SHIVAJI UNIVERSITY, KOLHAPUR.

B

Accredited By NAAC
2009
New Syllabus For

B.Sc. III

Biotechnology (Entire)

(Sem.-V & VI)

Syllabus to be implemented from June 2012 onwards.

SHIVAJI UNIVERSITY, KOLHAPUR

Biotechnology (Entire)

B. Sc III. Biotechnology (Entire)

Semester V

Course Code	Title of the Course	Theory	Internal
BTE – 501	**Basics in Genetic Engineering**	**40**	**10**
BTE - 502	**Industrial Biotechnology**	**40**	**10**
BTE - 503	**Application of Biotechnology in Agriculture**	**40**	**10**
BTE - 504	**Developmental Biology (Plant and Animal)**	**40**	**10**
BTE - 505	**Techniques in Genetic engineering**	**Practical**	**--**
BTE - 506	**Techniques in Industrial Biotechnology**	**Practical**	---
BTE - 507	**Project (Part I)**		---

BTE – 501 Basics in Genetic Engineering

Sr. No.		Lectures 45
	Unit I	**12**
1.	**Molecular Tools in r-DNA technology** 1. Introduction and Scope 2. Molecular tools and its application 2.1 Restriction enzymes- types (I, II, III), nomenclature, recognition sequences, cleavage patterns, modification of cut ends (linkers and adaptors), application –RFLP, Restriction mapping. 2.2 Alkaline phosphatases 2.3 DNA ligases T4 and *E. coli* Ligases 2.4 Methylases 2.5 Reverse Transcriptases 2.6 Polymerases- Klenow enzymes, T4 DNA polymerases, Taq DNA polymerases 2.7 Polynucleotide kinase	
	Unit II	**12**
2.	**Cloning Vectors:** 1. Introduction 2. Properties of good vectors 3. Cloning & expression vectors 4. Types- 4.1 *E.coli* vector 4.1.1 plasmid – pBR 322 and pUC18 4.1.2 Bacteriophage vectors – λ phage vector, M 13 Vectors (λ replacement e. g. EMBL 3, EM BL 4and λ insertional e.g λ gt 10 and λgt 11) 4.2 Cosmid vector 4.3 Phagemid vector e.g pBlue script II KS/SK 4.4 Yeast vector- YAC and BAC 4.5 Animal vectors – Retroviral 4.6 Plant vector – Ti plasmid,Ri plasmid 4.7 shuttle vector- e.g pJBD 219 5. Selection of recombinant vector	
	Unit III	**11**
3.	**Nucleic Acid Hybridisation :** 3.1 Nucleic Acid and plasmid purification. 3.2 Probe Preparation 3.3 Methods of labelling probes. 3.3.1 Radio labelling – Nick translation, End labeling, Primer extension	

	3.3.2 Non Radiolabelling – Biotin, dioxygenin , fluorescent dyes, 3.3.3 Applications of probes.	
	Unit IV	**10**
4.	**DNA Sequencing and blotting technique** 4.1 Maxam Gilbert method 4.2 Sanger Coulson method 4.3 Automated DNA sequencing 4.4 Southern Blotting 4.5 Northern Blotting. 4.6 Western blotting	

References :

1. **Molecular Biotechnology – Principles & applications of Recombinent DNA : Glick B. R. & Padtranak**
2. **Gene cloning & manipulating – Christopher**
3. **An introduction to genetic engineering – Nicholl D.S. T.**
4. **Principle of gene manipulation : An introduction to genetic engineering – Old R.W. & Primrose S. B.**
5. **Gene VIII – Lewin**
6. **Fundamentals of Biotechnology – S. S. Purohit**
7. **Fundamentals of Biotechnology – H. S. Chawala**
8. **Genetic engineering – P. K. Gupta**
9. **Priciple of Biochemistry – Wilson & Walker**
10. **Plant genetic engineering – P. K. Gupta**
11. **Molecular Biotechnology of gene – S. N. Jogdan**
12. **Protein Biotechnology – M. Philopse**
13. **Molecular Biotechnology – Principle & practices by Channarayappa**
14. **Biotechnology – R. C. Dubey**
15. **Molecular cloning (Vol I, II, III) – Sambrook and Russel**

