Shree Manibhai Virani and Smt. Navalben Virani Science College, Rajkot (Autonomous)
Affiliated to Saurashtra University, Rajkot

Department of Biotechnology

B. Sc. BIOTECHNOLOGY
Regulations for Students Admitted from A.Y. 2016-2017 & Onwards

ELIGIBILITY

Candidate who has passed 02 years Higher Secondary Certificate (10+2) examination with Science subjects in respective streams of Gujarat State or any other examination recognized as equivalent thereto with a good academic record, shall be eligible for admission, subject to such other conditions prescribed by the Saurashtra University and State Government from time to time. All admissions are provisional and subject to the approval of Saurashtra University.

DURATION OF THE PROGRAMME

The Programme shall extend over a period of three years comprising of six semesters with two semesters in one academic year. Each semester normally consists of 90 teaching days.

STRUCTURE OF THE PROGRAMME

The UG programme shall have a curriculum comprising theory and practical courses with a specified syllabus. The curriculum of the programme is a blend of theory courses and practical courses as Core, Discipline Specific Electives (DSE) and Generic Electives (GE). In addition, project, internship/training and personality development courses as Ability Enhancement Courses (AEC) and Skill Enhancement Courses (SEC) shall be offered.

The medium of instruction and examinations shall be English except for courses on languages other than English

EVALUATION

The evaluation shall generally comprise of Continuous Internal Evaluation (CIE) and Semester End Examination (SEE) with percentage weightage as specified below, unless specified otherwise in the Scheme of Instruction and Examinations.

Theory Courses		***Practical Courses***	
Continuous Internal Evaluation (CIE)	30%	Continuous Internal Evaluation (CIE)	40%
Semester End Examination (SEE)	70%	Semester End Examination (SEE)	60%

For the purpose of computation of credits the following mechanism is adopted:

a) 1 hour instruction of Theory = 1 Credit
b) 1 hour instruction of Tutorial = 1 Credit
c) 2-3 hours instructions of Practical = 1 Credit

ISSUE OF MARKSHEET AND DEGREE CERTIFICATE

The college shall publish the result after evaluation and with the recommendations of Result Passing Board at the end of each semester. On approval/ratification of the results by the Academic Council, the candidate will be recommended to Saurashtra University for award of the degree on completion of all courses and components of the curriculum.

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SCHEME OF INSTRUCTION AND EXAMINATIONS

For Students Admitted from A.Y. 2016-2017 & Onwards

Semester I							
Course Code	**Course**	**Hrs. of Instruction/ week**	**Exam Duration (Hours)**	**Maximum Marks**			**Credits**
				CIE	**SEE**	**Total**	
Part -I							
16ULCEN01	Functional English-I	3	3	40	60	100	3
Part -II							
16UBTCC01	**Core 1:** Cell Biology	4	3	30	70	100	4
16UBTCC02	**Core 2:** Biomolecules	4	3	30	70	100	4
16UBTDA01	**DSE-Allied 1:** Chemistry-I	4	3	30	70	100	4
16UBTCC03	**Core Practical 1**: Cell Biology Practical	4	3	20	30	50	2
16UBTCC04	**Core Practical 2**: Biomolecules Practical	6	3	20	30	50	3
16UBTDA02	**DSE-Allied Practical 1**: Chemistry –I Practical	2	3	20	30	50	1
-	Lab to Land	1	-	-	-	-	-
		28				**550**	**21**
Part-III							
	AECC-1 : Environmental Science	1	--	-	-	-	-
	SEC-1: Value Education -I	1	--	Remarks			1
		30					

Semester II							
Course Code	**Course**	**Hrs. of Instruction/ week**	**Exam Duration (Hours)**	**Maximum Marks**			**Credits**
				CIE	**SEE**	**Total**	
Part- I							
16ULCEN02	Functional English- II	3	3	40	60	100	3
Part -II							
16UBTCC05	**Core -3**: Fundamentals of Microbiology	4	3	30	70	100	4
16UBTCC06	**Core -4:** Cellular Metabolism	4	3	30	70	100	4
16UBTDA03	**DSE- Allied 2:** Chemistry -II	4	3	30	70	100	4
16UBTCC07	**Core Practical 3**: Fundamentals of Microbiology Practical	5	6*	20	30	50	3
16UBTCC08	**Core Practical 4**: Cellular Metabolism Practical	5	3	20	30	50	2
16UBTDA04	**DSE- Allied Practical 2:** Chemistry-II Practical	2	3	20	30	50	1
	Lab to Land	1	-	-	-	-	-
		28				**550**	**21**
Part -III							
	AECC-1 : Environmental Science	1	--	Remarks			2
	SEC 2: Value Education -II	1	--	Remarks			1
		30					

Semester III							
Course Code	**Course**	**Hrs. of Instruction/ week**	**Exam Duration (Hours)**	**Maximum Marks**			**Credits**
				CIE	**SEE**	**Total**	
Part -I							
16ULCEN03	Advanced English Language -I	3	3	40	60	100	3
Part- II							
16UBTCC09	**Core -5:** Genetics	4	3	30	70	100	4
16UBTCC10	**Core -6:** Molecular Biology	4	3	30	70	100	4
16UBTCC11	**Core -7:** Mathematics for Biologist	4	--	100	--	100	4
16UBTDA05	**DSE- Allied 3:** Plant Science	4	3	30	70	100	4
16UBTCC12	**Core Practical 5**: Genetics and Molecular Biology Practical	6	6	40	60	100	3
16UBTDA06	**DSE- Allied Practical 3**: Plant Science Practical	2	3	20	30	50	1
	Lab to Land	2	--	--	-	-	-
		29				**650**	23

Semester IV							
Course Code	**Course**	**Hrs. of Instruction/ week**	**Exam Duration (Hours)**	**Maximum Marks**			**Credits**
				CIE	**SEE**	**Total**	
Part -I							
16 U LCEN04	Advanced English Language - II	3	3	40	60	100	3
Part- II							
16UBTCC13	**Core -8:** Analytical Techniques	4	3	30	70	100	4
16UBTCC14	**Core -9:** Plant Biotechnology	4	3	30	70	100	4
16UBTDA07	**DSE- Allied 4:** Animal Science	4	3	30	70	100	4
16UBTCC15	**Core Practical 6:** Analytical Techniques Practical	4	3	20	30	50	2
16UBTCC16	**Core Practical 7:** Plant Biotechnology Practical	5	3	20	30	50	2
16UBTDA08	**DSE- Allied Practical 4:** Animal Science Practical	2	3	20	30	50	1
16UBTCC17	Lab to Land	2	--	100	-	100	1
		28				**650**	21

