

SHIVAJI UNIVERSITY, KOLHAPUR



“A” Re-accredited By NAAC
(2014) with CGPA-3.16

New Syllabus For
B.Sc. III
Biotechnology (Entire)
(Sem.-V & VI)

Syllabus to be implemented from June, 2015 onwards.

Equivalence of the Pre-revised and revised course

Prerevised Course		Revised Course	
BTE – 501	Basics in Genetic Engineering	BTE – 501	Basics in Genetic Engineering
BTE – 601	Advances in Genetic Engineering	BTE – 601	Advances in Genetic Engineering
BTE – 502	Industrial Biotechnology	BTE – 502	Industrial Biotechnology
BTE – 602	Food and Microbial Biotechnology	BTE – 602	Food and Microbial Biotechnology
BTE – 503	Application of Biotechnology in Agriculture	BTE – 503	Application of Biotechnology in Agriculture
BTE – 603	Application of Biotechnology in Health	BTE – 603	Application of Biotechnology in Health
BTE – 504	Developmental Biology (Plant and animal)	BTE – 504	Developmental Biology (Plant and animal)
BTE – 604	Bioinformatics	BTE – 604	Bioinformatics
BTE – 505	Techniques in Genetic engineering.	BTE – 505	Techniques in Genetic engineering.
BTE – 605	Techniques in Bioinformatics	BTE – 505	Techniques in Bioinformatics
BTE – 506	Techniques in Industrial Biotechnology	BTE – 505	Techniques in Industrial Biotechnology
BTE – 606	Techniques in Agricultural and Health Biotechnology	BTE – 605	Techniques in Agricultural and Health Biotechnology
BTE – 507	Project part-I	BTE – 507	Project part-I
BTE – 60	Project part-II	BTE – 607	Entrepreneurship

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		---

BTE – 501 Basics in Genetic Engineering

Sr. No.		Lectures 40
	Unit I	10
1.	<p>Enzymes in r-DNA technology</p> <p>1. Introduction and Scope</p> <p>1.1. Enzymes and its applications</p> <p>1.2 Restriction enzymes- types (I, II, III), nomenclature, recognition sequences, cleavage patterns, modification of cut ends (linkers and adaptors), application –RFLP, Restriction mapping.</p> <p>1.3 Alkaline phosphatases</p> <p>1.4 DNA ligases T4 and <i>E. coli</i> Ligases</p> <p>1.5 Methylases</p> <p>1.6 Reverse Transcriptases</p> <p>1.7 Polymerases- Klenow enzymes, T4 DNA polymerases, Taq DNA polymerases</p> <p>1.8 Polynucleotide kinase</p>	
	Unit II	10
2.	<p>Cloning Vectors:</p> <p>2. Introduction</p> <p>2.1. Properties of good vectors</p> <p>2.3 Cloning & expression vectors</p> <p>2.4 Types-</p> <p>2.4.1 <i>E. coli</i> vector- plasmid – pBR 322 and pUC18</p> <p>2.4.2 Bacteriophage vectors – λ phage vector, M 13 Vectors (λ replacement e. g. EMBL 3, EM BL 4 and λ insertional e.g λ gt 10 and λgt 11)</p> <p>2.4.3 Cosmid vector</p> <p>2.4.4 Phagemid vector e.g pBlue script II KS/SK</p> <p>2.4.5 Yeast vector- YAC and BAC</p> <p>2.4.6 Animal vectors – Retroviral</p> <p>2.4.7 Plant vector – Ti plasmid, Ri plasmid</p> <p>2.4.8 shuttle vector- e.g pJBD 219</p> <p>2.4.9 Ta cloning vector (introductory)</p> <p>2.5 Selection of recombinant vector</p>	
	Unit III	10
3.	<p>Nucleic Acid Hybridisation :</p> <p>3.1 Nucleic Acid and plasmid purification.</p> <p>3.2 Probe Preparation</p> <p>3.3 Methods of labelling probes.</p> <p>3.3.1 Radio labelling – Nick translation, End labeling Primer extension</p> <p>3.3.2 Non Radiolabelling – Biotin, dioxygenin , fluorescent dyes,</p> <p>3.3.3 Applications of probes.</p>	
	Unit IV	10
4.	<p>DNA Sequencing and blotting technique</p> <p>4.1 Maxam Gilbert method</p> <p>4.2 Sanger Coulson method</p> <p>4.3 Automated DNA sequencing</p> <p>4.4 Southern Blotting</p> <p>4.5 Northern Blotting.</p> <p>4.6 Western blotting</p> <p>4.7 Dot blotting</p>	