BTE-502 Industrial Biotechnology

Sr. No.		No. of Lectures
	Unit I	**12**
1.	**Introduction to Industrial Biotechnology** 1.1 Concept and range of fermentation technology 1.2 Types of commercially important fermentations	
2.	**Basic Design of Fermenter and types** 2.1 Components of fermenter and their functions 2.2 Types of fermenters. - Stirred tank Fermenter - Airlift fermenter . - Tower fermenter - Tubular fermenter	
	Unit II	**10**
3.	**Microbial Screening** 3.1 Selection strategy and techniques 3.2 Primary and secondary screening 3.3 Primary screening of antibiotics, organic acids and amines, enzymes, vitamins and amino acid producers, volatile component degraders. 3.4 Secondary screening of antibiotic producers 3.5 Scale up 3.6 Strain improvement-- Concept. 3.7 Stock culture maintenance and preservation	
	Unit III	**11**
4.	**Fermentation Media** 4.1 Composition of typical fermentation media. 4.2 Criteria for typical fermentation medium 4.3 General role of media components- water, carbon source, nitrogen source, minerals, precursors, growth factors, buffers, antifoams, oxidation-reduction potentials, inducers, inhibitors.	

	4.4 Optimization of media 4.5 Types of fermentation media 4.6 Factors affecting fermentation process 4.7 Sterilization of air and media	
	UNIT IV	**13**
5.	**Downstream Process and Product Recovery** 5.1 Downstream Processes in fermentation and bioprocess technology - Solid and liquid separation - Flocculation and crystallization - Drying, filtration and centrifugation - Cell disruption by solid and liquid shear, ultrasonication, enzyme action and mechanical disruption 5.2 Product recovery and purification principle - Extraction and precipitation - Distillation (Fractional and Steam)- Principle, Process - Evaporation - Chromatographic separation (Principles of all methods) - Adsorption and concentration - Lyophilization, spraying, drying and packing	

References :

1. **Text Book of Biotechnology – Dr. H. K. Das**
2. **Industrial Microbiology & Biotechnology – Arnold L.**
3. **Fermentation Technology – Jayanto Acharekar**
4. **Basic Biotechnology – Colin and Bjrorn**
5. **Frontiers in Microbial Biotechnology – Bisel P.S.**
6. **Industrial Microbiology – Prescot and Dunn**
7. **Principle of Fermentation Technology – Stanbury P.F., Whitekar H., Hall S.**
8. **Bioprocess Engineering : Principles – Nielson T. and Villadeson J.**
9. **Industrial Microbology- L.E. Casida**
10. **Fermentation Biotechnology- H.A. Modi**
11. **Industrial Microbiology- A.H.Patel**

BTE-503 Application of Biotechnology in Agriculture

Sr.No.		Lectures 45
1	**UNIT – I**	**12**
	Methods for crop Improvement 1.1 Introduction 1.2 Acclimatization 1.3 Breeding for self and cross pollinated plants and vegetatively reproducing plants- Selection (pure line and mass), Hybridization and Mutation. 1.4 Somaclonal variations in crop improvement 1.5 Haploids in Breeding 1.6 Micropropagation for virus free plant. 1.7 Somatic embryogenesis in crop improvement	
2	**Unit II**	**10**
	2.1 **Somatic hybridization-** Definition, protoplast fusion technique, selection of hybrids, symmetric and asymmetric hybrids, cybrid production. 2.2 **Artificial Seed –** Definition, Techniques, factors affecting, applications limitations 2.3 **Germplasm preservation-** Introduction, principle, Long term storage, factors affecting, short/medium storage techniques, applications, limitations.	
3	**Unit III**	**11**
	GM Crops 3.1 Herbicide resistance, bacterial, fungal, virus, insect resistance 3.2 GM Foods , ethical & social aspects 3.3 Concept of IPR and IPP, forms of protection 3.4 Molecular farming.	
4	**Unit IV**	**12**
	A) Biofertilizers and Biopesticide **Biofertilizers –** 4.1 Definition , Principle, advantages 4.2 Mass production and field application – *Rhizobium, Azotobacter, Azospirillum, Acetobacter, Azolla, Cyanobacteria,* PSB, VAM 4.3 Green manure and compost **Biopesticide –** Principles and applications of Bacterial , fungal, viral , Plant origin Biopesticides	

References :

1) Biotechnology – U. Satyanarayana

2) A textbook of plant breeding – B.D. Singh

3) Medical biotechnology – S. N. Jogdand

4) Advances in Biotechnology- S.N.Jogadand

5) Introduction to plant breeding – R. C. Chaudhary

6) A textbook of Biotechnology - R. C. Dubey

7) Pharmaceutical Biotechnology – S. P. Vyas ,V. K. Dixit

8) Biotchnology – B. D. Singh

9) Fundamentals of agriculture biotechnology – S. S. Purohit

10) Animal & cell biotechnology – Ian, Freshney

11) Animal cell biotechnology – Buttler

12) Methods in cell biology – Volume 57

13) Cell and Developmental Biotechnology.-Raj narian Desikar

14) Text Book of Bryophytes, Pteridophytes, Gymnosperms, and Paleobotany- Subramurti.

