BHAKTA KAVI NARSINH MEHTA UNIVERSITY JUNAGADH

Accredited Grade "A" by NAAC (CGPA 3.05)

COURSE STRUCTURE & SYLLABUS

FOR

UNDERGRADUATE PROGRAMME

IN

BIOTECHNOLOGY

(Faculty of Science)

[As per Choice Based Credit System (CBCS) as recommended by UGC]

Effective from June - 2018

PREFACE

Updating and revision of the Curriculum at regular interval of time is a prime criterion of IQAC – NAAC and a prime need for the college and educational systems affiliated to University.

Biotechnology is applied subject that refers to the use of living organisms or the products of these organisms to improve human health and the human environment. It is revolutionizing the way we manufacture products and view the relationships of all living things. Although biotechnology is considered a growing science, the processes used today have their basis in the nature. These processes are used to transfer genetic materials from one cell into another by using a common bacterium. This transfer of DNA permits variance of one or several traits and confers a new property on an organism. For example, tomato plants have been made resistant to Tobacco Mosaic Virus, which can cause large crop loss.

Biotechnology has the potential to affect a number of fields and issues, including agriculture, food processing, health care, forensics, energy production, and the environment. Current applications include diagnostics, the production of vaccines and pharmaceuticals, and improved crop and livestock the life sciences such as biotechnology, medicine, biomedical research, bioinformatics, etc.

Composition of Curriculum for a particular subject requires following criteria to be considered:

1. Guidelines and Model curriculum given by the UGC and the University
2. Regional needs
3. Present national and International trends in the subject
4. Geographical parameters of the University and its demographic property
5. Relationship with other related subjects
6. Financial and statuary provisions of the state government
7. Resources of educational needs.

The content of a syllabus should be such that it maintains continuity with the course content of higher secondary class and post graduate course. The present curriculum is made keeping this in mind and is an effort to impart fundamental knowledge of the subject needed at this level.

Annexure – "B"

BHAKTA KAVI NARSINH MEHTA UNIVERSITY
SCIENCE FACULTY

Subject: **BIOTECHNOLOGY**

Sr. No.	Level	Semester	Course Group	Course (Paper) Title	Course (Paper) No.	Credit	Internal Marks	External Marks	Practical /Viva Marks	Total Marks	Course (Paper) Unique Code
01	UG	01	Core	Introduction to Biotechnology and Cell Biology	BT-101	7	30	70	50	150	1603 1800 0101 0100
02	UG	02	Core	Fundamentals of Biomolecules	BT-201	7	30	70	50	150	1603 1800 0102 0100
03	UG	03	Core	Metabolism of Biomolecules	BT-301	7	30	70	50	150	1603 1800 0103 0100
04	UG	04	Core	Environmental Biotechnology and Biostatistics	BT-401	7	30	70	50	150	1603 1800 0104 0100
05	UG	05	Core	Bioprocess and Biochemical Engineering	BT-501	7	30	70	50	150	1603 1800 0105 0100
06	UG	05	Core	Genetics and Molecular Biology	BT-502	7	30	70	50	150	1603 1800 0105 0200
07	UG	05	Core	Immunology	BT-503	7	30	70	50	150	1603 1800 0105 0300
08	UG	06	Core	Principles of Biotechnology Applied to Plants and Animals	BT-601	7	30	70	50	150	1603 1800 0106 0100
09	UG	06	Core	Analytical Techniques in Biotechnology	BT-602	7	30	70	50	150	1603 1800 0106 0200
10	UG	06	Core	Advanced Molecular Techniques and Bioinformatics	BT-603	7	30	70	50	150	1603 1800 0106 0300

COURSE CONTENT FOR

UNDER GRADUATE BIOTECHNOLOGY

SEMESTER I to VI

SEMESTER	PAPER NO. & CODE	TITLE OF THE PAPER	CREDIT
I	BT-101 (Theory)	Introduction to Biotechnology and Cell Biology	4
	BT -101 (Practical)	-do-	3
II	BT -201 (Theory)	Fundamentals of Biomolecules	4
	BT -201 (Practical)	-do-	3
III	BT -301 (Theory)	Metabolism of Biomolecules	4
	BT -301 (Practical)	-do-	3
IV	BT -401 (Theory)	Environmental Biotechnology and Biostatistics	4
	BT -401 (Practical)	-do-	3
V	BT -501 (Theory)	Bioprocess and Biochemical Engineering	4
	BT -501 (Practical)	-do-	3
	BT -502 (Theory)	Genetics and Molecular Biology	4
	BT -502 (Practical)	-do-	3
	BT -503 (Theory)	Immunology	4
	BT -503 (Practical)	-do-	3
VI	BT -601 (Theory)	Principles of Biotechnology Applied to Plants and Animals	4
	BT -601 (Practical)	-do-	3
	BT -602 (Theory)	Analytical Techniques in Biotechnology	4
	BT -602 (Practical)	-do-	3
	BT -603 (Theory)	Advanced Molecular Techniques and Bioinformatics	4
	BT -603 (Practical)	-do-	3

Annexure – "C"

SKELETON OF THEORY EXAMINATION
(SEMESTER – I to VI)

Paper Style for All Semester

1. The syllabus consists of five Units.
2. All Units carry equal marks.
3. There should be five questions in a question paper.
4. One question is to be asked from each Unit.
5. Each question carries 14 marks.
6. Time duration of 70 marks question paper is 2:30 hours.
7. Each question should be divided into a, b and c as shown below.
   a. Answer the following. (Any one out of Two)----------(07 marks)
      (Theory Question)
   b. Attempt any one. (Out of Two)----------(04 Marks)
      (Application/Example/Problem/Theory)
   c. Attempt any three. (Out of Five) ---------- (03 Marks)
      (short answer/one word/one line/true or false/fill up the blanks)

