Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Biotechnology

SEMESTER PATTERN

(w.e.f. Academic Year 2015-16)

SYLLABUS FOR

B.Sc. (Biotechnology)

JUNE -2015

Rajarshi Shahu Mahavidyalaya, Latur (Autonomous)

Department of Biotechnology

Course Structure of B.Sc. Biotechnology Third Year (w.e.f. June 2015)

B. Sc. III [Biotechnology] Semester V

Code No.	Title of the course	Hours/ Week	Marks (100)		Credits
			In Sem	End Sem	
U- RET-607	Recombinant DNA Technology	04	**20**	**30**	02
U-MIT-608	Microbial Technology	04	**20**	**30**	02
U-ANB-609	Animal Biotechnology	04	**20**	**30**	02
U-DEB-610	Developmental Biology	04	**20**	**30**	02
U-LAC-611	Lab Course XVII (Practical based on BTT 17)	03	**20**	**30**	02
U-LAC-612	Lab Course XVIII (Practical based on BTT 18)	03	**20**	**30**	02
U-LAC-613	Lab Course XIX (Practical based on BTT 19)	03	**20**	**30**	02
U-LAC-614	Lab Course XX (Practical based on BTT 20)	03	**20**	**30**	02
U-SEM-615	Seminar	03		**50**	02
U-ENS-616	Environmental Studies	02			GRADE
	Total Credits				18

B.Sc. III [Biotechnology] Semester VI

CodeNo.	Title of the course	Hours/ Week	Marks (100)		Credits
			In Sem	EndSem	
U-COB-707	**Computational Biology**	04	**20**	**30**	02
U-PHB-706	**Pharmaceutical Biotechnology**	04	**20**	**30**	02
U-BIS-707	**Biodiversity and Systematic**	04	**20**	**30**	02
U-AGB-708	**Agriculture Biotechnology**	04	**20**	**30**	02
U-LAC-709	**Lab Course XXI (Practical based on BTT 21)**	03	**20**	**30**	02
U-LAC-710	**Lab Course XXII (Practical based on BTT 22)**	03	**20**	**30**	02
U-LAC-711	**Lab Course XXIII (Practical based on BTT 23)**	03	**20**	**30**	02
U-LAC-712	**Lab Course XIV(Practical based on BTT 24)**	03	**20**	**30**	02
U-PRW-713	**Lab Course XV (Project Work)**	03		**100**	04
	TOTAL				18

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B.Sc. Biotechnology Third Year
(Semester V)

Course Title: Recombinant DNA Technology **Course Code: U-RET-607**

Marks 50 **Hours 45** **Credit: 02**

Learning Objectives

- Understand the methods of genetic manipulations in living organisms
- List out tools used for gene exploration.
- Utilize the knowledge on creation of a genomic and c-DNA library.
- Understand the ethical consideration in about transgenic plants & animals.
- Learn the tools and techniques used for genetic manipulation of living organisms

Course Outcomes

- Understand the difference between old biotechnology and modern biotechnology
- Provide examples of current applications of biotechnology and advances in the different areas like medical, microbial, environmental, bioremediation, agricultural, plant, animal, and forensic.
- Understand the concept of recombinant DNA technology or genetic engineering
- Describe DNA fingerprinting, and restriction fragment length polymorphism (RFLP) analysis and their applications
- Describe the steps involved in the production of biopharmaceuticals in microbial and mammalian cell systems
- Explain the concept and applications of monoclonal antibody technology
- Explain the general principles of generating transgenic plants, animals and microbes.

UNIT-I:

Principles of Gene cloning

Molecular tools and their applications: Restriction Endonuclease and their types, DNA Ligases, Alkaline phosphatase. Vectors {Plasmids (pBR322, pUC18/19), Bacteriophages (λ Phage, M 13 Phage) and Cosmids.} Gene cloning strategies- insertion of DNA molecule into a vector (Transformation, Conjugation, Electroporation, Agrobacterium-mediated transformation).

UNIT -II:

r- DNA Techniques.

Blotting techniques: Southern Blotting, Northern Blotting, Western Blotting, Dot Blot Blotting, Autoradiography. DNA Sequencing: Sanger's and Maxam Gilbert's Method. PCR: Mechanism, Types and Application. DNA chips (Micro array)

UNIT-III:

Library construction and screening

Cosntruction of Genomic library Maniatis Strategy, cDNA cloning with conventional cDNA and full length cDNA.-genomic library. Nucleic Acid Probe, Screening of library-Probe based direct and indirect methods.

UNIT - IV:

Applications of r-DNA technology.

