Rayat Shikshan Sanstha's

Yashavantrao Chavan Institute of Science, Satara Syllabus for Master of Science Part II

1. Title: **M.Sc. Biotechnology (Entire)**

2. Year of Implementation: 2019-20

3. Preamble:

The M. Sc. Biotechnology course under autonomy has been prepared keeping in view the unique requirements of M. Sc. Biotechnology students. The emphasis of the contents is to provide students the latest information along with due weightage to the concepts of classical biotechnology so that they are able to understand and appreciate the current interdisciplinary approaches in the study of plant and animal biotechnology, genetic engineering, bioinformatics, genomics, proteomics and applied subjects like Bio-entrepreneurship, IPR etc. The course content also lists new practical exercises so the students gets a hands on experience of the latest techniques that are currently in use. Project curriculum spanning over the two years of the course is designed in a way to give the students first hand research experience as it consists of writing of synopsis, literature review along with actual table work. Along with it students are also provided with an opportunity to peruse internship in industry or research centers. The

course will also inspire students to pursue higher studies and research in biotechnology, for becoming an entrepreneur and enable students to get employed in food, pharmaceuticals and agriculture industries.

4. General Objectives:

- Construction and designing of the courses to suite industrial needs.
- More emphasis on applied aspects of biotechnology
- To develop aptitude of students in the field of research.
- Enrichment of basic knowledge in areas of Biotechnology

5. Duration: One Year

6. Pattern: Semester wise

7. Medium of Instruction: English

8. Structure of Course:

a. Semester III :

Theory: 04 Papers
Practical's: 02 Papers

b. Semester IV :

Theory: 04 Papers
Practical's: 02 Paper

9. Structure of Course:

YASHAVANTRAO CHAVAN INSTITUTE OF SCIENCE, SATARA									
COURSE STRUCTURE UNDER CHOICE BASED CREDIT SYSTEM (CBCS)									
M. Sc. BIOTECHNOLOGY (ENTIRE)									
M. Sc. II SEMESTER– III (Duration – 6 Months)									
Sr. No.	**SUBJECT CODE**	**PAPER NO AND TITEL**	**TEACHING SCHEME**						
			Theory			**Practical**			
			No. of lectures	**Hours**	**Credits**	**Subject**	**No. of lectures**	**Hours**	**Credits**
1	MBTT--301	Bioprocess and Fermentation Technology	4	5	4	MBTP--305 : Bioprocess and Fermentation Technology & Enzymology	5	5	4
2	MBTT--302	Enzymology	4	5	4				
3	MBTT--303	Genetic Engineering	4	5	4	MBTP--306 : Genetic Engineering and Biostatistics / Bioinformatics	5	5	4
4	MBTT-304 A	Bioinformatics	4	5	4				
5	MBTT 304 B	Biostatistics							
	Total of SEM III		**16**	**20**	**16**		**10**	**10**	**08**

YASHAVANTRAO CHAVAN INSTITUTE OF SCIENCE ,SATARA									
COURSE STRUCTURE UNDER CHOICE BASED CREDIT SYSTEM (CBCS)									
M. Sc. BIOTECHNOLOGY (ENTIRE)									
M. Sc. II SEMESTER– IV (Duration – 6 Months)									
Sr. No.	**SUBJECT CODE**	**PAPER NO AND TITEL**	**TEACHING SCHEME**						
			Theory			**Practical**			
			No. of lectures	**Hours**	**Credits**	**Subject**	**No. of lectures**	**Hours**	**Credits**
1	MBTT--401	Genomics and Proteomics	4	4	4	MBTP--405 : Project	5	5	4
2	MBTT--402	Research Methodology	4	4	4				
3	MBTT—403	Bio-entrepreneurship and IPR	4	4	4	MBTP--406 : Internship	5	5	4
4	MBTT--404 A	Animal Biotechnology	4	4	4				
5	MBTT--404 B	Food Biotechnology	4	4	4				
	Total of SEM IV		**13**	**13**	**11**		**10**	**10**	**8**

Other Feature:

A) Library:

Reference and Textbooks, Journals and

Periodicals B) Specific Equipment's:

Computer, LCD Projector, Visualizer, Smart Board

C) Laboratory Equipment's:

Sr No.	Name of Instrument
1	Atomic Absorption Spectrometer
2	Autoclave Vertical
3	Bacteriological Incubator
4	Binocular Research Microscope CX 21i
5	BOD Incubator
6	Centrifuge Remi R-4C
9	COD refluxing unit
10	Colorimeter
11	Combined pH and Conductivity Meter
12	Compound Microscope
13	Conductivity Meter
14	Deep freezer
16	Dissection microscope
17	Distillation assembly
18	Flame Photometer
19	Hemocytometer
24	Horizontal Electrophoresis unit
25	Horizontal Laminar Airflow
26	Hot Plate
27	Lux Meter
29	Microcentrifuge
30	Microscope camera device
31	Microwave Oven
32	MiniCentrifuge Remi
33	Mixer
34	pH Meter
35	Refractometer
38	Refrigerator
39	Rotary Shaker

40	Sonicator Waterbath
42	Spectrophotometer UV-Vis
43	Stabilizer
44	Thermal Cycler
45	Ultra microtome
46	UV transilluminator
47	Vacuum pump
48	Variable type power pack
49	Vertical Electerophoresis Unit
51	Visible Spectrophotometer
52	Water bath
53	Weighing balance

SEMESTER III

SUBJECT CODE	PAPER NO AND TITEL
MBTT-301	Bioprocess and Fermentation Technology
MBTT-302	Enzymology
MBTT-303	Genetic Engineering
MBTT-304 A	Bioinformatics
MBTT-304 B	Biostatistics
MBTP-305	Bioprocess and Fermentation Technology & Enzymology
MBTP-306	Genetic Engineering and Biostatistics / Bioinformatics

MBTT 301 Bioprocess engineering &Fermentation Technology

Lectures: 60 **Credits: 4 C**

Objectives:

- To learn concept of Bioreactor.
- To understand the digital monitoring in fermentation.
- To learn concept upstream and downstream processing.
- To understand the lab fermentation to scale up

Unit I **15**

Introduction to fermentation and Basic aspects of bioengineering

Introduction to fermentation, Type of fermentation– Batch, Fed Batch and Continuous processes. Basic Design of fermentor – design aspect of Stirred tank reactor and non- mechanically agitated bioreactors (Air lift and Bubble column).

Design and operation of immobilized cell reactors. Mass transfer, Aeration and agitation of fermentation broth, Aeration and agitation of fermentor broth.

Unit II **15**

Fermentation Media, Sterilization and monitoring of process variables

Media components and their optimization, Sterilization of media: Kinetics of destruction of microorganisms, indicator organism Del factor, designs of Batch and continuous sterilization (Del factor calculation), equipment used. Filter sterilization.