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Annexure – "C"

FACULTY OF SCIENCE

Syllabus

Subject: **BIOTECHNOLOGY**

Course (Paper) Name & No.: Bioprocess and Biochemical Engineering (BT-501)

Course (Paper) Unique Code: 1603 1800 0105 0100

External Exam Time Duration: 2.5 Hours

Name of Program	Semester	Course Group	Credit	Internal Marks	External Marks	Practical /Viva Marks	Total Marks
Bachelor of Science	05	Core	7	30	70	50	150

Course Objective:

The objective of the paper is to impart the fundamental knowledge of industrial bioprocess and production of commercial products to the students and to develop their ability to enhance skills in the areas of biochemical processes, bio-chemical engineering, and advanced bioprocess engineering.

COURSE STRUCTURE FOR UG PROGRAMME

BIOTECHNOLOGY- BT-501

SEMESTER- V

Semester	Course	Title	Hours /week	Credit	Exam duration	Internal marks	External marks	Total marks
V	BT-501 (Theory)	Bioprocess and Biochemical Engineering	6	4	2.5 hrs	30	70	100
V	BT-501 (Practical)	Bioprocess and Biochemical Engineering	6	3	One day per batch	15	35	50
Total credits				7	Total marks			150

General instructions

1. The medium of instruction will be English for theory and practical courses
2. There will be 6 lectures / week / theory paper / semester.
3. Each lecture will be of 55 mins.
4. There will be 2 practical / week / paper / batch. Each practical will be of 3 periods
5. Each semester theory paper will be of "*five*" units. There will be 60 hrs. of theory teaching / paper / semester.
6. Each Theory Paper / Semester will be of 100 Marks. There will be 30 marks for internal evaluation and 70 marks for external evaluation. Each Practical Paper / Semester will be of 50 Marks with 15 marks for internal and 35 marks for external evaluation. So, Total Marks of Theory and Practical for each Paper will be 150. (100 + 50 = 150)

BT – 501 - BIOPROCESS AND BIOCHEMICAL ENGINEERING

THEORY

Unit – 1 Isolation, Screening and Improvement of Strain

1.1 General Consideration: Metabolic Pathways and Metabolic Control Mechanism, Primary and Secondary Metabolites.
1.2 Enrichment Techniques for isolation and Screening of microorganism, Primary and Secondary screening
1.3 Strain Improvement : Nature of mutation, mutagenesis, isolation of mutants
1.4 Strain Improvement : Application of recombinant DNA technique in strain construction
1.5 Techniques for preservation and storage of cultures

Unit – 2 Growth Kinetics

2.1 Fermenter and bioreactor : Design and types of various fermenters
2.2 Introduction to Aeration and agitation, oxygen transfer rate, heat control
2.3 Basic concept of growth and growth kinetics
2.4 Batch, fed-batch and continuous culture operations,
2.5 Starter culture, its importance and preparation

Unit – 3 Media Formulation and Sterilization

3.1 Introduction and types of fermentation media
3.2 Raw materials used in fermentation media
3.3 Media optimization
3.4 Sterilization of media, air and equipment's
3.5 Automation (process computerization)

Unit – 4 Downstream Processing

4.1 Overview of downstream processing
4.2 Extraction and separation techniques;
- Cell disruption – disintegration
- Flocculation & Floatation
- Filtration
- Centrifugation

4.3 Purification & Concentration of product by:
- Solvent-Solvent Extraction
- Distillation
- Membrane filtration and dialysis
- Chromatographic methods
- Crystallization and drying

4.4 Bioassay, Quality control procedure
4.5 Fermentation Economics

Unit – 5 Immobilization and Fermented Products

5.1 An overview of solid state fermentation
5.2 Fermentation processes of alcohol, organic acids (Gluconic acid & Citric acid)
5.3 Fermentation processes of amino acids (Lysine), vitamins (Vit. B_{12}), antibiotics (penicillin)
5.4 Immobilization Techniques: Immobilization of cell and enzyme: Basic concept of immobilization, principles, mechanism and techniques of immobilization. Choice of immobilization methods, properties of immobilized enzyme Supporting matrices used and their properties.
5.5 Fermented foods: Cheese, Bread and Sauerkraut

LIST OF PRACTICAL

Exp. 1 Isolation, Screening and characterization of Lipolytic, Proteolytic, Amylolytic microbes and enzymes
Exp. 2 Screening of antibiotic producing microorganisms (Crowded & Wilkins Method).
Exp. 3 Determination of growth phases of microorganisms
Exp. 4 Media Optimization by RSM/Plackett Burman theory
Exp. 5 Bioassay for antibiotic by agar diffusion method
Exp. 6 Typical fermentation of alcohol.
Exp. 7 Typical fermentation of Citric acid or Gluconic Acid.
Exp. 8 Gel entrapment of yeast cells and to determine Invertase activity by the immobilized cells
Exp. 9 Production of Cheese (Demonstration)
Exp. 10 Production of Bread (Demonstration)

LIST OF INSTRUMENTS

1. pH Meter
2. Hot Air Oven
3. Weigh Balance
4. Water Bath
5. Refrigerator
6. Autoclave
7. Spectrophotometer and/or Colorimeter
8. Incubator
9. Stirrer
10. Centrifuge
11. Vortex
12. Differential Distillation unit
13. Convection Oven