Agricultural and Industrial Applications : i) BT-Cotton, ii) Transgenic maize, iii)Golden rice iv) Protein engineering to Improve Detergent Enzymes.
Pharmaceutical Applications : i) Recombinant Human Insulin ii)Hepatitis B-vaccine iii) Monoclonal Antibodies iv)Clotting factors v) Tissue Plasminogen Activator vi) Erythropoietin v) Human growth hormone.

Text & References:

1. Principles of Gene Manipulation and Cloning - Old & Primrose.

2. Gene Manipulation and Cloning – Christopher Howe.

3. Molecular Biotechnology -Glick

4. Molecular Cloning- A practical approach-T.A. Brown.

5. Genomes 3 - T.A.Brown.

6. Genetic Engineering – Sandhya Mitra

7. Genes – B. Lewin

8. Text book of Biotechnology – U Satyanarayan Arora M.P (2003), Biotechnology,

Himalaya Pub.House, Mumbai.

9. Jogdand S.N (2006)- Gene Biotechnology, Himalaya Publishing House, Mumbai.

10. Joshi P (2002) - Genetic Engineering and its applications,Agrobios Pub, Jodhpur.

11. Mitra Sandhya (2006) - genetic Engineering, MacMillan India Ltd,Delhi.

12. Satyanarayana U. (2007) - Biotechnology, Books and Allied Pvt. Ltd .Kolkata.

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B.Sc. Biotechnology Third Year

(Semester V)

Course Title: Lab course XVII **Course Code: U-LAC-611**

Marks 50 **Hours 45** **Credit: 02**

Course Outcomes

- Students will be able to perform practical's related to recombinant DNA technology

Practicals :

1. Isolation of Genomic DNA from Bacterial cell.
2. Isolation of Plasmid DNA from resistant clinical isolates.
3. Agarose gel electrophoresis and restriction digestion of DNA.
4. Ligation of DNA
5. Preparation of competent cells and Bacterial transformation
6. Screening of recombination by blue white selection.
7. Southern blotting
8. Western blotting
9. PCR amplification of isolated bacterial genomic DNA using universal primers
10. Extraction and purification of amplified DNA fragment from gel.
11. RFLP
12. RAPD
13. GFP cloning
14. Visit to Molecular Biology & Genetic Engineering Research Laboratory

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B.Sc. Biotechnology Third Year
(Semester V)

Course Title: Microbial Technology **Course Code: U-MIT-608**
Marks 50 **Hours 45** **Credit: 02**

Learning Objective

- To evaluate the role of micro-organisms in specific biotechnological processes
- To explain the complex processes behind the development of genetically manipulated organisms.

Course Outcome

- Demonstrate a clear understanding of how biochemical pathways relate to biotechnological applications
- Conduct a comprehensive search for original research literature pertinent to a selected area of microbiology and biotechnology.
- Understanding of upstream and downstream processes.
- Understanding of Quality Control, Process Economics and GLP**.**

UNIT I **(12)**

Microbial Growth

Microbial Biotechnology –Historical perspectives

Microbial growth kinetics: Continuous culture, Batch culture, fed Batch culture, Thermodynamics of Growth, Fermentation concept and types.

Basic nutrition & metabolism. Novel pathways of microorganisms.

UNIT II **(15)**

Down Stream Processing.

Removal and Recovery of cell mass (Precipitation, Filtration and Centrifugation). Cell disruption: Physical and Chemical methods. Purification of Product: Liquid-liquid extraction, Solvent Recovery. Chromatography: Adsorption, Ion-exchange, HPLC. Membrane processes: Ultrafiltration and Reverse Osmosis. Drying and Crystallization.

UNIT -III

Fermentation Processes.

Fermentation processes: Microorganisms involved, Inoculum preparation, Medium used, Fermentation process, Recovery. Enzyme: Protease, Pectinase. Organic acid: Citric acid. Antibiotic: Penicillin, Erythromycin. Vitamin: Vitamin B12, vitamin B2.

UNIT- IV :

Quality Control, Process Economics and GLP.

Sterility testing. Pyrogen testing. Carcinogenicity testing. Toxicity testing.

Fermentation Economics: Cost Estimates, Process Design ,Capital Cost Estimates, Operating Cost Estimates. Good Laboratory Practices.

Text & References :

1. Casida L.E (1991) - Industrial Microbiology, Wiley Eastern, New Delhi.

2. Crueger W and Crueger A (2000) - Biotechnology: A Textbook of Industrial Microbiology,

2nd Edi. Panima Publishing Corporation, New Delhi.

3. Patel A.H. (2004) - Industrial Microbiology, Macmillan India Ltd.,New Delhi.

4. Peppler H.J and Perlman D (2006) - Microbial Technology,Vol I and II,Academic Press,New

York.

5. Parihar Pradeep (2007) - A textbook of Biotechnology, Student edition, Jodhpur.

6. Stanbury P.F., Whitaker A. and Hall S.J (1997) - Principles of Fermentation Technology, Aditya Books Pub., Ltd., New Delhi.