Semester V							
Course Code	**Course**	**Hrs. of Instruction/ week**	**Exam Duration (Hours)**	**Maximum Marks**			**Credits**
				CIE	**SEE**	**Total**	
Part -II							
16UBTCC18	**Core 10: Bioprocess Engineering**	4	3	30	70	100	4
16UBTCC19	**Core 11: Immunology**	4	3	30	70	100	4
16UBTCC20	**Core 12: Physiology (Self Study)**	1	2	15	35	50	4
16UBTDC01/ 16UBTDC02/ 16UBTDC03	**DSE-Core 1: Food and Dairy / Forensic Science/ Pharmaceutical Biotechnology**	4	3	30	70	100	4
16UBTCC21	**Core Practical 08: Bioprocess Engineering Practical**	5	6	20	30	50	3
16UBTCC22	**Core Practical 09: Immunology Practical**	4	4	20	30	50	2
16UBTDC04/ 16UBTDC05/ 16UBTDC06	**DSE-Core Practical 1: Food and Dairy Practical / Forensic Science Practical / Pharmaceutical Biotechnology Practical**	2	4	20	30	50	1
16UBTCC23	**Core 13: CBT**	-	-	100	-	100	1
	Generic Elective -I	2	-	100	-	100	2
	Project / Internship / Training	2	-	-	-	-	-
		28				**700**	**25**

Semester VI							
Course Code	**Course**	**Hrs. of Instruction/ week**	**Exam Duration (Hours)**	**Maximum Marks**			**Credits**
				CIE	SEE	Total	
Part- II							
16UBTCC24	**Core- 14: rDNA Technology**	4	3	30	70	100	4
16UBTCC25	**Core- 15: Bioinformatics**	3	3	30	70	100	3
16UBTCC26	**Core- 16: Environmental Biotechnology**	3	3	30	70	100	3
16UBT DC07/ 16UBT DC08/ 16UBT DC09	**DSE-Core 4: Molecular Diagnosis and Drug Designing/ Biosafety and IPR / Animal biotechnology**	4	3	30	70	100	4
16UBTCC27	**Core Practical 10: rDNA Technology and Environmental Biotechnology Practical**	3	6	40	60	100	1
16UBTCC28	**Core Practical 11: Bioinformatics Practical**	2	4	20	30	50	1
16UBT DC10/ 16UBT DC11/ 16UBT DC12	**DSE-Core Practical 4: Molecular Diagnosis and Drug Designing Practical /Biosafety and IPR Practical / Animal Biotechnology: Practical**	2	4	20	30	50	1
16UBTCC29	**Project / Internship / Training**	6	-	60	40	100	2
	Generic Elective - II	2	-	100	-	100	2
		29				**800**	**21**
						Total Marks :	**3900**

* 3hrs each on Day1 and Day 2.

Part III

Part III						
Course Code	Semester	Particulars	Hrs of instruction/week	No. of Courses	Credit/Course	Total Credits
Ability Enhancement Compulsory Course (AECC)						
As per common list	I & II	**AECC-I** Environment Science	1	1	2	2
	IV & V	**AECC-II** Communication Skill/Soft Skills	2	2	1	2
					Sub Total	**4**
Skill Enhancement Course (SEC)						
As per common list	I	**SEC-I** Value Education-I	1	1	1	1
	II	Value Education-II	1	1	1	1
	Any Semester between II - V	**SEC-II** *Co-Curricular Course	> 40 hours in total	1	1	1
	Any Semester between II - V	**SEC-III** **Value Added Courses	40 hours in total	1	1	1
					Sub Total	4
					Grand Total	8

***Co-Curricular Courses** - Option to students to choose 1 from a list of courses offered by the college, such as Add on Courses, Gandhian Studies Certificate Course, Women Studies Course, etc.

****Value Added Courses** - Option to student to choose at least 1 from a list of courses offered by UG departments.

TOTAL MARKS & CREDIT DISTRIBUTION

S.NO	PART	Total Marks	Total Credits
1.	**PART I:** Language Course	400	12
2.	**PART II :** Core, DSE Allied, DSE Elective, Generic Elective	3500	120
3.	**PART III:** AECC- I & II, SEC- I,II & III	Remarks	08
TOTAL		**3900**	**140**

- **PART- I: LANGUAGE COURSE**

The following are compulsory courses offered in First to Fourth semesters

S.No	Semester	Course Code	Course
1.	I	16ULCEN01	Functional English- I
2.	II	16ULCEN02	Functional English- II
3.	III	16ULCEN03	Advanced English Language -I
4.	IV	16ULCEN04	Advanced English Language -II

- **PART-II: CORE, DSE ALLIED, DSE CORE, GE**

CORE COURSES [Theory]

S.No	Semester	Course Code	Course
1.	I	16UBTCC01	Cell Biology
2.		16UBTCC02	Biomolecules
3.	II	16UBTCC05	Fundamentals of Microbiology
4.		16UBTCC06	Cellular Metabolism
5.	III	16UBTCC09	Genetics
6.		16UBTCC10	Molecular Biology
7.		16UBTCC11	Mathematics for Biologist

8.	IV	16UBTCC13	Analytical Techniques
9.		16UBTCC14	Plant Biotechnology
10.	V	16UBTCC18	Bioprocess Engineering
11.		16UBTCC19	Immunology
12.		16UBTCC20	Physiology (Self-Study)
13.		16UBTCC23	Computer Based Test (MCQs on Fundamentals and Principles of Core up to 5th Semester)
14.	VI	16UBTCC24	rDNA Technology
15.		16UBTCC25	Bioinformatics
16.		16UBTCC26	Environmental Biotechnology

