

1) Knowledge about various methodological and analytic approaches that are used within the specialization.
2) Knowledge of the leading edge in a chosen specialized area of Microbiology, based on own research experience from a master's project and literature survey.
3) Aptitude to compete in national level competitive exams such as NET-JRF or GATE or International exams and can pursue career in higher studies.
4) A better theoretical and practical insight into methods used to obtain the knowledge of microbiology with respect to microbial physiology and metabolism, molecular genetics, biosynthesis of proteins, enzymology, microbial pathogenicity, environmental and agricultural microbiology, genetic engineering and microbial technology.
5) The practical skills to demonstrate the use of equipments, technologies and standard operating procedures common to microbiology.
6) Ability to apply the scientific method and hypothesis testing in the design and execution of experiments, hypothesis generation, collection and analysis of data, and interpretation and presentation of results.
7) Talent to critically evaluate and predict the technological, ethical, social and environmental impacts associated with the microbiological activities and their by acknowledges health, safety and environment (HSE) issues in handling chemicals and microbiological materials.
8) Skill to communicate scientific outcomes to the general public and experts by writing well structured reports; through scientific publications and posters, and by Oral presentations.

4. Employability

- Skilled manpower suitable for academic and research institutions as technicians.
- Suitable for different government and non-governmental and private companies
- Skilled students who can do PhD and contribute to field of Microbiology

5. Duration of the Course: Two years.

6. Eligibility for the Course: B.Sc. Microbiology or on of the optional subject should be Microbiology at B.Sc. Level.

7. Intake Capacity: 30

8. Fees for Course: As per University/College rules.

9. Admission / Selection procedure: Admission by merit through Registration

10. Standard of Passing: As per BOE Norms.

11. Nature of question paper with scheme of marking: As per BOE Norms.

13. List of book recommended: Included in syllabus.

15. Rules and regulations and ordinance if any: As per UGC/University/College rules

16. Medium of the language: English

RAJARSHI SHAHU MAHAVIDYALAYA, LATUR

M. Sc. First Year

Semester II

MICROBIOLOGY

PAPER V – MICROBIAL METABOLISM

COURSE CODE: P-MIM-280

Periods/Week: 4, Credits: 4, Total Periods: 60 Max. Marks: 100, CIA- 40, ESE- 60

Course objectives:

- Understand universal physiological laws its applicability in biological processes.
- Understand importance of carbohydrate as prime energy source.
- Understand how biomolecules are synthesize in bacterial cell .
- Understand utilization of lipids as energy source.
- Understand utilization of less energy rich compounds.

Course outcome:

After successful completion of course students are able to

- Describe thermodynamic laws of energy.
- Describe various pathways of carbohydrate and lipid utilization.
- Describe various pathways of synthesis of biomolecules.
- Describe process of energy extraction form nontraditional sources.

Unit I: Thermodynamics and Bioenergy Transduction (11)

1.1 Scope of thermodynamics. Laws of Thermodynamics.

1.2 Concept of enthalpy, free energy, free energy and equilibrium constant, Gibbs free energy equation,

1.3 Determination of free energy of hydrolytic and biological oxidation reduction reactions, under standard and non-standard conditions.

1.4 High energy compounds, Structure and properties of ATP

1.5 Standard Free energy change of hydrolysis of ATP and other high energy compounds, coupled reactions, determination of feasible reaction.

1.6 Atkinson's energy charge theory.

Unit II: Carbohydrate Metabolism (12)

2.1 Major Carbohydrate catabolic pathways, their regulation and significance: EMP, HMP, ED, PKP,

2.2 TCA, Methyl glyoxylate bypass, Anaplerotic Sequences.

2.3 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)

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

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

Unit IV: Metabolism of lipids and hydrocarbons **(10)**

Lipid Biosynthesis:
Biosynthesis of palmitate, its role in other fatty acid synthesis.
Biosynthesis of Membrane Phosopholipids
β Oxidation of fatty acids.
Microbial synthesis, Degradation and regulation of glycogen, Poly-phosphate, Poly β hydroxybutyrate (PHB) production.
Microbial degradation of aliphatic and aromatic hydrocarbon.