7. Satyanarayana U. (2007) - Biotechnology, Books and Allied Pvt.Ltd.Kolkat

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B.Sc. Biotechnology Third Year
(Semester V)

Course Title: Lab Course XVIII **Course Code: U-LAC-612**
Marks 50 **Hours 45** **Credit: 02**

Course Outcome

- Critically evaluate the role of micro-organisms in specific biotechnological processes
- Students will be able to development genetically manipulated organisms.
- Students will be able to develop skills in production of organic acid and solvents

Practical:-

1. Production of primary and secondary metabolite (one organic acid and one antibiotic)
2. Biomass production (Baker's yeast and Spirulina) 2P
3. Production of beverages (alcohol, wine) 2P
4. Immobilization of yeast on calcium alginate
5. Estimation of the fermentation products by titration method 2P
6. Estimation of fermentative product (Acetic acid from vinegar).
7. Production of cheese using different substrate from microorganism.
8. Isolation & identification of bacteria from different milk & water samples.
9. Visit to Fermentation Industry

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B.Sc. Biotechnology Third Year
(Semester V)

Course Title: Animal Biotechnology **Course Code: U-ANB-609**
Marks 50 **Hours 45** **Credit: 02**

Learning Objectives

- To know the exact infrastructure and useful and desirable facilities for developing cell culture labs.
- To know the traditional practices with certain modifications and emphasis on the need to improve the existing methodologies.
- To cater the curiosity and knowledge about newer approaches regarding transgenic cloni9ng artificial vaccine etc.
- To study the interpretation and relationship via forensic and evolutionary studies particularly in animal biotechnology and conservation of endangered animals.

Course Outcomes

- The students would be well aware about basic infrastructure and culture technique of ATC.
- Students would be more beneficial to understand the process concerning with veterinary and biotechnology day to day practices and approaches.
- Students would be more curious and methodical and innovative by studying the approaches and would formulate newer strategies to establish the betterment.

Unit-I

Structure of animal cell, history of animal cell culture, cell culture media and reagents, culture of mammalian cells, tissues and organs, primary culture, secondary culture, continuous cell lines, suspension cultures, somatic cell cloning and hybridization, transfection and transformation of cells, commercial scale production of animal cells, application of animal cell culture for *in vitro* testing of drugs, testing of toxicity of environmental pollutants in cell culture, application of cell culture technology in production of human and animal viral vaccines and pharmaceutical proteins

Unit –II

Introduction to the concept of vaccines, conventional methods of animal vaccine production, recombinant approaches to vaccine production, hybridoma technology, phage display technology for production of antibodies, commercial scale production of diagnostic antigens and antisera, animal disease diagnostic kits.

Unit-III

Structure of sperms and ovum, cryopreservation of sperms and ova of livestock, artificial insemination, super ovulation, *in vitro* fertilization, culture of embryos, cryopreservation of embryos, embryo transfer, embryo-spliting, embryo sexing, transgenic manipulation of animal embryos, different applications of transgenic animal technology, animal viral vectors, animal cloning basic concept, cloning from- embryonic cells and adult cells, cloning of different animals, cloning for conservation of endangered species, ethical, social and moral issues related to cloning, *in situ* and *ex situ* preservation of germplasm, *in utero* testing of foetus for genetic defects, pregnancy diagnostic kits, antifertility animal vaccines, gene knock out technology and animal models for human genetic disorders.

Unit-IV

Transgenic animal production and application in expression of therapeutic proteins, Immunological and nucleic acid based methods for identification of animal species, detection of meat adulteration using DNA based methods, and detection food/feed adulteration with animal protein, identification of wild animal species using DNA based methods using different parts including bones, hair, blood, skin and other parts confiscated by anti-poaching agencies.

Reference:-

- Gordon I. 2005. Reproductive Techniques in Farm Animals. CABI.
- Kindt TJ, Goldsby RA & Osbrne BA. 2007. Kuby Immunology. WH Freeman.
- Kun LY. 2006. Microbial Biotechnology. World Scientific.
- Levine MM, Kaper JB, Rappuoli R, Liu MA, Good MF. 2004. New Generation Vaccines. 3 rd Ed. Informa Healthcare.
- Lincoln PJ & Thomson J. 1998. Forensic DNA Profiling Protocols. Humana Press.
- Portner R. 2007. Animal Cell Biotechnology. Humana Press.
- Spinger TA. 1985. Hybridoma Technology in Biosciences and Medicine. Plenum Press.
- Twyman RM. 2003. Advanced Molecular Biology. Bios Scientific

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(Semester V)

Course Title: Lab Course XIX **Course Code: U-LAC-613**
Marks 50 **Hours 45** **Credit: 02**

Course Outcomes

- The students would be well aware about basic infrastructure and culture technique of ATC.
- Students will learn to handle cell line

Practicals

1. Preparation of animal cell culture media and their sterility test
2. Initiation of primary culture from chick embryo
3. Preparation of single cell suspension from spleen, liver and thymus
4. Cell counting and cell viability
5. MTT assay for cell viability and cell growth
6. Cell fusion by PEG assay
7. Cell transformation by viruses
8. Macrophage monolayer from PEC and measurement of phagocytic activity.
9. Karyotyping
10. Visit to Animal tissue culture/Biotechnology Research centres.