- **CORE COURSE [Practical]**

S.No	Semester	Course Code	Course
1.	I	16UBTCC03	Cell Biology Practical
2.		16UBTCC04	Biomolecules Practical
3.	II	16UBTCC07	Fundamentals of Microbiology Practical
4.		16UBTCC08	Cellular Metabolism Practical
5.	III	16UBTCC12	Genetics & Molecular Biology Practical
6.	IV	16UBTCC15	Analytical Techniques Practical
7.		16UBTCC16	Plant Biotechnology Practical
8.	I-IV	16UBTCC17	Lab to Land
9.	V	16UBTCC21	Bioprocess Engineering
10.		16UBTCC22	Immunology
11.	VI	16UBTCC27	rDNA Technology & Environmental Biotechnology
12.		16UBTCC28	Bioinformatics

- **OTHER CORE COURSES**

S.No.	Semester	Course Code	Course
1.	V-VI	16UBTCC29	Project / Internship / Training

DSE CORE COURSE (Theory & Practical)

Students are required to opt for any one of the courses offered in the Fifth and Sixth semester respectively

S. No	Semester	Theory		Practical	
		Course Code	Course	Course Code	Course
1.	V	16UBT	Food and Dairy	16UBT	Food and Dairy Science

		DC01/	Science/	DC04/	Practical/
		16UBT DC02/	Forensic Science/	16UBT DC05/	Forensic Science Practical/
		16UBT DC03	Pharmaceutical Biotechnology	16UBT DC06	Pharmaceutical Biotechnology Practical
2.	VI	16UBT DC07/	Molecular Diagnosis and Drug Designing/	16UBT DC10/	Molecular Diagnosis and Drug Designing Practical/
		16UBT DC08/	Biosafety and IPR /	16UBT DC11/	Biosafety and IPR Practical/
		16UBT DC09	Animal Biotechnology	16UBT DC12	Animal Biotechnology Practical

DSE ALLIED COURSES (Theory)

S.No	Semester	Course Code	Course
1.	I	16UBTDA01	Chemistry I
2.	II	16UBTDA03	Chemistry II
3.	III	16UBTDA05	Plant Science
4.	IV	16UBTDA07	Animal Science

- **DSE ALLIED SUBJECT [Practical]**

S.No	Semester	Course Code	Course
1.	I	16UBTDA02	Chemistry I
2.	II	16UBTDA04	Chemistry II
3.	III	16UBTDA06	Plant Science
4.	IV	16UBTDA08	Animal Science

- **GENERIC ELECTIVE**

S.No	Semester	Course
1.	V	Any one course from list of courses offered under UG Departments
2.	VI	

- **PART III :- AECC & SEC**

Part III						
Course Code	Semester	Particulars	Hrs of instruction/week	No. of Courses	Credit/Course	Total Credits
Ability Enhancement Compulsory Course (AECC)						
As per common list	I & II	**AECC-I** Environment Science	1	1	2	2
	IV & V	**AECC-II** Communication Skill/Soft Skills	2	2	1	2
					Sub Total	**4**
Skill Enhancement Course (SEC)						
As per common list	I	**SEC-I** Value Education-I	1	1	1	1
	II	Value Education-II	1	1	1	1
	Any Semester between II - V	**SEC-II** *Co-Curricular Course	> 40 hours in total	1	1	1
	Any Semester between II - V	**SEC-III** **Value Added Courses	40 hours in total	1	1	1
					Sub Total	4
					Grand Total	8

***Co-Curricular Courses** - Option to students to choose 1 from a list of courses offered by the college, such as Add on Courses, Gandhian Studies Certificate Course, Women Studies Course, etc.

****Value Added Courses** - Option to student to choose at least 1 from a list of courses offered by UG departments.

Courses offered by the department to UG students of other department

I. Generic Elective Course

S.No	**Semester**	**Course Code**	**Course**	**Name of Programme**
1.	V			For all Other UG Programmes
2.	VI			

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Department of Biotechnology Program

SYLLABUS FOR SEMESER V and VI

For B. Sc. BIOTECHNOLOGY

For Students Admitted from A.Y. 2016-2017 & Onwards

SEMESTER – V

16UBTCC18	**Core 10: Bioprocess Engineering**	**4hrs/week**	**4 Credits**

Objectives:

The student will be able to:

1. Learn and reinforce fundamental bioprocess principles, strain improvement and preservation techniques.
2. Understand basic design of bioreactor, mass transfer process and kinetic studies.
3. Ability to design growth parameter, media components and process optimization.
4. Understand separation and purification of fermentation product using various methods and calculate the economy of bioprocess.
5. Application of knowledge of bioprocess engineering for biological product and its biochemical pathway.

Unit 1: Basic of bioprocess and strain improvement (9 hrs)

- Introduction to bioprocess technology, Principle components of fermentation technology
- Isolation and Screening of microorganism- Primary and Secondary screening
- Strain Improvement by mutagenesis and isolation of mutants
- Strain Improvement by application of recombinant DNA technique
- Techniques for preservation and storage of cultures

Unit 2: Design of fermentor and growth kinetics (11 hrs)

- Submerged and Solid substrate fermentation
- Design of fermentor; Types of fermentor and bioreactor
- Oxygen transfer rate, Kla value determination
- Types of microbial culture: Batch, Continuous and Fedbatch culture
- Growth kinetics: Batch culture

Unit 3: Fermentation media and Process measurement (9 hrs)

- Starter culture, its importance and preparation
- Raw materials used in fermentation media
- Media optimization
- Bioprocess measurement- inline, online and offline
- Application of computer in control system

Unit 4: Downstream processing (10 hrs)

- Disruption of cells: Physical, chemical and mechanical methods
- Separation of cells: Flocculation, Floatation, Filtration (types of filter) and Centrifugation (types of centrifuge)
- Purification of product (Basic concepts): Solvent-Solvent Extraction, Distillation, Dialysis, Chromatography
- Concentration of product: Crystallization and Drying
- Fermentation Economics

Unit 5: Production of microbial products (9 hrs)

- Fermentation processes of alcohol
- Fermentation processes of organic acids (Gluconic acid & Citric acid)
- Fermentation processes of amino acids (Lysine), vitamins (Vit. B_{12})
- Fermentation processes of antibiotics (Penicillin)
- Fermentation processes of SCP

Text books:

1. Stanbury, P. F., Whitaker, A., & Hall, S. J. (2013). Principles of fermentation technology. Elsevier.
2. Crueger, W., & Crueger, A. (2006). Biotechnology: a textbook of industrial microbiology.

