

**Syllabus
Biotechnology
(UG courses)
Admitted Batch 2008 -2009**



2008
A.P. State Council of Higher Education

SUBJECT COMMITTEE

1. Prof. T. Ramana	Member	Andhra University, Waltair
2. Prof. Md. Ishaq	Member	Osmania University, Hyderabad
3. Prof. Varadarajulu Naidu	Member	S. V. University, Tirupati
4. Prof. A. Sadanandam	Member	Kakatiya University, Warangal
5. Prof. K.R.S. Sambasiva Rao	Member	Acharya Nagarjuna University, Nagarjuna Nagar
6. Prof. Ch. Sudhakar	Member	S.K. University, Anantapur
7. Dr. Varalakshmi	Member	Govt. Degree College, Anantapur
8. Dr. Annapurna Bhavani	Member	Kasturba Degree College, Maredpally Secunderabad
9. Dr. Y. Udaya Bhaskara Rao	Member- Co-opted	Shantha Biotechnics Ltd., Hyderabad
10. Prof. Irfan Ali Khan	Member- Co-opted	Anwarul Uloom College, Hyderabad
11. Prof. P.B. Kavi Kishor	Coordinator	Osmania University, Hyderabad

* The scheme of instructions and the model curriculum for B.Sc Biotechnology course was thoroughly discussed on 19th March, 2008 and again on 13th April, 2008. The committee members unanimously resolved to approve the Model Curriculum prepared for B.Sc Biotechnology course.

B.Sc. Courses (Structure)

First year:

S.no.	Subject	Hrs per week
1.	English language including communication skills	6
2.	Second language	4
3.	Core1-I	4
4.	Core2-I	4
5.	Core3-I	4
6.	Core1-lab I	3
7.	Core2-lab I	3
8.	Core3-lab I	3
9.	Foundation course	3
10.	Computer skills	2
Total		36

Second year:

S.no.	Subject	Hrs per week
1.	English language including communication skills	6
2.	Second language	4
3.	Core1-II	4
4.	Core2-II	4
5.	Core3-II	4
6.	Core1-lab II	3
7.	Core2-lab II	3
8.	Core3-lab II	3
9.	Environmental studies	4
10.	Computer skills	2
Total		37

Third year:

S.no.	Subject	Hrs per week
1.	Core1-III	3
2.	Core1-IV	3
3.	Core2-III	3
4.	Core2-IV	3
5.	Core3-III	3
6.	Core3-IV	3
7.	Core1-lab III	3
8.	Core1-lab IV	3
9.	Core2-lab III	3
10.	Core2-lab IV	3
11.	Core3-lab III	3
12.	Core3-lab IV	3
13.	Foundation course	3
Total		39

A.P. State Council of Higher Education, Hyderabad

Model Curriculum, Course Structure and Scheme of Instructions for Biotechnology

Year	Paper No. Theory/ Practical	Title	Work load /Hours/ Week	Exam Duration Hours	Marks
I	I Theory	Cell Biology and Genetics	4	3	100
	I Practicals	Cell Biology and Genetics	3	3	50
II	II Theory	Biological Chemistry and Microbiology	4	3	100
	II Practicals	Biological Chemistry and Microbiology	3	3	50
III	III Theory	Molecular Biology, Genetic Engineering and Immunology	3	3	100
	III Practicals	Molecular Biology, Genetic Engineering and Immunology	3	3	50
	IV Theory	Applications of Biotechnology	3	3	100
	IV Practicals	Applications of Biotechnology	3	3	50

Note: The students should be exposed to the biotechnological industries available for practical experience and awareness, during the III year of the course study

Andhra University
Biotechnology
I Year B.Sc Syllabus for the Admitted Batch 2008-09

Paper I – Cell Biology and Genetics

120 hrs
(4 hrs/ week)