Monitoring of process variables: Types of sensors, Measurement and control of various parameters (pH, Temperature, dissolved oxygen, microbial biomass, inlet and exit gases, fluid flow, Pressure, Foam), Scale Up and Scale Down

Unit II I **15**

Production and Downstream processing

Concept of primary (growth associated) and secondary metabolites (Growth non -associated) metabolites, kinetics of growth and product formation. Yield coefficient and efficiency.

Downstream processing and unit operations, General strategy of downstream processing, Production, recovery (with principles of techniques involved) and fermentative product of Vitamins (Vitamin C), Amino acids, Enzymes, Antibiotics, Organic acids.

Biotransformation product (steroid). Effluent Disposal strategies used for Textile, dye, dairy, paper and pulp industries, fermentation economics.

4. Fermentation Product **15**

Wine, beer, Cheese, Xanthan gum, Lactic acid, Bread, organic acid, Citric acid, vitamins. Antibiotics.

Learning outcome:
After completing the modules the students gain knowlwdge about:

1. Design of fermentor/ biorectors
2. Fermentation media , sterilization
3. Strain improvement
4. Industrial production of Upstream and Down Stream Processing

References:

- A. H. Patel. (1985), Industrial Microbiology, Macmillan India Ltd. C, (Unit-1-II)
- Bioprocess Engineering Principles - Pauline Doran, Academic Press 1995, (Unit-1)
- Bioreactor Design & Product Yield, BIOTOL series - Butter worth Heinemann 1992. (Unit-1-II)
- Casida, L. E., 1984, Industrial Microbiology, Wiley Easterbs, New Delhi, (Unit-1-II)
- Crueger, W. and Crueger, A. (2005) A Text Book Of Industrial Biotechnology, Panima , New Delhi. (Unit-IV)
- Harrison,R, Todd, P(2006), Bioseparations science and Engineering, Oxford University Press(Unit-1-II)
- Lydersen, Bioprocess Engineering : Systems, Equipment & Facilities Ed. B. N.A. Delia & K.M. Nelson, John Wiley & Sons Inc,1993 (Unit-1-II)
- Operational Modes of Bioreactors, BIOTOL series - Butter worth, Heinemann 1992(Unit-1-II)
- Peppler, H. L 1979, Microbial Technology, Vol I and II, Academic Press. (Unit-1
- Prescott. S.C and Dunn, C.G,1983 Industrial Microbiology, Reed G. AVI tech books.
- Satyanarayan U, Biotechnology, Arunabha Sen Books allied Publishers. (Unit-1-IV)
- Schuler,M. and Kargi,F.Bioprocess Engineering -Basic Concept, Prentice Hall of India, New Delhi. (Unit-1)
- Stanbury, P. F. and Whittaker, A. (1984) Principles of Fermentation technology, Pergamon press page number, (Unit-1)
- Stanbury, P. F. and Whittaker, A. (1984) Principles of Fermentation technology, Pergamon press, (Unit-1-II, III)

MBTT 302: Enzymology

Lectures: 60 **Credits: 4 C**

Objectives:

- To learn concept of Enzyme.
- To understand the Enzyme Kinetics.
- To learn concept of Structure, Function Relation of Enzyme.
- To understand the immobilization enzyme.

Unit I **15**

ENZYMES:

Classification - IUB system, rationale, overview and specific examples. Characteristics of enzymes, enzyme substrate complex. Concept of active centre, binding sites, stereospecificity and ES complex formation. Effect of temperature, pH and substrate concentration on reaction rate. Activation energy. Transition state theory. Enzyme activity, international units, specific activity, turnover number, end point kinetic assay, Factors affecting catalytic efficiency - proximity and orientation effects, distortion or strain, acid - base and nucleophilic catalysis. Methods for studying fast reactions. Chemical modification of enzymes. Isoenzymes and multiple forms of enzymes.

Unit I **15**

ENZYME KINETICS:

Michaelis - Menten Equation - form and derivation, steady state enzyme kinetics. Significance of Vmax and Km. Bisubstrate reactions. Graphical procedures in enzymology - advantages and disadvantages of alternate plotting. Enzyme inhibition - types of inhibitors - competitive, noncompetitive and uncompetitive, their mode of action and experimental determination.

Unit III **15**

STRUCTURE FUNCTION RELATIONS ;
Lysozyme, ribonuclease, trypsin, carboxypeptidase, phosphorylase, aspartate transcarbamylase, glutamine synthetase and phosphofructo kinase. Multi enzyme complexes - pyruvate dehydrogenase and fatty acid synthetase; Na - K ATPase.

Protein ligand binding including measurements, analysis of binding isotherms, co-operativity , Hill and Scatchard plots and kinetics of allosteric enzymes.

Product inhibition, feedback control, enzyme induction and repression and covalent modification. Allosteric regulation.

Unit IV **15**

IMMOBILIZED ENZYMES:

Relative practical and economic advantage for industrial use, effect of partition on kinetics and performance with particular emphasis on charge and hydrophobicity (pH, temperature and Km). Various methods of immobilization - ionic bonding, adsorption, covalent bonding (based on R groups of amino acids) , microencapsulation and gel entrapment. Immobilized multienzyme

systems
Biosensors - glucose oxidase, cholesterol oxidase, urease and antibodies as biosensors

Learning outcome: After completing the modules the students gain knowledge about:

1. Characteristics of enzymes,
2. steady state enzyme kinetics
3. Structure Function Relations
4. Application of Immobilization of Enzyme

Suggested Readings :

- D. W. Moss Isoenzymes by . Oct 13, 2011, (Unit –III)
- M. & Webb, E. C. Dixon , 1964, Enzymes (2nd Ed) Hardcover. (Unit –I)
- Nicholas C. Price and Lewis Stevens, 2000, Fundamentals of Enzymology,The Cell and Molecular Biology of Catalytic Proteins. (Unit I –II)
- R. Wirtz, E. Weise, et al Immobilized Biocatalysts to Isoprene, Ullmann's Encyclopedia of Industrial Chemistry, 5th Edition Volume A14, (Unit –III)
- Tokushige M. Ed, Selected papers Allosteric Regulation M. Tokushige , Selected Papers in Biochemistry, 1971, Volume 8 University Park Press, (Unit –III & IV)

MBTT-303: Genetic Engineering

Lectures: 60 **Credits: 4 C**

Objectives:

- To learn Microscopic analysis of DNA structure.
- To learn concept of designing and construction of vector
- To Understand PCR, its type and designing of primer
- To learn concept cloning methodology

Unit I **15**

DNA & Basics of Recombinant DNA Technology

Introduction to DNA structures, Enzymes used in rDNA technology

Modification systems, type II restriction endonucleases and properties, isoschizomers and neoschizomers, mcr/mrr genotypes, Cohesive and blunt end ligation, linkers, adaptors, homopolymeric tailing. Labeling of DNA: Nick translation, random priming, radioactive and non-radioactive probes, use of Klenow enzyme, T4 DNA polymerase, bacterial alkaline phosphatase, polynucleotide kinase, ligase, nuclease. Reverse transcriptase.