Reference books:

1. Shuler, M. L., & Kargi, F. (2002). Bioprocess engineering. New York: Prentice Hall.
2. Bailey, J. E., & Ollis, D. F. (1986). Biochemical. Engineering Fundamentals, McGraw-Hill, New York, 984.
3. Doran, P. M. (1995). Bioprocess engineering principles. Academic press.

16UBTCC19	Core 11: Immunology	4hrs/week	4 Credits

Objectives:

After completion of this course, student will be able to:

1. Understand the structure and functions of immune cells, immune organs and other components of immune system
2. Define and describe the structure and function of antigens and antibodies and basis of their interaction.
3. Understand the principles of antigen antibody interactions and will be able to perform the diagnostic test based on these reactions
4. Understand the molecular basis of clinical immunology immune related diseases and allergic responses

Unit 1: Immune system and immunity (10 hrs)

- Historical perspective and development of immunology
- Innate and adaptive immunity: major component and its role
- Structure and functions of cells involved in immune system; B and T lymphocyte, macrophages, Dentritic cells, natural killer cells and other blood leucocytes.
- Primary immune organs - Structure and functions of primary immune organs (thymus and bone marrow)
- Secondary immune organs - Structure and functions of secondary immune organs; lymph node, spleen and mucosal and cutaneous associated lymphoid tissue.(MALT & CALT)

. Unit 2: Antigens, immunoglobulin and complement system (10 hrs)

- Antigens – antigenicity and immunogenicity, structure, function and properties of antigen.
- Antigen specificity, epitopes, heptanes, cross reactivity and adjuvants.
- Immunoglobulin – structure, classification, properties and functions
- Monoclonal antibodies; method of production and applications
- Complement – structure, components, properties and functions of complement system, complement pathways and biological consequences of complement activation.

Unit 3: Antigen antibody interactions (10 hrs)

- Mechanism and forces involved in Ag/Ab interactions, affinity/avidity and cross reactivity.
- Agglutination; characteristics, properties and application of agglutination with examples ; agglutination inhibition

- Precipitation reactions; precipitation in fluid and gel, SRID, ODD and immuno electrophoresis.
- Radioimmunoassay; ELISA - principles and types of ELISA
- Western blotting and immuno-fluorescence

Unit 4: Antigen processing and presentation (9 hrs)

- Antigen processing and presentation and generation of humoral and cell mediated immune response
- Cytokines and their role in immune regulation
- MHC- general organization of MHC molecules and genes
- Mechanism of inflammation and cells involved in the process
- Hypersensitivity reactions

Unit 5: Clinical Immunology (9 hrs)

- Vaccines & Vaccination – DNA vaccines, recombinant vaccines, bacterial vaccines, viral vaccines, passive & active immunization, recent advancement in vaccination
- Immuno deficiency diseases - Primary Immuno deficiency (AIDS) and Secondary Immuno deficiency (SCID)
- Autoimmunity and autoimmune diseases - Organ Specific (Graves disease, Insulin dependent diabetes mellitus), Systemic Autoimmune Diseases (Rheumatoid Arthritis, Multiple sclerosis).
- Transplantation Immunology: Graft rejection, Evidence & Mechanism of Graft rejection
- Prevention of Graft rejection - Immunosuppressive Drugs

Text books:

1. Abbas, A.K., Lichtman, A.H. & Pillai, S. (2011). Cellular and Molecular Immunology (Sixth edition). Saunders Publication
2. Abbas, A. K., Lichtman, A. H., & Pillai, S. (2012). Basic immunology: functions and disorders of the immune system. Elsevier Health Sciences.
3. Delves, P., Martin, S., Burton, D. & Roitt, I.M. (2011). Roitt's Essential Immunology (Eleventh edition) Wiley-Blackwell Scientific Publication, Oxford.

Reference books:

1 Goldsby R.A., Kindt T.J., Osborne B.A. (2007). Kuby's Immunology. 6th edition W.H. Freeman and Company, New York.

2 Murphy K, Travers P, Walport M. (2008). Janeway's Immunobiology. 7th edition Garland Science Publishers, New York.

3 Peakman M, and Vergani D. (2009). Basic and Clinical Immunology. 2nd edition Churchill Livingstone Publishers, Edinberg.

4 Richard C and Geiffrey S. (2015). Immunology. 6th edition. Wiley Blackwell Publication.

16UBTCC20	Core 12: Physiology (Self Study)	1hrs/week	4 Credits

Objectives:
After completion of the course student will be able to:

1. Understand human physiology such as sensory, cardiovascular and renal regulation
2. Learn coordination of nervous with muscle for physiological activity
3. Understand and intricate the important relationship between plants and water, translocation and regulation of stomatal opening.
4. Able to distinguish elements required by plants, criteria for selection of nutrients; effect of light on plants like photorespiration, photoperiodism, seed germination and vernalization.

Unit 1: Sensory Physiology

- Structure of the eye
- Mechanism of vision
- Structure and function of auditory apparatus – external, middle and internal ears.
- Mechanism of hearing
- Regulation of body temperature in homeotherms

Unit 2: Cardio-Vascular and renal physiology

- Structure and function of heart
- Cardiac cycle
- Overview of electrocardiography
- Mechanism of urine formation
- Renal regulation of osmolarity, Role of renin-angiotensin system

Unit 3: Nerve-Muscle Physiology

- Propagation of nerve impulse
- Neurotransmitters
- Structure of skeletal, smooth and cardiac muscles
- The neuromuscular junction: structure, transmission
- Mechanism of muscle contraction and relaxation

Unit 4: Plant water relations and nutrition

- Water potential
- Mechanism of water transport
- Loss of water by guttation, transpiration and stomata (mechanism of opening & closing)
- Micro & macro nutrients: Roles and deficiency
- Mechanism of uptake of nutrients, mechanism of food transport

Unit 5: Photosynthesis and photoperiodism

- Photosynthesis- pigments, concept of photo systems, photphosphorylation
- Dark reaction- calvin cycle
- CAM plants, photorespiration
- Seed dormancy and seed germination
- Concept of photoperiodism and vernalization

Text books:

1. Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. /W.B. Saunders Company.
2. Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition. John wiley & sons,Inc.
3. Taiz, L. and Zeiger, E. 2006 Plant Physiology, 4th edition, Sinauer Associates Inc .MA, USA

Reference books:

1. Bhatia K.N. & Tyagi M.P. (2017 ed.). Trueman's Elementary Biology - Vol. 1. Trueman Book Company
2. Salisbury, F.B. and Ross, C.W. 1991 Plan t Physiology, Wadsworth Publishing Co. Ltd.
3. Hopkins, W.G. and Huner, P.A. 2008 Introduction to Plant Physiology. John Wiley and Sons.