REFERENCES:

1. *Bacterial metabolism* by Gerhard Gottschalk (second edition), (1986) Springer VerlagNew 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 LubertStryer (Dec 24, 2010), W.H. Freeman & Company.
4. *Chemolithoautotrophic bacteria*: Biochemistry and environmental biology by TateoYamanaka, (Jan. 2008). Springer.
5. *Lehninger: Principles of Biochemistry* by Albert L. Lehninger, Michael Cox and DavidL. Nelson (4 May 2004), W. H. Freeman.
6. *Microbial Biochemistry (Second Edition)* by G.N. Cohen, (2011) Springer DordrechtHeidelberg 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].
10. Segel Irvin H. (1997) Biochemical Calculations 2nd Ed., John Wiley and Sons, New York
11. Garrett, R. H. and Grisham, C. M. (2004) Biochemistry. 3rd Ed. Brooks/Cole, Publishing Company, California.

Lab. Course-V
MICROBIAL METABOLISM
(Course Code: P-LAC-284)

Marks 50 (Credit: 02) Hours 45

Course objectives:

- Understand Methods Estimation of different types of biomolecule.
- Understand membrane component and its chemical nature.
- Understand what kinds of reserve food components are present in microbes.

Course outcomes:

After successful completion of lab course students will be

- Explain types of reserve food material
- Biomolecules and it's estimation.
- Membrane composition and it's isolation
- Microbes involved in hydrocarbon degradation.

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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.

RAJARSHI SHAHU MAHAVIDYALAYA, LATUR

M. Sc. First Year

Semester II

MICROBIOLOGY

PAPER VI – MODERN MICROBIAL GENETICS

COURSE CODE: P-MIG-281

Periods/Week: 4, Credits: 4, Total Periods: 60 Max. Marks: 100, CIA- 40, ESE- 60

Course objectives:

- Understand fundamental molecular processes like replication transcription translation.
- Understand how the cell information is changes due to chemical and physical factors.
- Understand cell defense mechanism to recollect the correct information.
- Understand regulatory mechanism for gene expression.
- Understand horizontal gene transfer in microbes and its role in mapping.

Course outcomes:

After successful completion of course students are able to

- Describe protein machinery involved in basic function of cell.
- Describe various pathways of damage repair system.
- Describe importance of gene regulation.
- Describe how microbes exchange information between them.

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.

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 Viley& 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. Himalaya Publishing House, Book Edition & Year of Publication: 1st, 2008. ISBN No.: 971-81-8318-832-6

Lab. Course-VI
MODERN MICROBIAL GENETICS
(Course Code: P-LAC-285)

Marks 50(Credit: 02) Hours 45

Course Objectives

Learning objectives of the Lab course are

- Understand Basic molecular techniques.
- Understand isolation techniques of DNA,RNA and Plasmid.
- Understand and design experiments to study gene expression in bacteria.

Course outcomes

After successful completion of course student will be able to

- Isolate DNA,RNA, and Plasmid
- Study conjugation.
- Isolate mutants.

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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 Tm 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.

RAJARSHI SHAHU MAHAVIDYALAYA, LATUR

M. Sc. First Year

Semester II

MICROBIOLOGY

PAPER VII – BIOPROCESS ENGINEERING

COURSE CODE: (P-BIE-283)

Periods/Week: 4, Credits: 4, Total Periods: 60 Max. Marks: 100, CIA- 40, ESE- 60

Maximum Marks: 100(Credit:4) Periods: 45

Course objectives:

- Understand ancient microbial practice that is fermentation.
- Understand industrial utilization of microbial fermentation processes.
- Understand upstream and downstream practices.
- Understand process of isolation and manipulation of industrially important microbes.
- Understand methods of separation of final fermented products.

Course outcomes:

After successful completion of course students are able to

- Describe basic modern design of bioreactors.
- Describe different types of cultures and its requirements.
- Describe importance of upstream and downstream processes.

Unit I: Introduction to Industrial Bioprocess Engineering and Bioreactors (14)

1.1 Bioprocess engineering and industrial microbiology.

1.2 Batch growth(growth pattern and kinetics in batch culture, Environmental factors affecting growth kinetics), Monod's equation.

1.3 Continuous culture, Chemostat and Turbitostat (Construction and Working).

1.4 Basic design of bioreactor.

1.5 Bioreactor configuration-Different parts of the bioreactor, Baffles, Impellers, Foam separators, Air spargers, Culture vessel, Cooling and heating devices, Probes for on-line monitoring

1.6 Different types of bioreactor-Batch,Continuous flow stirred tank bioreactor, Packed bed bioreactor,bubble column bioreactor, Fluidized bed bioreactor, Trickle bed bioreactor.
(Their basic construction and Working, and distribution of gases.)

1.7 Atomization in fermentation technology.

Unit II: Mass Transfer and Sterilization (09)

2.1 Transport phenomena in bioprocess system: Gas liquid mass transfer in cellular systems,

2.2 The oxygen requirement in industrial fermentation.

2.3 Determination of Kla values, Gassing out techniques.

2.4 Aeration/Agitation and its importance.

2.5 Medium sterilization,
i) The Design of Batch sterilization processes calculation of Del factor.
ii) The design of continuous sterilization processes.

Unit III: Upstream processing **(09)**

3.1 Screening and strain development program, maintenance of stock culture.
3.2 Formulation of media, Development of Inoculum.
3.3 Sterilization of fermentation media bioreactors, Media.
3.4 Scale up of the fermentation process from shake flask to industrial level.
3.5 Solid state fermentation process.

Unit IV: Down Stream Processing **(14)**

4.1 Downstream processes: Introduction,
4.2 Separation of particulates material- Filtration, Centrifugation, Sedimentation,
4.3 Emerging technologies for cell recovery,
4.4 Product isolation, Extraction, Solvent extraction, Aqueous two phase system, sorption, Precipitation, Reverse osmosis, Ultra filtration.
4.5 Recent trends in Product recovery:

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. Peppler and Perlmen, Microbial Technology, Vol I and II, Academic Press.
5. Cruger and Cruger, Biotechnology: A text Book of Industrial Microbiology.

Lab. Course-VIII
BIOPROCESS ENGNEERING
(Course Code: P-LAC-287)

Marks 50(Credit: 02) Hours 45

Course Objectives

Learning objectives of the Lab course are

- Understand isolation techniques of industrially important microbes and the effect of different physical parameter on it.
- Understand effect of various culture on fermentation process.
- Understand isolation and estimation of enzyme, protein and amino acid.

Course outcomes

After successful completion of course student will be able to

- Isolate industrially important microbes.
- Study different types of culture methods.
- Isolation and estimation of biomolecules.

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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.

RAJARSHI SHAHU MAHAVIDYALAYA, LATUR

M. Sc. First Year

Semester II

MICROBIOLOGY

PAPER VII – ENZYME TECHNOLOGY

COURSE CODE: P-ENZ-282

Periods/Week: 4, Credits: 4, Total Periods: 60 Max. Marks: 100, CIA- 40, ESE- 60

Course Objectives:

- To understand structure ,working and function of biocatalyst.
- To understand different extraction and purification methods for biocatalyst.
- To study use of biocatalyst in different industries.

Course Outcomes:

The students able to

- Describe roles of biocatalyst in living system.
- Describe allosteric regulation and their significance in metabolic regulation.
- Describe different immobilization techniques.

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

1.1 Active site,
1.2 Co-enzymes: Structure and functions with suitable examples,
1.3 Metallo enzymes and Metal ions as co-factors and enzyme activators.
1.4 Mechanism of enzyme action- with reference to chymotrypsin.
1.5 Chemical modification of enzymes
1.6 Application of Site directed mutagenesis to study structure –function relationship of enzyme.