Hybridization techniques: Northern, Southern and Colony hybridization, Fluorescence in situ hybridization Restriction maps and mapping techniques, DNA fingerprinting, chromosome walking & chromosome jumping

Unit II **15**

Cloning Vectors

Gene Cloning Vectors: Plasmids, bacteriophages, Cloning in M13 mp vectors, phagemids, Lambda vectors; insertion and replacement vectors, Cosmid vectors.

Artificial chromosome vectors (YACs, BACs), Animal Virus derived vectors- SV-40, vaccinia/bacculo & retroviral vectors.

Expression vectors; pMal, GST, pET-based vectors. Viral vectors

Unit III **15**

Cloning Methodologies Insertion of Foreign DNA into Host Cells: Transformation, Transfection: Chemical and physical methods, liposomes, microinjection, macroinjection, electroporation, biolistics, somatic cell fusion, gene transfer by pronuclear microinjection.

Cloning and expression in yeasts (Saccharomyces), animal and plants cells, methods of selection and screening, cDNA and genomic cloning, expression cloning, jumping and hopping libraries, southwestern and far western cloning, yeast two hybrid system, phage display, Construction of cDNA libraries in plasmids and screening methodologies,

Construction of cDNA and genomic DNA libraries in lambda vector. Principles in maximizing gene expression, Site-directed mutagenesis.

Unit IV **15**

PCR and Its Applications

Primer design, Fidelity of thermostable enzymes, DNA polymerases, multiplex, nested, reverse transcriptase , real time PCR, touchdown PCR, hot start PCR, colony PCR, cloning of PCR products, T-vectors, proof reading enzymes, PCR in gene recombination, deletion, addition, overlap extension, and SOEing, site specific mutagenesis, PCR in molecular diagnostics, viral and bacterial detection,

PCR based mutagenesis. Applications:, Sequencing methods: Enzymatic DNA sequencing, Chemical sequencing of DNA, principle of automated DNA sequencing, RNA sequencing.

Gene silencing techniques: Introduction to siRNA and siRNA technology, micro RNA, construction of siRNA vectors, principle and application of gene silencing.

Gene Therapy: germ-line therapy in vivo and ex-vivo, suicide gene therapy, gene replacement, gene targeting

Learning outcome: The students gain knowlwdge about:

1. Various natural and labouratory based modification of DNA
2. How damaged is repaired
3. Tool creating DNA constucts
4. Various protein expression stratergies

References:

1. DNA Cloning : A practical approach D.M. Glover and D.B. Hames, RL Press, Oxford, 1995 (Unit -I1)
2. DNA Science: A First Course in Recombinant Technology, D. A. Mickloss and G. A Freyer, Cold Spring Harbor Laboratory Press, New York, 1990. (Unit -I)
3. Genetic Engineering : An Introduction to Gene Analysis and Exploitation in Eukaryotes, S. M. Kingsman, Blackwell Scientific Publications, Oxford, 1998, (Unit- IV)
4. Kim and L.J. Cseke, CRC Press Florida 1995 (Unit -III)
5. Methods in Enzymology Gene Expression Technology, Vol. 185D. V. Goedel, Academic Press Inc, San Diego, 1990 (Unit -III)
6. Methods in Enzymology Guide to Molecular Cloning Techniques, Vol. 152 S.L.Berger and A. R. Kimmel, Academic Press Inc, San Diego, 1996 (Unit -III)
7. Milestones in Biotechnology, Classic Papers on Genetic Engineering, J. A. Davis and
8. Molecular and cellular methods in Biology and Medicine, P.B. Kaufman, W. Wu , D.
9. Molecular Biotechnology, 2nd Ed. S. B. Primrose, Blackwell Scientific publishers,
10. Oxford, 1994 (Unit -III)
11. Oxford, 1997 (Unit- IV)
12. Route Maps in Gene Technology, M. R. Walker, and R. Rapley, Blakwell Science,
13. Sambrook J, Fritsch E. F. and Maniatis (1989) Molecular cloning, vol. I, II, III, II nd edition, Cold spring harbor laboratory press, New York. (Unit -1)
14. W. S. Reznikoff, Butterworth-Heinemann Boston 1992, (Unit -II)

MBTT-304 A: Bioinformatics

Lectures 60 **Credits 04**

Objective:

- To make students aware about various bioinformatics tools and techniques
- To understand Concepts of various databases and various methods
- To understand how to use bioinformatics tools for the analysis of the biological experimental data.
- To learn Sequencing techniques and gene annotation

UNIT I: Introduction to Bioinformatics (15)

Bioinformatics: Introduction and definition, History, Scope and Applications.
Introduction to Biological Databases: Types of Databases, Biological Databases, Information Retrieval from Biological Databases.
Protein sequence databases:
Primary protein sequence databases: SWISS-PROT, PIR, MIPS, NRL-3D, TrEMBL.
Secondary protein sequence databases: PROSITE, PROFILE, PRINT, pfam, BLOCK, IDENTIFY.
Literature database: PubMed, PubMed Central.
Structural databases: PDB, MMDB, CATH, SCOP, PdbSum.

UNIT II: STRUCTURAL BIOINFORMATICS (15)

Protein Structure Basics: Amino acids, Peptide bond formation, Secondary Structures, Tertiary Structures, and Determination of Protein Three-Dimensional Structure.
Protein Structure Visualization, Comparison and Classification, CATH & SCOP
Protein Secondary Structure Prediction, Protein Tertiary Structure Prediction: Homology Modeling
GENE AND PROMOTER PREDICTION
Gene Prediction: Gene Prediction in Prokaryotes, Gene Prediction in Eukaryotes
Promoter and Regulatory Element Prediction: Promoter and Regulatory Elements in Prokaryotes, Promoter and Regulatory Elements in Eukaryotes

UNIT III: Sequence Alignment and Molecular Phylogenetics: (15)

Sequence alignment

Sequence alignment: Significance of Sequence alignment, Global Alignment and local sequence alignment
Pairwise Sequence Alignment: Dot matrix, the dynamic programming (or DP) algorithm, Word or *k*-tuple methods, Database Similarity Searching: FASTA and BLAST
Multiple Sequence Alignment: Exhaustive Algorithms, Heuristic Algorithms, iterative algorithms.
PAM matrices, BLOSSUM matrices
Primer designing

UNIT IV: **(15)**

Phylogenetic analysis

Relationship of phylogenetic analysis to sequence alignment, Genome complexity and phylogenetic analysis, Concept of evolutionary trees, Maximum parsimony method, Distance methods, The maximum likelihood approach, Sequence alignment based on an evolutionary model, Reliability of phylogenetic predictions, Complications from phylogenetic analysis

Learning Outcome:

The students should acquire the knowledge about:

1. Various bioinformatics tools and techniques and how to use that for the analysis of the biological experimental data.
2. Concepts of various databases and various methods for the data retrieval, data storage, and data mining and use that data for the further analysis.
3. In- Silico approach for the protein modeling and drug discovery process.
4. Sequencing techniques and gene annotation as well as submission of the sequences to the various databases.