16UBTDC01	DSE Core 1: Food and Dairy Science	4hrs/week	4 Credits

Objectives:

This course will impart the graduate students with knowledge about:

1. The industrial aspects of food and dairy biotechnology.
2. It explores manufacturing, preservation of food and food products
3. Course is intended to develop knowledge of food preservation and food industrial quality aspects
4. Student will develop knowledge and aware about food standards and safety.
5. This course will describe characteristics of food borne diseases and spoilage of food by microbes and their preservation techniques

Unit 1: Food Microbiology (8 hrs)

- Introduction to food and its types
- Microbes important in food microbiology
- Food safety acts and standards: FDA, FSSAI and HACCP
- Food poisoning, infection and intoxication
- Food borne diseases and their control

Unit 2: Food Spoilage and Preservation (10 hrs)

- Spoilage of various foods: Microbial, Physical & Enzymatic
- Factors affecting food spoilage: Intrinsic and Extrinsic factors
- Food preservation methods: Principle, Conventional methods of food preservation
- Preservation techniques: High temperature and Low temperature
- Applications of radiation, chemicals (Additives) in food preservation

Unit 3: Food Processing and Packaging (10 hrs)

- Food processing: Introduction, principles and applications
- Processing of Fruits and vegetables: Pickle, Jam and Sauerkraut
- Processing of Cereals and Pulses
- Processing of Fish, poultry and meat products
- Food packaging types and applications

Unit 4: Dairy Technology (10 hrs)

- Milk - Definition, composition and constituents of milk
- Microbial spoilage of milk and milk products

- Pasteurization of milk - Methods of Pasteurization – LTH, HTST, and UHT
- Microbiological assessment of milk: Dye reduction tests-MBRT Resazurin Test, Indicator Organisms, Direct Examination, Cultural techniques, Enumeration methods-plate counts, MPN and other molecular methods
- Overview of Production and Processing of milk products: Yoghurt, Curd, Cheese and Paneer

Unit 5: Advances in Food technology: (10 hrs)

- Neutraceuticals
- Functional foods
- Probiotics, Prebiotics and Synbiotics
- GM foods
- Agricultural GM crops

Text books:

1. "Food Microbiology" by W. C. Frazier & D.C. Westhoffs, IV th edn., Tata McGraw-Hill Publishing Company Ltd, New Delhi, India (1993)
2. Modern Food Microbiology by Jay JM Loessner MJ and Golden DA, 7th edition, CBS Publishers and Distributors, Delhi, India (2005)

Reference books:

1. Food Microbiology by Adams MR and Moss, MO, New Age International Limited publishers, New Delhi, India. (1995)
2. Industrial Microbiology by A. H. Patel, Mac Millan India Pvt. Ltd.
3. Modern Food Microbiology" by James M. Jay, IV th Edn. CBS Publishers Delhi (1993)
4. Applied Dairy Microbiology –Elmer Marth and James Steele 2nd edition, publisher Marcel Dekker Inc.
5. Basic Food Microbiology by Banwart JM 1ST Edition, CBS Publishers and Distributors, Delhi, India (1987)
6. Davidon PM and Brannen AL, Antimicrobials in Foods, Marcel Dekker, New York, (1993)

16UBTDC02	DSE Core 2: Forensic Science	4hrs/week	4 Credits

Objectives:

After completion of the course the student will be able to:

1. Understand the fundamentals of forensic sciences with emphasis on forensic biology
2. Demonstrate competency in the principles of crime scene investigation, including the recognition, collection, identification, preservation, and documentation of physical evidence.
3. Demonstrate an understanding of the scientific method and the use of problem-solving within the field of forensic science.
4. Understand the importance of serological and biotechnological techniques in forensic investigations

Unit 1: Introduction to forensic Sciences (9 hrs)

- Introduction, areas and history
- Basics of crime scene investigation: The sevens S's
- Types of evidence and Evidence collection
- Analysis of evidence
- Safety aspects

Unit 2: Forensic Biology (9 hrs)

- The decay, discovery and recovery of human bodies: The dead body, stages of decomposition, Factors affecting the speed of decay
- The decay, discovery and recovery of human bodies: Discovery and recovery of human remains, Determining the age and provenance of skeletonized remains
- Study of hair, bones and teeth
- Study of Fiber and textiles
- Pollen and spore examination

Unit 3: Illicit Drugs and Forensic toxicology (10 hrs)

- Introduction to illicit drugs
- Classification of illicit drugs: based on origin and psychoactive effects and their analysis
- Introduction to drugs, poisons and ethyl alcohol
- Identification of drugs in body
- Measurement of alcohol in body: blood and breath alcohol testing

Unit 4: Forensic Serology (10 hrs)

- Major body fluids: Blood, Semen, Saliva and Urine

- Collection of body fluids
- Presumptive and confirmatory test for blood, semen, saliva and urine
- Composition of Blood and Blood typing
- Crime scene investigation of blood and Blood spatter analysis

Unit 5: DNA based forensics **(10 hrs)**

- Sources of DNA and DNA identification at crime scenes
- Use of probes and PCR
- Collection and Preservation of DNA evidence
- DNA fingerprinting
- Analysis of DNA fingerprints

Text Books:

1. Gunn, A. (2009). Essential Forensic Biology (2nd Edition). John Wiley and Sons Let, U.K.
2. James, S.H., Nordby, J.J. (2011) Forensic Science: An Introduction to Scientific and Investigative Techniques (4th Edition)
3. Houck, M. M., Siegel, J. A. (2015) Fundamentals of Forensic Science (3rd Edition). Elsevier Ltd.