REFERENCES

1. Mukhopadhyay. Process Biotechnology Fundamental. Viva Book
2. Shuler and Kargi, 1992. Bioprocess engineering. Prentice-Hall.
3. Bialy & Ollis. 1986. Biochemical Eng. Fundaments. McGraw-Hill.
4. Schugerl. 1987. Bioreaction engineering. J/W.
5. Stanbury and Whitaker. Principles of fermentation technology.
6. Sikyta. Methods in Industrial microbiology. Ellis Hardwood Ltd.
7. Krijsman. Product recovery in bioprocess technology.
8. T.K.Ghose. Bioprocess computation in biotechnology. Ellis Hardwood Ltd.
9. Murray Joh. 1997. Microorganisms and Biotechnology.
10. Demain (ED). 1999. Manual of mdustrial Microbiology and Biotechnology. Asm Press.
11. Bioprocess Engineering Principles by Doran (D); Academic Press, 1998
12. Cooney, A.E. Humphrey, Comprehensive Biotechnology: The principles and Regulation of Biotechnology in Industry, Agriculture and Medicine, Vol.2, Pergamon Press, 1985
13. Doran. Bioprocess Engineering Principles - Academic Press - 2001
14. Michael L. Shuler and Fikret Kargi (2003). Bioprocess engineering basic concepts. (2nd edition). Prentice Hall of India Pvt. Ltd. India.
15. Bioprocess technology: Fundamentals and applications, KTH Stockholm.

Annexure – "C"

FACULTY OF SCIENCE

Syllabus

Subject: **BIOTECHNOLOGY**

Course (Paper) Name & No.: Genetics and Molecular Biology (BT-502)

Course (Paper) Unique Code: 1603 1800 0105 0200

External Exam Time Duration: 2.5 Hours

Name of Program	Semester	Course Group	Credit	Internal Marks	External Marks	Practical /Viva Marks	Total Marks
Bachelor of Science	05	Core	7	30	70	50	150

Course Objective:

The objective of the paper is to impart the fundamental knowledge of basic concepts of genetics, providing a conceptual framework which is one of important components of biotechnology. Paper focuses on different aspects of genetics like population, molecular basis of genetics and applications of genetics.

COURSE STRUCTURE FOR UG PROGRAMME
BIOTECHNOLOGY- 502
SEMESTER- V

Semester	Course	Title	Hours /week	Credit	Exam duration	Internal marks	External marks	Total marks
V	BT-502 (Theory)	Genetics and Molecular Biology	6	4	2.5 hrs	30	70	100
V	BT-502 (Practical)	Genetics and Molecular Biology	6	3	One day per batch	15	35	50
Total credits				7	Total marks			150

General instructions

1. The medium of instruction will be English for theory and practical courses
2. There will be 6 lectures / week / theory paper / semester.
3. Each lecture will be of 55 mins.
4. There will be 2 practical / week / paper / batch. Each practical will be of 3 periods
5. Each semester theory paper will be of "*five*" units. There will be 60 hrs. of theory teaching / paper / semester.
6. Each Theory Paper / Semester will be of 100 Marks. There will be 30 marks for internal evaluation and 70 marks for external evaluation. Each Practical Paper / Semester will be of 50 Marks with 15 marks for internal and 35 marks for external evaluation. So, Total Marks of Theory and Practical for each Paper will be 150. (100 + 50 = 150)

BT – 502 - GENETICS & MOLECULAR BIOLOGY

THEORY

Unit - 1 Classical Genetics (Credit - 0.8)

1.1 Gene structure & organization: Structure of prokaryotic and eukaryotic gene, Organization of genes, Pseudo genes, Allele, Multiple allele, Pseudo allele, Lethal genes, Pleiotropic gene.
1.2 Mendelian inheritance: Inheritance patterns & Laws of Heredity, Pedigree Analysis
1.3 Gene Interaction: Allelic Interaction (Dominance, Incomplete Dominance & Co-Dominance) Non allelic Interaction (Supplementary, Complementary & Duplicative genes, Epistasis).
1.4 Linkage & Linkage Maps
1.5 Chromosomal Aberrations, Sex Determination

Unit - 2 Population Genetics & Molecular Genetics (Credit - 0.8)

2.1 Genetic polymorphism, Genetic Drift & Hardy Weinberg Law of equilibrium
2.2 Extra chromosomal Inheritance
2.3 DNA as genetic material: Experimental evidences (Direct & Indirect Evidences)
2.4 Watson & Crick Model, Alternative forms of DNA, C-value paradox
2.5 Genomic organization of prokaryotic & eukaryotic cells, Concepts of Central Dogma.