References :

1. **Molecular Biotechnology – Principles & applications of Recombinant 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. **Principle 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.		Lectures
	Unit I	09
1.	Introduction to Industrial Biotechnology 1.1 Concept and range of fermentation technology 1.2 Types of fermentations (Batch, continuous, dual, multiple) 1.3 Concept of solid state & submerged fermentation. 1.4 Microbial metabolic products- Primary & Secondary products. 1.5 Basic design of fermenter- Components of fermenter and their functions 1.6 Fermentation economics 1.7 Types of fermenters- - Stirred tank fermenter - Airlift fermenter - Tower fermenter - Tubular fermenter - Bubble cap fermenter	
	Unit II	09

2.	Microbial Screening, Scale up and strain improvement 2.1 Selection strategy and techniques 2.2 Primary and secondary screening 2.3 Primary screening of antibiotics, organic acids and amines, enzymes, vitamins and amino acid producers, volatile component degraders, organisms using specific carbon and nitrogen sources. 2.4 Secondary screening of antibiotic producers 2.5 Scale up of fermentations 2.6 Strain improvement- concept and methods -mutation, genetic recombination. 2.7 Maintenance and preservation of industrially important cultures. Microbial culture collections centers in India like NCIM 2.8 Microbiological assay	
Unit III		10
3.	Fermentation Media 3.1 Composition of typical fermentation media. 3.2 Criteria for typical fermentation medium 3.3 Types of fermentation media 3.4 General role of media components- water, carbon source, nitrogen source, minerals, precursors, growth factors, buffers, antifoams, oxidation-reduction potentials, inducers, inhibitors. 3.5 Optimization of media 3.6 Factors affecting fermentation process	
Unit IV		12
4.	Downstream Process and Product Recovery 4.1 Downstream Processes in fermentation and bioprocess technology 4.1.1 Solid and liquid separation - Flocculation and Flotation - filtration and centrifugation - Cell disruption by solid and liquid shear, ultrasonication, enzyme action and mechanical disruption 4.1.2 Product recovery and purification principle - Precipitation, Crystallization. - Liquid-Liquid extraction - Distillation (Fractional and Steam) - Evaporation - Chromatographic separation (Principles) - Adsorption and concentration - Membrane filtration - 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 Bjorn**
5. **Frontiers in Microbial Biotechnology – Bisel P.S.**
6. **Industrial Microbiology – Prescott 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 Microbiology- 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 40
1	Unit I	10
	<p>Methods for crop Improvement</p> <p>1.1 Introduction</p> <p>1.2 Acclimatization</p> <p>1.3 Breeding for self and cross pollinated plants and vegetatively reproducing plants, selection (pure line and mass) hybridization and mutation.</p> <p>1.4 Somaclonal variations</p> <p>1.5 Haploids</p> <p>1.6 Micropropagation</p> <p>1.7 Somatic embryogenesis</p>	
2	Unit II	10
	<p>Somatic hybridization, Artificial Seed and Germplasm preservation</p> <p>2.1 Somatic hybridization- Definition, protoplast fusion technique, selection of hybrids, symmetric and asymmetric hybrids, cybrid production.</p> <p>2.2 Artificial Seed – Definition, Techniques, factors affecting, applications limitations</p> <p>2.3 Germplasm preservation- Introduction, principle, Long term storage, short, medium storage techniques, factors affecting, cryopreservation, applications, limitations.</p>	
3	Unit III	10
	<p>Transgenic Plants</p> <p>3.1 Herbicide resistant – Glyphosate resistance, Phosphinothricin resistance</p> <p>3.2 Fungal and Bacterial disease resistance approaches- PR proteins, Chitinase, Glucanase, RIPs proteins.</p> <p>3.3 Virus resistance –Virus coat proteins, Movement proteins, Transmission proteins, Satellite RNAs, Antisense RNAs, Ribozymes.</p> <p>3.4 Insect resistance approaches – Bt protein (Bt-Cotton, Bt-Brijal), Non Bt protein</p> <p>3.5 Transgenic plant with improved nutrition - Golden Rice</p> <p>3.6 Molecular farming.</p> <p>3.7 GM Foods, ethical & socio-economic, legal and environmental issues.</p> <p>3.7 Forms of protection -IPR and IPP- Patents, copyright, trademark, trade secret and PBR</p>	
4	Unit IV	10
	<p>Biofertilizers and Biopesticide</p> <p>Biofertilizers –</p> <p>4.1 Definition, Principle (Biological nitrogen fixation)</p> <p>4.2 Mass production and field application – <i>Rhizobium</i>, <i>Azotobacter</i>, <i>Azospirillum</i>, <i>Acetobacter</i>, <i>Azolla</i>, <i>Cyanobacteria</i>, PSB, VAM</p> <p>4.3 Biopesticide – Definition, production and applications of Bacterial, fungal, viral, Plant origin Biopesticides</p>	