Reference books:

1. Bertino, A. J., Bertino, P.N. (2009) Forensic Science: Fundamentals and Investigations. Cengage Learning.
2. Anthony J. Bertino, Patricia Bertino. (2009) Forensic Science: Fundamentals and Investigations (2nd Edition). Cengage Learning, Sason, USA.
3. MacKay J. (2009) Forensic Biology. Gale Cengage Learning, Sason, USA.

16UBTDC03	DSE Core 3: Pharmaceutical Biotechnology	4hrs/week	4 Credits

Objectives:

This course will impart the graduate students with knowledge of Pharmaceutical industry to

To get better opportunities in pharmaceutical industry/laboratories/ Research institutes

1. To be equipped with terminologies of regulatory authorities
2. The course intended to impart knowledge about QC and QA with other departments
3. Student will develop knowledge and aware about Compliance, standards and safety
4. The course will also be a good foundation for the masters degree aspirants

Unit 1: General introduction of pharmaceutical Biotechnology (10 hrs)

- Introduction and types of Pharmaceutical Biotech industry
- Role of a Biotechnology in pharmaceutical industry
- Terminologies and procedures
- Components of manufacturing units and departments in industry
- Regulatory bodies in Pharmaceutical industry : USFDA, OECD Central Drugs Standard Control Organization (CDSCO)

Unit 2: Regulations and practices in pharmaceutical industry (10 hrs)

- Good laboratory practices and Good manufacturing practices in industry
- Quality Control in pharma industry : types and its role
- Total Quality Management System in Industry as per standards
- Quality Assurance : types, role and organization
- Compliance and Qualifications

Unit 3: Biotechnology in Pharma Industry (10 hrs)

- Biopharmaceuticals : Introduction types and applications
- Microbiology laboratory : Analysis in microbiology labs, sterile and non-sterile
- Vaccine production technology: Recombinant vaccines, Protein purification, r-DNA drugs, hormones and antibodies
- Production of important pharmaceutical proteins(Growth Factors, t-PA, Factor VIII) through animal cell culture
- Research and Development in pharmaceutical industry

Unit 4: Instrumentation in pharmaceutical biotech (10 hrs)

- Basics instruments and Equipments: Production, Analysis, Warehouse, Packaging, Engineering
- Clean rooms : Classification, Control, maintenance and importance
- Introduction of major instruments and their applications
- Walk in Incubators, Cold rooms, Archival chambers, pass box & dispensers
- Standard operating procedure its importance and applications

Unit 5: Advances in Pharma technology (08 hrs)

- Recombinant DNA vaccine technology
- Principles and application of the molecular diagnosis via protein, DNA and other bio-Molecular detections
- Applications of nanoparticles and Animal cell culture in Pharmaceuticals
- Genetically modified cell technology in Biopharmaceutical production
- Advances and future in Pharma biotechnology sector

Text books:

1. Vyas S. P., Dixit V. (2007) *Pharmaceutical Biotechnology,* CBS Publishers & Distributors
2. S.S. Kori and M. A. Halkai (2016) *Pharmaceutical Biotechnology fundamental and Applications,* 3rd Edt. Vallabh Prakashan
3. A. K. Seth (2006) Pharmaceutical Microbiology (Pratical) Ed 1. Pee Vee Publications Jalandhar

Reference books:

1. Stephen P. D., Norman A. H., Sean P. G., Brendan F. G. (2011) *Hugo & Russell Pharmaceutical Microbiology* 8th Ed. Wiley-Blackwell Publishing house
2. Sidney H.W. Murray M. Tuckerman, W., S.Hitchings IV. Mercel D. (2007) *Good Manufacturing Practices for Pharmaceuticals,* Second Edition, NC New York
3. Sandy Weinberg (2007) Good Laboratory Practices Essentials 4th Edn. CRC Press

16UBTCC21	Core Practical 8: Bioprocess Engineering Practical	5hrs/week	3 Credits

Objectives:

The student will be able to:

1. Isolate and screen industrially important microorganisms
2. Optimize process parameter essential for microbial growth to yield maximum product
3. Exploit isolated microorganisms for production and estimation of various metabolites

List of Experiments:

1. Isolation, Screening and characterization of Lipolytic, Proteolytic, Amylolytic microbes and enzyme
2. Screening of antibiotic producing microorganisms (Crowded & Wilkins method)
3. Determination of growth phases of microorganism
4. Optimization of medium parameters (pH, Temperature, Carbon & Nitrogen) for the production of biomass and enzymes
5. Demonstration of various techniques of bioassay for antibiotic
6. Estimation of sugar by DNSA and Cole's method
7. Alcohol Fermentation using Yeast
8. Estimation of alcohol
9. Fermentation of citric acid
10. Estimation of citric acid

References:

1. MacNeil, B., & Harvey, L. M. (Eds.). (1990). Fermentation: a practical approach. IRL press.
2. Cappuccino, J. G., Sherman, N., & Microbiology, A. (1983). A laboratory manual.
3. Kulandaivel, S. & Janarthanan, S. (1st Ed.). (2012). Practical Manual on Fermentation Technology. I K International Publishing House Pvt. Ltd

16UBTCC22	Core Practical 9: Immunology Practical	4hrs/week	2 Credits

Course Objectives:

After completion of this course, student will be able to:

1. Identify and count the blood cells
2. Understand the principal of Ag/Ab interaction and perform diagnostic test based on these interaction

Laboratory Exercise

1. To perform the total count of RBC
2. To perform the total count of WBC
3. To perform the differential count of WBC
4. ABO Blood Grouping
5. To perform the Widal Test to find out the presence or absence of *Salmonela* pathogen
6. Oucterlouny Double diffusion (ODD)
7. SRID (Single Radial Immunodiffusion)Test
8. HIV detection through rapid test
9. Latex Agglutination test
10. Dot ELISA/ELISA Test
11. Coomb's Test

References:

1 Goldsby R.A., Kindt T.J., Osborne B.A. (2007). Kuby's Immunology. 6th edition W.H. Freeman and Company, New York.

2 Talwar G.P. and Gupta S.K. (2017). A Handbook Of Practical And Clinical Immunology. 2nd edition CBS publisher, New Delhi.