Unit I	Cell Structure, Function and Cell Division	30 hours
1.1	Cells as basic units of living organisms Viral, bacterial, fungal, plant and animal cells	
1.2	Ultra structure of prokaryotic cell (Cell membrane, plasmids)	
1.3	Ultra structure of eukaryotic cell (Cell wall, cell membrane, mitochondria, chloroplast, endoplasmic reticulum, Golgi apparatus, vacuoles).	
1.4	Chromosome organization in Prokaryotes and Eukaryotes	
1.5	Structure of specialized chromosomes (Polytene and Lamp Brush)	
1.6	Cell Division and Cell Cycle	
1.7	Significance of mitosis and meiosis	
Unit II	Mendel's Laws and Mechanism of Inheritance	30 hours
2.1	Mendel's experiments – Factors contributing to success of Mendel's experiments	
2.2	Law of segregation – Monohybrid ratio	
2.3	Law of Independent assortment – Dihybrids, Trihybrids	
2.4	Deviation from Mendel's Laws - partial or incomplete dominance, co-dominance	
2.5	Penetrance and expressivity, pleiotropism	
2.6	Epistatic gene interaction – Modified dihybrid ratios (12:3:1; 9:7; 15:1; 9:3:4; 9:6:1; 13:3)	
2.7	Genes and environment – phenocopies	
2.8	Linkage and recombination – Discovery of linkage, cytological proof of crossing over Recombination frequency and map distance Interference and coincidence Mitotic crossing over in <i>Drosophila</i>	
2.9	Mechanism of sex determination-genic balance theory - <i>Drosophila</i> Homogametic and Heterogametic theory (Human, Mamalian, Birds)	
2.10	X – linked inheritance (eg. Haemophilia)	
Unit III	Structure and Function of Nucleic Acids	30 hours
3.1	DNA as the genetic material – Griffiths experiments on transformation in <i>Streptococcus pneumoniae</i> . Avery, McLeod and Mc Carty's experiments. Hershey – Chase experiments with radio-labelled T ₂ bacteriophage	
3.2	RNA as genetic material – Tobacco Mosaic Virus	
3.3	Structure of DNA – Watson and Crick Model	

- Forms of DNA – A, B and Z forms of DNA, Super coiled and related DNA – Role of topoisomerases
- 3.4 DNA Replication – Models of DNA replication (Semi-conservative, non-conservative models)
Mechanisms of DNA replication – Linear and circular – Rolling circle and theta mechanism of replication
- 3.6. DNA damage and Repair

Unit IV Concepts of Biostatistics and Bioinformatics 30 hours

- 4.1 Concept of probability, basic laws and its application to Mendelian segregation. Concept of probability distribution. Binomial and Poisson distributions, Normal distribution and their application to biology
- 4.2 Concept of sampling and sampling distribution. Concept of test of hypothesis. Applications of t-test statistics to biological problems/data: Chi-square, statistic applications in biology
- 4.3 Simple Regression and Correlation. Concept of analysis of variance (one-way classification).
- 4.4 Introduction to Bioinformatics
Biological Databases – Nucleotide sequence and Protein databases, their utilization in Biotechnology, Storage of biological data in databanks, data retrieval from databases and their utilization

Practical Paper – I

90 hrs
(3 hrs/ week)

Practicals

1. Monohybrid and dihybrid ratio in *Drosophila*/maize
2. Estimation of DNA by diphenylamine method
3. Estimation of RNA by orcinol method
4. Preparation of different stages of Mitosis and Meiosis
5. Types of chromosomes
6. Finding statistical significance of a given data using 't' test
7. Graphical representation of data (Histograms, frequency polygen, Pie diagram)
8. Fitting of binomial and Poisson distributions
9. Acquaintance with the Biological databases through Internet

Recommended Books

1. Biometry - By Sokal and Rohlf W.H. Freeman
2. Fundamentals of Biometry - By L.N. Balaram (George Allen and Unwin Ltd, London
(1972)
3. Biostatistics - By N.T.J. Bailey
4. Biostatistics- Manual of biostatistical methods for use in health, nutrition and Anthropology - By K. Visweshwar Rao (Jaypee Publications).
5. Genetics - By Gardner (Macmillan Press)
6. An introduction to Genetic Analysis - By Griffith and others – Freeman and Company
7. Bioinformatics and Bioprogramming in C - By L.N. Chavali
8. Cell Biology - By S.C. Rastogi (New Age International (P) Ltd)
9. Statistical Genetics – Principles and Practice - By Prem Narain
10. Biotechnology - By K. Trehan
11. Biotechnology –I - By R.S. Setty and G.R. Veena
12. Biotechnology – II - By R.S. Setty and V. Sreekrishna
13. Fundamentals of Genetics – By B.D. Singh, N. Pratibha, P.H. Rao and P.B. Kavi Kishor
13. Genetics - By B.D. Singh
14. Genetics - By Mohan P. Arora, Gurdarshan and S. Sandhu
15. Introduction to Bioinformatics - By V. Kothekar
16. An Introduction to Kothekar - By V. Kothekar and T. Nandi
17. Introduction to Bioinformatics - By Arthur M. Lesk
18. Cell and Molecular Biology - By De Robertis
19. Cell and Molecular Biology - By Lodish
20. Cell Biology and Genetics - By P.K. Gupta
21. Theory and Problems in Genetics - By Stransfield

22. Introduction to Bioinformatics - By T.K. Attwood, D.J. Parry-Smith,
Samiron Phukan
(Pearson Education)
23. Introduction to Biotechnology - By W.J. Thieman and M.A. Palladino
(Pearson Education)
24. Discovering Genomics, Proteomics and Bioinformatics - By A.M. Campbell and
L.J. Heyer (Pearson Education)
25. The World of the Cell - By Becker (Pearson Education)
26. Concepts of Genetics - By Klug (Pearson Education)
27. Genetics - By Strickberger (Pearson Education)
28. Fundamental Concepts of Bioinformatics - By Krane (Pearson Education)
29. Fundamentals of Biostatistics - By Khan and Khanum (Ukaaz Publications)
30. Basic Concepts of Bioinformatics - By Irfan Ali Khan and Atiya Khanum
(Ukaaz Publications)

Andhra University
II B.Sc Biotechnology Syllabus for Academic Year
2009-10

120 hrs/ week)

Paper II – Biological Chemistry and Microbiology

UNIT- I	Biomolecules	35 hours
1.1	Carbohydrates : Importance, classification and properties	
1.2	Structure, configuration and biochemical importance of monosaccharides (glucose and fructose)	
1.3	Dissacharides – Structures and biochemical importance of sucrose and trehalose Physiologically important glycosides (streptomycin, cardiac glycosides, ouabain)	
1.4	Structure and function of homo polysaccharides – starch, inulin, cellulose and glycogen Structure and function of heteropolysaccharides – Hyaluronic acid	
1.5	Proteins : Classification, structure and properties amino acids	
1.6	Peptide bond – Synthesis and characters	
1.7	Primary, secondary, tertiary and quaternary structures of proteins	
1.8	Lipids : Fatty acids : Saturated and unsaturated	
1.9	Triacylglycerols, Sphingolipids, Sterols Phospholipids (phosphatidic acid, phosphatidylcholine)	
1.10	Enzymes : Classification and nomenclature of enzymes Kinetics of enzyme catalyzed reactions	
1.11	Factors influencing enzymatic reactions (a) pH (b) Temperature (c) Substrate concentration (d) Enzyme concentration	
1.12	Enzyme Inhibition – Competitive and non-competitive	
Unit II	Intermediary Metabolism	30 hours
2.1	Glycolysis	
2.2	Citric acid cycle	
2.3	Gluconeogenesis and its significance	
2.4	Mitochondrial electron transport Chemiosmotic theory of ATP synthesis	
2.5	β -Oxidation of fatty acid	
2.6	Deamination, decarboxylation and transamination reactions of amino acids	
2.7	Catabolism of amino acids – phenyl alanine and tyrosine (Phenylketonuria and albinism)	
2.8	Photosynthesis – Light reaction and photophosphorylation	
2.9	Carbon assimilation	

Unit III **Fundamentals of Microbiology** **25 hours**

- 3.1 Outlines of classification of microorganisms
- 3.2 Structure and general characters of Viruses, Bacteria, Fungi and Micro Algae (one example from each group)
- 3.3 Disease causing pathogens and their symptoms (examples; Typhoid, HIV only)
- 3.4 Isolation, identification and preservation of microorganisms (Bacteria)
- 3.5 Identification methods of Fungi and useful Micro Algae
- 3.6 Methods of sterilization
- 3.7 Bacterial reproduction and growth kinetics (Batch and continuous cultures)
- 3.8 Pure cultures and cultural characteristics

UNIT – IV **Principles and Applications of Biophysical Techniques** **30 hours**

- 4.1 Microscopy – Light, Inverted, Fluorescent and Electron microscopy
- 4.2 Colorimetry – Beer – Lambert’s Law
- 4.3 UV-VIS Spectrophotometry
- 4.4 Chromatography
(a) Paper (b) Thin Layer (c) Ion-exchange (d) Gel-filtration
- 4.5 Electrophoresis – Native gels and SDS-PAGE, Agarose
- 4.6 Centrifugation and filtration – Basic Principles
- 4.7 Dialysis and lyophilization
- 4.8 Radio isotopes and their uses in biology

Practical Paper - II

90 hrs
(3 hrs/ week)

Practicals

1. Preparation of Normal, Molar and Molal solutions
2. Preparation of Buffers (Acidic, Neutral and Alkaline Buffers)
3. Qualitative tests of sugars, amino acids and lipids
4. Estimations of protein by Biuret method
5. Estimation of total sugars by anthrone method
6. Separation of amino acids by paper chromatography
7. Electrophoretic separation of proteins (SDS-PAGE)
8. Technique of Micrometry (Stage and ocular)
9. Enzyme assay – Catalase or Invertase (or any other enzyme)
10. Preparation of routine microbiological media.
11. Isolation of common non-pathogenic bacteria
12. Staining and identification of bacteria – *E.coli*, *Pseudomonas*, *Bacillus* and *Staphylococcus*

Recommended Books

1. Biochemistry - By Dr. U. Satyanarayana, U. Chakrapani
2. Biochemistry - By J.L. Jain
3. Biochemistry - By Conn and Stumpf
4. Biochemistry - By Lehninger
5. Textbook of Medical Biochemistry - By S. Ramakrishnan, R. Rajan, and K.G. Prasannan (Orient Longman)
6. Biochemistry - By Stryer
7. Biochemistry - By Voet and Voet
8. Biochemistry (Jaypee) - By Vasudevan
9. Biochemistry - By David Rawn
10. General Biochemistry - By J.H. Well
11. Biochemistry - By K. Trehan
12. Biochemical Methods - By S. Sadasivam and A. Manickam
12. An introduction to Practical Biochemistry - By T. Plummer
13. Experimental Biochemistry - A Student Companion - By V. Deshpande and B. Sasidhar Rao
14. Practical Biochemistry – By Upadhayay, Wilson and Wilson, Wilson & Walker
15. Biochemistry – Viva Series
16. Text Book of Microbiology - By Ananthanarayan and Paniker
17. Microbiology - By Cappuccino (Pearson Education)
18. Microbiology - By Tortora (Pearson Education)
19. Microbiology - B.J. Pelczar, E.S.N. Cfan and N.R. Kreig, McGraw Hill Publ.
20. General Microbiology – By Stanier, R.Y, J.L. Ingrahm, M.L. Wheel is & P.R. Painter
21. General Microbiology – By Powar (Vol. I and Vol. II).
22. Practical Microbiology - By Aneja.

Andhra University
III B.Sc Biotechnology for the Academic Years 2010-11

90 hrs
(3 hrs/ week)

III Year B.Sc

Paper III – Molecular Biology, Genetic Engineering and Immunology

Unit I	Gene and Genome organization	24 Hours
1.1	Organization of nuclear genome – Genes and gene numbers – essential and non essential genes	
1.2	Denaturation and renaturation of DNA - T _m values and Cot curves	
1.3	Kinetic classes of DNA - Single copy sequences, and repeated sequences. Inverted, tandem and palindromic repeats	
1.4	Satellite DNA	
1.5	Mitochondrial genome organization (eg: Human)	
1.6	Chloroplast genome organization in plants	
1.7	Organization of eukaryotic genes - Exons, introns, promoters and terminators	
1.8	Gene families and clusters – eg. Globin gene, histones and ribosomal genes.	
Unit-II	Gene expression and Gene Regulation	22 Hours
2.1.	Prokaryotic and Eukaryotic transcription Post-transcriptional modifications (Capping, polyadenylation, splicing and alternate splicing)	
2.2	Translation Genetic code and its features, Wobble Hypothesis Synthesis of polypeptides - initiation, elongation and termination in prokaryotes and eukaryotes	
2.3	Regulation of gene expression in prokaryotes and eukaryotes Operon concept in bacteria – Lac operon	
Unit III	Recombinant DNA Technology	22 Hours
3.1.	Enzymes used in gene cloning : Restriction endonucleases, Ligases, Phosphatases, Methylases, Kinases	
3.2.	Cloning vehicles – Plasmids, Cosmids, Phage vectors, Shuttle vectors,	
3.3.	Baculovirus vector system, Expression vectors - expression cassettes	
3.4.	Construction of genomic and cDNA libraries	
3.5.	Identification of cloned genes	
3.6.	Principles involved in Blotting Techniques – Southern, Northern and Western	
3.7.	Principles and Applications of PCR Technology	
3.8.	DNA Finger printing technique and its applications	
Unit IV	Basics of Immunology	22 Hours
2.1	Introduction to immune system – Organs and cells of the immune system	
2.2	Antigens, Haptens – physico-chemical characteristics	

- 2.3 Structure of different immunoglobulins and their functions – Primary and secondary antibody responses
- 2.4 Antigen - Antibody Reactions
- 2.5 The Major Histocompatibility gene complex and its role in organ transplantation, Generation of antibody diversity
- 2.6 Hypersensitivity – Coombs classification, Types of hypersensitivity
- 2.7 Autoimmune diseases – mechanisms of auto immunity

Practical paper - III

Practicals

90 hrs
(3 hrs/ week)

1. Isolation of DNA from plant/animal/bacterial cells
2. Analysis of DNA by agarose gel electrophoresis
3. Restriction digestion of DNA
4. Immuno-diffusion test
5. ELISA Test
6. Microagglutination using microtiter plates (eg. ABO and Rh blood grouping)
7. Viability tests of cells/bacteria (Evans blue test or Trypan blue test)
8. Coomb's test
9. Preparation of competent cells of Bacteria
10. Bacterial transformation and selection of transformants under pressure (antibiotic).

Recommended Books

1. Concepts in Biotechnology - By D. Balasubramanian, C.F.A. Bryce, K. Dharmalingam, J. Green and Kunthala Jayaraman
2. Essential Immunology - By I. Roitt, Publ: Blackwell
3. Molecular Biology of the Gene - By Watson, Hopkins, Goberts, Steitz and Weiner
(Pearson Education)
4. Cell and Molecular Biology - By Robertis & Robertis, Publ: Waverly
5. Text Book of Biotechnology - By H.K. Das (Wiley Publications)
6. Gene Structure & Expression - By J.D. Howkins, Publ: Cambridge
7. Genetic Engineering - By R. Williamson, Publ: Academic Press
8. Test Book of Molecular Biology - By K.S. Sastry, G. Padmanabhan & C. Subramanyan, Publ: Macmillan India
9. Microbial Genetics - By S.R. Maloy, J.E. Cronan & D. Freifelder, Publ: Jones & Barlett
10. Principles of Gene Manipulation - By R.W. Old & S.B. Primrose, Publ: Blackwell
11. Genes - By B. Lewin - Oxford Univ. Press
12. Molecular Biology & Biotechnol. - By H.D. Kumar, Publ: Vikas
13. Immunology - By G. Reeve & I. Todd, Publ: Blackwell
14. From Genes to Clones - By E.L. Winnacker, Publ: Panima, New Delhi
15. Methods for General & Molecular Bacteriology - By P. Gerhardt et al., Publ: ASM
16. Molecular Biotechnology - By G.R. Glick and J.J. Pasternak, Publ: Panima