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Course Title: Developmental Biology **Course Code: U-DEB-610**
Marks 50 **Hours 45** **Credit: 02**

Learning Objectives

- Understand the molecular and cellular mechanisms of development
- Learn about basic embryology
- Strengthen understanding of the design and interpretation of biological experiments
- Gain experience reading the primary developmental biology literature

Course Outcomes

- Student understood basics of embryology and can interpret biological experiment related to animal development.

UNIT I-How development works in Animals

Developmental biology-Introduction, Present and future impact of developmental biology on biology.

Gametogenesis-Spermatogenesis, Oogenesis;

Early development-Fertilization, Cleavage-Patterns and Types, Gastrulation, axes and symmetry orientation, Developmental control genes in brief, Morphogen gradients,

Morphogenetic Processes-cell movement, cell adhesion, classification of morphogenetic processes

Growth, Cell lineage and Apoptosis

Aging

UNIT II-Approaches to Development in Animals: experimental embryology

Normal development-Cell fate and potency, the fate map concept, Clonal analysis

Developmental commitment-Cytoplasmic determinant, Cell-cell interaction-Induction, Competence, Instructive and permissive induction, Lateral inhibition and community effect, Specification, Determination and differentiation, Developmental plasticity

Regeneration of missing parts in animals-Planarian regeneration, vertebrate limb Regeneration

UNIT III-.Plant Development:-Plant Life Cycles

Gamete Production in Angiosperms

Pollination, Fertilization in plant

Embryonic Development in Monocotyledonous plant

Germination

Vegetative Growth

The Vegetative-to-Reproductive Transition

Senescence

Unit IV-Model Organisms in Development Study

Embryonic Development in Animals

***Xenopus laevis*-**Blastulation, Gastrulation, Organogenesis-neurulation

The Chick-Blatulation, Gastrulation, Organogenesis-whole embryo, Heart and circulation

***Drosophila melanogaster*-**Role of genes in Patterning during development.

Embryonic Development in plant

Arabidopsis thaliana (A dicotyledonous plant)-Role of genes in embryogenesis, Role of genes in Organogenesis-Shoot patterning, Root patterning, Leaf patterning, Flower patterning

Reference Books:

1. *Developmental Biology*, 8th edition (2006), S.F. Gilbert. Publisher - Sinauer Associates Inc.

2. *Principles of Development*, 3rd edition (2007), Lewis Wolpert, Publisher- Oxford University Press.

3. *An Introduction to Embryology*, 5th edition (2004), B. I. Balinsky. Publisher - Thomas Asia Pvt. Ltd

4. *Developmental Biology*, (2001), R. M. Twyman, Publisher - Bios Scientific Publishers LTD

5. N. Arumugam (1994) Developmental Biology, Saras Publication, Nagercoil.

6. A practical Guide to Developmental Biology(international student edition), Melissa A. Gibbs, Oxford university press.

7. Developmental Biology by Veerbala Rastogi

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B.Sc. Biotechnology Third Year

(Semester V)

Course Title: Lab Course XX **Course Code: U-LAC-614**

Marks 50 **Hours 45** **Credit: 02**

Course Outcomes

- Student will be able seek knowledge related to animal and plant embryology

PRACTICALS:

1. Introduction to developmental biology-embryo protocols, ethics, and model Systems.
    - General embryo protocols and ethics (1 practical)
    - Model systems-Drosophila fly, fish, chick, any suitable plant development study by using chart/ videos /Practical handling of animals and plant during development.
2. Study of frog development by using permanent mounted slides from zygote to Tadpole.
3. Study of chick development by using permanent slides from 18 hours to 96 hours Of chick embryo.
4. A study types of egg by using chart, as well as real specimen eggs.
5. A study of blastodisc of chick for their feature from hen egg.
6. A study of chick development up to eight days through egg incubation, candling andEgg dissection technique.
7. A study of different types of sperms and its features by using chart.
8. A study of pollen genesis by using T.S. of Anther preparation technique.
9. A study of T.S. of ovary for arrangement of ovules within ovary.
10. A study of Flower development from vegetative shoot of any suitable plant.
11. A study of morphological and anatomical changes in plants- (about tissue organisation) during plant development from germinated seed, seedling and other stages of development.