Unit – 3 Replication, DNA Repair and Gene Recombination (Credit - 0.8)

3.1 Replication – Experimental evidences of DNA replication & Enzymes involved in DNA replication
3.2 Process of replication in Prokaryotes & Eukaryotes
3.3 DNA repair Mechanism: Preventative, Direct & Post Replication repair
3.4 Process of gene recombination: Mechanism of gene transfers – transformation, conjugation and transduction.
3.5 Transposable elements: Structure & Mechanism of Transposition, Transposable elements in eukaryotes (Ac-Ds Elements, P-elements, Retro-Transposons & retroposons)

Unit – 4 Transcription, Translation and Regulation of Gene Expression (Credit - 0.8)

4.1 Transcription**:** Overview of Transcription & Types of RNA Molecules.
4.2 Process of Transcription, RNA Processing & Post Transcriptional Modifications.
4.3 Machinery of Protein Synthesis: Genetic code, Ribosomes & Role of t-RNA.
4.4 Process of Translation & Brief discussion of Post translational modifications
4.5 Regulation of gene expression Lac-operon & Trp operon

Unit – 5 Concept of Gene Cloning (Credit - 0.8)

5.1 Steps of Genetic Engineering & Enzymes involved
5.2 Cloning Vectors: Plasmids, Phages, Cosmids, BACs, YACs
5.3 Cloning strategies: Shot gun method, Homopolymer tailing, Linkers and Adaptors.
5.4 Screening of Recombinants (Blue white screening, Nucleic Acid Hybridization Method)
5.5 Applications of Genetic Engineering

PRACTICAL

Exp. 1 Isolation of genomic DNA from Bacteria
Exp. 2 Isolation of genomic DNA from Blood
Exp. 3 Isolation of plasmid DNA from Bacteria
Exp. 4 Quantitation of DNA by spectrophotometry

Exp. 5 Agarose gel electrophoresis of isolated DNA
Exp. 6 Bacterial transformation:
a. Preparation of competent cells
b. Transformation
Exp. 7 Restriction enzyme digestions and its analysis by gel electrophoresis
Exp. 8 U.V. Induced Mutagenesis.
Exp. 9 Problem solving on Mendelian Principles
Exp. 10 Problem solving on Hardy Weinberg Law of equilibrium
Exp. 11 Problem solving on Pedigree Analysis

LIST OF INSTRUMENTS

1. pH Meter
2. Hot Air Oven
3. Weigh Balance
4. Water Bath
5. Refrigerator
6. Autoclave
7. Spectrophotometer and/or Colorimeter
8. Incubator
9. Stirrer
10. Centrifuge
11. Vortex
12. Agarose Gel Electrophoresis Unit
13. Deep Freezer
14. Autopipettes
15. UV Transilluminator
16. UV Exposure Chamber

REFERENCES

1. Garder, Principles of genetics, Wiley Publications, 8th edition
2. Levin, Gene VI to Gene VIII, Oxford Pub.
3. T. A. Brown, Genome-3 3rd Edition
4. Old & primrose, Principle of Gene Manipulation, Blackwell Pub.
5. Griffith, Introduction to genetic analysis, Freeman publication, 8th edition
6. Robert Broker, Genetics, Mc Graw Hill
7. T. A. Brown, Gene Cloning DNA analysis-Blackwell Pub.
8. Stephen Hunt, Functional Genomics Oxford, Tokyo
9. Alberts. Molecular Biology of cell. Garland Pub.
10. Karp,Cell & Molecular Biology: concepts & Experiments.4th Edition.
11. Lodish,Cell & Molecular Biology,W.H.Freeman.5th Edn.
12. Watson, Molecular Biology of the Genes. Pearson Publication.
13. Becker. 1996. Biotechnology: A laboratory course
14. Glick, Molecular Biotechnology,ASM Publication.
15. Becker & Hardin, The world of the Cell, Pearson Pub.
16. Geoffrey Cooper ,The- Cell Molecular Approach, ASM Pub.
17. Ben Hui Liu, Statistical Genomics : Linkage, mapping & QTL Analysis, CRC press
18. Nicholl, An Introduction to Genetic Engg. - 2 ed, Cambridge

P.S. The above reference book list are common for all the unit

Annexure – "C"

FACULTY OF SCIENCE

Syllabus

Subject: **BIOTECHNOLOGY**

Course (Paper) Name & No.: Immunology (BT-503)

Course (Paper) Unique Code: 1603 1800 0105 0300

External Exam Time Duration: 2.5 Hours

Name of Program	Semester	Course Group	Credit	Internal Marks	External Marks	Practical /Viva Marks	Total Marks
Bachelor of Science	05	Core	7	30	70	50	150

Course Objective:

The aim of this paper is to provide the basic knowledge and understanding, the mechanism of immune system. It also imparts practical skills in immunology and the way it is applied in diagnostic, therapeutic techniques and research**.**

COURSE STRUCTURE FOR UG PROGRAMME

BIOTECHNOLOGY- 503

SEMESTER- V

Semester	Course	Title	Hours /week	Credit	Exam duration	Internal marks	External marks	Total marks
V	BT-503 (Theory)	Immunology	6	4	2.5 hrs	30	70	100
V	BT-503 (Practical)	Immunology	6	3	One day per batch	15	35	50
Total credits				7	Total marks			150

General instructions

1. The medium of instruction will be English for theory and practical courses
2. There will be 6 lectures / week / theory paper / semester.
3. Each lecture will be of 55 mins.
4. There will be 2 practical / week / paper / batch. Each practical will be of 3 periods
5. Each semester theory paper will be of "*five*" units. There will be 60 hrs. of theory teaching / paper / semester.
6. Each Theory Paper / Semester will be of 100 Marks. There will be 30 marks for internal evaluation and 70 marks for external evaluation. Each Practical Paper / Semester will be of 50 Marks with 15 marks for internal and 35 marks for external evaluation. So, Total Marks of Theory and Practical for each Paper will be 150. (100 + 50 = 150)

BT – 503 - IMMUNOLOGY

THEORY

Unit – 1: Overview of Immune system

1.1 Historical Perspective, Innate Immune response and its role in protection
1.2 Adaptive Immune response - Humoral and cellular component of the Immune response, Comparison between Innate and adaptive immunity.
1.3 Hematopoiesis
1.4 Cells of the Immune System.
1.5 Organs of the Immune System: Primary and Secondary Lymphoid Organs