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) Agricultre application of Microbiology- Neeelima Rajvaidya.

BTE-504 Developmental Biology (Plant and Animal)

Sr. No.	Developmental Biology (Plant and Animal)	Lecture 40
	Unit I	12
1.	<p>Plant Embryology</p> <p>1.1 Gametogenesis and Fertilization in plants Gametogenesis in Plants, Development of male and female Gametophyte, Process of fertilization in Angiosperm.</p> <p>1.2 Development of Embryo and Endosperm Development of embryo and endosperm, Types of endosperm in Angiosperm.</p> <p>1.3 Apomixis- Introduction , Definition, Types.</p> <p>1.4 Polyembryony- Introduction, Definition, Types.</p>	
	Unit II	8
2	<p>Pollen germination and Meristem organization</p> <p>2.1 Pollen germination Pollen germination, factors affecting.</p> <p>2.2 Self incompatibility Definition, types and its genetic control.Plant meristem</p> <p>2.3 Plant meristem, organization and differentiation</p> <p>2.4 Organization of shoot apical meristem</p> <p>2.5 Organization of root apical meristem.</p>	
	Unit III	10
3.	<p>Animal embryology</p> <p>3.1 Gametogenesis , gametes and fertilization in Animals Gametogenesis in animals,Types of eggs and sperms in animals,Fertilization in animals.</p> <p>3.2 Early development in animals Types and patterns of cleavages in animals, Blastulation , gastrulation in frog and chick up-to the formation of three germ layers, Embryonic induction, Foetal membranes, Types and significance of</p>	

	placentae.	
	Unit IV	10
4	Differentiation and Regeneration 4.1 Differentiation, Didifferentiation, Redifferentiation, Commitment, Transdifferentiation, Developmental Plasticity. 4.2 Regeneration Definition, mechanism, factors affecting regeneration.	

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. **David M. Hill, Craig Martiz and Barke Mable, Molecular systematics**
7. **Plant Anatomy – E.Cutter.**
8. **The Embryology of Angiosperm – Bhojawani .S.S and Bhatnagar.S.P**
9. **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	Minor
2.	Construction of restriction map of plasmid DNA	02	Minor
3.	Western blotting technique	03	Major
4.	Southern blotting technique	03	Major
5.	DNA Amplification by PCR	01	Minor
6	RAPD Analysis	01	Major
7.	cDNA cloning by Reverse Transcription PCR	02	Major
8.	Purification of DNA fragments from agarose gel	02	Minor
9.	Ligation of DNA	02	Minor
10.	Transformation of <i>E. Coli</i> and Selection of recombinants (β -galactosidase)	02	Major
11.	<i>Agrobacterium</i> transformation in plants	02	Minor
12.	Expression of gene in <i>E. Coli</i> (GST)	02	Major

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	Major
2	Primary screening of antibiotic producers by crowded plate technique	01	Major
3	Production of Amylase - Purification, Immobilization and Activity	02	Major
4	Production of alcohol and estimation by colorimetric method	02	Minor
5	Production of sauerkraut.	01	Minor
6	Mushroom Cultivation.	01	Minor
7	Isolation of vitamin B ₁₂ requiring mutants.	01	Major
8	Production of citric acid and Recovery.	01	Minor
9	Bioassay- a) Vitamin B ₁₂ b) Penicillin	02	Major
10	Detection and isolation of pathogens (enteropathogenic <i>E.Coli</i> , <i>Salmonella</i> , <i>Staphylococci</i>) from spoiled food.	02	Major