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(Semester VI)

Course Title: Computational Biology **Course Code: U-COB-705**
Marks 50 **Hours 45** **Credit: 02**

Learning objectives

- To gain insight into the public and private data repositories,
- To understand search algorithms and analysis tools in bioinformatics,
- To integrate and apply the learned computational knowledge and techniques to the healthcare applications.

Course outcomes

- Demonstrate knowledge of the world-renowned biotechnology information repositories, such as NCBI databases, and the proficient use of the search algorithms for genes, proteins, RNA's, peptides, disease biomarkers, compounds and biologics from these repositories;
- Apply the bioinformatics analysis tools for DNA sequencing, structure modeling, sequence alignment, microarray analysis and pathway analysis; and
- Apply bioinformatics analysis knowledge and techniques to answer scientific questions in the health sciences.

Unit I: Fundamentals of computers

Introduction Overview and functions of a computer system, storage, devices, memory, etc. The Minicomputer, Mainframe Computers, Parallel Processing Computer, The Super Computer, etc. The Internet and its Resources, World Wide Web (WWW): associated tools, services, resources and various terminologies; Introduction to operating systems; File System Concept – NTFS, FAT, etc.

Unit II : Introduction to bioinformatics and data generation

What is bioinformatics and its relation with molecular biology. Examples of related tools (FASTA, BLAST, RASMOL), databases (GENBANK, Pubmed, PDB) and software (RASMOL) Data generation; Generation of large scale molecular biology data (Through Genome sequencing, Protein sequencing, Gel electrophoresis, Applications of Bioinformatics.

Unit III : Biological Database and its Types

Introduction to data types and Source. Population and sample, Classification and Presentation of Data. Quality of data, private and public data sources. General Introduction of Biological Databases; Nucleic acid databases (NCBI, DDBJ, and EMBL). Protein databases (Primary, Composite, and Secondary).

Unit IV : Sequence Alignments and Visualization

Introduction to Sequences, alignments, Local alignment and Global alignment (algorithm and example),Pairwise alignment (BLAST and FASTA Algorithm) and multiple sequence alignment

(Clustal W algorithm). Methods for presenting large quantities of biological data: sequence viewers, 3D structure viewers (Rasmol, SPDBv, Chime, Cn3D, PyMol).

References

1. Teresa Attwood, David Parry-Smith - Introduction to Bioinformatics Prentice Hall, 1999
2. Pierre Baldi, Søren Brunak -Bioinformatics : the Machine Learning Approach MIT Press, c2001.
3. Andreas D. Baxevanis, B.F. Francis Ouellette - Bioinformatics : A Practical Guide to the Analysis of Genes and Proteins, J. Wiley, c1998.
4. Philip E. Bourne, Helge Weissig - Structural Bioinformatics Wiley, c2003. Projected Pub. Date: 0311
5. Jean-Michel Claverie, Cedric Notredame - Bioinformatics for Dummies Wiley Pub., 2002. Projected Pub. Date: 0211
6. Peter Clote, Rolf Backofen - Computational Molecular Biology : an Introduction, Wiley, 2000.
7. Richard Durbin, Sean R. Eddy, Anders Krogh, Graeme Mitchison - Biological Sequence Analysis : Probabilistic Models of Proteins and Nucleic Acids ,Cambridge University Press, 1998
8. Warren J. Ewens, Gregory R. Grant - Statistical Methods in Bioinformatics : an Introduction Springer, c2001.
9. Dan Gusfield, Algorithms on Strings, Trees, and Sequences : Computer Science and Computational Biology, Cambridge University Press, 1997.
10. D. Higgins and W. Taylor - Bioinformatics : Sequence, Structure, and Databanks : a Practical Approach, Oxford University Press, 2000.
11. Timo Koski , Hidden Markov - Models for Bioinformatics Kluwer Academic Publishers, c2001.
12. Stephen A. Krawetz and David D. Womble - Introduction to Bioinformatics : a Theoretical and Practical Approach Humana Press, 2002.
13. Arthur M Lesk - Introduction to Bioinformatics, Oxford University Press, 2002.
14. David W. Mount - Bioinformatics : Sequence and Genome Analysis, Cold Spring Harbor Laboratory Press, c2001.
15. Pavel A. Pevzner - Computational Molecular Biology : an Algorithmic Approach MIT Press, c2000.
16. João Carlos Setubal, João Meidanis - Introduction to Computational Molecular Biology, PWS Pub., 1997.
17. Michael S. Waterman - Introduction to Computational Biology : Maps, Sequences, and Genomes : Interdisciplinary Statistics, Chapman & Hall/CRC, 1995 (2000 printing)

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B.Sc. Biotechnology Third Year

(Semester VI)

Course Title: Lab Course XXI **Course Code: U-LAC-709**
Marks 50 **Hours 45** **Credit: 02**

Course outcomes

- Apply the bioinformatics analysis tools for DNA sequencing, structure modeling, sequence alignment.
- Apply bioinformatics analysis knowledge and techniques to answer scientific questions in the health sciences.

Practicals:

1. Study architecture of computer system
2. Study of different modern computers.
3. Study of internet
4. Practical bases on Windows o/s
5. A guided tour of NCBI/EBI : Data acess – standard search engines : data retrievals tools – Entrez, DBGET and SRS (sequence retrieval systems); software for data building. submission of new revised data.
6. Sequence homology as product of molecular evolution, sequence similarity searches, sequence alignment-global, local, end free-space; measurement of sequence similarity, similarity and homology.
7. Multiple sequence alignment
8. Phylogeny reconstruction, PHYLIP package
9. Word processing.
10. Getting an amino acid sequence, nucleotide sequence by blasting.
11. Multiple sequence alignment
12. Homology modeling
13. Protein identification & characterization with peptide mass fingerprinting data.
14. Primary structure analysis of proteins.
15. Secondary structure analysis of proteins (helical content of peptide).
16. Tertiary structure analysis of proteins (3D structure prediction).

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(Semester VI)

Course Title: Pharmaceutical Biotechnology **Course Code: U-PHB-706**
Marks 50 **Hours 45** **Credit: 02**

Learning Objectives

- To understand the difference between old biotechnology and modern biotechnology
- To provide examples of current applications of biotechnology and advances in the different areas like medical, microbial, environmental, bioremediation, agricultural, plant, animal, and forensic.
- To understand the concept of recombinant DNA technology or genetic engineering

Course Outcome

- Understanding of steps involved in the production of biopharmaceuticals in microbial and mammalian cell systems
- Understanding of the concept and applications of monoclonal antibody technology
- Study of general principles of generating transgenic plants, animals and microbes

Unit I: **10L**

Drug Development in Pharmaceutical Process - Production of pharmaceuticals by genetically engineered cells (hormones, interferons) - Microbial transformation for production of important pharmaceuticals (steroids and semi-synthetic antibiotics) - Techniques for development of new generation antibiotics

Unit II: **10L**

Antibodies in research, diagnostics and therapeutics

Production of monoclonal antibodies and techniques to make them clinically applicable

Gene therapy – background, types of gene therapy (ex vivo & in vivo)

Vaccines – Vaccine vectors, nucleic acid vaccines, immuno-enhancing technology. Toxicogenomics

Unit III: **15L**

Delivery of Biotechnology products: transdermal, parenteral, oral, mucosal, ocular, buccal, rectal and pulmonary delivery

Tissue Engineering – Skin, Liver, Pancreas, Xenotransplantation – terminology, technology behind it, organ donors, social & ethical issues

Stability of Biotechnology products: Physical instability- denaturation, aggregation, adsorption; Chemical instability- oxidation, hydrolysis

Unit IV: **10L**

Diagnosis and Kit Development - Use of enzymes in clinical diagnosis - Use of biosensors for rapid clinical analysis - Diagnostic kit development for microanalysis

Products of Biotechnology-current FDA approved biotechnology: drugs- human insulin, growth hormone, interferon; Future biotechnology drugs

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Course Title: Lab Course XXII **Course Code: U-LAC-710**
Marks 50 **Hours 45** **Credit: 02**

Course Outcome

- To provide examples of current applications of biotechnology and advances in the different areas like medical, microbial, environmental, bioremediation, agricultural, plant, animal, and forensic.
- Able to develop skills in detection of toxicity of drugs, antimicrobial activity and MIC.

Practicals:

1. Antimicrobial assay against bacteria
2. Antimicrobial assay against fungi
3. Extraction of natural molecules
4. Cytotoxicity assay
5. Stability of drugs using spectrophotometry
6. Thin Layer chromatography of plant extratcs

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Course Title: Biodiversity &Systematic **Course Code: U-BIS-707**
Marks 50 **Hours 45** **Credit: 02**

Learning Objectives:

- To educate the students about the existing biodiversity in world with special reference to Indian continent, various geographical hotspot and losses and remedial conservation and mitigation strategies.
- To inculcate the values and knowledge about classification of flora and fauna and their detail studies with new methods such as identification keys and evolutionary relationship.
- To study the interpretation and analysis of results with the reference material it would be key to identification of new plants and animals.

Course Outcomes:

- The students would be more learned about reasons of losses of biodiversity and existing conservation strategies and laws with new approaches such as gene bank etc.