3 Hay, F. C., & Westwood, O. M. (2008). Practical immunology. John Wiley & Sons.

16UBTDC04	DSE Core Practical 1: Food and Dairy Science Practical	2hrs/ week	1 Credits

Objectives:

1. To acquire skills to examine food and milk for its microbial load.
2. To understand the role of microbes in milk and food
3. To identify different microbes associated with food, enumerate them and understand their role
4. To evaluate different parameters affecting food quality and methods of preparation of different dairy products.

List of Experiments:

1. Isolation of lactic acid bacteria from curd samples
2. Isolation of lactococcal cultures from fermented milk
3. Isolation of lipolytic microorganisms from butter.
4. Isolation of spoilage microorganisms from spoiled vegetables/fruits.
5. Examination of purity and activity of starter cultures;
6. Preparation of concentrated starters and quality evaluation;
7. Production of bacteriocins by LAB.
8. Estimation of milk sugar by Benedict's method.
9. Determination of Calcium in milk.
10. Determination of Magnesium in milk.
11. Qualitative analysis of milk sample by Methylene Blue Reduction Time Test.
12. Enumeration of bacteria in milk by Standard Plate Count.
13. Determination of efficiency of pasteurization of milk by alkaline phosphatase test.
14. Microbiological examination of foods (Canned food, Packed food)
15. Microbiological examination of packaged beverages and drinking water as per standards
16. Determination of food quality (Adulterant) by Organoleptic and RPT test

References:

1. Baker, F.J., Breach, M.R. (1967). Handbook of Bacteriological Technique: Butterworth & Co Publishers Ltd.
2. Smith, S (2010) Food Biotechnology Practical Manual, Deakin University.
3. Dietrich, W. K. (2004) Food Science and technology by Taylor and Fransis.

16UBTDC05	DSE Core Practical : Forensic Science Practical	2hrs/week	1 Credits

Course Objectives:

After completion of the course the student will be able to

1. Perform DNA isolation and amplification of specific DNA segment using PCR
2. Perform various biochemical tests used for detection of blood and saliva and alcohol in given samples
3. Use microscopy to analyse hair, pollens and spores in forensic samples collected from crime scene

List of experiments

1. DNA isolation from animal tissue
2. TLC analysis of dyes
3. Blood typing
4. PCR
5. Estimation of ethyl alcohol in given sample
6. Microscopic examination of pollen and spores
7. Microscopic examination of hair and its analysis
8. Study of bones and teeth
9. Presumptive (Kastle – Meyer test) and confirmatory tests for blood
10. Phadebas test for amylase

References:

1. Petraco, N., Kubic, T. Forensic Science Laboratory Manual and Workbook (3rd Edition). CRC Press, Taylor and Francis Group, London.
2. Kubic, T., Petraco, N. Forensic Science Laboratory Experiment Manual and Workbook. CRC Press, Taylor and Francis Group, London.
3. Goodwin, W. Forensic DNA Typing Protocols (2nd Edition). Humana Press, Springer Nature, New York, USA.

16UBTDC06	DSE Core Practical 1: Pharmaceutical Biotechnology Practical	2hrs/week	1 Credits

Course Objectives:

After completion of the course the student will be able to

1. Perform sterility testing of different pharmaceutical products
2. To evaluate the efficacy of disinfectants in cleaning surfaces
3. To perform environmental monitoring of clean room areas
4. To perform validation studies

List of Practicals:

1. Microbiological examination of Eye drops and liquid dosages
2. Particulate matter testing by Visual inspection method for Injections
3. To perform sterility testing of absorbent cotton gauze, IV sets & surgicals
4. To perform sterility testing of ampoules and vials having water for injection.
5. To check efficacy of various disinfectants in cleaning of surfaces
6. Environmental monitoring of clean room area
7. Demonstration of Cold room activity and validation studies

References:

1. Vyas, S.P., Dixit, V.K. (2007) Pharmaceutical Biotechnology. 1st Ed. CBS Publications. New Delhi. India.
2. Upasani, V.N., Dhardia, P. D., Patel, P.B. (2011). Lab Manual in Pharmaceutical Microbiology and Biotechnology – I. Nirav and Roopal Prakashan, Ahmedabad, India.
3. Hanlon, G., Sandle, T. (2015). Industrial Pharmaceutical Microbiology: Standards and controls. Euromed Communications.

SEMESTER - VI

16UBTCC24	Core 14: rDNA Technology	4hrs/week	4 Credits

Objectives:

To enable the students to

1. Understand the basic concept and molecular tools used in Recombinant DNA technology
2. Understand the Gene cloning vectors and it's types
3. Describe the techniques used to purify and introduce rDNA into Host cells
4. Evaluate the Screening strategies
5. Understand the principles and application of various techniques associated to genetic engineering.

Unit 1: Molecular Tools used in Genetic Engineering (10 hrs)

- Introduction to Recombinant DNA technology
- Exo and Endo Nucleases: Classification, Mechanism of Action
- Restriction Endonuclease: Classification, Restriction and Modification system
- DNA ligase: Classification, Mechanism of Action
- Polynucleotide kinase, Alkaline phosphatases,Reverse Transcriptase , Polymerase

Unit 2: Isolation of desired gene and selection of cloning vectors (10 hrs)

- Preparation of genomic and plasmid DNA , Bacteriophage DNA
- Characteristic feature of an ideal Vectors
- Plasmid; Properties and Types
- Phage: Basic Biology, Cloning vectors based on M13 and λ bacteriophage
- Phagemids, Cosmids, BAC and YAC

Unit 3: rDNA: preparation and introduction into Host cells (10 hrs)

- Adaptors, Linkers, Homopolymer tailing
- Transformation: the uptake of DNA by bacterial cells
- Introduction of phage DNA into bacterial cells
- Microinjection, Shot gun method
- Electroporation, liposome fusion

Unit 4: Screening of the recombinants (8 hrs)

- Antibiotic Screening / Marker based selection
- Insertional inactivation; Bacteria: Lac Z , Phage : Lac Z, λ cI, SpI
- Probe Preparation and Labeling
- Hybridization Techniques: Southern, Northern, Western Blotting
- Genomic library and c-DNA library

Unit 5: Advance Techniques (10 hrs)