Reference Books:

- Bioinformatics - From Genomes to Drugs (2001) Thomas Langauer (editor) Wiley-VCH; 1st edition (Unit I,II)
- Bioinformatics-Sequence and Genome Analysis (2004) David W Mount Cold Spring Harbor Laboratory Press; 2nd edition (Unit I)
- Broad-based Proteomics strategies: a practical guide to proteomics and functional screening David R M Graham et al J.Physiol 2005, 563.1, 1-9 (Unit III,IV)
- Comparative Genomics Webb Miller et al Annu.Rev.Genomics Hum.Genet 2004, 5, 15-56 (Unit II)
- Discovering genomics, Proteomics and Bioinformatics (2006) A. Malcoln Campbell,laurie J. (Unit I, IV)
- Heyer Benjamin Cummings; 2nd edition (Unit II)
- DNA microarrays and gene expression (2002) P Baldi and G W Hatfield Cambridge University Press (Unit II)
- Essential Bioinformatics (2006) Jin Xiong Cambridge University Press; 1st edition (Unit I, III,IV)
- Introduction to genetic analysis (2008) Griffiths et al W. H. Freeman (Unit II)
- Introduction to genomics (2007) Arthur M. Lesk OUP Oxford (Unit IV)
- Principles of proteomics (2004) Twyman Richard Taylor & Francis (Unit II)

MBTT-304B: Biostatistics

Lecture 45 **Credits: 04**

Objectives:

- To make students aware about the importance of Biostatistics in Life science research
- To teach students how to analyses and present the data
- To make students aware about statistical inferences based on statistical tools and techniques
- To teach students the applications of MSEXCEL

UNIT I 15

Scope of Biostatistics, Samples & population & Sampling techniques, Kinds of variable, Theory of errors, measure of precision, Probable errors of function, rejection of observation Mean (Arithmetic, Harmonic, & Geometric), Median & Mode.

Introduction: Biological variables, parameters of statistical data display.

Types of scales: linear, power, log, circular (with biological examples)

Curves and Equations (Graphical & diagrammatic representation) **:** Linear, saturating, sigmoid, exponential, logistic, power, multinomial, algebraic, differential, partial differential.

UNIT II 15

Probability & Sample

Probability Distributions: binomial and Poisson

Frequency distributions: central tendency, dispersal, skewness, kurtosis, Multimodality Sampling methods

Normal Distributions and applications

Properties of Gaussian distributions, Central Limit theorem, Std. error and confidence limits Measure of dispersion, standard deviation & standard errors

UNIT III 15

Hypothesis Testing (with biological examples)

Principles of hypothesis testing, significance level, null hypothesis, Type I and Type II errors Examples of hypothesis testing: comparison of means, t-test, Chi-square test,

Regression Correlation:- Linear, Bivariate & Polynomial regression

analysis **Mathematical models**

Concept of models: growth and decay, population interactions, optimization, Equilibrium solutions, Analytical solutions, numerical solutions and simulation.

UNIT IV 15

APPLICATION SOFTWARE:

Introduction to MSEXCEL-Use of worksheet to enter data, edit data, copy data, move data. Use of in-built statistical functions for computations of Mean, S.D., Correlation, regression coefficients etc. Use of bar diagram, histogram, scatter plots, etc. graphical tools in EXCEL for presentation of data. Introduction to MSWORD word processorediting, copying, moving, formatting, Table insertion, drawing flow charts etc.

Learning outcomes:

The students should acquire the knowledge about:

- How data is analyzed and presented
- Statistical inferences based on statistical tools and techniques.
- How to design an experiment
- Use of MSEXEL for data processing and graphical arragements.

References:

1. Biostatistics: A foundation for Analysis in the Health Sciences 7/E Wayne W. Daniel, Wiley Series in Probability and Statistics. (Unit II)
2. Biostatistics-An introductory text - (Auram Gold Stein). (Unit I-IV)
3. High Yield Biostatistics. (2001) Antony N Glaser. Lippincott Williams and Wilkins, USA (Unit III)
4. Introduction to Mathematics for Life Scientists. 3rd edition (1979). Edward Batschalet, (Unit I, II)
5. Introductory biostatistics. 1st edition. (2003), Chap T. Le. John Wiley, USA (Unit I,III)
6. Introductory Statistics. Fifth Edition. (2004) Prem S. Mann. John Wiley and Sons (ASIA) Pte Ltd.(Unit I-IV)
7. Mathematics for the Biological Sciences. Illustrated edition(1979) J.C. Acharya and Lardner, Prentice Hall, USA (Unit III)
8. R.G. Bartle and D.R. Sherbert 2nd edition, (1992), Introduction to real analysis, John Wiley, USA (Unit I, II)

MBTP 305: Bioprocess and Fermentation Technology & Enzymology

Credit: 4

Objectives:

- To learn concept of Bioreactor.
- To understand the digital monitoring in fermentation.
- To learn concept upstream and downstream processing.
- To understand the lab fermentation to scale up

Bioprocess and Fermentation Technology

1. Screening and identification (Genus Level) of a production strain (enzyme/antibiotic) from soil samples 02
2. Maintenance of the isolated production organism (Agar slants/ glycerol stocks /soil culture/ lyophilization) at least two methods. 02
3. Optimization of different parameters of the isolated organism (conventional and Statistical design). 02
4. Inoculum buildup of the isolated organism for use in bench top fermentation 01
5. Study of Working of lab bench fermenter (with production of enzyme or antibiotic using screened organism), Study of different parts and assembly of the bench top fermenter. 01
6. Assay of product formed (Bioassay or Enzyme assay). 01
7. Solid state fermentation: Lab scale production of a product. 02
8. Demonstration of working of industrial fermenters by visiting fermentation industry 01

Enzymology

1. Detection of some common enzymes. 1
2. Extraction and Isolation of enzyme invertase/amylase/peroxidase/catalase. 1
3. Study of specific activity and progress curve. 1
4. To Asses effect of substrate conc.(Vmax and Km)on enzyme activity 1
5. To Asses effect of pH on enzyme activity. 1
6. To Asses effect of enzyme conc. 1
7. To Asses temperature stability of the enzyme. 1
8. To Asses effect of activator on enzyme activity. 1

9. To Asses effect of inhibitor on enzyme activity. 1

10. Effect of enzyme immobilization on its activity 1

Learning Outcomes:

- Students will learn operations of Bioreactor.
- Students will understand the digital monitoring in fermentation.
- Students will learn concept upstream and downstream processing.
- Students will understand the lab fermentation to scale up

References:

- Stanbury, P. F. and Whittaker, A. (1984) Principles of Fermentation technology, Pergamon press .
- Sadashivam abd manikam (2000) handbook of biochemistry springer
- Sadashivam and Manikam, 2000, practical book of biochemistry springer.
- Tokushige M. Ed, Selected papers Allosteric Regulation M. Tokushige , Selected Papers
- H. Patel. (1985), Industrial Microbiology, Macmillan India Ltd. C.