15) Agricultutre application of Microbiology- Neeelima Rajvaidya.

BTE-504 Developmental Biology (Plant and Animal)

Sr. No.	Developmental Biology (Plant and Animal)	Lecture
	Unit I	**10**
1.	**Gametogenesis and Fertilization in plants** 1.1 Gametogenesis in Plants 1.2 Development of male and female gametophyte 1.3 Process of fertilization in Angiosperm	**6**
2.	**Development of Embryo and Endosperm** 2.1 Development of embryo and endosperm 2.2 Types of endosperm in Angiosperm	**4**
	Unit II	**10**
3.	**Plant Meristem** 3.1 Plant meristem , Definition , characters 3.2 Organization of shoot apical meristem 3.3 Organization of root apical meristem.	**8**
4.	**Pollen germination** 4.1 Pollen germination. 4.2 Self incompatibility and its genetic control.	**2**
	Unit III	**12**
5.	**Gametogenesis , gametes and fertilization in animals** 5.1 Gametogenesis in animals. 5.2 Types of eggs and sperms in animals. 5.3 Fertilization in animals.	**5**
6.	**Early development in animals** 6.1 Types and patterns of cleavages in animals. 6.2 Blastulation ,gastrulation in frog and chick up-to the formation of three germ layers. 6.3 Embryonic induction .	**7**

	Unit IV	**13**
7	**Differentiation** 7.1 Differentiation 7.2 Didifferentiation 7.3 Rediffrentitation 7.4 Commitment 7.5 Transdifferentiation 7.6 Developmental plasticity	**(8)**
8	**Cell fusion , somatic cell genetics and immunoglobulin genes** 8.1 cell fusion and somatic cell genetics 8.2 Immunoglobulin genes and antibody Diversity	**(5)**

References:-

1. **Developmental Biology-Gilbert**
2. **Foundations of Embryology – Patten**
3. **Cell and Developmental Biotechnology – Raj Narian Desikar**
4. **Text book of Bryophytes, Pteridophytes , Gymnosperms and Paleobotany - Subramurti**
5. **Plant Anatomy and Embryology- S.N. Pandey, A. Chadha**
6. **Teresa K Attwood and David J. Parry-Smith, Introduction to Bioinformatics, Pearson Education Asia, 2001**
7. **Bexavanis & Francis, Bioinformatics-A practical guide to the analysis of genes and proteins, John Wiley and Sons, 2001**
8. **Rushidi, Basics of Bioinformatics, CRC Publications, 2001**
9. **Irfan Khan and Atiya Khanum, Emerging trends in Bioinformatics, Ukaaz Publishers, 2002**
10. **David M. Hill, Craig Martiz and Barke Mable, Molecular systematics**
11. **Khan Imtiyaz alam ,Rai University, Hydrabad:- Elementry Bioinformatics**
12. **N. Gautam Bioinformatics- Databases and algorithm**
13. **Plant Anatomy – E.Cutter.**
14. **The Embryology of Angiosperm – Bhojawani .S.S and Bhatnagar.S.P**
15. **An Introduction to the Embryology of Angiosperm. – P.Maheswari.**

BTE– 505 Techniques in Genetic engineering

Sr. No.	Practical	15 P
1.	Calculation of molecular size of digested DNA	01
2.	Construction of restriction map of plasmid DNA	02
3.	Western blotting technique	03
4.	Southern blotting technique	03
5.	DNA Amplification by PCR	01
6	RAPD Analysis	01
7.	cDNA cloning by Reverse Transcription PCR	02
8.	Purification of DNA fragments from agarose gel	02
9.	Ligation of DNA	02
10.	Transformation of *E. Coli* and Selection of recombinants (β-galactosidase)	02
11.	*Agrobacterium* transformation in plants	02
12.	Expression of gene in *E. Coli* (GST)	02
13.	Compulsory visit to molecular biology laboratory	

BTE – 506 Techniques in Industrial Biotechnology

Sr. No.	Practicals	15 P
1	Primary screening of amylase producers by Replica Plate technique	**02**
2	Primary screening of antibiotic producers by crowded plate technique	**01**
3	Production of Amylase - Purification, Immobilization and Activity	**02**
4	Production of alcohol and estimation by colorimetric method	**02**
5	Production of sauerkraut.	**01**
6	Mushroom Cultivation.	**01**
7	Isolation of vitamin B_{12} requiring mutants.	**01**
8	Production of citric acid and Recovery.	**01**
9	Bioassay- a) Vitamin B_{12} b) Penicillin	**02**
10	Detection and isolation of pathogens (*E.Coli, Salmonella, Staphlococci*) from spoiled food.	**02**

BTE – 507 Project (Part I)

Guidelines -

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 related to selected discipline
6. Students are expected to work on "Project Work" for about 10 periods per week.
7. A single student will normally do a project. In case of joint projects maximum number of students, in a team for joint project, should not exceed 3.
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. Each "Project Supervisor" may be assigned maximum 5 students.
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 university 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 50 and the external examiner (appointed by university), who will assign marks out of 50, Thus the total will be out of 100 marks.
12. Theory, practical and project report shall form separate heads of passing.

SHIVAJI UNIVERSITY, KOLHAPUR
Biotechnology (Entire)
B. Sc III. Biotechnology (Entire)
Semester VI

Course Code	Title of the Course	Theory	Internal
BTE – 601	**Advances in Genetic Engineering**	**40**	**10**
BTE - 602	**Food and Microbial Biotechnology**	**40**	**10**
BTE - 603	**Application of Biotechnology in Health**	**40**	**10**
BTE - 604	**Bioinformatics**	**40**	**10**
BTE - 605	**Techniques in Bioinformatics**	**Practical**	**--**
BTE - 606	**Techniques in Agricultural and Health Biotechnology**	**Practical**	**---**
BTE - 607	**Project (Part II)**	**---**	**---**

BTE – 601 Advances in Genetic Engineering

Sr. No.		Lectures 45
	Unit I	**12**
1.	**Isolation of Gene** 5.1 Chemical synthesis 5.2 Isolation desired gene from DNA 5.3 Isolation of specific gene with PCR 5.4 cDNA and genomic library . 5.5 Screening of libraries- immunological screening and colony or plaque hybridization.	
	Unit II	**12**
2.	**PCR and its application** 6.1 Primer designing 6.2 Fidelity of thermostable enzymes. 6.3 Steps in PCR reaction 6.4 Types of PCR – RT-PCR,real time PCR, touch down PCR,hot start PCR,colony PCR 6.5 Applications- site directed mutagenesis, Molecular diagnostics ,viral and bacterial detection ,	
	Unit III	**12**
3.	**Cloning methodologies** 7.1 Construction of plasmid – e. g. Somatostatin 7.2 Insertion of foreign DNA into host cells 7.2.1 Transformation 7.2.2 Transfection 7.2.3 Chemical methods- $CaCl_2$ coprecipitation, polycation mediated gene transfer. 7.2.4 Physical methods- Liposomes, microingection, electroporation, biolistics. 7.3 screening of recombinants	
	Unit IV	**09**
4.	**Application of r-DNA technology** 8.1 Production of transgenics-knock out mice 8.2 In medicines –Insulin and Somatostatin 8.3 Gene Silencing- Introduction, Principle of Si-RNA and Si- RNA technology	

	Molecular Markers 2.1 Introduction – Morphological , Biochemical, Molecular Markers Molecular markers RFLP,RAPD,AFLP,STRS,QTL,SSR	

References :

1. **Molecular Biotechnology – Principles & applications of Recombinent DNA : Glick B. R. & Padtranak**
2. **Gene cloning & manipulating – Christopher**
3. **An introduction to genetic engineering – Nicholl D.S. T.**
4. **Principle of gene manipulation : An introduction to genetic engineering – Old R.W. & Primrose S. B.**
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12. **Protein Biotechnology – M. Philopse**
13. **Molecular Biotechnology – Principle & practices by Channarayappa**
14. **Biotechnology – R. C. Dubey**
15. **Molecular cloning (Vol I, II, III) – Sambrook and Russel**

BTE-602 Food and Microbial Biotechnology

Topic No.		No. of Lectures
	Unit I	**12**
1.	**Microbial Cultures and Production** 6.1 Concept of pure and mixed culture 6.2 Microbial growth kinetics (Batch, Continuous and Fed Batch) 6.3 Microbial Production of - Enzymes (amylase) - Antibiotics (Penicillin) -Vitamins (B_{12}) - Single Cell Protein- (Spirulina) - Amino acids (Lysine).	
	Unit- II	**11**
2.	**Fermented Foods and Beverages** 7.1 Dairy Products – Cheese , Yoghurt, Indian Dairy Products 7.2 Indian Foods – Idli, Dahi , Gilebi 7.3 Bakery Products – Bread 7.4 Basics of Extruded Foods Fermented Pickles – Sauerkraut 7.5 Beverages – Beer, Wine	
	Unit- III	**10**
3	**Food Spoilage and Preservation** 8.1 Types of spoilage- Physical, Chemical and Biological (auto and microbial) 8.2 Preservation methods - High and Low temperatures - Controlled atmosphere and Anerobiosis - Radiations and Asepsis - Chemical preservatives (Salt, sugar, organic acids,SO_2)	
	Unit- IV	**12**
4	**Introduction to Food Biotechnology** 10.1 Principle, Risk analysis and Regulations 10.2 Multidisciplinary perspectives of GM crops	
5	**Impact of food on human health** 11.1 Public health principles 11.2 Characteristics of food supply for public health	

	- Food Safety - Capacity to supply nutritional adequacy. - Sustainability - Capacity for Consumer choice - accessibly and affordability to all. 11.3 Food Toxicity – Mycotoxin (Aflatoxin), Exotoxin (*Staphylococcal*), Botulism. 11.4 Food borne illness- Shigellosis, Amoebiosis , Aspergillosis. 11.5 Impact of GM food.	

References :

1. **Text Book of Biotechnology – Dr. H. K. Das**
2. **Industrial Microbiology & Biotechnology – Arnold L.**
3. **Fermentation Technology – Jayanto Acharekar**
4. **Basic Biotechnology – Colin and Bjrorn**
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8. **Bioprocess Engineering : Principles – Nielson T. and Villadeson J.**
9. **Industrial Microbology- L.E. Casida**
10. **Fermentation Biotechnology- H.A. Modi**
11. **Industrial Microbiology- A.H.Patel**
12. **Food Biotechnology- Varun Mehta**

BTE 603 Application of Biotechnology in Health

Topic No.		No. of Lectures
1	**Unit I**	**12**
	Applications of animal cell culture. 5.1 Characteristics of stem cells , 5.2 Concept of stem cell progenitors. 5.3 Concept of stem cell technology and its application. 5.4 Transgenic technology & cloning in mammals	
2	**Unit II**	**10**
	Vaccines- Principle & practices 6.1 Subunit vaccines- Hepatitis B vaccine, Foot and Mouth disease Vaccine, AIDS Vaccine 6.2 DNA Vaccines 6.3 Edible Vaccines 6. 4Recombinant vaccines- Cholera Vaccine, Vaccinia Virus Vaccine	
3	**Unit III**	**12**
	Monoclonal antibodies & hybridoma technology 7.1 Production 7.2 Formulation 7.3 Applications- Diagnostics & Therapeutics **Biosensors-** 7.4 Principle & applications. 7.5 Biochips & microarray technology **Gene therapy –** 7.6 Types – Somatic, Germline, Argumentation 7.7 Gene therapy strategies for cancer	
4	**Unit IV**	**11**
	Forensic medicine 8.1 Prepration of DNA sample 8.2 Approches of DNA analysis **Public health** 8.3 Epidemiology 8.4 Diagnosis of infectious diseases 8.5 Detection of genetic diseases 8.6 Diagnosis of cancers	

References:

1) Biotechnology – U. Satyanarayana

2) A textbook of plant breeding – B.D. Singh

3) Medical biotechnology – S. N. Jogdand

4) Advances in Biotechnology- S.N.Jogadand

5) Introduction to plant breeding – R. C. Chaudhary

6) A textbook of Biotechnology - R. C. Dubey

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12) Methods in cell biology – Volume 57

13) Cell and Developmental Biotechnology.-Raj narian Desikar

14) Text Book of Bryophytes, Pteridophytes, Gymnosperms, and Paleobotany- Subramurti.

15) Agricultutre application of Microbiology- Neeelima Rajvaidya .

BTE – 604 Bioinformatics

Sr. No.		Lectures 45
	Unit I	**10**
1.	**Introduction to Bioinformatics**:-History, Computers in Biology and Medicines, Internet, and related programs; Networking HTTP, HTML, WAN, LAN, MAN, applications in communication. **Information Resources**:- Introduction, aim and objectives, National Centre for Biotechnology Information(NCBI), National Library of Medicine (NLM), and National Institute of Health (NIH), EBI, Sequence retrieval system (SRS):- Entrez, DBGet	
	Unit II	**10**
2.	**Genomics:-** Human Genome Project (HGP)- Goal and applications, final draft of HGP **Genome databases**:- Introduction, Databases, Data, Nucleic acid sequence database, Gene Bank, EMBL, DDBJ **Proteomics**: - Introduction to amino acids and protein, Proteome, Protein structure, **Primary protein sequence databases-** SWISS-PROT, PIR, MIPS, NRL-3D, TrEMBL, Annotation and applications. **Secondary protein sequence databases:-** PROSITE, PROFILE, PRINT, pfam, BLOCK, IDENTIFY; applications. Other databases: - Literature database, PubMed, PubMed central, **Structural databases:-** Introduction, Difference between Primary structure and 3D structure, Protein databank(PDB), - Molecular modeling databank (MMDB). CATH, SCOP, PdbSum	
	Unit III	**12**
3.	**Sequence Alignment**:- Introduction, Protein sequence, Nucleic acid sequence, Pair wise sequence alignment, Multiple sequence alignment, Local and Global sequence alignment, Algorithm used in sequence alignment, Matrices- Dot matrix, PAM, BLOSSOM, **Phylogenetic analysis**:- Introduction: Evolution, definition of phylogenetic tree, nodes, internodes, root, tree, styles; cladogram, phenogram, curvogram, Steps involved in construction of phylogenetic tree **Methods of phylogenetic analysis**:- Distance method, Character based Method Phylogenetic analysis tool (Phylip, ClustalW).	

	Unit IV	**13**
4.	**Structure-based drug designing** Introduction; Structure-based drug designing approaches: Target Identification and Validation, homology modeling and protein folding, receptor mapping, active site analysis and pharmacophore mapping, Grid maps .**Ligand-based drug designing and Docking** Introduction; Ligand-based drug designing approaches: Lead Designing, combinatorial chemistry, High Throughput Screening (HTS), QSAR, Database generation and Chemical libraries, ADME property. Introduction to docking methods to generate new structure; Tools and Molecular docking programs: AutoDock, Dock, HEX	

References

1. **Bioinformatics methods and applications by S. C. Rastogi, N. Mendiratta, P.Rastogi.**
2. **Principle of bioinformatics by p. shanmughavel.**
3. **Computarional Drug Designing , David C. Young**
4. **Computational Drug Design: A Guide for Computational and Medicinal Chemists, David C. Young**
5. **Textbook of drug design and discovery, Povl Krogsgaard-Larsen, Tommy Liljefors, Ulf Madsen**
6. **Computer-aided drug design: methods and applications, Thomas J. Perun,Catherine Lamb Propst**
7. **An introduction to Bioinformatics by T. K. Attwood,Parry-Smith D. J.**

BTE – 605 Techniques in Bioinformatics

Sr. No.	Practicals	15
1	Introduction to PUBMED Central database using the ENTREZ search engine.	**01**
2	Getting the amino acid sequences by exploring and querying the protein Sequence database.	**01**
3	Getting the gene sequences by exploring and querying the nucleic acid Databases.	**01**
4	Functional site prediction using Web-Gene Server.	**01**
5	Construction of Phylogenetic Tree using ClustalW.	**01**
6	Similarity search for nucleotide using the BLASTn and interpretation of the results.	**01**
7	Smilarity search for protein using the BLASTp and interpretation of the results.	**01**
8	Protein and nucleic acid pair-wise sequence alignment by using ClustalW	**01**
9	Analysis of Secondary and tertiary structure of protein using visualizing software like Pymol or Rasmol.	**01**
10	Prediction of the secondary structure of protein using ExPasy web tool (GOR method).	**01**
11	Three dimensional structure prediction by using the homology modeling technique using SPDBV.	**01**
12	Energy calculation of the biomolecules using molecular mechanics and quantum mechanics. (Argus lab).	**01**
13	Calculate PI/MW of protein using ExPasy web tool.	**01**
14	Molecular Docking of protein and ligand by Argus lab	**02**

BTE – 606 Techniques in Agricultural and Health Biotechnology

Sr. No.	Practicals	15
1	Isolation of *Azotobacter*	**02**
2	Isolation of *Rhizobium* from root nodules	**02**
3	Isolation of PSB from soil.	**02**
4	Production of Biofertilizer- *Azotobacter*,PSB	**02**
5	Isolation of *Trichoderma*	**01**
6	Production of Biopesticide - *Trichoderma*	**01**
8	Production of Artificial seed	**01**
9	Analysis of Milk and milk products - a) Estimation of lactic acid. b) Estimation of total fat. c) MBRT	**02**
10	Determination of antibacterial activity of crude plant extract.	**02**
11	Industrial Visit- Wine Industry, Food Processing Industry.	

BTE – 606 Project (Part –II)

Practical Examination:-

A) The practical examination will be conducted on three (3) consecutive days for each practical not less than 5 hours on each day of the practical exanimation.

B) Each candidate must produce a certificate from the Head of the Department in his/her college stating that he/she has completed in a satisfactory manner the practical course on the guidelines laid down from time to time by Academic Council on the recommendation of Board of studies and has been recorded his/her observations in the laboratory journal and written a report on each exercise performed. Every journal is to be checked and signed periodically by a member teaching staff and certified by the Head of the Department at the end of staff and certified by the Head of the Department at the end of the year. Candidates are to produce their journal at the time of practical examination. Candidates have to visit the Biotechnological institutes as per the syllabus and satisfactorily complete project work. The visit and project report should be duly certified by the Head of the Department and submit the reports at the time of examination.

BTE– 505:- Techniques in Genetic engineering.

and

BTE– 605:- Techniques in Bioinformatics

Q.1	**A)**	**Major Experiment**	**20 Marks**
	B)	**Major Experiment**	**20 Marks**
Q.2	**A)**	**Minor Experiment**	**10 Marks**
	B)	**Minor Experiment**	**10 Marks**
Q.3		**Spotting**	**10 Marks**
Q.4		**Tour Report**	**10 Marks**
Q.5		**Journal**	**10 Marks**
Q.6		**Viva-voce**	**10 Marks**

BTE – 506 Techniques in Industrial Biotechnology

and

BTE – 606 Techniques in Agricultural and Health Biotechnology

Q.1	**A)**	**Major Experiment**	**20 Marks**
	B)	**Major Experiment**	**20 Marks**
Q.2	**A)**	**Minor Experiment**	**10 Marks**
	B)	**Minor Experiment**	**10 Marks**
Q.3		**Spotting**	**10 Marks**
Q.4		**Tour Report**	**10 Marks**
Q.5		**Journal**	**10 Marks**
Q.6		**Viva-voce**	**10 Marks**

BTE 507 and BTE 607: Project

A) Internal Examination 50 Marks

B) External Examination 50 Marks

COMMON NATURE OF QUESTION FOR THEORY PAPER MENTIONED SPERATELY:

Equivalence of the Pre-revised and revised course

Prerevised Course		Revised Course	
BTE – 301	Genetic Engineering	BTE – 501 BTE – 601	Basics in Genetic Engineering Advances in Genetic Engineering
BTE – 302	Industrial, Food and Microbial Biotechnology	BTE – 502 BTE – 602	Industrial Biotechnology Food and Microbial Biotechnology
BTE – 303	Application of Biotechnology in Agriculture and Health	BTE – 503 BTE – 603	Application of Biotechnology in Agriculture Application of Biotechnology in Health
BTE – 304	Developmental Biology	BTE – 504 BTE – 604	Developmental Biology (Plant and animal) Bioinformatics
BTE – 311	Techniques in Genetic engineering and Bioinformatics	BTE – 505 BTE – 605	Techniques in Genetic engineering Techniques in Bioinformatics
BTE – 312	Techniques in Industrial, Food, Agricultural, Health and Microbial Biotechnology	BTE – 506 BTE – 606	Techniques in Industrial Biotechnology Techniques in Agricultural and Health Biotechnology
BTE – 313	Project	BTE – 507 BTE – 607	Project (Part I) Project (Part II)