- Students would be more beneficial and facilitated with appropriate understanding of the traditional and newer method of classification and identifying characters.

Unit-1.

Basic concept of Biodiversity – What is Biodiversity, Why should we conserve it, Elements of Biodiversity - Ecosystem Diversity, Genetic Diversity, Species Abundance & Diversity, Patterns of Species Diversity. Global patterns of Biodiversity – measuring biodiversity, Cataloging and Discovering Species, Geographical Patterns of Species Richness, Biogeography, Importance of Distribution Patterns (Local Endemics, Sparsely Distributed Species, Migratory Species).

U**nit-II.**

Biodiversity & Conservation – Overexploitation threatening living species,

International Trade, Animals threatened by International trade, Problems in Controlling International Trade (Enforcement, Reservations, Illegal Trade), Free Trade & the Environment, Free Trade & Conservation, Common patterns of Over exploitation. Exotic Species – Plants, Invertebrates, Fishes, Amphibians, Reptiles, Birds, Mammals, Detrimental Effects of Exotic Species.

Unit III

Endangered Species Conservation – The US Endangered Species Act, State Endangered Species Acts Successes and Failures of the Endangered Species Act Role of ESA in Habitat Protection, Critical Habitat, Problems with the Endangered Species Act, Habitat Conservation Plans.

Ethics of Conservation – Values of Biodiversity, Biopiracy, Hybridized plants, GM crops (benefits & criticism), and Economic Value of Biodiversity & Legal, Ethical and Conservation issues related to uses of biodiversity, Global Conservation Issues.

Unit IV

Basic concept of Taxonomy – Classification, Construction of Phylogenetic tree, Systematics, Cladistics, Cladograms, Phenetics, Nomenclature. (5 Periods)

Molecular Taxonomy in relation to DNA characteristics & Protein sequences – modes of molecular evolution, Neutral theory of Molecular evolution, genetic markers for taxonomic purposes, comparing total genome by DNA-DNA hybridization, comparing DNA sequences, Cladistics, biological identification through DNA barcodes.

Reference:

1. M. Koto-The Biology of biodiversity – Springer
2. E.O. Wilson – Biodiversity – Academic Press Washington
3. G. G. – Simpson-Principle of animal taxonomy Oxford IBH Publication company.
4. E- Mayer – Elements of Taxonomy

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B.Sc. Biotechnology Third Year
(Semester VI)

Course Title: LAB COURSE XXIII **Course Code: U-LAC-711**
Marks 50 **Hours 45** **Credit: 02**

Course Outcomes:

- Students would be more beneficial and facilitated with appropriate understanding of the traditional and newer method of classification and identifying characters.

Taxonomy – Field Methods

1. Morphology of major groups (Bryophytes, Pteridophytes, Gymnosperms and Angiosperms)
2. Study of leaf and flower morphology
3. Study of fruits: expected abilities: field identification of at least 25 species and identification up to family level for all common plants in the study area)
4. Surveys, collection and preservation of different plant groups
5. Identification using reference material
6. Visits to herbaria, gardens, culture collections
7. Photography and illustration in field and laboratory conditions
8. Use of computers in analysis, documentation and dissemination of information.
9. Morphology of Insects
10. Classification of insects (all major orders using key)
11. Use of taxonomic literature and visit to local market for identification, morphometry
12. Methods of dry and wet preservation of animals
13. Dry preservation of insects for taxonomic studies
14. Visit to ZS

Rajarshi Shahu Mahavidyalaya, Latur
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B.Sc. Biotechnology Third Year

(Semester VI)

Course Title: Agricultural Biotechnology **Course Code: U-AGB-708**
Marks 50 **Hours 45** **Credit: 02**

Learning Objectives

- To aware and learn about the basic physiological process occurred in plants such as photoperiodism and dormancy along with stress and seed germination etc.
- To educate the students about various process of Biofertilizer preparation and Biopesticide formulations.
- To make them aware about various microbes and respective causative agents for disease and their proper management. by biological ways,
- To educate and aware about various applications such as biosensor and soil erosion and biodegrading microorganism and their enrichment etc.

Course Outcomes

- The students would be more learned and methodical about newer approaches and physiological phenomenon of plants.
- Student would be facilitated with day to day process of traditional methods and newer methods of microbial inoculums preparation.
- Students would be more beneficial and facilitated by studying aspect related to latest technology which has been incorporated in agricultural products.

UNIT- I:

Importance of secondary metabolites;
Pigments as photoreceptors (plastidial pigments and phytochrome);
Plant movements; Photoperiodism and flowering, vernalization, senescence;
Growth substances – their chemical nature, role and applications in agri-horticulture;
Growth indices, growth movements; Stress physiology (heat,water, salinity, metal);
Fruit and seed physiology;
Dormancy, storage and germination of seed;
Fruit ripening – its molecular basis and manipulation.