- Chemical Synthesis of DNA
- Nucleic acid Sequencing: Types, Principle and Application.
- PCR: Principle, Requirements, Steps involved, Selection of parameters (Primer designing, temperature, primer length)
- Molecular Markers : RFLP, RAPD, AFLP
- Applications of Recombinant DNA Technology

Text books:

1. Brown, T. A. (2016). *Gene cloning and DNA analysis: an introduction*. John Wiley & Sons.
2. Primrose S.B., Twyman R.H., and Old R.W (2001). *Principles of Gene Manipulation*, 6th ed., Blackwell Science

Reference books:

1. Winnacker, E. L. (1987). *From genes to clones: introduction to gene technology*.
2. Sambrook, J., & Russell, D. W. (2001). *Molecular Cloning: A Laboratory Manual*

16UBTCC25	Core 15: Bioinformatics	3hrs/week	3 Credits

Objectives:

Upon completion of this course students will be able to

1. Understand scope of Bioinformatics.
2. Introduce the application of computational approaches to biological problems.
3. Understand the latest advances in bioinformatics.
4. Retrieve biological information from biological database.
5. Use bioinformatics software, including web-based tools such as Entrez, BLAST and protein visualization tools.

Unit 1: Introduction to Bioinformatics (08 hrs)

- Overview of Bioinformatics; Scope and Applications
- Basic concepts: Sequence similarity, identity and homology
- History & prospects of Human Genome Project
- Major Bioinformatics Resources: NCBI, EBI & ExPASY

Unit 2: Biological Databases (07 hrs)

- Introduction, need & types of databases
- Introduction to bibliographic databases: PubMed
- Nucleic acid sequence databases: GenBank, EMBL, DDBJ
- Protein databases: SWISS-PROT, TrEMB, PDB

Unit 3: Sequence Alignment and Analysis (07hrs)

- Introduction to sequence alignment, dynamic programming
- Substitution matrices (PAM and BLOSUM)
- Homology and similarity search tools: BLAST, FASTA
- Multiple Sequence Alignment

Unit 4: Phylogenetic Analysis **(07 hrs)**

- Basic concepts in systematics, molecular evolution
- Definition, description and types of phylogenetic trees
- Clustering algorithm (Character Based algorithms, Distance Based algorithms)
- Tree evaluation (Bootstrapping methods)

Unit 5: Genomics & Primer Designing **(07 hrs)**

- Overview of Comparative Genomics
- Functional Genomics (EST, SAGE, Microarray)
- Types of PCR Primers
- Strategies for PCR Primer Designing

Text book

1. S.C. Rastogi & others, "Bioinformatics-Concepts, Skills, and Applications", CBS Publishing, 2003.
2. Andreas D Baxevanis & B F Francis, "Bioinformatics- A practical guide to analysis of Genes & Proteins", John Wiley, 2000.
3. T K Attwood, D J parry-Smith," Introduction to Bioinformatics", Pearson Education, 1st Edition, 11th Reprint 2005.

Reference book

1. C S V Murthy," Bioinformatics", Himalaya Publishing House, 1st Edition 2003
2. David W. Mount "Bioinformatics sequence and genome analysis", Cold spring harbor laboratory press, 2004.
3. S. Ignacimuthu, S.J., "Basic Bioinformatics', Narosa Publishing House, 1995

16UBTCC26	Core 16: Environmental Biotechnology	3hrs/week	3 Credits

Objectives:

After completion of this course, student will be able to:

1. Recognize the global environmental issues
2. Understand role of biotechnology in biodegradation and bioremediation
3. Develop the knowledge of liquid waste management.
4. Develop the knowledge of solid waste management.
5. Understand the evolution theories and phylogenetic analysis

Unit 1: Fundamentals of Environmental Biotechnology (8 hrs)

- Biodiversity- Loss of Biodiversity & Biodiversity conservation
- Population ecology- Characteristics of population
- Interaction among populations- Mutualism, Commensalism, Parasitism, Predation, Competition, Amensalism
- Overview of Global environmental issues- Deforestation, Greenhouse effect, Global Warming, Ozone depletion etc.

Unit 2: Biodegradation (8 Hr)

- Overview of Biodegradation& Factors affecting biodegradation
- Degradation of Basic Structures found in Hydrocarbons& Biomagnification
- Bioremediation- Process & applications
- Bioleaching- Process & applications

Unit 3: Management of Liquid waste (8 hrs)

- Physical, Chemical and Biological properties of waste water
- Sewage treatment process- Primary treatment
- Secondary treatment- Trickling filter & Oxidation pond
- Tertiary treatment- Carbon adsorption, Ion exchange, Chlorination

Unit 4: Management of Solid waste (6 hrs)

- Types of solid waste
- Land filling
- Composting
- Anaerobic sludge digestion

Unit 5: Biotechnological interventions **(6 hrs)**

- Biofertilizers- Types & preparation
- Biopesticides
- Biocontrol methods
- Bioplastics

Text books:

1. Verma, P. S., &Agarwal, V. K. (2000). Environmental Biology: Principles of Ecology. S. Chand.
2. Mohapatra, P. K. (2010). Textbook of environmental biotechnology. IK International Pvt Ltd.

Reference books:

1. McCarty, P. L. (2012). Environmental biotechnology: principles and applications. Tata McGraw-Hill Education.
2. Emery, H. C. (2003). Water and wastewater technology.
3. Evans, G. M., & Furlong, J. C. (2003). Environmental biotechnology: theory and application. IK International Pvt Ltd.
4. Cheremisinoff, N. P. (1997). Biotechnology for waste and wastewater treatment. Elsevier.
5. Gareth M. Evans & Judith C. Furlong, Environmental Biotechnology, Wiley pub.

16UBTDC07	DSE Core 4: Molecular Diagnosis and Drug Designing	4hrs/week	4 Credits

Objectives:

1. To introduce the students to the concepts of diseases and the requirements of diagnosis.
2. To impart the basic concept of molecular diagnostics to the students.
3. To give an elementary idea regarding drug designing and state its significance to the students.

Unit 1: Fundamentals of Disease (9 hrs)

- Disease: Definition and Types
- Infectious and Non infectious disease, Mode of transmission of infections.
- Factors affecting microbial pathogenicity.
- