Scheme of Courses/Examination 3rd YEAR B. Tech. (Bio-Technology)

Bachelor of Technology (Bio-Technology)

Scheme of Courses/Examination
(5th Semester)

Sr. No.	Course No.	Subject	Teaching Schedule L	T	P/D	TOTAL	Examination Schedule Th.	Sess.	P/VV	TOTAL	Duration of Exam.
1	BTT-301 E	Recombinant DNA Technology	3	1	-	4	100	50	-	150	3
2	BTT-303 E	Bioreactor Analysis and Design	3	1	-	4	100	50	-	150	3
3	BTT-305 E	Bioprocess Engineering	3	1	-	4	100	50	-	150	3
4	BTT-307 E	Downstream Processing	3	1	-	4	100	50	-	150	3
5	BTT-309 E	Diagnostic Techniques	3	1	-	4	100	50	-	150	3
6	BTT-311 E	Biostatistics & Computer Applications	3	1	-	4	100	50	-	150	3
7	BTT-313 E	r-DNA Tech. Lab	-	-	4	4	-	50	50	100	4
8	BTT-315 E	Fermentation & Downstream Processing Lab	-	-	4	4	-	50	50	100	4
9	BTT-317 E	Diagnostic techniques & Biostatistical analysis Lab	-	-	3	3	-	50	50	100	4
10	BTT-319 E	Training Evaluation (viva-voce)	-	-	-	-	-	50	-	50	4
		TOTAL	18	7	11	35	600	500	150	1250	

Bachelor of Technology (Bio-Technology.)

Scheme of Courses/Examination
(6th Semester)

Sr. No.	Course No.	Subject	Teaching Schedule L	T	P/D	TOTAL	Examination Schedule Th.	Sess.	P/VV	TOTAL	Duration of Exam.
1	BTT-302 E	Microbial Biotechnology	3	1	-	4	100	50	-	150	3
2	BTT-304 E	Plant Biotechnology	3	1	-	4	100	50	-	150	3
3	BTT-306 E	Animal & Aquaculture Biotechnology	3	1	-	4	100	50	-	150	3
4	BTT-308 E	Healthcare Biotechnology	3	1	-	4	100	50	-	150	3
5	BTT-310 E	Environmental Biotechnology	3	1	-	4	100	50	-	150	3
6	BTT-312 E	Food Biotechnology	3	1	-	4	100	50	-	150	3
7	BTT-314 E	Cell & Tissue Culture Lab	-	-	4	4	-	50	50	100	4
8	BTT-316 E	Healthcare Biotechnology Lab	-	-	4	4	-	50	50	100	4
9	BTT-318 E	Microbial, Food & Environmental Biotechnology Lab	-	-	3	3	-	50	50	100	4
10	BTT-320 E	Seminar	-	-	-	-	-	50	-	50	

5th Semester B. Tech. (Bio - Technology)
Recombinant DNA Technology
BTT-301 E

L	T	
3	1	**Theory : 100 Marks**
		Sessional : 50 Marks
		Total : 150 Marks
		Time : 3Hrs.

Note for paper setter : Question paper will consist of four units. Eight questions will be set in the question paper by selecting two from each unit. The students will be required to attempt five questions, selecting at least one from each unit.

UNIT I

Tools of Recombinant DNA: Restriction endonucleases. Plasmid cloning vectors. Creating and screening a gene library. Genetic transformation of prokaryotes. Cloning DNA sequences encoding eukaryotic proteins. Vectors for cloning large pieces of DNA.

Chemical synthesis, sequencing and amplification of DNA: Chemical synthesis of DNA. DNA sequencing techniques. PCR. Analysis of eukaryotic DNA by chromosomal walking. Southern and Northern Blotting. *In situ* hybridization.

UNIT II

Isolation of cloned genes: Basic strategies for cloning. Developing improved bacteria and vectors. Probes to locate clones and related genes. Identification and isolation of tissue specific cDNA. Procedures to analyze proteins encoded by cDNA clones.

DNA markers: RFLP. RAPD and DNA fingerprinting.

UNIT III

Study of gene functions: Directed mutagenesis. Identification of mutant clones. Use of PCR to construct genes encoding chimeric proteins.
Mutagenesis-gateway to gene function and protein engineering.

UNIT IV

Application of recombinant DNA in biotechnology:
In medicine and Industry: Production of small biomolecules: vitamin-C, amino acids and indigo. Production of insulin, human growth hormone and its variants. Hepatitis-B virus vaccine. Tailoring antibodies for specific applications. Biopolymers production.
Marshalling recombinant DNA to fight AIDS.

Text/ References Books:

1. Recombinant DNA 2nd Edition. Watson, James D. and Gilman, M. (2001) W.H Freeman and Company, New York.
2. Molecular Biotechnology: *Principles Application of Recombinant DNA* 2nd Edition. Glick, B. R. and Pasternak, J. J. (1998) ASM press Washington DC.
3. Genetic Engineering. Ahluwalia, K. B. (2002) New Age International (P) Ltd.
4. An Introduction to Genetic Engineering 2nd edition Desmond Nicholl S.T. (2002) Cambridge University Press.
5. Genetic Engineering: *An introduction to Gene analysis and exploitation in eukaryotes*. Kingsman and Kingsman (1998) Blackwell Scientific Publication, Oxford.