Unit – 2 Antigen & Antibodies

2.1 Antigen: Characteristics of antigens, Factors that influence immunogenicity, Cross reactivity, Epitopes, Haptens, Adjuvants.
2.2 Immunoglobulins: Structure, Classification & Functions.
2.3 Monoclonal Antibodies: Production by Hybridoma Technology & Applications
2.4 Antigen and Antibody Interactions: Immunoprecipitation, Agglutination, RIA, ELISA & Western Blotting
2.5 Antigen and Antibody Interactions: Immunofluorescence based imaging techniques, flow cytometer

Unit – 3: MHC Complex and Antigen Presentation, Signal transduction in T cell and B cell

3.1 MHC: MHC molecules and organization of their genes, Structure and function of MHC gene products
3.2 Antigen Processing and Presentation
3.3 T- Cell Receptor
3.4 Signal transduction in T- Cell
3.5 Signal transduction in B- Cell

Unit – 4: Molecules of Immune system

4.1 Cytokines: Properties of Cytokines, Cytokine receptors, Function of Cytokines
4.2 Complement System: Function, Component, Activation and Regulation
4.3 Cell Mediated Effector Responses
4.4 Inflammation
4.5 Vaccines

Unit – 5: Important disease associated with Human disease

5.1 Immune response to Infectious Diseases: Viral (Influenza), Bacterial (Tuberculosis), Protozoan (Malaria)
5.2 Immunodeficiency Diseases – Primary (SCID) & Secondary (AIDS)
5.3 Autoimmune Diseases: Organ Specific (Graves' disease, Insulin dependent diabetes mellitus) and Systemic Autoimmune Diseases (Rheumatoid Arthritis, Multiple sclerosis).
5.4 Transplantation Immunology: Graft rejection, Evidence & Mechanism of Graft rejection, Prevention of Graft rejection, Immunosuppressive Drugs
5.5 Hypersensitive Reactions

LIST OF PRACTICAL

Exp. 1 Total & Differential Count of blood cells
Exp. 2 Agglutination & Precipitation:

- Blood Grouping
- Widal Test (Slide /Tube)
- Oucterlouny Double diffusion (ODD)
- HIV detection rapid test
- SRID (Single Radial Immunodiffusion) Test

- Latex Agglutination

Exp. 3 Dot ELISA,
Exp. 4 ELISA Test
Exp. 5 Rocket Immunoelectrophoresis (Demonstration)
Exp. 6 Gel Techniques; SDS PAGE/Western blot
Exp. 7 Antigen-Antibody reactions – Coomb's test.

LIST OF INSTRUMENTS

1. pH Meter
2. Hot Air Oven
3. Weigh Balance
4. Water Bath
5. Refrigerator
6. Autoclave
7. Spectrophotometer and/or Colorimeter
8. Incubator
9. Stirrer
10. Centrifuge
11. Vortex

REFERENCES

1. Janis Kuby, Immunology, 5th Edition
2. Ivan Roitt, Essential Immunology, 9th Edn.
3. Ananthnarayan, Medical microbiology
4. Mary S. Leffell,& Noel R. Rose, Handbook of Human Immunology, CR
5. Tizzard, Immunology
6. Elgert Immunology
7. Lidyard, Instant notes in Immunology, 2nd Edition.
8. Darla J wise, Immunology-A comprehensive review : A Blackwell science Pub.
9. Todd & Spickett, Immunology
10. Delves & Roitte Encyclopedia of Immunology- Vol-1 to Vol.-4, 2nd Edition
11. A handbook of practical and clinical immunology. Talwar GP and Gupta SK (1992) CBS Publications
12. Using Antibodies: A Laboratory Manual. Harlow & Lane (1998) Cold Spring Harbor Lab Press.
13. Immunological Techniques Made Easy. Cochet, et al. (1998) Wiley Publishers, Canada.
14. Clinical Immunology Principles and Laboratory Diagnosis. Sheehan (1990)

Annexure – "C"

FACULTY OF SCIENCE

Syllabus

Subject: **BIOTECHNOLOGY**

Course (Paper) Name & No.: Principles of Biotechnology Applied to Plants and Animals (BT-601)

Course (Paper) Unique Code: 1603 1800 0106 0100

External Exam Time Duration: 2.5 Hours

Name of Program	Semester	Course Group	Credit	Internal Marks	External Marks	Practical /Viva Marks	Total Marks
Bachelor of Science	06	Core	7	30	70	50	150

Course Objective:

The aim of this paper is to provide the basic knowledge and understanding of plant tissue culture and animal tissue culture technique. Paper also focus on the laboratory and greenhouse procedures and equipment used to propagate plants using micropropagation. Observe the commercial application of the technology by visiting a commercial plant tissue culture laboratory and animal tissue culture laboratory.

COURSE STRUCTURE FOR UG PROGRAMME
BIOTECHNOLOGY- 601
SEMESTER- VI

Sem	Course	Title	Hours /week	Credit	Exam duration	Internal marks	External Marks	Total Marks
VI	BT-601 (Theory)	Principles of Biotechnology Applied to Plants and Animals	6	4	2.5 hrs	30	70	100
VI	BT-601 (Practical)	Principles of Biotechnology Applied to Plants and Animals	6	3	One day per batch	15	35	50
Total credits				7	Total marks			150

GENERAL INSTRUCTIONS

1. The medium of instruction will be English for theory and practical courses
2. There will be 6 lectures / week / theory paper / semester.
3. Each lecture will be of 55 mins.
4. There will be 2 practical / week / paper / batch. Each practical will be of 3 periods
5. Each semester theory paper will be of "*five*" units. There will be 60 hrs. of theory teaching / paper / semester.
6. Each Theory Paper / Semester will be of 100 Marks. There will be 30 marks for internal evaluation and 70 marks for external evaluation. Each Practical Paper / Semester will be of 50 Marks with 15 marks for internal and 35 marks for external evaluation. So, Total Marks of Theory and Practical for each Paper will be 150. (100 + 50 = 150)

BT – 601 - PRINCIPLES OF BIOTECHNOLOGY APPLIED TO PLANTS AND ANIMALS

THEORY

Unit - 1 Plant Tissue Culture - I

1.1 Introduction, principles and history of plant tissue culture.
1.2 Laboratory requirements and aseptic techniques used in plant tissue culture
1.3 Culture medium: Nutritional requirements and role of PGRs under *in vitro* conditions
1.4 Explant: Characteristics, Selection and Sterilization
1.5 Callus culture

Unit - 2 Plant Tissue Culture - II

2.1 Haploids: Anther & pollen culture
2.2 Somaclonal variations; causes and effects
2.3 Somatic embryogenesis & synthetic seed production
2.4 Protoplast Culture: Principle, Methods of fusion, somatic hybridization
2.5 Strategies for Identification of hybrids after fusion.

Unit - 3 Plant Tissue Culture - III

3.1 Genetic transformation in plants: Vector mediated & Non vector mediated methods.
3.2 Secondary metabolite production from plants using in vitro tools.
3.3 Bioreactors for cell culture techniques.
3.4 Application of plant tissue culture.
3.5 Transgenic plants applications - "Plantibodies, Edible Vaccines & BT Cotton"

Unit - 4 Animal Tissue Culture - I

4.1 Animal tissue culture: History, Scope & importance
4.2 Laboratory requirements & aseptic techniques
4.3 Culture medium: Requirements, Types: Natural, chemically defined & synthetic media
4.4 General procedure for tissue culture: Disaggregation (Enzymatic & Non enzymatic)
4.5 Maintenance, Quantitation.

Unit - 5 Animal Tissue Culture - II

5.1 Primary culture, Secondary culture (Transformed cell & continuous cell lines)
5.2 Cloning & Selection of Cell lines
5.3 In Vitro Fertilization: Need & general Methodology
5.4 Transformation method in animals: Biological, Physical & Chemical.
5.5 Application of transgenic animals

PRACTICAL

Exp. 1 Organization of plant tissue culture laboratory: facilities & equipment
Exp. 2 Introduction to aseptic techniques: washing, packing & sterilization
Exp. 3 Preparation of stock solutions and plant tissue culture medium (MS medium)
Exp. 4 Establishment of callus culture from leaf/internode explant
Exp. 5 Study of characteristics of callus
Exp. 6 Production of haploids through anther culture
Exp. 7 Establishment of culture through shoot tip for elimination of virus
Exp. 8 Isolation of Protoplast through enzymatic methods
Exp. 9 Total genomic DNA isolation from plants (CTAB method/Dellaporta method)
Exp. 10 Preparation of BSS (Balance salt solution) and serum free media for culturing of animal cells (Theory)

LIST OF INSTRUMENTS

1. pH Meter
2. Hot Air Oven
3. Weigh Balance
4. Water Bath
5. Refrigerator
6. Incubator
7. Autoclave
8. UV Spectrophotometer and Colorimeter
9. Incubator
10. Stirrer
11. Vortex
12. Centrifuge
13. Agarose Gel Electrophoresis Unit
14. Deep Freezer
15. Autopipettes
16. UV Transilluminator
17. Laminar Air Flow Hood
18. Filter Sterilization Unit

REFERENCES

1. Introduction to Plant Tissue Culture: M.K. Razdan
2. Plant Tissue Culture Theory & Practical: S.S. Bhojwani & M.R. Razdan
3. Plant Tissue Culture: Kalyankumar Dey.
4. Slan A.C. (1996) Plant Tissue Culture- Oxford & BH Publishing co. Pvt. Ltd.
5. Lydiane kyle John Kleyin plant test tubes: An Introduction to micro propagation.
6. Introduction to plant biotechnology by H.S. Chawla
7. Animal Tissue Culture - Mathur
8. Animal Tissue Culture - Freshney
9. Animal biotechnology – Ranga
10. Cell & Tissue Culture in animals – Masters

P.S. The above reference book list are common for all the unit

Annexure – "C"

FACULTY OF SCIENCE

Syllabus

Subject: **BIOTECHNOLOGY**

Course (Paper) Name & No.: Analytical Techniques in Biotechnology (BT-602)

Course (Paper) Unique Code: 1603 1800 0106 0200

External Exam Time Duration: 2.5 Hours

Name of Program	Semester	Course Group	Credit	Internal Marks	External Marks	Practical /Viva Marks	Total Marks
Bachelor of Science	06	Core	7	30	70	50	150

Course Objective:

The objective of the paper is to impart the fundamental knowledge of various techniques used in biotechnology. Mainly students learns about the principles, instrumentation and applications of analytical techniques in industry and research.