MBTP 307: Exercises in Genetic Engineering and Bioinformatics

Credit: 4

Objectives:

- To learn concept of designing and construction of vector
- To Understand PCR, its type and designing of primer
- To understand the molecular biology techniques.

Section A- Genetic Engineering

1. Isolation of plasmid DNA	02
2 .In vitro DNA ligation	02
3. Transformation of *E.coli*	02
4 .Restriction mapping	02
5. Southern blotting and hybridization	02
6. RFLP	02
7. Isolation of cytoplasmic RNA	02
8. Electrophoresis of RNA on denaturing gels	02
9. Northern and dot blotting technique	02

Learning Outcomes:

- Students will learn Microscopic analysis of DNA structure.
- Students will learn concept of designing and construction of vector
- Students will Understand PCR, its type and designing of primer
- Students will understand the molecular biology techniques.

References:-

- Sambrook J, Fritsch E. F. and Maniatis (1989) Molecular cloning, vol. I, II nd edition, Cold spring harbor laboratory press, New York.
- Sambrook J, Fritsch E. F. and Maniatis (1989) Molecular cloning, vol. II, nd edition, Cold spring harbor laboratory press, New York
- Sambrook J, Fritsch E. F. and Maniatis (1989) Molecular cloning, vol., III, II nd edition, Cold spring harbor laboratory press, New York

Section B: Bioinformatics

1. Retrieval of amino acid sequence and nucleotide sequence from NCBI database and perform BLAST. 01
2. Visualize and analyze the 3-D protein structure using RasMol. 01
3. Construction of three-dimensional model by using SPARTAN. 01
4. Model Building and Energy minimization using Swiss PDB viewer. 01
5. Molecular Docking and Drug designing. 01
6. Multiple sequence alignment 01
7. Homology modeling 01
8. Structure analysis: secondary, tertiary and Quaternary structure, bond angle, bond length, different interactions. 01
9. Searching for possible ligand, ligand protein interactions. 01
10. Primer designing. 01
11. Phylogenetic studies. 01

- Bioinformatics-Sequence and Genome Analysis (2004) David W Mount Cold Spring Harbor Laboratory Press; 2nd edition
- Essential Bioinformatics (2006) Jin Xiong Cambridge University Press; 1st edition
- Discovering genomics, Proteomics and Bioinformatics (2006) A. Malcoln Campbell,laurie J.

OR

Biostatistics

1. Measures of Central Tendency and Dispersion 02
2. Statistical Analysis using EXCEL. (Descriptive statistics and graphical presentation.) 02
3. Sketching of pmf/pdf of Binomial, Poisson and Normal distributions. 02
4. Correlation and Regression Analysis 01
5. Simple random sampling and stratified sampling. 01
6. Hypotheses testing and confidence intervals. 02
7. Analysis of Variance 01
8. Word processing. 01

References:-

- Biostatistics: A foundation for Analysis in the Health Sciences 7/E Wayne W. Daniel, Wiley Series in Probability and Statistics.
- Introductory Statistics. Fifth Edition. (2004) Prem S. Mann. John Wiley and Sons (ASIA) Pte Ltd.
- Biostatistics-An introductory text - (Auram Gold Stein).

SEMESTER IV

SUBJECT CODE	PAPER NO AND TITEL
MBTT-401	Genomics and Proteomics
MBTT-402	Research Methodology
MBTT- 403	Bio-entrepreneurship and IPR
MBTT-404 A	Animal Biotechnology
MBTT-404 B	Food Biotechnology
MBTP-405	Project
MBTP-406	Internship

MBTT-401: Genomics and Proteomics

Lectures 60 **Credits 04**

Objectives:

- To make students aware of omics era
- To teach students different advanced tools and techniques used in omics research.
- To introduce the concept and application s of gene expression studies
- To teach students the techniques of proteomics.

Unit I **15**

Genomics

Genomics and Proteomics overview, omes and omics, Concepts and applications

Genome overview at the level of Chromosome (with model organisms example); Strategies for large scale DNA sequencing- Whole genome analysis techniques, Next generation sequencing methods; Organization, structure and mapping of genomes (with model organisms example)

Comparative genomics - Goals, bioinformatics of genome annotation, methods and limitations

Structural genomics –Goals, methods, applications

Functional genomics –Goals, methods, applications

Unit II

Transciptomics and Microarray and Applications **15**

Introduction to transcriptomics and expression profiling

DNA and RNA Microarray– Preparation, working and analysis. Microarray databases and bioinformatics tools

Investigative techniques –EST, SAGE, SNP

Applications in basic research and medical genetics, Metagenomics, Toxicogenomics, Pharmacogenomics, Gene disease association.

Unit III **15**

Proteomics – Introduction, concept and applications;

Introduction, Concept, application, advantages and limitations of Expressional Proteomics, Functional Proteomics, Structural Proteomics-with at least one explanatory example for each.

Applications

Peptidomics/Drug discovery, Toxicoproteomics, Biomarkers in disease diagnosis, Identification and characterization of novel proteins

Unit IV **15**

Techniques in Proteomics

Protein separation techniques,

Strategies in protein identification, 2D Gel electrophoresis, Isoelectric Focusing

(IEF) Mass spectrometry in proteomics –

Principle, techniques, components and variations (HPLC, ESI, MALDITOF, FT-MS, MS/MS, Quadrupole) and analysis, applications

Protein- Protein interactions- experimental and computational- two hybrid, Phage display;

Protein Microarray- Preparation, working and analysis. Proteomics and Microarray databases and allied bioinformatics tools.

Learning Outcomes:

- Students will come to know about resent advances in genomics and proteiomics.
- Students will acquire knowledge about tools and techniques used in genomics and proteiomics research.
- Students will understand concept and application s of gene expression studies
- Students will learn the techniques of proteomics.

REFERENCES:

1. Bioinformatics - From Genomes to Drugs (2001) Thomas Langauer (editor) Wiley-VCH; 1st edition (Unit I)
2. Bioinformatics-Sequence and Genome Analysis (2004) David W Mount Cold Spring Harbor Laboratory Press; 2nd edition (Unit I, II)
3. Broad-based Proteomics strategies : a practical guide to proteomics and functional screening David R M Graham et al J.Physiol 2005, 563.1, 1-9 (Unit III)
4. Comparative Genomics Webb Miller et al Annu.Rev.Genomics Hum.Genet 2004, 5, 15-56 (Unit I, II)
5. Discovering genomics, Proteomics and Bioinformatics (2006) A. Malcoln Campbell, laurie J. Heyer Benjamin Cummings; 2nd edition (Unit I, III)
6. DNA microarrays and gene expression (2002) P Baldi and G W Hatfield Cambridge University Press (Unit II)
7. Essential Bioinformatics (2006) Jin Xiong Cambridge University Press; 1st edition (Unit II)
8. Functional Genomics : Methods and Protocols (2003) M J Brownstein, A B Khodursky Humana Press (Unit I, II)
9. Genome and proteome annotation: organization, interpretation and integration G A Reeves et al J.Roy.Soci. 2009,6, 129-147 (Unit III, IV)
10. Introduction to genetic analysis (2008) Griffiths et al W. H. Freeman (Unit III)
11. Introduction to genomics (2007) Arthur M. Lesk OUP Oxford (Unit I)
12. Principles of proteomics (2004) Twyman Richard Taylor & Francis (Unit III)
13. Protein Expression : A practical approach (series 1999) editor B. D. Hames Oxford University Press (Unit III, IV)
14. Proteomics from protein sequence to function (2001) Pennington SR, Dunn MJ., Stephen R BIOS (Unit III,IV)
15. Review: Protein identification methods in Proteomics Kris Gavaert and Joel Vandekerchhove Electrophoresis 2000, 21, 1145-1154 (Unit IV)
16. Transcriptomics (2003) Virendra Gomase VDM Publishing (Unit II)

MBTT 402: RESEARCH METHODOLOGY AND CLINICAL RESEARCH

Lectures 60 **Credits: 04**

Objective

- To understand basics of research
- To understand how define research problem
- To make students aware of Importance of Knowing How Research is Done.
- To learn drug development processes
- To learn different phases in clinical trails
- To learn standard operating procedures and good clinical practices.

UNIT I **15**

Introduction:

Meaning of Research, Objectives of Research, Types of Research, Research Approaches, Significance of Research, Research Methodology, Research and Scientific Method Defining the Research Problem:

What is a Research Problem, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem.

UNIT II **15**

Research Design

Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Basic Principles of Experimental Designs Sampling Design

Census and Sample Survey, Implications of a Sample Design, Steps in Sampling Design, Criteria of Selecting a Sampling Procedure, Characteristics of a Good Sample Design, Different Types of Sample Designs, How to Select a Random Sample, Random Sample from an Infinite Universe

UNIT III: **15**

Introduction to clinical research and Drug Development Process

Overview of Drug Development Process, briefing of clinical trials phases

Protocol and clinical trial Designing:

Definition of protocol, its importance and purpose, Protocol format: Chapters (Headings) and broad contents of protocol, Important scientific and administrative aspect included in protocol, Introduction to Research Methodology, Protocol writing team and role of each member, Clinical trial design: Types of study designs, Sampling, sample size, randomization, Inclusion & Exclusion criteria, Phases of clinical trial & Types of trials.

UNIT IV: **15**

Good Clinical Practice (GCP) ICH regulations:

Ethical Principles and their origin, Ethics in clinical research: As per ICMR & GCP, Ethics committees: Roles & responsibility of IEC and IRB, Ethics in relation to vulnerable groups & special situations, Responsibilities of Sponsors, Investigators & Regulators, ICH: Purpose, regulations & guidelines, Informed consent and Informed consent form, Essential Documents

Drug Regulatory Affairs (Clinical Trial):

Regulatory Authority in India (DCGI & CDSCO), Schedule Y of Drugs & Cosmetics Act, International Scenario of Regulatory Aspects: FDA, CFR

Learning Outcome:

The students will acquire the knowledge of:

- Drug development processes and phase trials
- Good Clinical Practices, Good Manufacturing Practices, GLP/ GMP
- Importance of documentations.
- Drugs and Cosmetics Act.
- Importance of Pharmacovigilance.

References:

- C. R. Kothari (2009) "Research Methodology: Methods & Techniques" (Second Revised Edition), New Age International Publishers, New Delhi.
- Mathur U.C., Product and Brand Management, Naraina phase I, New Delhi, 2007.
- S.A. Sherlekar, K. Nirmala Prasad & S.J. Salvadore Victor – Principles of Marketing – published by Himalaya Publishing House "Ramdoot", Dr. Bhalero Marg, Girgaon, Mumbai.2nd Edition.
- Basic and Clinical Pharmacology, Prentice hall, International, Katzung, B.G. (Unit I)
- Clinical Pharmacology, Scientific book agency, Laurence, DR and Bennet PN. (Unit I, II)
- Clinical pharmacokinetics, Pub. Springer Verlab, Dr. D.R Krishna, V. Klotz (Unit I)
- Remington Pharmaceutical Sciences, Lippincott, Williams and Wilkins (Unit I, II)
- Drug interaction, Kven Stockley. Hamsten (Unit III)
- Drug interaction, Basic Bussiness Publ, Bombay, J.K. Mehra (Unit I, III)
- Clinical pharmacology and drug therapy Grahame smith and Aronson, (Unit I, III)
- Text Book of Therapeutics Drug and Disease Management Hardbound. Richard A Helms, (Unit III)

MBTT 403: Bio-entrepreneurship and IPR

Lectures: 60 **Credits: 04**

Objectives:

- Understanding the dynamic role of entrepreneurship and small businesses
- Organizing and Managing a Small Business
- Business Plan Creation
- To learn IPR and patent laws.
- To understand IPR regulations with special reference GMO.
- To learn biosafety regulation and guidelines on developing and using the GMO.

UNIT I: **15**

An Overview of Entrepreneurs and Entrepreneurship: definition,
Basic principles and practices of management- Definition, concepts and application; Organization types, coordination, control and decision making in management
Characteristics for being an entrepreneur in biotechnology, Case studies of successful and unsuccessful bio-entrepreneurs
Core concept of Market: Identification and evaluation of market potential of various bio-entrepreneur sectors.
Marketing, Marketing research- concept and techniques

UNIT II **15**

Types of Enterprises and Ownership Structure: small scale, medium scale and large scale enterprises, role of small enterprises in economic development; proprietorship, partnership, Ltd. companies and co-operatives: their formation, capital structure and source of finance.
Projects: identification and selection of projects; project report: contents and formulation, concept of project evaluation, methods of project evaluation: internal rate of return method and net present value method.
Role of government and schemes, financial institutions in fostering bioentrepreneurship
Factors affecting biotech business: (finance, infrastructure, equipment, manpower, resources, project location, end product, quality issues, etc)

UNIT III: 15

Characteristics and Types of Intellectual Properties Tools of IPR- Introduction and types, Treaties, Conventions, Laws, Acts, agreements pertaining to Biotechnology, Tools of IPRs- 1. Patents- prerequisites for patenting, Biological Patents –a. Plant b. Animal c. Microbial patents 2. Process patents and Product patent with one case study each. Indian and International scenario, Protection of Plant varieties and Plant breeders rights, Industrial Designs-Designs of gadgets used in Biotechnology.