5th Semester B. Tech. (Bio - Technology)
Bioreactor Analysis and Design
BTT-303 E

L	T	
3	1	**Theory : 100 Marks**
		Sessional : 50 Marks
		Total : 150 Marks
		Time : 3Hrs.

Note for paper setter : Question paper will consist of four units. Eight questions will be set in the question paper by selecting two from each unit. The students will be required to attempt five questions, selecting at least one from each unit.

UNIT – I

Types of reactor: Batch, plug flow reactor (PFR), continuous stirred tank reactor (CSTR), Fluidized bed reactor, bubble column, air lift fermenter, mechanical design of bioreactors.

Concept of ideal and non ideal reactors, residence time distribution, models of non ideal reactors – plug flow with axial dispersion, tanks-in-series model, chemostat model with cell growth kinetics.

UNIT - II

Plug flow reactor: For microbial processes, optimization of reactor systems.

Multiphase bioreactors: Packed bed with immobilized enzymes or microbial cells, three phase fluidized bed trickling bed reactor, design and analysis of above reactor systems.

UNIT – III

Unconventional bioreactors: Gas liquid reactors, hollow fiber reactor, membrane reactor and perfusion reactor for animal and plant cell culture

UNIT – IV

High Performance Bio Reactors: Sterile and non sterile operations - Reactors in series with and without recycle. Design of Reactors.

Reactors for Solid state fermentation.

Text/Reference Books:

1. Landfill Bioreactor Design & Operation. Reinhart Debra R, Townsend Timothy G. and Townsend Tim(1997) Lewis Publishers, Inc.
2. Multiphase Bioreactor Design. Edited by: Joaquim M.S. Cabral, Manuel Mota, Johannes Tramper (2001) CRC Press.
3. Bioreactor & Ex Situ Biological Treatment Technologies – 5. Allerman Bruce, Allerman Bruce C, Leeson Andrea, (1999). Battelle publisher.
4. Bioreaction Engineering: Modeling & Control. vol. I&II. Schugerl K, and Bellgardt K.H, (2000), Springer Verlag pub.

5th Semester B. Tech. (Bio - Technology)
Bioprocess Engineering
BTT-305 E

L	T	
3	1	**Theory : 100 Marks**
		Sessional : 50 Marks
		Total : 150 Marks
		Time : 3Hrs.

Note for paper setter : Question paper will consist of four units. Eight questions will be set in the question paper by selecting two from each unit. The students will be required to attempt five questions, selecting at least one from each unit.

UNIT– I

Introduction: History and role of bioprocess engineering in biotechnology industries, Concept of unit operation unit processes.
Introduction to Engineering calculation: Variables, their dimensions and units, dimensionally homogeneous and non- homogeneous equations, standard conditions and ideal gases, physical and chemical property data, basics of materials and energy balances in a macroscopic view point.

UNIT – II

Fluid Mechanics: Principle of microbial nutrition, formulation of culture media, selective media, factors influencing the choice of various carbon and nitrogen sources, vitamins, minerals, precursors and antifoam agents, importance of pH, fluid vs. solids, fluid static's mass and energy balance in fluid flow, Bernoulli's equation, flow past immersed bodies and drag coefficient.
Sterilization of process fluids, recovering and purifying products, integration of reaction and separation.

UNIT – III

Heat Transfer: Principles and design of processes involving biochemical reactions, including aerobic and anaerobic respiration and fermentation (involving pure and mixed cultures). Shake flask, batch and continuous operations. Solid state fermentations. Primary and secondary metabolites Energy balances and biochemical kinetics.

UNIT – IV

Diffusion and Mass Transfer: Biological production consideration, large scale production, Enzyme kinetics, cell growth, energetics and mass transfer. Production of Penicillin, Streptomycin, Tetracycline and other Antibiotics.

Text/ Reference Books:

1. Bioprocess Engineering, Second Edition, Shuler ML; Kargi F (2002), Prentice Hall PTR, New Jersey.
2. Bioprocessing. Ward, O.P. (1991), New York,
3. Bioseparations- Downstream processing for biotechnology. Reinhold Van Nostrand, Belter P.A, Cussler E.L, Hu W.S. (1988), John Wiley and Sons. New York.
4. Process Engineering in Biotechnology. Jackson , A.T.
5. Bioprocess Engineering: Systems, equipments and facilities. Eds. Lydersen K.B., D'elia, N.A. and Nelson K.L. (1994), John Wiley & Sons, New York.
6. Chemical Engineering, Vol.1-6, Coulson J.M, and Richardson J.F (1999), Pergamon Press.

5th Semester B. Tech. (Bio - Technology)
Downstream Processing
BTT-307 E

L	T	
3	1	**Theory : 100 Marks**
		Sessional : 50 Marks
		Total : 150 Marks
		Time : 3Hrs.

Note for paper setter : Question paper will consist of four units. Eight questions will be set in the question paper by selecting two from each unit. The students will be required to attempt five questions, selecting at least one from each unit.