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(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 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 10 and the external examiner (appointed by university), who will assign marks out of 40, Thus the total will be out of 50 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	Entrepreneurship	---	---

BTE – 601 Advances in Genetic Engineering

Sr. No.		Lectures 40
	Unit I	10
1.	Isolation of Gene 1.1 Chemical synthesis 1.1.1 Phosphotriester approach 1.1.2 Phosphitetriester approach 1.2 Isolation desired gene from DNA 1.3 Isolation of specific gene with PCR 1.4 cDNA and genomic library . 1.5 Screening of libraries- immunological screening and colony or plaque hybridization.	
	Unit II	10
2.	PCR and its application 2.1 Primer designing 2.2 Fidelity of thermostable enzymes. 2.3 Steps in PCR reaction 2.4 Types of PCR – RT-PCR,real time PCR, touch down PCR,hot start PCR,colony PCR 2.5 Applications- site directed mutagenesis, Molecular diagnostics ,viral and bacterial detection 2.6 Introduction to molecular identification --16 s r RNA, 18 s r RNA, and Bar code	
	Unit III	11
3.	Cloning methodologies 3.1 Construction of plasmid – e. g. Somatostatin 3.2 Insertion of foreign DNA into host cells 3.2.1 Agrobacterium mediated gene transfer 3.2.2 Transformation 3.2.3 Transfection 3.2.4 Chemical methods- CaCl ₂ coprecipitation, polycation mediated gene transfer. 3.2.5 Physical methods- Liposomes, microinjection,	

	electroporation, biolistics. 3.3 screening of recombinants 3.3.1 Direct selection 3.3.2 Insertional inactivation selection 3.3.3 Blue white selection 3.3.4 Expression based screening (HART) 3.3.5 Fluorescent Activated Cell Sorter 3.3.6 South –Western Screening 3.3.7 North - western Screening	
	Unit IV	09
4.	Application of r-DNA technology 4.1 Production of transgenics- knock out mice 4.2 In medicines –Insulin and Somatostatin 4.3 Gene Silencing- Introduction, Principle of Si-RNA and Si- RNA technology Molecular Markers 4.5 Introduction – Morphological , Biochemical, Molecular Markers 4.6 Molecular markers- RFLP,RAPD,AFLP,STRS,QTL,SSR	

References :

1. **Molecular Biotechnology – Principles & applications of Recombinant 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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8. **Genetic engineering – P. K. Gupta**
9. **Principle 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-602 Food and Microbial Biotechnology

Topic No.		Lectures 40
	Unit I	12
1.	<p>Microbial Cultures and Production</p> <p>1.1 Concept of pure and mixed culture 1.2 Microbial growth kinetics basic concept (Batch, Continuous and Fed Batch) 1.3 Microbial Production of - Enzymes (amylase –koji fermentation) - Antibiotics (Penicillin) - Vitamins (B₁₂) - Amino acids (Lysine) - Organic acid (Citric acid) 1.4 Edible mushroom 1.5 Single Cell Protein- (Spirulina)</p>	
	Unit- II	09
2.	<p>Fermented Foods and Beverages</p> <p>2.1 Dairy Products – Cheese, Dahi, Yoghurt. 2.2 Indian Foods – Idli 2.3 Bakery Products – Bread 2.4 Fermented Pickles – Sauerkraut 2.5 Beverages – Beer, Wine (Red table and white table)</p>	
	Unit- III	10
3	<p>Food Spoilage, preservation & toxicity</p> <p>3.1 Types of spoilage- Physical, Chemical and Biological (auto and microbial) 3.2 Preservation methods - High and Low temperatures - Controlled atmosphere and Anerobiosis - Radiations and Asepsis - Chemical preservatives (Salt, sugar, organic acids,SO₂, NO₂) 3.3 Food Toxicity – Mycotoxin (Aflatoxin), Exotoxin (<i>Staphylococcal</i>), Neurotoxin (Botulinum) 3.4 Food borne illness- Shigellosis, Amoebiosis , Aspergillosis.</p>	
	Unit- IV	
4	<p>Impact of GM food on human health</p> <p>4.1 Principle, Risk analysis and Regulations 4.2 Multidisciplinary perspectives of GM foods and impact 4.2 Public health principles 4.3 Characteristics of food supply for public health - Food Safety - Capacity to supply nutritional adequacy. - Sustainability - Capacity for Consumer choice - Accessibly and affordability to all.</p>	