17. Recombinant DNA - By J.D. Watson et al., Publ: Scikentific American Books
18. Immuno diagnostics - By S.C. Rastogi, Publ: New Age
19. Molecular Biology - By D. Freifelder, Publ: Narosa
20. Genes and Genomes - By Maxine Singer and Paul Berg
21. Cell and Molecular Biology - By S.C. Rastogi
22. Genetic Engineering and Biotechnology - By V. Kumar Gera
23. Essentials of Biotechnology - By P.K. Gupta
24. Introduction to Applied Biology and Biotechnology - By K. Vaidyanath, K. Pratap Reddy and K. Satya Prasad
25. Laboratory Experiments in Microbiology - By M. Gopal Reddy, M.N. Reddy, D.V.R. Sai
Gopal and K.V. Mallaiah
26. Immunology - By Kubey
27. Gene Biotechnology - By Jogdand
28. Genome - T.A. Brown
29. Gene Cloning - T.A. Brown
30. Biotechnology, IPRs and Biodiversity - By M.B. Rao and Manjula Guru (Pearson Education)
31. Introduction to Biotechnology - By W.J. Thieman and M.A. Palladino
(Pearson Education)
30. Genetic Engineering - By Boylan (Pearson Education)
31. Basic Concepts of Biotechnology - By Irfan Ali Khan and Atiya Khanum (Ukaaz Publications)
32. Advances in Biotechnology - By Irfan Ali Khan and Atiya Khanum (Ukaaz Publications)
34. Genetic Engineering - By Sandhya Mitra.

III Year B.Sc

Paper IV – Applications of Biotechnology

Unit I	Animal Biotechnology	24 Hours
1.1	Introduction to animal biotechnology	
1.2	Principles of animal cell culture – culture vessels	
1.3	Cell culture media preparation, sterilization, types of cultures	
1.4	Establishment and preservation of cell lines	
1.5	Explants and cell disaggregation	
1.6	Culture of cells and tissues (including Stem cells and their application)	
1.7	<i>In vitro</i> fertilization and embryo transfer technology	
1.8	Methods of gene transfer – Microinjection and viral mediated gene transfer techniques Production of transgenic animals and molecular pharming	
1.9	Principles of <i>Ex vivo</i> and <i>In vivo</i> gene therapy	
Unit II	Plant Biotechnology	20 Hours
2.1.	Composition of media (Murashige and Skoog's and Gamborg's only) Preparation of media and methods of sterilizations	
2.2.	Role of plant growth regulators in differentiation	
2.3.	Induction of callus	
2.4.	Meristem culture and production of virus free plants Clonal propagation of plants on a commercial scale (Somatic embryogenesis and organogenesis)	
2.5.	Mass cultivation of cell cultures and process engineering – batch and continuous cultures, Bioreactors	
2.6.	Production of commercially useful compounds by plant cell culture	
2.7.	Methods of gene transfer techniques (<i>Agrobacterium</i> , Microprojectile bombardment)	
2.8.	Applications of recombinant DNA technology in agriculture	
2.9.	Production of therapeutic proteins from transgenic plants	
Unit III	Industrial Biotechnology	23 Hours
3.1	Introduction to industrial biotechnology.	
3.2	Primary and secondary metabolic products of microorganisms	
3.3	Screening and isolation and preservation of industrial microorganisms	
3.4	Principles of Fermentation technology	
3.5	Commercial production of fuels and chemicals by microbial fermentations	
3.6	Fermentative production of microbial enzymes (amylases, proteases), and antibiotics	
3.7	Fermentative production of foods and dairy products.	

- 3.8 Animal cells as bioreactors; characteristics of bioreactors, expression and over production of targeted proteins – human growth hormones – production of α and β - interferons, monoclonal antibodies
- 3.9 Good manufacturing practices, Biosafety issues, Bioethics
- 3.10 Intellectual Property Rights and Patenting issues

Unit IV

Environmental Biotechnology

23 Hours

- 4.1 Introduction to environmental biotechnology
- 4.2 Renewable and non-renewable energy resources
- 4.3 Conventional energy sources and their impact on environment.
- 4.4 Non-conventional fuels and their impact on environment (biogas, bioethanol, microbial hydrogen production)
- 4.5 Microbiological analysis of milk, food and water
- 4.6 Microbiological treatment of municipal and industrial effluents
- 4.7 Microbial degradation of pesticides and toxic chemicals
- 4.8 Biopesticides and Biofertilizers (Nitrogen fixing, phosphate solubilizing microorganisms)
- 4.9 Microbial ore leaching
- 4.10 Introduction to Bioremediation

Practical Paper - IV

90 hrs
(3 hrs/ week)

Practicals

1. Preparation of media, and initiation of callus from any one selected plant species
2. Micropropagation of plants (any one)
3. Preparation of synthetic seeds
4. Production of wine using common yeast
5. Production of hydrogen or biogas using cow/cattle dung
6. Isolation of microbes from soil or industrial effluents
7. Preparation of media and culture of animal cells/tissues
8. Cell disaggregation and cell counting
9. Cytotoxicity of the cells using the dye MTT method
10. Estimation of BOD in water samples
11. Production of alcohol by fermentation and estimation of alcohol by colorimetry
12. Production of biofertilizers (*Azolla*)
13. Growth curves of bacteria, Measurement of growth in liquid cultures
14. Quality testing of milk by MBRT

Recommended Books

1. Strategies in Transgenic Animal Sciences - By Glenn M.M. and James M. Robl
ASM
Press 2000.
2. Practical Biotechnology – Methods and Protocols - By S. Janarthanan and S. Vincent
(Universities Press)
3. Animal Cells as Bioreactors - By Terence Gatoright, Cambridge Univ Press
4. Molecular Biotechnology - By Chinnarayappa (Universities Press)
5. Principles and Practice of Animal Tissue Culture - By Sudha Gangal
(Universities Press)
6. Introduction to Veterinary Genetics - By F.W. Nicholas, Oxford University Press.
7. Text Book of Biotechnology - By H.K. Das (Wiley Publications)
8. Biotechnology - By H.J. Rehm and G. Reed Vol-1-86 VIH Publications,
Germany
9. Guide for the care and use of lab animals National Academy Press.
10. Biogas Technology - By b.T. Nijaguna
11. Biotechnology – I - By R.S. Setty and G.R. Veena
12. Biotechnology – II - By R.S. Setty and V. Sreekrishna
13. Introduction to Plant Tissue Culture - By M.K. Razdan (Oxford and IBH
Publishing Company, New Delhi)
14. Introduction to Plant Biotechnology - By H.S. Chawla (Oxford and IBH
Publishing

Comp., New Delhi)

15. Biotechnology - By K. Trehan
16. Industrial Microbiology - By L.E. Casida
17. Food Microbiology - By M.R. Adams and M.O. Moss
18. Introduction to Biotechnology - By P.K. Gupta
19. Frontiers of Plant Tissue Culture - By T.A. Thorpe
20. Plant Tissue Culture – Theory and Practice - By S.S. Bhojwani and M.K. Razdan
21. Biotechnology – By U. Satyanarayana
22. Plant Biotechnology New Products and Applications - By J. Hammond, P. McGarvey, and V. Yusibov
23. Plant Tissue Culture – Basic and Applied - By Timir Baran Jha and B. Ghosh
24. Essentials of Biotechnology for Students - By Satya N. Das
21. Plant Tissue Culture - By Kalyan Kumar De
22. Bioethics – Readings and Cases - By B.A. Brody and H. T. Engelhardt.
Jr.
- (Pearson Education)
23. Biotechnology, IPRs and Biodiversity - By M.B. Rao and Manjula
Guru (Pearson Education)
24. Bioprocess Engineering - By Shuler (Pearson
Education)
25. Essentials of Biotechnology - By Irfan Ali Khan and Atiya
Khanum (Ukaaz Publications)
26. Gene, Genomics and Genetic Engineering - By Irfan Ali Khan and Atiya
Khanum (Ukaaz Publications).

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AU/BT-8/syl/08

Prof. T.Ramana
Head of the Department &
Chairman, Adhoc BOS in Biotechnology

Dt:16-7-2008

To

The Registrar
Andhra University
Waltair.

Sir,

Sub:- Implementation of the model curriculum of Biotechnology (UG Courses)
from the academic year 2008-09– Reg.

Ref:- Your letter No; LI(2)/BOS Meet/2008, Dt:26-6-2008.

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With reference to the above, I wish to state that the model curriculum of Biotechnology (UG courses) suggested by the AP State Council of Higher Education, Hyderabad may be implemented in toto from the academic year 2008-2009 in all the affiliated colleges of Andhra University.

I am sending you herewith the model curriculum of Biotechnology (UG courses) (in the form of hard & soft copies) to be followed after necessary minor corrections from the academic year 2008-2009 and I request you to take necessary further action on this matter.

Thanking you,

Yours faithfully,

Encl: As above.

(PROF. T.RAMANA)
Head of the Department &
Chairman, Adhoc BOS in Biotechnology