COURSE STRUCTURE FOR UG PROGRAMME

BIOTECHNOLOGY- 602

SEMESTER- VI

Sem	Course	Title	Hours /week	Credit	Exam duration	Internal marks	External Marks	Total Marks
VI	BT-602 (Theory)	Analytical Techniques in Biotechnology	6	4	2.5 hrs	30	70	100
VI	BT-602 (Practical)	Analytical Techniques in Biotechnology	6	3	One day per batch	15	35	50
Total credits				7	Total marks			150

General instructions

1. The medium of instruction will be English for theory and practical courses
2. There will be 6 lectures / week / theory paper / semester.
3. Each lecture will be of 55 mins.
4. There will be 2 practical / week / paper / batch. Each practical will be of 3 periods
5. Each semester theory paper will be of "*five*" units. There will be 60 hrs. of theory teaching / paper / semester.
6. Each Theory Paper / Semester will be of 100 Marks. There will be 30 marks for internal evaluation and 70 marks for external evaluation. Each Practical Paper / Semester will be of 50 Marks with 15 marks for internal and 35 marks for external evaluation. So, Total Marks of Theory and Practical for each Paper will be 150. (100 + 50 = 150)

BT – 602 - ANALYTICAL TECHNIQUES IN BIOTECHNOLOGY

THEORY

Unit – 1: Basic Principles & Radioactivity

1.1 Quantitative biochemical measurements, Unit of measurements and safety in the laboratory
1.2 Radioisotope Techniques: The nature of radioactivity -atomic structure, atomic stability and radiation, types of radioactive decay, units of radioactivity.
1.3 Detection and measurement of radioactivity. Geiger Muller Counters, Scintillation Counting, Autoradiography,
1.4 Applications of Radioactivity
1.5 Health hazards associated with radioactivity safety guidelines

Unit – 2: Electrophoresis & Centrifugation

2.1 Electrophoresis: - Basic Principle, Support media
2.2 Agarose electrophoresis, PAGE, SDS PAGE, 2D PAGE
2.3 Isoelectric focusing, Capillary Electrophoresis
2.4 Centrifugation: Introduction, Basic Principle of Sedimentation, the basic components of centrifuge {Electric rotor, Drive Shaft, Rotors to hold Tubes etc.}
2.5 Preparative and analytical Centrifuges; Density gradient Centrifugation {Zonal and Isopycnic}, Differential Centrifugation

Unit – 3 Spectroscopic Techniques

3.1 Spectroscopy: Properties of electromagnetic radiation, Interaction of EM radiation with matter. Physical Phenomenon-Absorption, Emission, Refraction, Diffraction, Transmission, Fluorescence
3.2 Beer Lamberts Law, Extinction Coefficient, Principle and Application: UV-Visible light Spectroscopy. Microtiter plate and its applications
3.3 Atomic Absorption & Emission Spectroscopy
3.4 X ray Diffraction and Crystallization-Basic principle & biological applications.
3.5 Brief Overview of IR, Raman spectroscopy & NMR Principle & biological applications.

Unit – 4 Chromatography

4.1 Chromatography: Chromatography theory (plate theory and rate theory) and principles
4.2 Properties of solvents (MP), stationary phase and supporting phase.
4.3 Classifications of the technique, Types: Paper Chromatography, TLC, Column Chromatography, Partition, Adsorption, Ion exchange, size exclusion, Affinity chromatography.:
4.4 Principle, instrumentation and applications of GC/GLC,
4.5 Principle, instrumentation and applications of HPLC, UPLC and FPLC

Unit – 5 Recent advances in analytical technique and IPR

5.1 Biosensors: - Introduction, Principle, Characteristics of Ideal Biosensor, Application of Biosensor
5.2 Different types of biosensors
5.3 Nanotechnology: Fundamental Concept, Techniques & Applications.
5.4 Mass Spectroscopy: Principal, Instrumentation, Types and Applications
5.5 Patenting and IPR

LIST OF PRACTICAL

Exp. 1 Laboratory safety rules
Exp. 2 Complementary color
Exp. 3 Determining λmax of given solution using spectroscopy

Quantification of Protein using

Exp. 4 Folin-Lowry assay
Exp. 5 Bradford's method
Exp. 6 Spectrometric assay
Exp. 7 Centrifugation
a) Principles and Instrumentation

b) Problem solving g and RPM of centrifuge

Chromatography

Exp. 8 Solvent-Solvent extraction for plant pigments
Exp. 9 Separation of amino acids by Thin Layer chromatography
Exp. 10 Separation of plant pigments/ Amino acids by Paper Chromatography
Exp. 11 Demonstration of gel filtration/ ion exchange chromatography
Exp. 12 Polyacrylamide gel electrophoresis
Exp. 13 Ammonium Sulphate precipitation.
Exp. 14 Desalting of protein by dialysis

LIST OF INSTRUMENTS

1. pH Meter
2. Hot Air Oven
3. Weigh Balance
4. Water Bath
5. Refrigerator
6. Autoclave
7. Spectrophotometer and/or Colorimeter
8. Incubator
9. Stirrer
10. Centrifuge
11. Electrophoresis unit (PAGE Apparatus)
12. Chromatography unit
13. Filter unit
14. Separating Funnel
15. TLC Chamber

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1. Harmes. Biochemistry.2nd Ed. Viva Book.
2. Fisher. Chemistry for biologists. Viva Books.
3. Wilson, & Walker. 1995. Principles and techniques of practical Biochemistry. Cambridge Univ. Press.
4. Davidson V.L. & Sittman. 1993. Biochemistry.
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7. Becker. 1996. Biotechnology: A laboratory course. Alp
8. Plumner. An introduction to practical Biochemistry.
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10. Chirikjian, J.P. 1995. Biotechnology Theory and Technique for undergraduate laboratories Vol.1. Jones and Barlett Pub.
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16. Elliott & Elliott. 2001. Biochemistry and molecular bilogy. OUP.
17. Millar Thomas. (ED). 2000. Biochemistry explained: A practical guide to learning Biochemistry. Hardwood Aca. Publ.
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19. Hargreaves and Thmpson (Ed). 1999. Biochemistry of Exercises X. Human Kinetics Publ.
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21. Seidman and Moore. 2000. Basic laboratory methods for biotechnology. Longman

