



HIMACHAL PRADESH UNIVERSITY
DEPARTMENT OF BIOTECHNOLOGY
SUMMER HILL, SHIMLA 6 171 005

Guidelines for Master of Philosophy (M.Phil.) Degree Course in Biotechnology at Department of Biotechnology, Faculty of Life Sciences.

The M.Phil. Programme of 1-year duration has been conceived with sole aim of strengthening research activity in the field of Biotechnology.

- 1) Every year, a total of five seats shall be available for one year M.Phil. Programme.
- 2) The essential qualification for admission to M.Phil seats is M.Sc. Biotechnology (2 years Program). The admission(s) in M.Phil. Programme shall be as per Himachal Pradesh University rules.
- 3) The candidate registered for M.Phil. Programme will deliver a seminar at the beginning of the research work (Presentation of the plan of work), and another seminar before submission of the thesis.
- 4) All the M.Phil. Students shall regularly participate as well as regularly present seminars/Journal Club(s) as per roster made from time to time.
- 5) All other rules and regulations for admission, enrolment and registration for M.Phil. will be the same as approved by the H. P. University from time to time.



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M.Phil. in Biotechnology:

First semester

Teaching Hours: 45 (Each course)

<u>Course No.</u>	<u>Title of the course</u>	<u>Total Marks</u>
1.	Research Methodology, Scientific-Writing, Project Management in Biotechnology and Bioindustry	75
	Internal Assessment	25
2.	(One of the following options)	75
	i. Bioprocess Technology	
	ii. Enzyme Technology	
	iii. Recombinant DNA- Technology	
	Internal Assessment	25

Second semester

i.	M.Phil. Dissertation evaluation (Through external examiner)	75
ii.	Viva-voce on Dissertation	25
iii.	Seminar Presentation	Satisfactory/Unsatisfactory

The Internal Assessment shall comprise (i) First House Examination (ii) Second House Examination of 10 marks each and (containing 20 multiple-choice questions of 0.5 marks each), & (iii) An Assignment of 5 marks in each course.

COURSE-I:

Research Methodology and Project Management in Biotechnology

Theory Examination	=	75 marks
House Examinations	=	20 Marks
Assignment	=	5 marks
Total	=	100 marks

Examiner will set eight questions in total covering the entire syllabus. However, there will be one compulsory question containing fifteen questions with short answers. The students will attempt five questions including the compulsory question. All questions shall carry equal marks (15 marks each)

I. Research Methodology in Biotechnology

- 1) Survey of techniques used in biotechnology: Principal, general procedure and instrumentation in centrifugation, electrophoresis, chromatography, spectrophotometry, spectroscopy, crystallography autoradiography and microscopy, general techniques in microbiology.
- 2) Bioinformatics and computer applications: Computer network, on-line control using computers, Use of database, EMBL. NBAF, protein structural data bank, sequence analysis of proteins and nucleic acids, structure prediction, molecular modeling, bibliographic and non-bibliographic Research.

II. Scientific Writing:

- 3) Scientific document: Organization and writing of a research paper, short communications, review articles, monographs, technical and survey reports, authored books and edited books, and dissertation.
- 4) Scientific literature: Abstracts and journals in biotechnology floppy forms of journals, major libraries subscribing journals related to biotechnology in the region and country

III. Research and development of projects in biotechnology:

- 5) Funding agencies: National and international funding agencies for R & D projects.
- 6) Preparation of R & D projects for funding: Organization of a research project, identification of gap areas in the subject, aims and objectives of the projects, possible outcome of the project, funds requirements and justification(s).
- 7) Patents and patents writing: Parts of Patent applications characteristics of the disclosure for a biotechnology invention, marketing of biotechnological invention.



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IV. Project management in bioindustry:

- 8) Basis and technology for starting a new project: Market survey, futuristic estimates, indigenous and imported technology.
- 9) Cost estimation: Total product cost, capital investment and profitability manufacturing cost estimation, capital investment estimation, and use of cost analysis for decision-making.
- 10) Marketing strategies for biotechnological products: Product launching, evaluation and advertisements,

Books suggested:

1. Principles and Techniques of Practical Biochemistry, K. Wilson and J. Walker, Cambridge University Press, Cambridge.
2. Manual of Industrial Microbiology and Biotechnology. A. L. Demain and N.A. Solomon, American Society for Microbiology, USA.
3. Council of Biology Editors ó 1972. CRE Style Manual. 3rd Ed., American Institute of Biological Sciences, Washington. D.C.
4. Tichy, A.J., Effective Writing for engineers, managers, scientists. Wiley, New York and London.
5. Tribcase, S.F., Scientific and Technical papers. M.I.T. Press, Cambridge, Mass and London, England.
6. Day, R. A., How to write and publish a scientific paper. Philadelphia, IST Press.