UNIT IV: 15

Biosafety and Societal Concern, Public debate and concern on genetically modified microorganisms, plants and animals, scientific analyses of the concern, Biosafety regulation and guidelines on developing and using the genetically modified organisms. Patenting of Biological

Materials: International conventions. International cooperation, obligations with patent applications, Can live form be patented- with special reference to Factor VIII, Erythropoietin, tissue plasminogen, hybridoma technology etc. Patenting of higher plants, animals, genes, DNA sequences, transgenic organisms

Outcomes:

1. Students can able to develop the business plan
2. Students can understand fundamentals of Management and Administration.
3. Students will understand Legal forms of the business for registration of the small scale industries, agencies for the registration of the companies
4. IPR and patent rules and copyright act.
5. IPR regulations regarding GMO.

References:

1. Entrepreneurship And Business of Biotechnology, Prof S N Jogdand, Himalaya Publisher (Unit I, II)
2. Entrepreneurship Development, 2003, S Anil Kumar, New Age International (P) Ltd. Publishers (Unit I)
3. Entrepreneurship for Everyone: A Student Textbook, 2009, Robert Mellor, Sage Publication Ltd1. (Unit I, II)
4. Exploring Entrepreneurship: Practices and Perspective, 1/e, 27 Jul 2011 Author(s): Richard Blundel & Nigel Lockett Oxford University Pres (Unit I)
5. Entrepreneurial Development: Text and Cases,1992- Entrepreneurship Sultan Chand & Sons (Unit I, II)
6. Commercializing Successful Biomedical Technologies, 2008, Shreefal S. Mehta, Cambridge University Press (Unit I,II)
7. Handbook Of Bioentrepreneurship, 2008 , Patzelt, Holger; Brenner, Thomas, Springer (Unit I)
8. Dr. B.L.Wadehra 2011, Law Relating To Intellectual Property, Fifth Edition, *Universal Law Publishing Co.Pvt. Ltd.* (Unit III, IV)
9. TIFAC 2002 some questions and answers on Patents and Copyrights (Unit III)
10. H K Das 2010, Text book of Biotechnology,4th edition, Wiley India Pvt. Ltd, New Delhi (Unit IV)
11. H S Chawala 2009, Introduction to Plant Biotechnology, 3rd Edition, Science Publishers (Unit IV)
12. Hirvani R 2009, Patents in Plant Breeding: Guarding the Green Gold- Biotech News issue vol 4., No.4 (Unit III, IV)
13. Ganguli Prabuddh 2001, Intellectual Property Rights, Tata McGraw-Hill Publishing Company Ltd.7. World Intellectual Property Rights (WIPO) (Unit III)
14. Website http://www.wipo.int/portal/index.html.en (Unit III, IV)

MBTT 404 A: Animal Biotechnology

Lectures: 60 **Credits: 4 C**

Objectives:

- To learn concept of Animal cell line.
- To understand different media in animal cell culture.
- To learn concept of Organogenesis.
- To understand concept of stem cell and animal model.

UNIT I: **15**

Introduction to tissue culture:

Definition, principle and significance of tissue culture, Maintenance of sterility and use of antibiotics, Detection of Mycoplasma and viral contaminants. Prevention of Cross contamination Logic of formulation of tissue culture media: natural, synthetic media, and sera.

Sterilization of cell culture media and reagents. Introduction to the balance salt solutions and simple growth medium.

Role of carbon dioxide in animal cell culture. Various systems of tissue cultures with distinguishing features, advantages and limitations.

Methodology: i. Primary culture: Behavior of cells, properties, utility with different

examples ii. Explant culture, iii. Suspension culture.

Cell lines: Definition, establishment and maintenance.

Normal and established cell lines: Their characteristic features and utility, Characteristics of cells in culture.

UNIT II: **15**

Organ culture:

Methods, behavior of organ explant, and utility of organ culture, Histotypic and organotypic cultures. Growth studies: Cell proliferation, cell cycle, mitosis in growing cells.

Freeze storing of cells and transport of cultures, Measurement of viability and cytotoxicity.

Cell cloning and types of cloning, cell synchronization, micromanipulation, Cell transformation. Separation of cell types: Various methods: advantages and limitations; Flow cytometry.

Nuclear transplantation, Cell hybridization, Transfection studies. Growing cells in serum free media, scaling up.

Propagation of viruses (viral sensitivity of cell lines).

Application of animal cell culture for *in vitro* testing of drugs, in production of human and animal viral vaccines and pharmaceutical proteins.

UNIT III: **15**

Stem cells

Stem cells – adult, embryonic, induced pluripotent stem cells: Concept, principles for identification, purifications, assessment of proliferation long-term maintenance and characterization.

Overview-livestock breed and their productivity, artificial breeding methods and hazards, marker assisted breeding of livestock,

UNIT IV: **15**

Transgenic animals

Transgenic animals: artificial breeding – in vitro fertilization and embryo transfer technology, artificial insemination, germ cell storage

Genetic modifications – methods, transgenic fish and mammals (Mice)

Gene targeting: Targeted gene transfer. Mouse models for human, genetic disorders, Knockout mice, Study of animal models (Mice)

Learning outcome:

The student should understand

1. Concept and different types in animal culture.
2. Uses of molecular biology techniques genetically engineer the animal to improve sustainability, productivity and suitability for pharmaceutical, agriculture and industrial applications.
3. Concept and different types in animal culture.
4. Use of molecular biology techniques genetically engineering the animal to improve sustainability, productivity and suitability for pharmaceutical, agriculture and industrial applications.

References:

- R. Ian Freshney. Culture of Animal cells, 5rd Edition, 2010. A John Wiley & Sons, Inc., Publications, USA (UNIT -1& II)
- R.W.Masters. Animal Cell Culture- Practical Approach, 3rd Edithion,2000, Oxford University Press. USA (UNIT - II)
- Robert Lanza et al. *Essentials of Stem Cell Biology*", Academic Press, 2nd edition, 2006.USA, C
- Text book of Animal Husbandary, 8th edition, (1998) G.C. Banerjee,Oxford and IBH Publishin co.Pvt. Ltd. India (UNIT -IV)
- Molecular Biotechnology: 4th edition. (2010), Glick B.R., Pasternak J.J., Patten C. L., ASM press, USA (Unit I-IV)
- Gene Transfer to Animal Cells, 1st edition (2005), R. M. Twyman, Taylor & Francis USA , (Unit I-IV).

MBTT 402 B: Food Biotechnology

Lectures: 60 **4 Credits**

Objective:

- To make students aware about different methods of food processing.
- To make students aware of food preservation techniques.
- To teach Students different quality control aspects.
- To make students aware of food standards and laws.

Unit – 1 **15**

Food processing:

Starter cultures and their biochemical activities; production of alcoholic beverages; production of Single cell protein and Baker's yeast; Mushroom cultivation

Food and dairy products: Cheese, bread and yogurt.