UNIT –I

Introduction: History and scope of downstream processing in biotechnology, problems, requirement of purification. Overview of a bioprocess including upstream and downstream processing. Characteristics of biotechnology products, classes of bioproducts, physicochemical basis of bioseparation

UNIT – II

Cell disintegration: Separation of particulate by filtration, centrifugation, settling, sedimentation, decanting and micro filtration. Primary isolation methods including solvent extraction, sorption, precipitation, ultra filtration and reverse osmosis. Application of above methods in purification of antibiotics and enzymes.

Purification methods: Fractional precipitation, electrophoresis, electro dialysis and various kinds of chromatography.

UNIT – III

Emerging separation techniques: Dynamic immobilization, reverse osmosis, super critical fluid extraction evaporation, super liquid extraction and foam based separation.

Separation of intracellular, extracellular, heat and photosensitive materials. Product recovery trains - a few examples.

UNIT – IV

Downstream processes and effluent treatment: applications of Unit Operations in Downstream with special reference to membrane separations & extractive fermentation, anaerobic and aerobic treatment of effluents. Typical examples for downstream processing and effluent disposal in process industries.

Text/Reference Books:

1. Biochemical Engineering fundamentals 2nd ed. Bailey J. E. and Ollis D. F. (1986) MacGraw Hill, New York.
2. Principles of fermentation technology, Stanbury, P. F. and Whitaker, A. (1984), Pergamon press.
3. Unit Operation of Chemical Engineering 6th ed. McCabe, W. L; Smith J. C and Harriott P. (2000). MacGraw Hill, New York
4. Separation Process Principles, Seader, J.D. & Henley, E.J. (1998) John Wiley & Sons, Oxford.
5. Bioseparation: Downstream Processing for Biotechnology. Belter, P. A.; Cussler E. L. and Hu W. S. (2003) John Wiley & Sons. OXFORD.
6. Bioseparations Science and Engineering, Harrison R.G.; Todd P.; Rudge S.R. and Petrides D.P. (2003). Oxford Press.
7. Wastewater Engineering 4th ed. Metcalf and Eddy (2002). MacGraw Hill, New York.

5th Semester B. Tech. (Bio - Technology)
Diagnostic Techniques
BTT-309 E

L	T	
3	1	**Theory : 100 Marks** **Sessional : 50 Marks** **Total : 150 Marks** **Time : 3Hrs.**

Note for paper setter : Question paper will consist of four units. Eight questions will be set in the question paper by selecting two from each unit. The students will be required to attempt five questions, selecting at least one from each unit.

UNIT – I

Introduction: Comparison of the methods to diagnose bacterial & parasitic infections.
Immunological Diagnostic Procedures:
Basic considerations: Antigen-antibody reactions. Signal amplification systems. Isolation and characterization of antibodies. Immuno assay systems. Assay development, evaluation and validation. Reagent formulation and their shelf life evaluation.

UNIT-II

Enzyme-Linked Immunosorbent Assay (ELISA) systems: Applications in clinical diagnosis and prognosis of various diseases. Membrane based Rapid Immuno assays.
Monoclonal Antibodies: Formation and selection of hybrid cells. Screening for specific antibodies producing hybrid cell lines.
Applications of Monoclonal Antibodies: Detection of polypeptide hormones, Tumor markers and cytokines. Diagnosis of infectious diseases and drug monitoring. Detection of miscellaneous targets e.g. Thyroxin, Vit. B_{12}, Ferritin degradation products, Tau protein etc.

UNIT-III

DNA Diagnostics- a)Nucleic acid hybridization assay systems: Basic considerations. Production of various types of hybridization probes. Diagnosis of *Plasmodium faliciparum, Mycobactrium tuberculosus, Trypanosoma cruzi* and Sickle cell by DNA hybridization. **b) Non - radioactive Hybridization procedures:** Use of chromogenic or chemiluminesent substrates and specific enzymes for detecting signal amplification. **DNA Fingerprinting and RAPD as Diagnostic tools.**

UNIT-IV

Molecular diagnosis of Genetic Diseases: Significance In prenatal diagnosis, diagnosis before onset of symptoms and identification of carriers of hereditary disorders.
PCR/OLA Procedures: Diagnosis of hereditary diseases caused by mutations not affecting restriction endonuclease sites.
Genotyping with fluorescence labeled PCR primers. **Detection of mutations at different sites within one gene.**

Text/Reference Books:

1. Essentials of Diagnostic Microbiology. Shimeld Lissa Anne and Rodgers Anne T. (1998) Delmes Learning.
2. Recombinant DNA. 2nd Edition. Watson James D and Gilman Michael, (2001). W.H Freeman and Company, New York.
3. Molecular Biotechnology: *Principles Application of Recombinant DNA*. 2nd Edition. Glick Bernard R. and Pasternak Jack J. (1998), ASM press Washington DC.
4. Methodology of immunochemical and immuno-logical research Kwapinski G and Bannatyne (1973) Willey inter science.
5. A handbook of practical and clinical immunology. Talwar G.P. and Gupta S.K (1992).

5th Semester B. Tech. (Bio - Technology)
BIOSTATISTICS & COMPUTER APPLICATIONS
BTT-311 E

L	T
3	1

Theory : 100 Marks
Sessional : 50 Marks
Total : 150 Marks
Time : 3Hrs.

Note for paper setter : Question paper will consist of four units. Eight questions will be set in the question paper by selecting two from each unit. The students will be required to attempt five questions, selecting at least one from each unit.

UNIT I

Introduction: Define statistics. Difference between statistics and mathematics.
Data in Biology: Samples and variables, frequency distributions, graphics.
Basic quantitative methods.

UNIT II

Estimation, hypothesis testing: Confidence limits for means, t-distribution, chi-square distribution. Confidence limits for variances, t-tests, comparisons of variances.
Comparisons of several means: Analysis of Variance, A priori tests, A posteriori tests.
Two and three-way analyses of variance.

UNIT III

Regression and correlation: Multiple Regression. Analysis of covariance. Nonlinear fitting. Correlation.
Nonparametric statistics: Goodness of Fit tests. Resampling methods.

UNIT IV

Probability distributions: Normal, Binomial and Poisson.
Applications of Statistical Methods in Biotechnology.
Role of Computer in solving biostatistical problems.

Text/Reference Books:

1. Introduction to Biostatistics. Glover T. and Mitchell K. (2002). MacGraw Hill, New York.
2. Fundamentals of Biostatistics. Rosner Bernard. (1999), Duxbury Press.

5th Semester, B. Tech. (Bio - Technology)
Recombinant DNA Technology Lab.
BTT- 313 E

L	T	P
-	-	4

Practical/V.V.: 50 Marks
Sessional: 50 Marks
Total : 100 Marks
Time : 4 Hrs

Note: A college should offer 70% of the below listed experiments. The remaining 30% experiments may be modified by college according to facilities available

Cloning and expression of proteins:

1. Target selection
2. Strategy for cloning
3. Primer design
4. Isolation of genomic DNA
5. Gene amplification by PCR
6. Ligation of desired gene sequence
7. Transformation
8. Verification of cloned DNA
9. Induction of expression
10. Verification of protein expression

References:

Molecular Cloning – A laboratory manual 3rd Edition Vol. 1-3. Sambrook J. and Russell D.W. (2001) Cold Spring Harbor laboratory Press, New York.

5th Semester, B. Tech. (Bio - Technology)
Fermentation and Downstream Processing Lab.
BTT- 315 E

L	T	P
-	-	4

Practical/V.V.: 50 Marks
Sessional: 50 Marks
Total : 100 Marks
Time : 4 Hrs

Note: A college should offer 70% of the below listed experiments. The remaining 30% experiments may be modified by college according to facilities available

1. **Study of factors affecting bioprocesses in submerged fermenters** (pH, O_2, Temperature, Foam, Ingredients)
2. **Purify a bacterial protein**
   a) Cell lysis by different methods.
   b) Cell debris separation by different methods.
   c) Column purification
      I Separation by Molecular weight.
      II By charge.
      III By metal affinity.
      IV By Receptor-Ligand affinity.
   d) Dialysis
   e) Ultrafiltration
   f) Crystallization
   g) Lyophilization
3. **Purification of O-PS**
   a) Cell lysis
   b) Harvesting of cells
   c) Purification of O-PS antigens

References:

1. Bioprocess Engineering: Systems, Equipment & facilities. Eds. Lydersen K.B.; D'elia N.A. and Nelson K.L. (1994) John Wiley & Sons, New York.
2. Bioprocess Technology-Kinetics and Reactors. Moser Anton (1988) *Springer-Verlag*, New York.
3. Bioseparations- Downstream processing for biotechnology. Belter, P.A.; Cussler, E.L. and Hu, W.S. (1988) John Wiley and Sons, New York.
4. Encyclopedia of Bioprocess Technology: Fermentation, biocatalysis and bioseparation Vol. 1-5. Eds. Flickinger M.C. and Drew S.W. (1999) John Wiley & Sons, New York.
5. Physical Biochemistry: Principles & applications. Sheehan David (2000) John Wiley & Sons Ltd. New York.
6. Physical Biochemistry 2nd Edition. Friefelder D. (1983) W.H. Freeman & Co., USA.
7. Biophysical Chemistry: Principles & techniques 2nd Edition. Upadhyay, A.; Upadhyay, K. and Nath, N. (2002) Himalaya Publication House, New Delhi.

5th Semester, B. Tech. (Bio - Technology)
Diagnostic Techniques & Biostatistical Analysis Lab.
BTT – 317 E

L	T	P
-	-	3

Practical/V.V.: 50 Marks
Sessional: 50 Marks
Total : 100 Marks
Time : 4 Hrs

Note: A college should offer 70% of the below listed experiments. The remaining 30% experiments may be modified by college according to facilities available

1. **Enzyme Immunoassay in Plates**
    a. Conjugation of antibody with enzyme.
    b. OD vs. Antigen conc. plot and its analysis.
2. **Point of Care –Membrane based assays**
    a. Dipstick based assays
    b. Immunofiltration
    c. Lateral flow assays
3. **Immunoblots**
4. **DNA primer probe selection**
    a. Design probes for diseases
    b. Use commercially available probes to amplify gene fragment in clinical samples.
    c. Detection of amplified product
        1. Gel electrophoresis
        2. Dot Blots
        3. Hybrid capture assays
5. **Genotyping HLA**
6. **DNA Fingerprinting**
7. **Biostatistical analysis of scientific data**

References:

1. Antibodies: A laboratory manual. Harlow, Ed and Lane, David (1988) Cold Spring Harbor laboratory Press.
2. Introduction to Biostatistics: Glover, T. and Mitchell, K. (2002) McGraw-Hill, New York.

6th Semester B. Tech. (Bio - Technology)
Microbial Biotechnology
BTT-302 E

L	T	
3	1	**Theory : 100 Marks**
		Sessional : 50 Marks
		Total : 150 Marks
		Time : 3Hrs.

Note for paper setter : Question paper will consist of four units. Eight questions will be set in the question paper by selecting two from each unit. The students will be required to attempt five questions, selecting at least one from each unit.

UNIT I

Biocatalysis and Enzyme Biotechnology: Biomimetic catalysis, industrial biocatalysis, extremozymes, modular enzymes, cofactor dependent enzymes and cofactor regeneration

Isolation and Purification of Enzymes: Extraction of enzymes, preparation of crude enzymes, purification of enzymes, processing of enzymes.

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UNIT II

Protein and Enzyme Engineering: Basic principles, methods and their applications

Metabolic Engineering: Heterologous gene expression: complementing, transferring and engineering of metabolic pathways, redirecting metabolite flow.

UNIT III

Single Cell protein (SCP): Introduction, conventional protein sources, substrates, microorganisms used, SCP from CO_2 , carbohydrates, hydrocarbons.

Molecular Breeding of Biosynthetic pathways: Metabolic engineering for carotenoid, polyhydroxy-alkanoates and alkaloid biosynthesis.

Pathway analysis, metabolic control analysis, metabolomics.

UNIT IV

Microbes and Microbial Genomics for Industry: Microbial transformations: transformation of steroids, sorbitol, sorbose and antibiotics. Microbes in paper industry, biohydrometallurgy and biomineralization.

Microbial Genomics in industry: Analysis of microbial genomes and their use for designing vaccines and drugs.

Text/Reference Books:

1) Biotechnology and Genomics. Gupta, P.K. (2004) Rastogi Publications, Meerut, India.
2) Biotechnological Innovations in Chemical Synthesis. M.C.E Van Dam–mieras et al. (1997). Butterworth-Heinemann, Oxford.
3) Biotechnology. Smith, J. E. (1996) Cambridge University Press.
4) Methods for General and Molecular Bacteriology 2nd Edition. Gerhardt, P.; Murray, R.G.; Wood, W.A. & Kreig, N.R. (1994) Blackwell Publishing.

6th Semester B. Tech. (Bio - Technology)
Plant Biotechnology
BTT-304 E

L	T	
3	1	**Theory : 100 Marks**
		Sessional : 50 Marks
		Total : 150 Marks
		Time : 3Hrs.

Note for paper setter : Question paper will consist of four units. Eight questions will be set in the question paper by selecting two from each unit. The Students will be required to attempt five questions, selecting at least one from each unit.

UNIT I

Introduction: Cryo and organogenic differentiation. Types of culture: seed, embryo, callus, organ, cell and protoplast culture.

Micropropagation: Axillary bud proliferation, meristem and shoot tip culture, bud culture, organogenesis, embryogenesis, advantages and disadvantages of micropropagation.

In Vitro haploid production: Androgenic methods: anther culture, microspore culture, factors effecting and organogenesis. Significance and use of haploids, ploidy level and chromosome doubling, diplodization. Gynogenic haploids: factors effecting gynogenesis, chromosome elimination techniques for production of haploids in cereals.

UNIT II

Protoplast Isolation and fusion: Methods of protoplast isolation, protoplast development, somatic hybridization, identification and selection of hybrid cells, cybrids, potential of somatic hybridization, limitations.

Somaclonal variation: Nomenclature, methods, applications basis and disadvantages. Gametoclonal variation.

Plant Growth Promoting bacteria: Nitrogen fixation, nitrogenase, hydrogenase, nodulation, Growth promotion by free-living bacteria.

UNIT III

Plant Molecular Biology: Plant gene structure as a discontinuous gene, control sequences

Gene transfer in plants: Transient and stable gene expression, marker genes, selectable markers, chimeric gene vectors.

Gene transfer methods: Agrobacterium, viruses and transposable elements. Vectorless or direct DNA transfer: Physical, chemical and imbibation methods of gene transfer.

UNIT IV

Transgenics in crop improvement: Resistance to biotic stresses- insect, virus and disease (fungus and bacterium) resistance, herbicide resistance. Development of stress and senescence-tolerance – Oxidative stress, salt stress and fruit ripening. Transgenics for : improved quality, longer life, flower color and shapes, for male sterility, for terminator seed. Trangenic plants as bioreactors: production of carbohydrates, lipids, vitamins and minerals, biodegradable plastics, peptides, proteins and edible vaccines. Commercial transgenic crops.

Text/Reference Books:

1. Introduction to Plant Biotechnology 2nd edition. Chawla, H.S. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi
2. Molecular Biotechnology: Principles and Applications of recombinant DNA. Glick, B. R. and Pasternak J. J. (1998) ASM press, Washington DC.
3. Plant Tissue culture: Theory and Practice. Bhojwani, S.S. and. Razdan M.K (1996)

4. Improving Plant draught, salt and freezing tolerance by gene transfer of a single stress-inducible transcription factor. (1999) *Nature Biotechnology 17(3):* 287-291. Kasuga, M., Q. Liu, et al.
5. Heterologous expression of *Arabidopsis* phytochrome B in transgenic potato influences photosynthetic performance and tuber development.(1999) *Physiology***120,** (1):73-81. Thiele, A., Herold M., et al.
6. Building better trees with antisense. (1999) *Nature Biotechnology* **17** (8): 750-751. Sederoff R.
7. Exploiting the full potential of disease-resistance genes for agricultural use. Curr Opin Biotechnol. 2000 Apr;11(2):120-5. Review Rommens CM, Kishiore GM
8. Directed molecular evolution in plant improvement. Curr Opin Plant Biol. 2001 Apr;4(2):152-6. Review. Lassner M, Bedbrook J.

6th Semester B. Tech. (Bio -Technology)
Animal & Aquaculture Biotechnology
BTT-306 E

L	T	
3	1	**Theory : 100 Marks**
		Sessional : 50 Marks
		Total : 150 Marks
		Time : 3Hrs.

Note for paper setter : Question paper will consist of four units. Eight questions will be set in the question paper by selecting two from each unit. The students will be required to attempt five questions, selecting at least one from each unit.

UNIT I

Introduction: History and scope of animal biotechnology.
Basic techniques of animal cell culture & their applications. Balanced salt solutions and simple growth media. Serum quality and cell culture.
Preservation and maintenance of animal cell lines: Cryopreservation and transport of animal germplasm (i.e. semen, ovum and embryos).

UNIT II

Transgenic animals Methodology: Retroviral vector method, DNA microinjection method and engineered embryonic stem cell method. Cloning by nuclear transfer. Yeast artificial chromosome transgenesis.

In Vitro fertilization and embryo transfer.

UNIT III

Molecular biological techniques for rapid diagnosis of genetic diseases and gene therapy. Molecular maps of animal genomes. Chemical carcinogenesis. Transfection. Oncogenes and antioncogenes.

Gene cloning techniques for mammalian cells, establishment of immortal cell lines, cloning in mammalian cells, expression of mammalian genes in prokaryotic and eukaryotic systems. Extinction of gene function by antisense RNA and DNA.

UNIT IV

Aquaculture: Introduction. Water resources and types of culture systems (Fish & Prawn). General principles of nutrition. Engineering considerations. Food, bait and ornamental marine species. Transgenic fishes.

Text/Reference Books:

1. Principles of Gene Manipulations 6th edition. Primrose S.B.; Twyman, R. and Old B. (2002) Blackwell Publishing.
2. Molecular Biotechnology: Principles and Applications of recombinant DNA 2nd Edition. Glick, B. R. and Pasternak J. J. (1998) ASM press, Washington DC.
3. Animal Cell biotechnology : Spier, R.E. and Griffiths J.B. (1988) Academic press.
4. Living resources for Biotechnology, Animal cells. Doyle, A.; Hay, R. and Kirsop, B.E. (1990) Cambridge University Press, Cambridge.
5. Animal Biotechnology. Murray Moo-Young (1989) Pergamon Press, Oxford.
6. Introduction of Aquaculture Landau Matthew (1991) John Wiley & Sons, New York.

6th Semester B. Tech. (Bio - Technology)
Healthcare Biotechnology
BTT-308 E

L	T	
3	1	**Theory : 100 Marks**
		Sessional : 50 Marks
		Total : 150 Marks
		Time : 3Hrs.

Note for paper setter : Question paper will consist of four units. Eight questions will be set in the question paper by selecting two from each unit. The students will be required to attempt five questions, selecting at least one from each unit.

UNIT I

Simple proteins and therapeutic agents: Proteins as therapeutic agents, choice of expression systems and optimizing gene expression. Applications, delivery and targeting of therapeutic proteins. Engineering human interferons and human growth hormones. Regulatory aspects of therapeutic proteins.

Enzymes as therapeutic agents: Use of genetically engineered DNase I and alginate lyase for treatment of Cystic Fibrosis

UNIT II

Monoclonal Antibodies as Therapeutic agents: Production of Monoclonal antibodies. Human Monoclonal antibodies – its scope and limitations. Hybrid human - mouse antibodies.

Production of antibodies in *E. coli.*

Approaches for producing HIV therapeutic agents.

UNIT III

Human Diseases and Vaccines: Viral & bacterial diseases. Diseases caused by protozoan and parasitic worms (helminths). Emerging infectious diseases. Active and passive immunity. Autoimmunity. Rational of immunization. Diseases controllable by vaccination.

Vaccines: Designing vaccines adjuvants. Whole organisms vaccines-attenuated viruses and bacteria. Inactivation of pathogenic organisms by heat and chemical treatment.

UNIT IV

Purified macromolecules as vaccines: Bacterial polysaccharides , proteins and toxins as vaccines.

Recombinant vaccines: Subunit, attenuated and vector vaccines.

Multivalent vaccines

Vaccine development against AIDS.

Commercial and regulatory aspects of vaccine production and its distribution.

Text/Reference Books:

1. Molecular Biotechnology: Principles Application of Recombinant DNA. 2nd Edition Glick, B. R. and Pasternak, J. J. (1998) ASM press, Washington DC.
2. Basic Biotechnology 2nd Ed. Ratledge, C. and Kristiansen, B. (2001) Cambridge University press.
3. New generation vaccines. Woodsaw, G.C. & Leine, H. M. Marcel Dekker Inc., New York.
4. Recombinant DNA vaccines: Rationale & Strategies. Richard, E.I. (1992) Marcel Dekker Inc., New York.

6th Semester B. Tech. (Bio - Technology)
Environmental Biotechnology
BTT-310 E

L	T	
3	1	**Theory : 100 Marks**
		Sessional : 50 Marks
		Total : 150 Marks
		Time : 3Hrs.

Note for paper setter : Question paper will consist of four units. Eight questions will be set in the question paper by selecting two from each unit. The students will be required to attempt five questions, selecting at least one from each unit.

UNIT I

Role of Biotechnology in Environment Protection: Introduction and current status of biotechnology in environment protection and its future prospects.

Microbiology and Biochemistry of Waste Water Treatment: Biological treatment, impact of pollutatnts on biotreatment, cell physiology and important microorganisms, plasmid borne metabolic activities, bioaugmentation, packaged microorganisms, use of genetically engineered organisms.

UNIT II

Bioreactors for Waste Water Treatment: Biological processes for industrial effluent treatment, aerobic biological treatment, anaerobic biological treatment, periodic biological reactors, membrane bioreactors, use of immobilized enzymes and microbial cells.

Removal of Specific Pollutants: Sources of heavy metal pollution, microbial systems for heavy metal accumulation, biosorption, bioleaching.

UNIT III

Bioremediation : What is bioremediation? Types of bioremediation, bioaugmentation for bioremediation. Bioreactors for remediation processes. Applications of bioremediation.

Biotechnology for Hazardous Waste Management : Xenobiotic compounds, recalcitrance, hazardous wastes, biodegradation of xenobiotics, biological detoxification, biotechnological management of hazardous wastes.

UNIT IV

Restoration of degraded lands : Restoration through microorganisms, Casuarinas for tropical reforestation on adverse sites, development of stress tolerant plants, use of mycorrhizae in reforestation. Organic farming and use of microbes for improving soil fertility, reforestation of lands contaminated with heavy metals.

Biotechnology for Waste Treatment of Food and Allied Industries: Biological treatment, methods, SCP and biomass from waste and distillery industry.

Novel Methods for Pollution Control : Vermitechnology, waste water treatment using aquatic plants, root zone treatment. Aiming for biodegradable and ecofriendly products.

Text/Reference Books:

1. Waste water Engineering Treatment, Disposal and Reuse. Metcalf & Eddy (1991) McGraw Hill.
2. Environmental Biotechnology. Forster, C. F and. Wase, D. A. J. (1987) Ellis Horwood Halsted Press.
3. New Processes of Waste water treatment and recovery. G. Mattock E.D. (1978) Ellis Horwood.
4. Biochemical Engineering Fundamentals 2nd ed. Bailey, J. E. and Ollis, D. F. (1986) MacGraw Hill. New York.
5. Environmental Biotechnology. Jogdand, S.N. (1995) Himalaya Publishing House, New Delhi.
6. Comprehensive Biotechnology (Vol. 1-4) Young Murray Moo (Ed.) (1985) Elsever Sciences.
7. Standard Method for Examination of water & waste water 14th Ed. (1985) American Public

6th Semester B. Tech. (Bio - Technology)
Food Biotechnology
BTT-312 E

L	T
3	1

Theory : 100 Marks
Sessional : 50 Marks
Total : 150 Marks
Time : 3Hrs.

Note for paper setter : Question paper will consist of four units. Eight questions will be set in the question paper by selecting two from each unit. The students will be required to attempt five questions, selecting at least one from each unit.

UNIT I

Introduction: Microorganisms in food – historical developments.

Food Fermentation Technology: Origin, scope and development of fermented products, primary feed stock, raw materials and conversions, fermented food and microbial starters, commercial potential, food fermentation industries, their magnitude, R&D innovations.

UNIT II

Development of Novel Food and food Ingredients: Single cell protein, polysaccharides, low calorie sweeteners, naturally produced flavor modifiers, amino acids, vitamins, food supplements, food coloring, neutraceuticals, water binding agents.

Bioreactors in Food Fermentations: Cultivation of microorganisms, instrumentation regulation and process control, laboratory scale submerged and solid state fermentation, pilot scale submerged and solid state fermentation.

UNIT III

Food Spoilage and Preservation: General principle of spoilage, microbial toxins (endotoxins and exotoxins), contamination and preservation, factors affecting spoilage. Methods of food preservation (thermal processing, cold preservation, chemical preservatives & food dehydration).

Radiation and Food Preservation: Role of radiation in food preservation, characteristics of radiation of interest in food preservation. Principles underlying the destruction of microorganisms by irradiation. Effect of irradiation on food constituents. Legal status of food irradiation.

UNIT IV

Biological controls and Monitoring of food quality.

Packaging of Food: Need for packaging, requirements for packaging, containers for packaging (glass, metal, plastics, molded pulp and aluminium foil), dispensing devices.

Text/Reference Books:

1. Modern Food Microbiology 6th Ed. Jay, J.M. (2000). Kluwer Academic/Plenum Pub.
2. Food Microbiology: Fundamentals and Frontier 2nd Eds. Ed. Beuchat, Doyle & Montville. (2001). Blackwell Synergy.
3. Food Microbiology. Frazier, W.C. and Westhoff, D.C. (1988) Tata Mc-Graw Hill, New Delhi.
4. Biotechnology. Gupta, P.K. (1998) Rastogi Publication, Meerut. India
5. Biotechnology: Food Fermentation Vol. I & II. Eds. Joshi, V.K. & Pandey, A. (1999) Educational Publishers and Distributers, Kerala.
6. Biotechnological Strategies in Agroprocessing Eds. Marwaha S.S & Arora, J.K. (2003)

6th Semester, B. Tech. (Bio - Technology)
Cell and Tissue Culture Lab
BTT- 314 E

L	T	P
-	-	4

Practical/V.V.: 50 Marks
Sessional: 50 Marks
Total : 100 Marks
Time : 4 Hrs

Note: A college should offer 70% of the below listed experiments. The remaining 30% experiments may be modified by college according to facilities available.

A) <u>Animal Cell Culture</u>

1) Primary cell culture from 12-14 days mouse embryos.
2) Culture of fibroblast and epithelial cells.
3) Visualization of proteins by immunofluorescence.
4) Induction of interferon in cell culture.
5) Culture of human lymphocytes
   - PHA stimulation-estimation by amount of DNA.
   - Karyotyping.

B) <u>Plant Tissue Culture</u>

1) Plant cell culture from different types of explants.
2) Isolation of DNA/RNA from cultured cells and compare with seeds.
3) Callus development for somatic embryogenesis.
4) *Agrobacterium* mediated transformation.

References:

1. Culture of Animal Cells – a manual of basic techniques 4th Edition. Freshney, R. I. (2000) John Wiley & Sons, New York.
2. Animal Cell Biotechnology. Spier, R. E. and Griffiths, J. B. (1988) Academic Press.
3. Living resources for biotechnology: Animal Cells. Doyle, A.; Hay, R. and Kirsop, B. E. (1990) Cambridge University Press.
4. Plant Tissue Culture: Theory & Practice. Bhojwani, S. S. and Rajdan, M. K. (1996). Elsevier Amsterdam.
5. Experiments in Plant Tissue Culture. Dodde, J. H. and Robert, L. W. (1998).

6th Semester, B. Tech. (Bio - Technology)
Healthcare Biotechnology Lab.
BTT- 316 E

L	T	P
-	-	4

Practical/V.V.: 50 Marks
Sessional: 50 Marks
Total : 100 Marks
Time : 4 Hrs

Note: A college should offer 70% of the below listed experiments. The remaining 30% experiments may be modified by college according to facilities available.

1. Normal microflora of mouth and determination of its susceptibility to dental caries.
2. Preliminary identification of enteric bacteria by TSI agar.
3. Estimation of ketone bodies in the urine of normal persons.
4. Fasting and post-prandial determination of blood glucose.
5. Lipid profile (Total cholesterol, TG, VLDL, LDL and HDL) of human blood samples.
6. Determination of Rh factor.
7. VDRL test for syphilis.
8. WIDAL test for Salmonella/Typhoid.
9. Pregnancy test.
10. Cultural sensitivity of pathogens against various antibiotics.

6th Semester, B. Tech. (Bio - Technology)
Microbial, Food and Environmental Biotechnology Lab.
BTT- 318 E

L	T	P
-	-	3

Practical/V.V.: 50 Marks
Sessional: 50 Marks
Total : 100 Marks
Time : 4 Hrs

Note: A college should offer 70% of the below listed experiments. The remaining 30% experiments may be modified by college according to facilities available.

A. Microbial Biotechnology:

1. Production of organic acids (Citric and lactic) by microorganisms.
2. Production of antibiotics by microorganisms.
3. Production of industrially important enzymes (protease, amylase, cellulose, xylase or lipase) by microorganisms.
4. Demonstration of bacterial lysis by bactriophages.

B. Food Biotechnology:

1. Microbiological analysis (bacterial count) of food products.
2. Isolation of bacteriocin producing microorganisms from fermented foods and determination of the antimicrobial spectrum of bacteriocin producing isolates.
3. Cultivation of white button mushroom (*Agaricus biosporus*).
4. Determination of food toxins.

C. Environmental Biotechnology:

1. Qualitative analysis of water/waste water:
   a. Bacterial analysis
   b. Determination of hardness, alkalinity, conductivity, chlorides, temperature and pH.
   c. Determination of soluble phosphates.
   d. Determination of BOD, COD and DO contents.
2. Biobleaching/ Decolourization of industrial effluents/industrially important dyes by microbes.
3. Microbial degradation of organic wastes eg: Lignocelluloses/ pesticides/ hydrocarbons.
4. Vermicomposting.