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 Bjorn**
5. **Frontiers in Microbial Biotechnology – Bisel P.S.**
6. **Industrial Microbiology – Prescott and Dunn**
7. **Principle of Fermentation Technology – Stanbury P.F., Whitekar H., Hall S. J.**
8. **Bioprocess Engineering : Principles – Nielson T. and Villadeson J.**
9. **Industrial Microbiology- 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.		Lectures 40
1	Unit I	10
	Stem cells and transgenic technology 1.1 Characteristics of stem cells , 1.2 Concept of stem cell progenitors. 1.3 Concept of stem cell technology and its application. 1.4 Transgenic technology & cloning in mammals 1.4.1 Transgenic mice and their applications 1.4.2 Transgenic cattle	
2	Unit II	10
	Vaccines- Principle & practices 2.1 Concept and types of vaccine 2.2 Subunit vaccines- Hepatitis B vaccine, Foot and Mouth disease Vaccine, AIDS Vaccine 2.3 DNA Vaccines 2.4 Edible Vaccines 2.5 Recombinant vaccines- Cholera Vaccine, Vaccinia Virus Vaccine	
3	Unit III	10
	Monoclonal Antibodies, Biosensor and Gene therapy 3.1 Monoclonal antibodies 3.1.1 Production 3.1.2 Formulation 3.1.3 Applications- Diagnostics & Therapeutics 3.2 Biosensors- 3.2.1 Principle & applications. 3.3 Gene therapy – 3.3.1 Introduction and types	
4	Unit IV	10
	Forensic medicine and Public health 4.1 Prepration of DNA sample 4.2 Approches of DNA analysis 4.2.1 RFLP based 4.2.2 PCR based Public health 4.3 Epidemiology 4.4 Diagnosis of infectious diseases 4.5 Detection of genetic diseases 4.6 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**
- 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) **Agriculture application of Microbiology- Neeelima Rajvaidya .**

BTE – 604 Bioinformatics

Sr. No.		Lectures 40
	Unit I	10
1.	Introduction to Bioinformatics 1.1 History of bioinformatics 1.1.1 Multidisciplinary approach of bioinformatics, Computers in Biology and Medicines, 1.1.2 Internet, and related programs; Networking HTTP, HTML, WAN, LAN, MAN, applications in communication. 1.2 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 1.3 Introduction to Genomics and Genome databases: Introduction, Databases, Data, Nucleic acid sequence database, Gene Bank, EMBL, DDBJ 1.3.1 Genomics: Human Genome Project (HGP), Goal and applications, final draft of HGP (complete information resources covered)	
	Unit II	10
2.	Introduction to proteomics and protein sequence databases 2.1 Proteomics: Introduction to amino acids and protein, Proteome, Protein structure. 2.2 Primary protein sequence databases: SWISS-PROT, PIR, MIPS, NRL-3D, TrEMBL. 2.3 Secondary protein sequence databases: PROSITE, PROFILE, PRINT, pfam, BLOCK, IDENTIFY. 2.4 Literature database: PubMed, PubMed Central. 2.5 Structural databases: PDB, MMDB, CATH, SCOP, PdbSum.	
	Unit III	10
3.	Sequence Alignment and Phylogenetic analysis	

	<p>3.1 Sequence Alignment: Introduction, Protein sequence, Nucleic acid sequence, Pair wise sequence alignment, Multiple sequence alignment, Local and Global sequence alignment.</p> <p>3.2 Algorithm used in sequence alignment: Matrices- Dot matrix, PAM, BLOSSOM.</p> <p>3.3 Phylogenetic analysis:</p> <p>Introduction: Evolution, definition of phylogenetic tree, nodes, internodes, root, tree, styles; cladogram, phenogram, curvogram, Steps involved in construction of phylogenetic tree</p> <p>3.4 Phylogenetic analysis tools: Phylip, ClustalW</p>	
	Unit IV	10
4.	<p>Drug designing</p> <p>4.1 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</p> <p>4.2 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.</p>	