Unit II: Enzyme Kinetics and Enzyme Inhibition (11)

2.1 Enzyme kinetics: Steady state kinetics, Brigs Haldane equation, Michaelis Menten equation, The Monod-Wyman-Changeux (MWC) Model, the Koshland-Nemethy-Filmer (KNF) Model.
2.2 Enzyme inhibition-Reversible and Irreversible inhibition, competitive, noncompetitive and uncompetitive inhibition,with suitable example and their kinetics studies.
2.3 Enzyme regulation-Allosteric regulation, Types of allosteric regulation and their significance in metabolic regulation and their kinetics study (Hills equation).

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

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

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

4.1 Properties of Immobilized enzyme,

4.2 Methods of immobilization: Adsorption, Covalent bonding, Entrapment and Membrane confinement.
4.3 Analytical, Therapeutic and Industrial applications of immobilized enzymes.
4.4 Microbial enzymes in Textiles, Leather, Wood Industries and Detergent, Enzymes in clinical diagnosis,
4.5 Enzyme sensors for clinical processes and environment analysis,
4.6 Enzymes as therapeutic agents, Extremozymes, Solventogenic enzymes.

REFERENCES

1. Methods in enzymology. Volume22-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 sond Inc., New York.
3. Biotechnology, volume 7 A- enzymes in biotechnology 1983 Edited by H.J.Rehm and G.Reed Verlag Cheime.
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. AWood. Academic Press.
8. Advances in enzymology by Alton Meister, Interscience Publishers.
9. Topics in enzymes and fermentation biotechnology by L.N.Weiseman, 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

Lab. Course-VII

ENZYME TECHNOLOGY

(Course Code: P-LAC-286)

Marks 50 (Credit: 02) Hours 45

Course Objectives:

- To study production, extraction and purification processes.
- To study efficiency of enzyme purification.
- To study effect of heavy metals and chelating agents.

Course Outcomes:

- Students will able to design protocols for production of commercially important enzymes.
- Students will be able to isolate microorganisms producing enzymes.

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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.

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LIST OF INSTRUMENTS

Sr.no.	Equipments / Instruments	Unit
1.	Shaker 24x24	01
2.	VDRL shaker	01
3.	Autoclav	03
4.	Incubator	02
5.	Water bath	01
6.	Photocolorimeter	02
7.	Spectrophotometer	01
8.	Warming table	01
9.	Heating mantle	01
10.	TLC kit	01
11.	Rough balance	01
12.	Electronic balance	02
13.	One pan balance	01
14.	Distillation plant(steel)	01
15.	Microscope with oil emulsion objective	14
16.	Slide projector Automatic	01
17.	Haemocytometer	09
18.	Haemoglobinometer	09
19.	Air compressor with motor (Apollo)	01
20.	Micrometer slide	02
21.	Hot plate	01
22.	Homogenater	01
23.	Godrej Refrigetor 1.Model no.280 litre (30 DY) 2.Model no.230 litre (24AC)	 01 01
24.	Colony counter digital	
25.	Orbital shaking incubator (CIS-24)with voltage stabilizer	
26.	Cooling centrifuge (C-24 BL) with voltage stabilizer	
27.	Deluxe laboratory centrifuge (R-8C)	01
28.	Laminar air flow microfilt(microfilt make)	01

Sr.no.	Equipments / Instruments	Unit
29.	Hot air oven	01
30.	Electrophoresis kit	01
31.	Magnetic stirrer	01
32.	Vortex mixture	01
33.	UV chamber	01
34.	Paper chromatography Assembly	01
35.	Refrigetor kelvinator	01
36.	pH meter	01
37.	Bottle washing machine	01
38.	Soxhalet accelerator	01
39.	Vacuum pump	01
40.	Pipette washing machine	01
41.	ESR assembly	01
42.	Seitz filter assembly	01
43.	Micropipette	05
44.	Lab research microscope (microne)	03
45.	Metzes optik monocular microscope model METZ_777	02
46.	Digital photoelectric meter (systronics) make type 112	01
47.	Anaerobic jar (kumar make)	
48.	Vacuum cleaner.Eureks forbes make trendly model	01
49.	Electronics balance contech model CA-124 ,0.1 mg to 120 gm	01
50.	Distillation unit (Bhanu make)	01
51.	Anaerobic jar (kumar make)	01
52.	Lab Fermenter 5 lit capacity make (DYNA biotech)	01