Option (i) Bioprocess Technology

Theory Examination	=	75 marks
House Examinations	=	20 Marks
Assignment	=	5 marks
Total	=	100 marks

Examiner will set eight questions in total covering the entire syllabus. However, there will be one compulsory question containing fifteen questions with short answers. The students will attempt five questions including the compulsory question. All questions shall carry equal marks (15 marks each)

- I. Biochemical basis of product formation
Metabolic organization and regulation, catabolic regulations, regulation of anabolism, regulation of synthesis of macromolecules, products of catabolism, products from anabolism, macromolecular products and secondary metabolism.
- II. Raw material for bioprocessing
Conventional and Non-conventional substrates: Pretreatment & Treatment
- III. Sources, screening and strain development
Culture collections (National and International), typing centers, and culture transportation, isolation and screening of microbes for the production of primary and secondary metabolites, sources of microorganisms for fermentation industry, test systems, methods for strain development (selection, mutations, recombination and genetic engineering).
- IV. Preservation of cultures and development of inocula
Preservation of bacterial, fungal, plant and animal cell cultures, techniques for inoculum preparation with single celled and multicellular microorganisms.
- V. Media design and optimization
Basic requirements of fermentative microorganisms, carbon and nitrogen sources for large-scale fermentation, optimization of media and product information.
- VI. Reactor design and instrumentation
Batch, continuous and plug flow reactor systems, conventional stirred tank reactor (CSIR), bubble column reactor, air lift reactor, packed bed reactor, fluidized bed reactor, tube plug reactor, sterilization of bioreactors, aseptic function of bioreactor and instrumentation, bioreactors for plant, algal and animal cell cultures.

port in bioreactors

of the reactor, biological reaction rate equation, maintenance and cell yield, determination of parameters of rate equation, oxygen demand and transport, controlled oxygen transfer rate and analysis, internal diffusion in solid phase catalysis external diffusion at solid phase liquid interphases.

VIII. Modes of process operation and scale up

Batch, continuous & fed-batch fermentation, enzymatic processes, rheology of fermentation broth, power calculations, calculations of KLa, scale up criteria.

IX. Down stream processing

Centrifugation, filtration, cell disintegration, extraction in aqueous two phase system, liquid to liquid extraction, fractional precipitation, fractional distillation, chromatographic and electrophoretic techniques. Effluent treatments.

X. Integrated process analysis of some bioprocess technology products

Salient features of beer brewing, fermented milk products, fermented Indian foods and vegetables, wine production, production of baker's yeast, ethanol production, microbial transformations, production of citric acid, antibiotics, polysaccharides, enzymes, vitamins, glutamic acid, single cell protein (SCP) and recombinant proteins.

Books:

- 1) Bioprocess Technology: Fundamentals and Application, S.O. Enfors and L. Haggstrom, Royal Institute of Technology, Stockholm,
- 2) Biotechnology: A Text Book of Industrial Microbiology, T. D. Brock; W. Grueger and A. Grueger: Sinauer Publication, USA.
- 3) Biochemical Engineering, J.M. Lee, Prentice Hall International Ltd, U. K. London.
- 4) Principles of Fermentation Technology, P. F. Stanburry and A. Whitaker.
- 5) Manual of Industrial Microbiology and Biotechnology, A. L. Demain and N. A. Solomon, American Society for Microbiology, Washington.

Final Examination	=	75 marks
House Examinations	=	20 Marks
Assignment	=	5 marks
Total	=	100 marks

Examiner will set eight questions in total covering the entire syllabus. However, there will be one compulsory question containing fifteen questions with short answers. The students will attempt five questions including the compulsory question. All questions shall carry equal marks (15 marks each)

- I. Commercial sources of enzymes:
Sources of commercial enzymes, microbial enzymes, screening strategies for isolation of hyper-enzyme producing microbes, control of microbial enzyme production, genetic manipulation techniques, legal implications in the use of enzymes, growth of enzyme industry, economic considerations in the use of enzymes on a large scale
- II. Extraction and purification of enzymes
Enzyme extraction, enzyme purifications, large-scale purification enzyme specification, criteria of purity, molecular weight determination and characterization of enzyme.
- III. Enzyme kinetics:
Nomenclature of enzymes, simple and complex (bisubstrate) enzyme, inhibition of enzyme reactions, factors effecting enzyme activity, enzyme reactors with simple kinetics.
- IV. Immobilization of enzymes
Immobilization techniques, effect of mass transfer resistance, kinetics of immobilized enzymes, immobilization of amylase, cellulase, protease and lipase.
- V. Biocatalyst stabilization:
Immobilization, medium engineering, enzyme reactions in water restricted media and super critical fluids. Use of additives chemical modifications and protein engineering for enzyme stabilization.
- VI. Enzyme engineering:
Design and specialized construction of novel enzymes, synthetic enzymes, covalent modifications of enzymes, enzymic modifications of enzymes, substitution of bound metals in enzymes, non-and site-specific mutagenesis for the construction of desired enzymes.
- VII. Specialized biocatalysts:
Abzymes and Ribozymes.



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Enzyme therapy, analytical, food processing and pharmaceutical applications,
development of novel processes, enzymes in biosensors.

Books:

- 1) Biocatalysts for industry, J.S. Dordick, Plenum Press, New York, London.
- 2) Enzyme Technology, M.F. Chaplin & C. Bucke.
- 3) Enzymes in Industry, Production & Applications W. Gerhartz.
- 4) Enzymes Technology, P. Gacesa and J. Hubble, Open University Press, England,
UK.
- 5) Biochemical Engineering, J.M. Lee, Prentice Hall INC, New Jersey.

Technology

Theory Examination	=	75 marks
House Examinations (2)	=	20 Marks
Assignment	=	5 marks
Total	=	100 marks

Examiner will set eight questions in total covering the entire syllabus. However, there will be one compulsory question containing fifteen questions with short answers. The students will attempt five questions including the compulsory question. All questions shall carry equal marks (15 marks each)

I. Primary genetic material

Structure and chemical composition of genetic material (DNA & RNA) replication of DNA, genetic code, transcription, translation, regulation of gene expression in prokaryotes and eukaryotes.

II. Enzymes used in recombinant DNA- technology

Restriction endonucleases, isoschizomers, DNA methylases, DNA polymerases, DNA dependant RNA polymerases, ligases, kinases and phosphatases, nucleases, DNA binding proteins, single stranded ó DNA binding proteins, DNA- repairing enzymes and topoisomerases.

III. Vectors for molecular cloning

Plasmids, bacteriophages, cosmids, single stranded filamentous bacteriophages, charon phages, shuttle vectors. Vectors used for cloning in bacteria, yeast, plants and animal cells.

IV. Methodology for preparation and purification of genetic material

Agarose gel electrophoresis, preparation of agarose gels, recovery and purification of DNA fractionated on agarose gels polyacrylamide gel electrophoresis, non-denaturing polyacrylamide gels, detection of DNA in polyacrylamide gel electrophoresis, isolation of fragments from PAGE- gels, strand separating gel, DNA-PAGE-gel, pulse field PAGE gels. Growth of bacterial cultures, harvesting and lysis of bacteria, yeast, plant and animal cells. Methods for extraction and purification of genomic and vector DNA.

V. Strategies for cloning

Restriction endonucleases digestion of genomic and vector DNA; strategies for ligation, genomic DNA library, phosphorylation of linearized vector DNA, hosts for cloning, preparation and transformation of competent cells, identification of transformed bacterial colonies, construction and analysis of DNA libraries, analysis and cloning of eukaryotic genomic DNA, preparation of labeled DNA and NA probes, synthesis of oligonucleotide probes, screening and expression of libraries with oligonucleotides.

DNA sequencing, Sanger's method, Maxim and Gilberts method, random sequencing, direct sequencing, sequencing gels, autoradiography of sequencing gels, RNA sequencing and amino acid sequencing of proteins.

VII. Site directed mutagenesis and PCR technology:

Generation of deletion and insertion- Linker insertion mutagenesis, linker scanning mutagenesis, nested sets of deletion mutants, oligonucleotide mediated mutagenesis preparation of single stranded target DNA, design and selection of mutagenic oligonucleotides, use of site directed mutagenesis to study proteins, insertion of hexameric linkers into protein coding sequences, creation of mutations in defined fragment of DNA, modification and improvement of proteins using site directed mutagenesis, polymerase chain reaction technology (PCR technology). Quantification of constructed target sequencing.

VIII. Expression of cloned genes

Expression vectors for mammalian cells, yeast cells, plant cells and bacterial cells (*E. coli*, *Bacillus*, *Streptomyces*), introduction of recombinant vectors into the expression hosts (mammalian cells, plant cells, yeast cells and bacterial cells,) cloned gene product expressed as fusion proteins expressed from cloned genes- production of antibodies, purification of antibodies, purification technology.

Books:

- 1) Recombinant DNA, J.D. Watson, J. Witkowski, M. Gilman, M. Zoller, Scientific American Books New York.
- 2) Principles of Gene Manipulation, W. Old and S. B. Primrose.
- 3) Basic Methods in Molecular Biology, L.G. Davis, M.D. Dibner, J.R. Battey, Elsevier, New York, London.
- 4) Molecular Cloning. A laboratory Manual, (Vol-I-III). J. Sambrook, E.F. Fritsch, T. Maniatis, Cold Spring Harbor Laboratory PRESS.
- 5) Molecular Biology of Gene, J.D. Watson; J. NN. Roberts, N.H. Hopkins J.A. Steitz; A.N. Weiner, Benjamin/Cummings Pub. Cop. Inc. USA.