References

- 1. Bioinformatics methods and applications. S. C. Rastogi, N. Mendiratta, P.Rastogi.**
- 2. Principle of bioinformatics. P. Shanmughavel.**
- 3. Computational Drug Designing. David C. Young**
- 4. Computational Drug Design: A Guide for Computational and Medicinal Chemists. David C. Young**
- 5. An introduction to Bioinformatics. T. K. Attwood, Parry-Smith D. J.**
- 6. A textbook of bioinformatics. Sharma, Munjal, Shankar.**

BTE – 605 Techniques in Bioinformatics

Sr. No.	Practicals	15	
1	Introduction to PUBMED Central database using the ENTREZ search engine.	01	Minor
2	Getting the amino acid sequences by exploring and querying the protein Sequence database.	01	Minor
3	Getting the gene sequences by exploring and querying the nucleic acid Databases.	01	Minor
4	Similarity search for nucleotide using the BLASTn and interpretation of the results.	01	Major
5	Similarity search for protein using the BLASTp and interpretation of the results.	01	Major
6	Protein and nucleic acid pair-wise sequence alignment by using ClustalW.	01	Minor
7	Construction of Phylogenetic Tree using ClustalW.	01	Major

8	Analysis of Secondary and tertiary structure of protein using visualizing software like Pymol or Rasmol.	01	Major
9	Calculate PI/MW of protein using ExPasy web tool.	01	Minor
10	Prediction of the secondary structure of protein using ExPasy web tool (GOR method).	01	Minor
11	Three dimensional structure prediction by using the homology modeling technique using SPDBV.	01	Major
12	Molecular Docking of protein and ligand by Argus lab.	01	Major
13	Energy calculation of the biomolecules using molecular mechanics and quantum mechanics. (Argus lab)	02	Minor

BTE – 606 Techniques in Agricultural and Health Biotechnology

Sr. No.	Practicals	15	
1	Isolation of <i>Azotobacter</i>	02	Major
2	Isolation of <i>Rhizobium</i> from root nodules	02	Major
3	Isolation of PSB from soil.	02	Major
4	Production of Biofertilizer- <i>Azotobacter</i> , PSB	02	Major
5	Isolation of <i>Trichoderma / Bacillus thuringensis</i>	01	Minor
6	Production of Biopesticide – <i>Trichoderma / Bacillus thuringensis</i>	01	Minor
8	Production of Artificial seed	01	Minor
9	Analysis of Milk and milk products - a) Estimation of lactic acid. b) Estimation of total fat. c) MBRT	02	Minor
10	Determination of antibacterial activity of crude plant extract.	02	Minor

Industrial Visit- Wine Industry, Food Processing Industry.

BTE – 607 Entrepreneurship

Guidelines

1. Selection of the Entrepreneurship topic strictly related to biotechnology industry and allotment of supervisor.
2. Preparation of Entrepreneurship Execution Plan : Time and Resource Allocation
3. Guidance by the Entrepreneurship 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. Students are expected to work on Entrepreneurship for about 10 periods per week.
6. The Entrepreneurship must be allotted individually.

7. 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.
8. Students are expected to work on “how to settle a small scale /large scale industry based on production of biotechnological products e.g- Biofertilizer, biopesticide, commercial tissue culture lab, chees industries, breveries, enzyme production etc.
9. Submission Process: Student should prepare 2 copies of the Entrepreneurship 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.
10. The student has to submit one of these approved copies of Entrepreneurship report, duly signed by the project Supervisor and Principal, before practical examination. The report will be assessed by the external examiners (appointed by university), who will assign marks out of 50. At time of examination student has present his report with the help of power point presentation.Theory, practical, project and Entrepreneurship report shall form separate heads of passing.

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 examination.

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 and satisfactorily complete project work and entrepreneurship as per the syllabus. The report of the same should be duly certified by the Head of the Department and submit the respective reports at the time of examination.

BTE– 505:- Techniques in Genetic engineering.

and

BTE– 605:- Techniques in Bioinformatics

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|------------|-----------|-------------------------|-----------------|
| 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 Project **50 Marks**

A) Internal Examination	10 Marks
B) External Examination	(40 Marks)
Project report	25 Marks
Presentation	05 Marks
Viva-Voce	10 Marks

BTE – 607 Entrepreneurship **50 Marks**

Project report	30 Marks
Presentation	10 Marks
Viva-Voce	10 Marks

Nature of Question papers (Theory)

COMMON NATURE OF QUESTION FOR THEORY PAPER MENTIONED SPERATELY:

