

**Deccan Education Society's
FERGUSON COLLEGE, PUNE
(AUTONOMOUS)**

**SYLLABUS UNDER AUTONOMY
THIRD YEAR B.Sc. BIOTECHNOLOGY**

SEMESTER - V

**SYLLABUS FOR T. Y. B.Sc.
Academic Year 2018-2019**

**Deccan Education Society's
FERGUSSON COLLEGE (AUTONOMOUS), PUNE 411004
Scheme of Course Structure (Faculty of Science)**

2018-2019

T. Y. B. Sc. - Biotechnology

Particulars	Theory (T) / Practical (P)	Code	Course Title	Exam (I / E)	Credits	Marks (50/50)
T. Y. B.Sc. Sem. V	T	BTH3501	Large Scale Manufacturing Processes - I	I and E	3	50 + 50
	T	BTH3502	Model systems in Biotechnology	I and E	3	50 + 50
	T	BTH3503	Genetics and Introduction to Genetic Engineering	I and E	3	50 + 50
	T	BTH3504	Plant Tissue Culture	I and E	3	50 + 50
	T	BTH3505	Applications in Biotechnology - I	I and E	3	50 + 50
	T	BTH3506	OR Biosafety regulations and Bioethics	I and E	3	50 + 50
	T	BTH3507	Introduction to Diagnostic Techniques OR	I and E	3	50 + 50
	T	BTH3508	Techniques in Biotechnology - I	I and E	3	50 + 50
	P	BTH3511	Biotechnology Practical - I	I and E	2	50 + 50
	P	BTH3512	Biotechnology Practical - II	I and E	2	50 + 50
	P	BTH3513	Biotechnology Practical - III	I and E	2	50 + 50
			Total		24	
T. Y. B.Sc. Sem. VI	T	BTH3601	Large Scale Manufacturing Practices - II	I and E	3	50 + 50
	T	BTH3602	Enzymology	I and E	3	50 + 50
	T	BTH3603	Techniques and applications in Genetic Engineering	I and E	3	50 + 50
	T	BTH3604	Animal Tissue Culture	I and E	3	50 + 50
	T	BTH3605	Applications in Biotechnology - II OR	I and E	3	50 + 50
	T	BTH3606	Introduction to Nanotechnology	I and E	3	50 + 50
	T	BTH3607	Introduction to Bioinformatics OR	I and E	3	50 + 50
	T	BTH3608	Techniques in Biotechnology - II	I and E	3	50 + 50
	P	BTH3611	Biotechnology Practical - IV	I and E	2	50 + 50
	P	BTH3612	Biotechnology Practical - V	I and E	2	50 + 50
	P	BTH3613	Biotechnology Practical - VI	I and E	2	50 + 50
				Total		24

T.Y. B.Sc. (BIOTECHNOLOGY) SEMESTER - V
BIOTECHNOLOGY PAPER - I
TITLE- LARGE SCALE MANUFACTURING PROCESSES - I
PAPER CODE - BTH3501

[CREDITS - 3]

Learning Objectives:

The students should acquire the knowledge about:

1. Basic bioreactor design and types of reactors.
2. Kinetics for operation of Bioreactors.
3. Screening and Strain improvement techniques.
4. Media components used in fermentation industry, optimization techniques.
5. Techniques for Air and Media sterilization.

Units	Topic	No. of Lectures
Unit - I	<p>Fermentation: Definition, Product types, Historical perspective Lay out of a typical fermentation unit. Definition and Concept of Bioprocess Engineering, Types of fermentations; Submerged, Surface, Solid State, Dual, Batch, Continuous, Fed Batch. Microbial growth kinetics for operation of bioreactors; Batch, Continuous and Fed Batch.</p>	10
Unit - II	<p>Screening: Definition and Objectives, Primary and Secondary Screening Strain Improvement: Objectives, Methods for strain improvement with examples (mutant selection, mutants with altered permeability, auxotrophic mutants, analogue resistant mutants) rDNA technology for strain improvement. Microbes of industrial importance, Culture collection centers of industrially important microorganisms. Inoculum build up for Industrial fermentations ; Bacteria and Fungi</p>	8
Unit - III	<p>Bioreactor Design: Characteristics of an ideal Fermenter, Construction material used, surface treatment of material, Design of a typical Batch Fermenter, Aerator and Agitator - types, Baffles, Seals and valves used, steam traps, additional accessories and peripherals. Different designs of bioreactors: Mechanically agitated and non-mechanically agitated, Bubble column, Bubble Cap, Air Lift (internal and external loop), Packed Bed reactor, Fluidized bed reactor, Pressure cycle Animal and Plant cell Bioreactors Immobilized enzymes: Methods of immobilization, Immobilized cell bioreactors and industrial applications</p>	10
Unit - IV	<p>Media components and optimization: Media used for large scale production Carbon sources: Cane and Beet molasses, Malt, Corn, Starch, oils, hydrocarbons, alcohols. Nitrogen sources: Corn steep liquor, Soybean meal, peanut meal, distillers soluble, pharmamedia, Buffers, Chelators, Water Precursors, Inhibitors, Inducers, Antifoams- types, mode of action, advantages and disadvantages. Inoculum and Production media, Media for animal cell</p>	10

	<p>culture.</p> <p>Medium Optimization: Classical Approach, Plackett and Burman design, Response Surface Methodology (RSM)</p>	
Unit - V	<p>Air and Media Sterilization: Concept of Aseptic Operations and Containment.</p> <p>Air sterilization: Principles, Mechanism of capture of particles in air, fixed (absolute) and non-fixed pore (depth) filters, Filter sterilization of air, Theory of depth filter, Validation of air filters.</p> <p>Media Sterilization: Principles, Thermal Death time, Decimal reduction time, Del factor, Indicator organism, loss of nutrient quality during sterilization, Equipments used in sterilization; Batch and Continuous, Use of Non sterilized media.</p>	7
<p>References:</p> <ol style="list-style-type: none"> 1. Stanbury, P. F. and Whittaker, A.; Principles of Fermentation technology; 3rd edition (1984). 2. Butterworth Heinemann, Peppler, H. L. Microbial Technology, Vol. I and II, 2nd Edition (1979), Academic Press. 3. Casida, L. E., Industrial Microbiology, (1986), John Wiley Easterbs. 4. Prescott. S. C. and Dunn, C. G.; Industrial Microbiology, Reed G.; 5th edition (1983), AVI tech books. 5. Patel, A. H., Industrial Microbiology, 1st edition, (2007), Macmillan India Ltd. 6. Patel, A. H., Industrial Microbiology, 2nd edition, (2016), Laxmi Publications, New Delhi. 7. Crueger, W. and Crueger, A.; A Text Book of Industrial Biotechnology, (2005) Panima, New Delhi. 8. Schuler, M. and Kargi, F. Bioprocess Engineering - Basic Concepts, 2nd edition, (2002), Prentice Hall. 9. Pauline Doran, Bioprocess Engineering Principles, 2nd Edition, (2012), Academic Press. 10. Butterworth, Heinemann, Operational Modes of Bioreactors, (1992), BIOTOL 11. Aiba, S., Humphrey A. L. and Miles, N.F. Biochemical Engineering, 2nd Edition (1973), Academic Press, New York. 		

T.Y. B.Sc. (BIOTECHNOLOGY) SEMESTER - V
BIOTECHNOLOGY PAPER - II
TITLE- MODEL SYSTEMS IN BIOTECHNOLOGY
PAPER CODE- BTH3502

[CREDITS - 3]

Learning Objectives:

The students should acquire the knowledge about:

1. Model systems in biology
2. Why to use model systems
3. Different types of model organisms
4. How to choose a model system
5. How different models offer different advantages that make them suitable for different types of research.

Units	Topic	No. of Lectures
Unit - I	Introduction to model organisms, concept, examples and ideal model system.	5
Unit - II	Invertebrate model system: <i>Hydra, C. elegans, Drosophila, Zebrafish</i>	20
Unit - III	Vertebrate Model systems: <i>Xenopus, Chick, Mouse</i>	15
Unit - IV	Plant Model system: <i>Arabidopsis</i>	5
	All the model systems explained on the basis of following parameters: Maintenance and culturing, Life cycle, salient features, mutants, parameters making it an ideal model organism,	
	Applications and recent advances	

References:

1. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., Walter, P.; Molecular Biology of the Cell, 5th Edition (2007), Garland Science, USA.
2. Wolpert, L., Tickle, C., Jessell, T., Lawrence, P., Meyerowitz, E., Robertson, E., Smith, J.; Principles of Development. 4th edition (2011), Oxford University Press, UK
3. Westerfield, M.; The zebrafish book; A guide for the laboratory use of zebrafish (*Danio rerio*) 4th edition (2000), University of Oregon Press, Eugene.
4. <http://www.zfic.org>
5. Hedges, S. B.; The origin and evolution of model organisms. Nat. Rev. Genet.3; 838-849 (2002).
6. Grimmelikhuijzen, C.J.P. and Schaller, H. C.; "Hydra as a model organism for the study of morphogenesis." Trends in Biochemical Sciences 4, 12; 265-267 (1979).
7. Galliot, B.; Hydra, a fruitful model system for 270 years; International Journal of Developmental Biology, 56, 411-423 (2012).
8. Beckingham, K. M., Armstrong, J. D., Texada, M. J., Munjaal, R. and Baker, D. A.; *Drosophila melanogaster* : The model organism of choice for the complex biology of multi- cellular organisms. Gravitational and Space Research, 18(2) (2007).

T.Y. B.Sc. (BIOTECHNOLOGY) SEMESTER - V
BIOTECHNOLOGY PAPER - III
TITLE - GENETICS AND INTRODUCTION TO GENETIC ENGINEERING
PAPER CODE- BTH3503

[CREDITS - 3]

Learning Objectives:

The students should acquire the knowledge about:

1. Basics of microbial genetics, DNA transfer mechanisms, and gene mapping.
2. Basics of plant genetics, sexual incompatibility in flowering plants, Cytoplasmic inheritance of androgenic haploid plants
3. Basics of recombinant DNA technology, understanding different tools used in RDT

Units	Topic	No. of Lectures
Unit - I	<p>Microbial Genetics: Bacterial plasmids: Types; F, R, Col, broad host range and other plasmids, structure, properties and significance Transposable elements: Characteristics, transposable elements in prokaryotes (insertion sequences, Transposons) and eukaryotes (yeast Ty elements, Ac/Ds elements in maize, Copia and P elements in Drosophila, Alu sequences in humans), mechanisms of transposition, excision of transposons DNA transfer mechanisms: Bacterial Conjugation - F factor, mechanism of conjugation, Hfr strain and its transfer, recombination in recipient cells, F prime, sexduction Bacterial transformation - Discovery, detection of transformation, concept of transforming principle, Competence, DNA Uptake, Molecular mechanism of Transformation in <i>Streptococcus</i> and <i>Haemophilus influenzae</i> Transduction - virulent and temperate phages, lytic and lysogenic life cycles, Molecular basis of decision between lytic and lysogenic cycles in lambda phage, Mechanism of generalised and specialised transduction, abortive transduction, co-transduction and linkage Gene mapping: Transformation, conjugation & transduction</p>	15
Unit - II	<p>Plant Genetics: Genetics of plant breeding-Genetic basis and mechanisms of pre-and post zygotic incompatibility; Genetics of androgenic plants; Cytoplasmic inheritance Genetics of somaclonal variations</p>	15
Unit - III	<p>Genetic Engineering - Introduction: What is genetic engineering? Laying the foundations</p>	2
Unit - IV	<p>Tools of Recombinant DNA Technology: Restriction enzymes; Types, properties and application of REs. Other DNA modifying enzymes; ligases, polymerases, alkaline phosphatase, reverse transcriptase, polynucleotide kinase, terminal transferase. PCR and RT-PCR</p>	7
Unit - V	<p>Host cells and vectors: Host cell types ; Prokaryotic / Eukaryotic Vectors; Significance of vectors in RDT and their designing. Types and properties of vectors; plasmid vectors, bacteriophages, artificial chromosomes. Methods of vector delivery into the hosts; Viral and non-viral.</p>	6

References:

1. Watson, J., Baker, T., Bell, S., Gann, A., Levine, M. and Lodwick, R.; Molecular Biology of the Gene, 6th Edition (2008), Pearson Education, Inc. and Dorling Kindersley Publishing, USA.
2. Glick, B. R., Pasternak, J. J. and Patten C. L.; Molecular Biotechnology, 4th edition (2010), ASM press, USA.
3. Primrose, S. and Twyman, R.; Principles of gene manipulation and genomics, 7th Edition (2006). Blackwell Publishing, USA.
4. Sambrook, J., Fritsch, E., and Maniatis T.; Molecular cloning; a laboratory manual, 2nd edition (1989), Cold Spring Harbor Laboratory Press, USA.
5. Freifelder D.; Microbial Genetics, 2nd edition (2009), Narosa book distributors Pvt. Ltd., New Delhi.
6. Stanier, R. Y., Adelberg, E. A. and Ingraham, J. L.; General Microbiology; 5th Edition (1987), Macmillan Press Ltd.
7. Snustad, Simmons, Principles of genetics, 6th Edition (2011), John Wiley & Sons, Inc.
8. Williams, E. G., Clark, A. E. and Bruce Knox R.; Genetic control of self incompatibility and reproductive development in flowering plants (1994), Kluwer Academic Publ., Netherlands.
9. Franklin, T. V.; Self incompatibility in flowering plants-evolution, diversity and mechanisms, (2008), Springer Berlin, Heidelberg.
10. Acquaah, G.; Principles of plant genetics and breeding, 2nd edition (2012), Wiley Blackwell, U.K.
11. Singh, B. D.; Plant breeding; principles and methods, 11th edition, (2009), Kalyani Publisher, India.
12. Hartl, D. L., Jones, E. W., Genetics- Analysis of genes and genomes, 8th Edition, (2011), Jones and Bartlett learning.

T.Y. B.Sc. (BIOTECHNOLOGY) SEMESTER – V
BIOTECHNOLOGY PAPER - IV
TITLE - PLANT TISSUE CULTURE
PAPER CODE- BTH3504

[CREDITS - 3]

Learning Objectives:

The students should acquire the knowledge about:

1. Significance of PTC in biotechnology.
2. Different techniques used in Plant tissue culture.
3. Applications of PTC in plant breeding, genetic engineering, production of secondary metabolites.

Units	Topic	No. of Lectures
Unit - I	Need for plant tissue culture: Concepts of Cell theory & Cellular totipotency, Landmarks in plant tissue culture.	3
Unit - II	PTC Laboratory: Organization of facility and equipment. Stock solutions & media preparation; Aseptic manipulation - washing, capping, packing & sterilization, laminar flow operation and safety precautions. Culture media- nutritional requirements of the explants, PGRs and their <i>in vitro</i> roles, media preparation	11
Unit - III	Micropropagation: 'Explant' for plant tissue culture. Response of explants <i>in vitro</i> : Dedifferentiation and redifferentiation. Micropropagation - Advantages over conventional methods. Stages of Micropropagation (stage 0 to stage 4); Callus formation. Organogenesis (direct and indirect). Embryogenesis (direct and indirect);	8
Unit - IV	Callus culture technique: Introduction, principle, factors affecting, Morphology & internal structure; applications and limitations	3
Unit - V	Suspension culture technique: Introduction, principle, types, synchronization; applications and limitations	3
Unit - VI	Organ culture technique: Introduction, principle, factors affecting root tip culture, leaf culture, shoot tip & meristem culture. Anther & pollen culture - Introduction, principle, factors affecting. Ovary, ovule, embryo and endosperm culture; applications and limitations.	8
Unit - VII	Protoplast: Isolation, culture and fusion, Somatic hybridization and cybridization, applications and limitations	4
Unit - VIII	Somaclonal variation: Introduction, terminology, origin, methods to understand and identify somaclonal variation	2
Unit - IX	Parameters to assess growth and development <i>in vitro</i> Applications of plant tissue culture: Case studies, model plants and their uses in PTC with specific examples	3

References:

1. Razdan, M. K.; Introduction to Plant Tissue culture; 2nd Edition (2009); Oxford & IBH Publishing Co.; New Delhi.
2. Bhojwani, S. S. and Razdan, M. K.; Plant Tissue Culture; Theory & Practice; (1996); Elsevier, New Delhi.

3. Jha, T. B. and Ghosh, B.; Plant tissue culture Basic and applied; (2007); University Press; Hyderabad.
4. Vasil, I. K. and Thorpe, T.A.; Plant cell and Tissue culture; (1994); Springer press.
5. Crichton, M.; Essentials of Biotechnology (2014); MedTec, Scientific International Pvt. Ltd., New Delhi.

T.Y. B.Sc. (BIOTECHNOLOGY) SEMESTER – V
BIOTECHNOLOGY PAPER - V
TITLE - APPLICATIONS OF BIOTECHNOLOGY-I
PAPER CODE- BTH3505

[CREDITS - 3]

Learning Objective:

The students should acquire the knowledge about:

1. The importance of biotechnology and its applications in medical, microbial and research fields.

Units	Topic	No. of Lectures
Unit - I	Introduction to Applications of biotechnology in different spheres of life sciences	2
Unit - II	Microbial Biotechnology: Microbial enhanced oil recovery (MEOR), microbial leaching, biosurfactants, biofertilizers, biopolymers, biopesticides, biosensors and biochips, bioluminescence, pre-and probiotics	15
Unit - III	Medical Biotechnology: Role of Biotechnology in healthcare- disease diagnosis, prevention and treatment; Development of diagnostics (including molecular diagnostics), vaccines- principle and practice; and therapy; Recombinant products for human health; personalized medicine and its application; monoclonal antibodies as therapeutics; mass-production of insulin, hormones, and other drugs	15
Unit - IV	Applications of biotechnology in research: Mass production of enzymes, lab chemicals and media components; lab kits- design, assembly and testing (QA, QC process); transformed cell lines; genetically modified animals; model organisms	13

References:

1. Sasson, A.; Medical biotechnology; Achievements, Prospects and Perceptions, (2005), United Nations University Press, NY, USA.
2. Glick, B., Delovitch, T. and Patten, C.; Medical Biotechnology (2014), ASM Press, NW, Washington DC, USA.
3. Pongracz, J. and Keen, M.; Medical Biotechnology E-Book, (2008), Elsevier Health Sciences, Amsterdam, Netherlands.
4. Glazer, A. and Nikaido, H.; Microbial biotechnology; fundamentals of applied microbiology, (2007), Cambridge University Press, Cambridge, England.
5. Farshad, H. and Chen, H.; Microbial Biotechnology; Progress and Trends (2014), CRC Press, NW, Boca Raton, FL.
6. Arora, R.; Microbial biotechnology; energy and environment, (2012), CABI, Wallingford, Oxfordshire, USA.

T.Y. B.Sc. (BIOTECHNOLOGY) SEMESTER – V
BIOTECHNOLOGY PAPER - VI
TITLE - BIOSAFETY AND BIOETHICS
PAPER CODE - BTH3506

[CREDITS - 3]

Learning Objectives:

The students should acquire the knowledge about:

1. Concepts of biosafety, bioethics and quality assurance in the context of modern biotechnology.
2. Commercial potential of research and business in Biotechnology.
3. Concepts of Intellectual Property Rights and its applications in biotechnology

Units	Topic	No. of Lectures
Unit - I	History and Introduction: Ethics and genetic engineering, Genetic Privacy Patent of genes, Human races, Trading Human Life, Human Cloning, Stem Cells, Eugenics, Institutional Bioethical Committee CPEAE, Stem Cells-ethical committee ,ethics during science practice, plagiarism, Laboratory ethics, Writing ethics, credit for individual during reference, Ethical consideration during Human Genome Project, Bioethical issues related to Healthcare & medicine Food & agriculture Genetic	10
Unit - II	Biosafety guidelines: Government of India; Definition of GMOs & LMOs; Roles of Institutional Biosafety Committee, RCGM, GEAC etc. for GMO applications in food and agriculture; Environmental release of GMOs; Risk Analysis; Risk Assessment; Risk management and	10
Unit - III	Good Lab Practices, Biosafety Introduction: Historical Background; Introduction to Biological Safety Cabinets; Primary Containment for Biohazards; Biosafety Levels; Biosafety Levels of Specific Microorganisms; Recommended Biosafety Levels for Infectious Agents and Infected Animals;	15
Unit - VI	Intellectual Properties: Copyrights, trademarks, trade secrets, patents, geographical indications, etc; Protection of plant variety and farmers right act; Indian patent act and amendments, patent filing; Convention on biological diversity; implications of intellectual property rights on the commercialization of biotechnology products.	10

References:

1. Beier, F.K., Crespi, R.S. and Straus, T.; Biotechnology and Patent protection, Oxford and IBH Publishing Co., New Delhi.
2. Sasson, A.; Biotechnologies and Development, UNESCO Publications.
3. Gimble, M. J.; Academia to Biotechnology, Elsevier Academic Press.
4. Joshi, R.; Biosafety and Bioethics (Ed.) (2006), Isha Books, Delhi.
5. Myneni, S.R.; Law of Intellectual property (2001) Butterworth's London.
6. Cornish, W.R.; Intellectual property: Patents trademarks and allied rights (2001), Universal Law Publishing, Delhi
7. patentoffice.nic.in
8. World Intellectual Property Organisation. <http://www.wipo.int>
9. Kuhse, H.; Bioethics: an Anthology. (2006) Malden and Blackwell Publishing.
10. Department of Biotechnology, Ministry of Science and Technology, Government of India; Revised guidelines for safety in biotechnology. Available from: <http://dbtbiosafety.nic.in/guideline/pdf/guidelines94.pdf>

T.Y. B.Sc. (BIOTECHNOLOGY) SEMESTER – V
BIOTECHNOLOGY PAPER - VII
TITLE - INTRODUCTION TO DIAGNOSTIC TECHNIQUES
PAPER CODE - BTH3507

[CREDITS - 3]

Learning Objectives:

The students should acquire the knowledge about:

1. Different diagnostic techniques and procedures involved in investigations and tests intended to identify the cause of an illness or disorder.

Units	Topic	No. of Lectures
Unit- I	Diagnostic Biology Introduction	1
Unit -II	Diagnostic Microbiology: Safety and special precautions in clinical microbiology lab, Legislative and regulatory Control, Infectious waste management, Methods of sterilization. Antimicrobial susceptibility testing; Selection of antimicrobial agents, Disc diffusion test, Dilution antimicrobial susceptibility test, E test, commercial systems	5
Unit- III	Laboratory tests for infectious agents: Guidelines for the collection, Transport, Processing, Analysis, and Reporting of Cultures from specific specimen sources like respiratory tract, gastrointestinal tract , urinary tract, genital tract , CNS	10
Unit -IV	Understanding Pathology Lab reports: Hemogram; Differential count, Total Red Blood cell count, Total White blood cell count, Platelet count. Haemoglobin estimation, Erythrocyte Sedimentation Rate.; Blood groups; matching and cross matching.; Blood coagulation tests; clotting time and prothrombin time.; Estimation of Blood sugar, Liver function tests.; Urine analysis and kidney function tests; Lipid profile; Cholesterol, triglyceride, HDLs, LDLs, VLDLs; Hormone Testing; Thyroid function tests.	12
Unit -V	Prenatal Diagnosis: Early blood test, triple test, fetal development ultrasound, chorionic villus sampling (CVS), Amniocentesis.	3
Unit -VI	Histopathology: Introduction to collection, preparation and processing of the samples, interpretation of the slides. Application is various diseases like cancer, myocardial infarctions, and infectious diseases. Immunohistochemistry.	10
Unit -VII	Medical Imaging Techniques: X-rays, CT scan, PET scan, MRI, Ultrasound, Mammograms	5

References:

1. Robbins, S.L.; Pathological basis of Disease; 9th Edition; (2015); W B Saunders Publishing.
2. Macleod, J.; Davidson's Principles & Practice of Medicine; A textbook for students and doctors' 14th Edition. Churchill Livingstone.
3. Guyton, A.C. and Hall, J.E.; Textbook of Medical Physiology 11th Edition; (2006). W B Saunders Publishing.
4. Hage, D. S. and Carr, J. D.; Analytical Chemistry & Quantitative Analysis; (2010); Prentice Hall.
5. Berg, J.M., Tymoczko, J.L. and Stryer L.; Biochemistry, 5th Edition. W.H. Freeman & Co.
6. Koneman's Color Atlas and Textbook of Diagnostic Microbiology, 7th Edition. Wolters Kluwer, Lippincott Williams & Wilkins.

T.Y. B.Sc. (BIOTECHNOLOGY) SEMESTER - V
BIOTECHNOLOGY PAPER - VIII
TITLE - TECHNIQUES IN BIOTECHNOLOGY - I
PAPER CODE- BTH3508

[CREDITS - 3]

Learning Objectives:

The students should acquire the knowledge about:

1. Theories, techniques and methodologies routinely practiced in teaching and research labs.
2. Foundation for advanced techniques.

Units	Topic	No. of Lectures
Unit - I	Lab safety and Reagent Preparation Safety in the laboratory, Preparation of reagents and solutions, Water purity, Major biological buffers and their role. Calculations of molarity, normality, osmotic pressure.	3
Unit - II	Hybridization based techniques Principle, working and applications of: <ul style="list-style-type: none"> • Southern Blotting • Western blotting • Northern blotting • FISH • Microarrays • Quantification, visualization and image analysis of each technique. 	12
Unit - III	Electrophoresis Principle, working and applications of: Native and SDS-PAGE, Isoelectric focusing, 2-D Electrophoresis, Immunoelectrophoresis, Agarose gel electrophoresis, Pulse field gel electrophoresis, Capillary electrophoresis. Various visualization methods and image analysis of gels.	12
Unit - IV	Chromatography Principle, working and applications of: <ul style="list-style-type: none"> • High Performance Liquid Chromatography (HPLC) • Gas Liquid Chromatography (GLC) Analysis of chromatograms	10
Unit - V	Applications and current research focus Current research publications Visit to a laboratory/industrial facility	8

References:

1. Wilson and Walker, Principles and techniques of Biochemistry and Molecular Biology, 8th Edition, Cambridge Ed.
2. Cooper T., The Tools of Biochemistry, (2011), Wiley-India Ed.
3. David Freifelder, Physical Biochemistry, Applications to Biochemistry and Molecular Biology.
4. Cotteril R., Biophysics, An Introduction, 1st edition (2002), John Willey and Sons Ltd., USA.

T.Y. B.Sc. (BIOTECHNOLOGY) SEMESTER – V
BIOTECHNOLOGY PAPER - IX
TITLE -BIOTECHNOLOGY PRACTICAL-I
PAPER CODE - BTH3511

[CREDITS - 2]

Sr. No.	Title	No. of Practicals
1.	Study of Growth curve and Generation time of Bacteria and yeast.	2
2.	Primary screening of a production strain (antibiotic or enzyme)	2
3.	Calculation of D value of the given organism	1
4.	Immobilization of whole yeast cells / enzyme by suitable method and determination of stability of immobilized enzyme.	1
5.	Study of different parts of a Laboratory scale Bioreactor	1
6.	Maintenance and culturing of Hydra	2
7.	Regeneration in Hydra	1
8.	Identification of different types of cells in Hydra by staining	2
9.	Drosophila culture and identification of mutants	3

T.Y. B.Sc. (BIOTECHNOLOGY) SEMESTER – V
BIOTECHNOLOGY PAPER - X
TITLE - -BIOTECHNOLOGY PRACTICAL-II
PAPER CODE - BTH3512

[CREDITS - 2]

Sr. No.	Title	No. of Practicals
1.	Genomic (Animal) DNA isolation	2
2.	Plasmid DNA isolation	3
3.	Preparation of competent Cells	2
4.	Transformation of <i>E. coli</i> and selection of recombinants	3
5.	Isolation of mutants by replica plate technique	3
6.	Study of somaclonal variations / Induction of androgenesis <i>in vitro</i>	2

T.Y. B.Sc. (BIOTECHNOLOGY) SEMESTER – V
BIOTECHNOLOGY PAPER - XI
TITLE- -BIOTECHNOLOGY PRACTICAL-III
PAPER CODE: BTH3513

[CREDITS - 2]

Sr. No.	Title	No. of Practicals
1.	PTC Laboratory: organization of facility and equipment	1
2.	Aseptic manipulation - washing, capping, packing & sterilization, laminar flow operation and safety precautions	2
3.	Stock solutions & media preparation	2
4.	Callus culture technique - Initiation of culture, callus morphology & internal structure	2
5.	Suspension culture technique - Initiation of culture, sub culture and growth measurement	1
6.	Effect of plant growth regulators on <i>in vitro</i> response of explants.	2
7.	Initiation of shoot tip culture / axillary bud culture	1
8.	Embryo culture	1
9.	Micropropagation	3

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FERGUSSON COLLEGE, PUNE
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SYLLABUS UNDER AUTONOMY
THIRD YEAR B.Sc. BIOTECHNOLOGY
SEMESTER - VI

SYLLABUS FOR T. Y. B.Sc.
Academic Year 2018-2019

T.Y. B.Sc. (BIOTECHNOLOGY) SEMESTER - VI
BIOTECHNOLOGY PAPER - I
TITLE - LARGE SCALE MANUFACTURING PROCESSES - II
PAPER CODE - BTH3601

[CREDITS - 3]

Learning Objectives:

The students should acquire the knowledge about:

1. Methods of measurement and control of various parameters.
2. Concept and importance of KLa.
3. Processes involved in recovery of a product.
4. Industrial manufacturing process of some products.
5. QA and QC techniques and importance.
6. Bioprocess economics.

Units	Topic	No. of Lectures
Unit - I	<p>Measurement and Control of different Bioprocess Parameters (Physical and Chemical Parameters): Temperature, pH, Dissolved oxygen, Microbial biomass, Fluid flow, Pressure, Weight, inlet and exit gas, foam, CO₂, Use of computers in Bioprocess. Oxygen Uptake rate, Oxygen transfer rate, Concept and importance of KLa, Different rheologies of fermentation media Scale Up and Scale down.</p>	12
Unit - II	<p>Methods and equipments used in Downstream processing: Definition; Unit operations and downstream processing, General strategy of product recovery; Precipitation (Agents used; Salts, Organic solvents, polyelectrolytes, acids and bases); Filtration (Plate Frame, Rotary Vacuum, Filter Aids, Flocculating agents); Centrifugation (types used in Industry; basket, tubular bowl, Scroll, multichamber, disc bowl); Cell Disruption (Physico – mechanical and chemical methods). Liquid-Liquid extraction(Principle, Co and counter current extraction) Chromatography (one example each of use of Adsorption, Ion exchange, Gel and Affinity in product recovery can be explained along with manufacturing process of antibiotics, enzymes and vaccines). Membrane Processes (Ultra filtration, Reverse Osmosis); Drying (Drum and Spray Drying); Whole broth Processing.</p>	12
Unit - III	<p>Large Scale Manufacturing Process of: Biomass based Products; Baker's Yeast, Single cell Protein; Enzymes; amylase, Restriction Enzymes; Antibiotics; Penicillin, Streptomycin Vitamins; B12, Riboflavin; Amino acids; Glutamic acid, Lysine Vaccines; DPT, Polio; Biotransformation Products ; Steroids, Ascorbic acid; Alcohol and Wine</p>	10
Unit - IV	<p>Quality Control and Quality Assurance: Concept of Good Manufacturing Practices (GMP), Standard Operating Practices (SOP) Quality Control and Quality Assurance (Definition, Functions and Responsibilities) Tests Used for Quality Assurance of finished product; Sterility Testing, Pyrogen testing, Bacterial endotoxin (LAL test), Ames Test.</p>	8

Unit - V	Bioprocess Economics: Basic objectives in developing economically viable process, Market Potential, Fixed and Variable costs, Depreciation, Amortization, and Selection of Pricing. Visit to a fermentation unit	3
References: <ol style="list-style-type: none"> 1. Stanbury, P. F. and Whittaker, A.; Principles of Fermentation technology; 3rd edition (1984). 2. Butterworth. H. and Pepler, H. L.; Microbial Technology, Vol. I and II, 2nd Edition (1979), Academic Press. 3. Casida, L. E., Industrial Microbiology, (1986), John Wiley Eastern. 4. Prescott. S. C. and Dunn, C. G.; Industrial Microbiology, Reed G.; 5th edition (1983), AVI tech books. 5. Patel, A. H., Industrial Microbiology, 1st edition, (2007), Macmillan India Ltd. 6. Patel, A. H., Industrial Microbiology, 2nd edition, (2016), Laxmi Publications, New Delhi. 7. Crueger, W. and Crueger, A.; A Text Book of Industrial Biotechnology, (2005) Panima, New Delhi. 8. Schuler, M. and Kargi, F. Bioprocess Engineering - Basic Concepts, 2nd edition, (2002), Prentice Hall. 9. Pauline Doran, Bioprocess Engineering Principles, 2nd Edition, (2012), Academic Press 10. Butterworth, Heinemann, Operational Modes of Bioreactors, (1992), BIOTOL 11. Aiba, S., Humphrey A. L. and Miles, N.F. Biochemical Engineering, 2nd Edition (1973), Academic Press, New York. 		

T.Y. B.Sc. (BIOTECHNOLOGY) SEMESTER - VI
BIOTECHNOLOGY PAPER - II
TITLE - ENZYMOLOGY
PAPER CODE - BTH3602

[CREDITS - 3]

Learning Objectives:

The students should acquire the knowledge about:

1. Fundamental forces of chemistry defining the structure and activities of enzyme.
2. Enzyme and substrate interaction.
3. How to fit experimental data to theoretical description of enzyme-substrate interaction.
4. Steady state kinetic measurements.

Units	Topic	No. of Lectures
Unit - I	<p>Thermodynamics of chemical reactions:</p> <p>The laws of thermodynamics, Concept of free energy change, Coupled reactions, Transition state of chemical reactions, Activation energy, Acid-base chemistry, Henderson Hasselbalch equation, Noncovalent interactions in reversible binding, Rates of chemical reactions, Reaction order, Reversible chemical reactions, measurement of initial velocity.</p>	5
Unit - II	<p>Enzyme-substrate binding equilibria:</p> <p>Equilibrium dissociation constant, Kinetic approach to equilibrium, Binding measurements at equilibrium, Langmuir isotherm for single specific binding site, Graphical analysis of enzyme-substrate binding data; direct plot on semilog scale, Wolff plots, Scatchard plot.</p>	10
Unit - III	<p>Cooperativity in enzyme catalysis:</p> <p>Positive and negative cooperativity, Pyruvate dehydrogenase as example of allostery in proteins, models of allosteric behaviour; Sequential interaction model (Koshland), Concerted transition model (Mwc).</p>	15
Unit - IV	<p>Experimental methods to study enzyme kinetics:</p> <p>Detection methods, Assay based on optical spectroscopy, Fluorescence measurements, Radioisotopic measurements.</p>	10
Unit - V	<p>Artificial enzymes, Synzymes:</p> <p>Requirements for synzyme activity, examples of synzymes, e.g. Protein derived synzymes, Cyclodextrin synzymes, Organic synzymes, Metallo-synzymes etc. Abzymes; Immunoglobulin as transition state analogues, examples of abzymes; Applications of synzymes and abzymes.</p>	5

References:

- 1) Nicholas P., Lewis S.; Fundamentals of Enzymology, 3rd ed. (1999), Oxford University Press, UK.
- 2) Lehninger A., Nelson D., Cox M.; Principles of Biochemistry; 5th ed. (2008), W.H. Freeman and Company, USA.
- 3) Berg J., Stryer L; Biochemistry; 7th ed. (2006), W.H. Freeman and Company, USA.
- 4) Palmer T., Bonner P.; Enzymes; Biochemistry, Biotechnology and Clinical Chemistry; 2nd ed. (2014), Woodhead Publishing Ltd., UK.
- 5) Voet, D., Voet, J.; Biochemistry; 4th ed. (2012), John Wiley and Sons, USA.
- 6) Segel, I.; Biochemical calculations; 2nd ed. (2010), Wiley publications, USA.

7) Plummer D.; An introduction to practical Biochemistry; 3rd ed. (2004), Tata McGraw Hill, India.

T.Y. B.Sc. (BIOTECHNOLOGY) SEMESTER – VI
BIOTECHNOLOGY PAPER - III
TITLE - TECHNIQUES AND APPLICATIONS IN GENETIC ENGINEERING
PAPER CODE - BTH3603

[CREDITS - 3]

Learning Objectives:

The students should acquire the knowledge about:

1. Various natural and laboratory based modifications of DNA
2. Tools for creating DNA constructs
3. Various protein expression strategies
4. Importance of genetic engineering in creating transgenic animals

Units	Topic	No. of Lectures
Unit - I	Techniques in Genetic Engineering: Cloning Strategies: Understanding basic principle of Cloning from genomic DNA; Making genomic libraries. Packaging, amplification and expression of cloned DNA molecules. Cloning from RNA; Synthesis, cloning and expression of cDNA molecules site directed mutagenesis and applications.	10
Unit - II	Selection, screening, and analysis of recombinants: Genetic selection and screening methods; by chromogenic substrates, insertional inactivation, complementation. Screening using nucleic acid hybridisation; Nucleic acid probes, screening clone banks. PCR in screening protocols. Restriction mapping, Blotting techniques.	10
Unit - III	DNA Sequencing: Principles of DNA sequencing ;Preparation of DNA fragments Maxam - Gilbert (chemical) sequencing; Sanger - Coulson (dideoxy or enzymatic) sequencing; Automated DNA sequencing; Next generation sequencing	10
Unit - IV	Applications of genetic Engineering: Human genome project; Healthcare; Gene therapy; recombinant vaccines and proteins as therapeutics; Agriculture; RNA interference; Forensics	10
Unit - V	Transgenics: Why transgenic animals; Methods of producing transgenic animals; Applications of transgenic animal technology	5

References:

1. Watson, J., Baker, T., Bell, S., Gann, A., Levine, M. and Lodwick, R.; Molecular Biology of the Gene, 6th Edition (2008), Pearson Education, Inc. and Dorling Kindersley Publishing, Inc. USA.
2. Glick, B. R., Pasternak, J. J., and Patten, C. L.; Molecular Biotechnology, 4th edition (2010), ASM press, USA.
3. Primrose, S. and Twyman, R.; Principles of gene manipulation and genomics, 7th Edition (2006). Blackwell Publishing, USA.
4. Sambrook, J., Fritsch, E., and Maniatis, T.; Molecular cloning; a laboratory manual, 2nd edition (1989), Cold Spring Harbor Laboratory Press, USA.

T.Y. B.Sc. (BIOTECHNOLOGY) SEMESTER – VI
BIOTECHNOLOGY PAPER - IV
TITLE - ANIMAL TISSUE CULTURE
PAPER CODE- BTH3604

[CREDITS - 3]

Learning Objectives:

The students should acquire the knowledge about:

1. basic concepts in animal tissue culture with understanding of different physicochemical requirements, variations in techniques and applications of animal tissue culture

Units	Topic	No. of Lectures
Unit - I	Animal Tissue culture: Introduction; Comparison with bacterial culture; Maintenance of aseptic conditions. Contamination; type and detection methods. <i>In vivo</i> vs. <i>in vitro</i> growth conditions for cells of multicellular organisms. Concept of monolayer, suspension, histotypic / organotypic, organ culture.	15
Unit - II	Equipment and infrastructure: Laboratory design, Instruments used in ATC, Labware; TC flasks etc.	4
Unit - III	Nutrition & Physiology: Media and rationale behind medium formulation. Advantages and disadvantages of serum. Serum free media Balanced salt solutions	4
Unit - IV	Primary cell culture: Source selection, different methods of establishing primary cell culture. Special reference to fibroblast culture and lymphocyte culture	4
Unit - V	Cell lines: Evolution of cell line, Finite and transformed cell lines, Mammalian and insect cell line growth conditions, Subculture	6
Unit - VI	Characterization of cell lines: Need for characterization. Methods of Characterization; Karyotyping, biochemical & genetic characterization of cell lines.	2
Unit - VII	Cell storage and distribution: a. Cryopreservation b. Cell repositories	3
Unit - VIII	Application of Animal cell cultures.	4

References:

1. Freshney, I.; Culture of Animal Cells, 6th Edition, 2010. Wiley & Sons, Inc., USA
2. Masters, J.; Animal Cell Culture- Practical Approach, 3rd Edition, 2000, Oxford University Press, USA
3. Gangal, S.; Principles and Practice of Animal Tissue Culture, 2nd Edition, University Press, India

T.Y. B.Sc. (BIOTECHNOLOGY) SEMESTER - VI
BIOTECHNOLOGY PAPER - V
TITLE - APPLICATIONS OF BIOTECHNOLOGY - II
PAPER CODE - BTH3605

[CREDITS - 3]

Learning Objectives:

The students should acquire the knowledge about:

1. The importance of biotechnology and its applications in agriculture, conservation, environment and bioinformatics fields.

Units	Topic	No. of Lectures
Unit - I	Agriculture Biotechnology: Biotechnology in crop trait improvement, selection of crops for biotic and abiotic stress resistance, gene pyramiding, metabolite engineering, genetically modified crops, biofortification and nutrition enhancement; bioenergy crops, case studies.	15
Unit - II	Environmental Biotechnology: Use of Biotechnology for environment monitoring, biomarkers, RS-GIS; satellites, principle; biosensors; Biotechnology for pollution (air, water and soil) control; new approaches to prevent pollution use of bioplastics Improvement of fuel sources, alternate fuel sources; Phytoremediation; effluent treatment for textile, agri and dairy industries; community sampling and its methods; Field Visit	14
Unit - III	Conservation Biotechnology: Role of Biotechnology in conservation, need for conservation - environment impact assessment case studies - Aswan lake and Lavasa; use of genetically modified organisms, DNA hybridization, barcoding and its use in identification and conservation; anti-poaching	8
Unit - IV	Biotechnology and Bioinformatics: Importance of bioinformatics in various fields of biotechnology; 'Omics' (genomics proteomics, transcriptomics) applications, chemo informatics, drug discovery and development; waste cleanup, forensic sciences	8

References:

1. Kayser, O. and Quax, W.; Medicinal plant biotechnology; From basic research to industrial applications, (2007), Wiley - VCH Verlag GmbH and Co. KGaA, Weinheim, Germany.
2. Thangadurai, D. and Jeyabalan, S.; Biotechnology and Bioinformatics; Advances and Applications for Bioenergy, Bioremediation and Biopharmaceutical Research, (2014). CRC Press, NW, Boca Raton, FL, USA.
3. Altman, A.; Agricultural biotechnology, (1997), CRC Press NW, FL, USA.
4. Altman, A. and Hasegawa, P.; Plant biotechnology and agriculture; prospects for the 21st century, (2011). Academic press, Cambridge, Massachusetts, USA.
5. Hardy, R. and Segelken, J.; Agricultural Biotechnology; Novel Products and New Partnerships. Vol. 8, (1998), DIANE Publishing, Collingdale, PA, USA.
6. Jördening, H. and Winter, J.; Environmental Biotechnology; Concepts and Applications, (2005), John Wiley & Sons, Inc., New York.
7. Chuvieco, E.; Fundamentals of Satellite Remote Sensing; An Environmental Approach, (2016), CRC Press, NW, Boca Raton, FL, USA.
8. Ruane, J. and Sonnino, A.; The role of biotechnology in exploring and protecting agricultural genetic resources (2006). Food and Agriculture Organization, Italy.

T.Y. B.Sc. (BIOTECHNOLOGY) SEMESTER – VI
BIOTECHNOLOGY PAPER - VI
TITLE - INTRODUCTION TO NANOTECHNOLOGY
PAPER CODE - BTH3606

[CREDITS - 3 (2T+1P)]

Learning Objectives:

The students should acquire the knowledge about:

1. Fundamentals of nanotechnology
2. Synthesis and characterization of nanoparticles
3. Applications of nanomaterials
4. Techniques in synthesis and detection of nanoparticles

Units	Topic	No. of Lectures
Unit - I	Introduction to Nanoworld, Nanoscience and Nanotechnology: Nanoparticles, nanowires, thin films and multilayers, Applications in various fields viz. Physical and Chemical, Materials, Life Sciences. Nanobiotechnology; Introduction, Biomolecules as nanostructures and their applications in nanotechnology viz. Biosensors, separation of cells and cell organelles, cancer therapy, gene therapy etc.	8
Unit - II	Synthesis of Nanostructure: Physical methods - mechanical methods, methods based on evaporation sputter deposition, chemical vapour deposition (CVD), electric arc deposition. Chemical methods - Synthesis of nanoparticles by colloidal route, microemulsion, sol-gel method, chemical precipitation, pyrolysis. Biological methods - Synthesis using microorganism, synthesis using plant extracts, use of proteins and template like DNA.	8
Unit - III	Properties and Characterization of Nanomaterials: Optical (UV-Vis / Fluorescence), X-ray diffraction, Imaging and size (Electron microscopy, Light scattering, Zetapotential), Surface and composition (ECSA, EDAX, AFM/STM), Magnetic, Electrical and Electrochemical.	8
Unit - IV	Functionalization of Nanoparticles for biological applications: Proteins- Lipids-RNA-DNA, Protein targeting – small molecules / Nanomaterial-Protein interaction. Nanomaterial-cell interaction – manifestation of surface modification (polyvalency), Lipid nanoparticles for Drug Delivery, Inorganic Nanoparticles for Drug Delivery, metal / Metallic oxide nanoparticles (antibacterial / antifungal / antiviral).	6

Practicals [1C]

Sr. No.	Title	No. of Practicals
1.	Synthesis of Al ₂ O ₃ nanoparticles using Sol Gel method	2
2.	Synthesis of semiconductor (ZnS, CdS etc.) nanoparticles by chemical method.	2
3.	Synthesis of nanoparticles using Biological process.	1
4.	Detection of nanoparticles in colloidal solutions using UV-Vis absorption technique.	1
5.	Analysis of AFM, SEM and TEM pictures	1.5

References:

1. Kulkarni, S. K.; Nanotechnology; Principals and Practices by, (2009 Revised edition), Capital Publishing company, New Delhi.
2. Strocio, M.A. and Dutta, M.; Biological Nanostructures and Application of Nanostructures in Biology (2004), Kulwer Academic Publishers,
3. Papazoglou, E. S. and Parthasarathy, A.; BioNanotechnology, 1st Edition (2007), Morgan & Claypool Publishers' series.
4. Goodsell, D. S.; Bionanotechnology, (2004), John Wiley & Sons, Inc, Publication.

T.Y. B.Sc. (BIOTECHNOLOGY) SEMESTER – VI
BIOTECHNOLOGY PAPER - VII
TITLE - INTRODUCTION TO BIOINFORMATICS
PAPER CODE - BTH3607

[CREDITS - 3]

Learning Objectives:

The students should acquire the knowledge about:

1. Various bioinformatics tools and techniques and how to use that for the analysis of the biological experimental data.
2. Concepts of various databases and various methods for the data retrieval, data storage, and data mining and use that data for the further analysis.
3. In-Silico approach for the protein modeling and drug discovery process.
4. Sequencing techniques and gene annotation as well as submission of the sequences to the various databases.

Units	Topic	No. of Lectures
Unit - I	Bioinformatics: Introduction and definition, History and Scope, Applications of Bioinformatics in various fields.	5
Unit - II	Nucleic Acid Sequence Databases: Nucleic acid sequence databases (GenBank, EMBL, DDBJ), Keyword-based search at Entrez Search Engine at NCBI. Sequence Submission tools at NCBI, EMBL etc. Protein sequence database; UniProtKB(SwissPort, TrEMBL). Practicals based on the above databases.	10
Unit - III	Open Access Bibliographic Resources and Literature Databases: PubMed, MEDLINE, PubMedCentral at NCBI Practicals based on the above databases.	10
Unit - IV	Sequence Analysis: Various File Formats for Biomolecular Sequences: GenBank, FASTA Basic concepts of sequence analysis: Global Pairwise Sequence Alignment, Local Pairwise Sequence Alignment, Needleman and Wunsch, Smith and Waterman algorithms for pairwise alignments, gap penalties, use of pairwise alignments for analysis of nucleic acid and protein sequences and interpretation of results. Database Searches: BLAST, FASTA Practicals based on the above tools	10
Unit - V	Multiple Sequence Alignment: The need for MSA, Basic concepts of various approaches for MSA (e.g. progressive, hierarchical, iterative etc.). Concept of Phylogeny: Molecular Phylogeny, Various Methods of Phylogenetic Tree Construction Scoring Matrices: Basic concept of a scoring matrix, Matrices for nucleic acid and proteins sequences, PAM and BLOSSUM series.	10

References:

1. Mount David; Bioinformatics Sequence and Genome Analysis (2004), Cold Spring Harbor Laboratory Press, New York.
2. Xiong Jin ; Essential Bioinformatics (2006) ,Cambridge University Press ,USA.
3. Wood, A. H., Parry, T. K. and Smith D. J.; Introduction to bioinformatics, 2001 Pearson education, Asia.

4. Baxevanis, A. D. and Ouellette, B. F. F.; *Bioinformatics: A practical guide to the analysis of genes and proteins*, (2001), New York.
5. Higgins Des and Taylor Willie; *Bioinformatics Methods and Protocols* - 2000, Oxford University Press.
6. Bosu Orpita, Thukral Simminder Kaur; *Bioinformatics Databases, Tools and Algorithms* (2007), Oxford University Press.

T.Y. B.Sc. (BIOTECHNOLOGY) SEMESTER - VI
BIOTECHNOLOGY PAPER - VIII
TITLE- TECHNIQUES IN BIOTECHNOLOGY - II
PAPER CODE- BTH3608

[CREDITS - 3]

Learning Objectives:

The students should acquire the knowledge about:

1. Theories, techniques and methodologies routinely practiced in teaching and research labs.
2. Foundation for advanced techniques.

Units	Topic	No. of Lectures
Unit - I	Spectrophotometry Principle, working and applications of: <ul style="list-style-type: none"> • CD • IR • NMR • ESR • XRD 	15
Unit - II	Microscopy <ul style="list-style-type: none"> • Cryo • SEM • TEM • Gold Labelling • AFM Specimen preparation, thin sectioning, immune - labelling, negative staining. Limitations and applications.	10
Unit - III	PCR <ul style="list-style-type: none"> • Primer design • Gradient PCR • Colony PCR • RT-PCR • Nested PCR • RT-qPCR Applications of PCR	12
Unit - IV	Applications and current research focus Current research publications Visit to a laboratory / industrial facility with advanced instrumentation facilities.	8

References:

1. Wilson and Walker, Principles and Techniques of Biochemistry and Molecular Biology, 8th Edition, Cambridge Ed.
2. Glick, B. R., Pasternak, J. J. and Patten C. L., Molecular Biotechnology, 4th edition (2010), ASM Press, USA.
3. Cooper T., The Tools of Biochemistry, (2011), Wiley-India Ed.
4. David Freifelder, Physical Biochemistry, Applications to Biochemistry and Molecular Biology.
5. Cotteril R., Biophysics, An Introduction, 1st edition (2002), John Willey and Sons Ltd., USA.

T.Y. B.Sc. (BIOTECHNOLOGY) SEMESTER - VI
BIOTECHNOLOGY PAPER - IX
TITLE - -BIOTECHNOLOGY PRACTICAL-IV
PAPER CODE - BTH3611

[CREDITS - 2]

Sr. No.	Title	No. of Practicals
1.	Production, Recovery and estimation of Primary metabolite (Organic acid and Ethanol)	3
2.	Production, Recovery (Filtration, Solvent extraction) and estimation (Bioassay) a of Secondary metabolite (Antibiotic)	2
3.	Sterility testing of injectables / autoclave	1
4.	Preparation and study of different properties of wine.	1
5.	Visit to Fermentation industry	1
6.	Enzyme assay; β -galactosidae / acid phosphatise / amylase Determination of Km and Vm	3
7.	Effect of pH on enzyme activity	2
8.	Effect of temperature on enzyme activity	2

T.Y. B.Sc. (BIOTECHNOLOGY) SEMESTER - VI
BIOTECHNOLOGY PAPER - X
TITLE - -BIOTECHNOLOGY PRACTICAL-V
PAPER CODE-BTH3612

[CREDITS - 2]

Sr. No.	Title	No. of Practicals
1.	Plasmid DNA digestion, ligation and restriction mapping	4
2.	Types of Blotting techniques	4
3.	Transfection of recombinant DNA into mammalian cells	3
4.	PCR, DNA fingerprinting using molecular markers	4

T.Y. B.Sc. (BIOTECHNOLOGY) SEMESTER – VI
BIOTECHNOLOGY PAPER - XI
TITLE - -BIOTECHNOLOGY PRACTICAL-VI
PAPER CODE- BTH3613

[CREDITS - 2]

Sr. No.	Title	No. of Practicals
1.	ATC laboratory design and equipment used in ATC	1
2.	Aseptic conditions	2
3.	Animal cell culture media preparation, sterilization, washing, packing	2
4.	Observation of cells in culture - Principles & practice	1
5.	Isolation of Lymphocyte for culture; Ficoll-hypaque density gradient separation	2
6.	Maintenance of cell lines	3
7.	Cell staining methods viz. Giemsa	1
8.	Viable cell count and growth studies	2
9.	Visit to cell culture facility / Production set up	1