Annexure – "C"

FACULTY OF SCIENCE

Syllabus

Subject: **BIOTECHNOLOGY**

Course (Paper) Name & No.: Advanced Molecular Techniques & Bioinformatics (BT-603)

Course (Paper) Unique Code: 1603 1800 0106 0300

External Exam Time Duration: 2.5 Hours

Name of Program	Semester	Course Group	Credit	Internal Marks	External Marks	Practical /Viva Marks	Total Marks
Bachelor of Science	06	Core	7	30	70	50	150

Course Objective:

The objective of the paper is to understand techniques used in molecular biology for the analysis of macromolecules and genetic material. It also gives basic knowledge of using bioinformatics tools and its application.

COURSE STRUCTURE FOR UG PROGRAMME

BIOTECHNOLOGY- 603

SEMESTER- VI

Sem	Course	Title	Hours /week	Credit	Exam duration	Internal marks	External Marks	Total Marks
VI	BT-603 (Theory)	Advanced Molecular Techniques & Bioinformatics	6	4	2.5 hrs	30	70	100
VI	BT-603 (Practical)	Advanced Molecular Techniques & Bioinformatics	6	3	One day per batch	15	35	50
Total credits				7	Total marks			150

General instructions

1. The medium of instruction will be English for theory and practical courses
2. There will be 6 lectures / week / theory paper / semester.
3. Each lecture will be of 55 mins.
4. There will be 2 practical / week / paper / batch. Each practical will be of 3 periods
5. Each semester theory paper will be of "*five*" units. There will be 60 hrs. of theory teaching / paper / semester.
6. Each Theory Paper / Semester will be of 100 Marks. There will be 30 marks for internal evaluation and 70 marks for external evaluation. Each Practical Paper / Semester will be of 50 Marks with 15 marks for internal and 35 marks for external evaluation. So, Total Marks of Theory and Practical for each Paper will be 150. (100 + 50 = 150)

BT – 603 - Advanced Molecular Techniques & Bioinformatics

THEORY

Unit – 1 Molecular Biology-1

1.1 DNA Amplification: PCR -Types and Applications
1.2 DNA Sequencing: Maxam Gillbert, Sangers Dideoxy
1.3 Next Generation Sequencing
1.4 Artificial synthesis of DNA (Gene Machine/ DNA Synthesizer)
1.5 Hybridization Techniques: Southern, Northern & Western Blotting

Unit - 2 Molecular Biology-2

2.1 Molecular Markers: AFLP, RFLP, RAPD, SSR, SNP, Micro satellite & Mini satellite
2.2 Gene Therapy
2.3 Restriction Mapping
2.4 DNA Foot Printing
2.5 Chromosome Walking & Chromosome Jumping

Unit – 3 Introduction to Bioinformatics

3.1 Overview of Genome projects & Human Genome Project
3.2 Overview of Bioinformatics, Branches & Applications
3.3 Major Bioinformatics Resources: NCBI, EBI, SIB, ExPASy, JCVI, SANGER Institute, KEGG, NIH, NIG
3.4 Biological Databases: Nature of Biological data, Importance of Biological Databases in Biological Discovery
3.5 Brief classification of Biological Databases (Based on Nucleic Acids Research (NAR) Journal)

Unit – 4 Biological Databases

4.1 Differences and sources of primary and secondary databases with a few examples
4.2 Nucleic acid sequence databases: GenBank, ENA, DDBJ
4.3 Protein databases: UniProt, InterPro, RCSB-PDB & MMDB
4.4 Introduction to literature databases: PubMed, PMC, OMIM & NCBI Bookshelf
4.5 Structural Classification of Proteins: SCOP & CATH

Unit – 5 Bioinformatic Tools

5.1 Pairwise and Multiple Sequence Alignment & Basics of Phylogenetic Analysis
5.2 Similarity search tools: BLAST, FASTA
5.3 Overview of Comparative & Functional Genomics (Basics of Microarray protocol and introduction to RNA-Seq)
5.4 Primer Designing: Basic concept & Bioinformatics tools
5.5 Computer Aided Drug Discovery

LIST OF INSTRUMENTS

1. PCR
2. Bioinformatics softwares

LIST OF PRACTICAL

1. Retrieve DNA sequences from GenBank, ENA & DDBJ
2. Retrieve Protein Sequence from UniProt
3. Analyze protein sequence with the help of InterPro

4. Retrieve literature: Research & Review articles; Books & Book chapters from PUBMED, OMIM, NCBI Bookshelf
5. Find the Database similarity search through BLAST & FASTA.
6. Multiple sequence alignment of the given sequences by using ClustalW
7. Primer designing Softwares
8. Retrieve protein 3D structure from RCSB-PDB & visualization and measurement of bond length, bond angle and torsion angles using RasMol, SPDBV & PyMol.
9. Amplification of DNA by PCR (Demonstration)
10. Problem based on Restriction Mapping (ReBase)

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2. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins by A.D. Baxevanis and B.F.F Ouellette, Wiley Interscience.
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