UNIT-II:

Biomass: Composition , Types, Biomass as a energy Source ,Biomass conversion and Utilization.
Enzymatic, Aerobic and Anaerobic digestion.
Biofertilizers:Concept and Types of Biofertilizer. Microbial Inoculum - Rhizobium Inoculant, Blue Green algae, Azotobacter, Sulphur and Phosphate Solubilizing Biofertilize. Applications of Biofertilizer.
Bio-pesticides- Definition and Types (Microbial and Botanical)Advantages of Biopesticides over chemical pesticides.

Single Cell Protein and its Nutritive Value eg. Spirulina.
Bio-Processing Technologies: Agricultural Biotech Products in the market.

UNIT- III:
Important crop diseases caused by viruses, bacteria, mycoplasma, fungi and nematodes; (Wilt of Arhar, Rust and Smut diseases, Downy Mildew and Powdery Mildew, Green air disease of Bajra, Tundy disease of wheat, Red rot of sugarcane)
Modes of infection and dissemination;
Molecular basis of infection and disease resistance/defence;
Physiology of parasitism and control measures;
Fungal toxins;
Modelling and disease forecasting;
Plant quarantine.

UNIT- IV :
Methods of plant breeding – introduction, selection and hybridization (pedigree, backcross, mass selection, bulk method);
Mutation, polyploidy, male sterility and heterosis breeding;
Use of apomixes in plant breeding;
DNA sequencing; Genetic engineering – methods of transfer of genes;
Transgenic crops and biosafety aspects;
Development and use of molecular markers in plant breeding;
Tools and techniques - probe, southern blotting, DNA fingerprinting, PCR and FISH.

Text & References :
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2. Gupta P.K. (1998) - Genetics and Biotechnology in Crop Improvement, Rastogi Publications, Meerut.
3. Pathak V.N,Khatri N.K.,Pathak M.(1996) - Fundamentals of Plant Pathology, Agrobotanical Publications, Bikaner.
4. Powar C.B., Daginawala H.F., (1990) - General Microbiology,Vol. II,Himalaya Publishing House,Mumbai.
5. Purohit S.S.(2002) - Agricultural Biotechnology,Agrobios India, Jodhpur.
6. Satyanarayana U. (2007) - Biotechnology, Books and Allied Pvt.Ltd.Kolkata.
7. Vyas S.C.,Vyas S., Vyas S.,and Modi H.A.(1998) - Biofertilizer and Organic Farming, Akta Prakashan, Nadiad,G.S, Meerut.
8. Vyas S.C.,Vyas S., Vyas S.,and Modi H.A (1998) - Experiments in Microbiology, Plant pathology, Tissue culture and Mushroom cultivation, Vishwa Prakashan, New age international (p) Ltd.,New Delhi.
9. Kalaichelvan P.T. and Dandiya P.C (2004), Microbiology and Biotechnology: A Laboratory Manual, MJP Publishers, Chennai.
1. Purohit S.S. (1995), A . Aneja K.R. - Laboratory manual of Plant Biotechnology, Agrobotonical Pub.India.
12. Schmauder Hans Peter (1997) - Methods in Biotechnology, Taylor and Francis, London.
13. Schuler M. A. and Zielinski R. E. (1989) - Methods in Plant Molecular Biology.
14. Vyas S.P. and Kohli D.V. (2002) - Methods in Biotechnology and Bioengineering, CBS Publishers and Distributors, New Delhi.

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(Semester VI)

Course Title: Lab course XXIV **Course Code: U-LAC-712**
Marks 50 **Hours 45** **Credit: 02**

Course Outcomes

- Students will be able to estimate and detect the concentration of hormones, secondary and primary metabolites.

1. Study of Stomatal Physiology.
2. Determination of IAA Oxidase activity.
3. Estimation of leg haemoglobin from root nodule of leguminous plant.
4. Isolation and identification of plant pathogen *(Xanthomonas citri)* from infected citrus fruit or leaf.
5. Preparation and Application of Biofertilizers.
6. Isolation of *Rhizobium sp.*from root nodule of leguminous plant.
7. Isolation and Culture of Plant Protoplast
8. Determination of minimum size of quadrate by 'Species-Area-Curve' method.
9. Study of Community by quadrate method (Frequency, Density and Abundance of different Species in Community.
10. Visit to Cell Culture Facilities /Production /Biofertilizer Industry.
11. Determination of Total Phosphorus, sulphur and nitrogen of soil.
12. Study of stress response in plant.
13. Production of plant secondary metabolites.
14. Identification of plant secondary metabolites.
15. Effect of phytohormones on plant growth.