Fermented vegetables – Saurkraut; Fermented Meat – Sausages,

Unit-2 **15**

Food preservation:

Food preservation by heating: drying, osmotic dehydration, blanching, canning, pasteurization, sterilization, extrusion cooking.

Non-thermal preservation: Hydrostatic pressure, dielectric heating, microwave processing, hurdle technology, membrane technology, irradiation.

Food preservation by low-temp: Refrigeration, freezing and freeze-drying.

Unit -3 **15**

Quality assurance:

Microbiological quality standards of food**,** Intellectual property rights and animal welfare, Government regulatory practices and policies. FDA, EPA, HACCP, ISI Risk analysis; consumer and industry perceptions

Unit 4 **15**

Food standards and laws:

International – Concept of Codex alimentarius, HACCP, GMP, GHP, USFDA, ISO 9000, ISO 22000, ISO 14000. National – Introduction of BIS/IS, Food Safety and standards – 2006, Food Safety and standard regulation 2010, FPO, MPO, MMPO, Agmark.

Prevention of food adulteration Act: Food Adulteration: definition, common adulterants in different foods, contamination, methods of detection. Food additives and legislation; coloring matter, preservatives, poisonous metals, antioxidants and emulsifying and stabilizing agents, insecticides and pesticides. PFA specification for food products, Nutritional labeling

Expected Outcomes:

- Students will learn about different methods of food processing.
- Students will be aware of food preservation techniques.
- Students will acquire knowledge of different quality control aspects.
- Students will understand food standards and laws.

References:

- *Industrial Microbiology* by Casida LE,1st Ed. Wiley Eastern Ltd., 2005 (Reprint) (Unit I, II)
- Food Microbiology (Sie) 5^{Ed} – Frazier McGraw-Hill Companies (Unit I, II)
- Early R.1995.Guide to Quality Management Systems for Food Industries. Blackie Academic. (Unit III and IV)
- Krammer A & Twigg BA.1973. Quality Control in Food Industry. Vol. I, II. AVI Publ. (Unit III and IV)
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- Food Processing and Nutrition. Academic Press, London. Fellows, P. and Ellis H. 1990 (Unit I & II).
- Food Processing Technology: Principles and Practice, New York. Jelen, P. 1985 (Unit III and IV).
- Introduction to Food Processing. Prentice Hall, Reston Virginia, USA. Lewis, M.J. 1990. Physical Properties of Food and Food Processing Systems. Woodhead, UK. (Unit I)

MBTP 405: PROJECT

4 Credits

Learning Objectives:

- To provide the practical knowledge of experiment designing
- To provide the knowledge of literature review
- To make students capable of writing research proposal and projects

1. Selection of the Project topic and allotment of project supervisor.
2. Preparation of Project Execution Plan : Time and Resource Allocation
3. Guidance by the Project Supervisor, for the self-study of relevant course topics and concepts by the student.
4. Self-study and reference work of relevant topics and concepts by the student.
5. The Project Work must involve practical work(wet lab.) related to selected discipline
6. Students are expected to work on "Project Work" for about 10 periods per week.
7. The project work must be allotted individually.
8. The student invests his energy, time and resources in a project. The project therefore should, if possible, have important bearing on some practical aspect. This will help student to justify his efforts on project.
9. It is the joint responsibility of student and project supervisor to maintain daily register book of his/her project work and has to be produced at the time of examination if asked.
10. Submission Process: Student should prepare 2 copies of the Project Report. At the beginning, the respective Project Supervisor must approve both copies positively before final examination. Then respective Head or Coordinator approves both copies of the Project Report.
11. The student has to submit one of these approved copies of project report, duly signed by the project Supervisor and Principal, before practical examination. The report will be assessed by both Internal examiner (The project supervisor), who will assign the marks out 30 and the external examiner (appointed by university), who will assign marks out of 140, Thus the total will be out of 170 marks. Theory, practical and project report shall form separate heads of passing.

Learning outcomes:

- Students will acquire the practical knowledge of experiment designing.
- Students will be able to review available literature on a particular topic.
- Students will be capable of writing research proposal and projects

MBTP 406: Internship

4 Credits

Learning Objectives:

- Expose Technical students to the industrial environment, which cannot be simulated in the classroom and hence creating competent professionals for the industry.
- Provide possible opportunities to learn, understand and sharpen the real time technical / managerial skills required at the job.
- Exposure to the current technological developments relevant to the subject area of training.

Guidelines:

Internships may be full-time or part-time; they are full-time in the summer vacation and part-time during the academic session. Curriculum is flexible to adjust internship duration. Therefore, opportunities must be provided for experiences that cannot be anticipated when planning the course. The institutes have the flexibility to schedule internship, Project work, Seminar etc. according to the availability of the opportunities. However, minimum requirement regarding Internship duration is three weeks.

During the vacation after 2nd and/or 3rd semester, students are ready for industrial experience. Therefore, they may choose to undergo Internship / Innovation / Entrepreneurship related activities. Students may choose either to work on innovation or entrepreneurial activities resulting in start-up or undergo internship with industry/ NGO's/ Government organizations/ Micro/ Small/ Medium enterprises to make themselves ready for the industry.

Every student is required to prepare a file containing documentary proofs of the activities done by him. The evaluation of these activities will be done by Programmed Head/Cell In-charge/ Project Head/ faculty mentor or Industry Supervisor as specified in evaluation scheme.

General Procedure:

Step 1: Upon request of student, request Letter/ Email from the department should go to industry to allot various slots of 3-6 weeks during vacation as internship periods for the students. Students request letter/profile/ interest areas may be submitted to industries for their willingness for providing the training.

Step 2: Industry will confirm the training slots and the number of seats allocated for internships via Confirmation Letter/ Email. In case the students arrange the training themselves the confirmation letter will be submitted by the students in the department. Based on the number of slots agreed to by the Industry, department will allocate the students to the Industry. In addition, the internship slots may be conveyed through Telephonic or Written Communication (by Fax, Email, etc.) by Faculty members who are particularly looking after the Internship of the students.

Step 3: Students on joining Training at the concerned Industry / Organization, submit the Joining Report/ Letters / Email.

Step 4: Students undergo industrial training at the concerned Industry / Organization. In-between Faculty Member(s) evaluate(s) the performance of students once/twice by visiting/ coordination with the Industry/Organization and Evaluation Report of the students is submitted in department office.

Step 5: Students will submit training report after completion of internship.
Step 6: Training Certificate to be obtained from industry.
Step 7: Presentation along with brief report on training to be given at the time of examination for final evaluation.

Learning outcomes:

- Students will get exposure to the industrial environment becoming competent professionals for the industry.
- Students will learn, understand and sharpen the real time technical / managerial skills required at the job.
- Student will be exposed to the current technological developments relevant to the subject area of training.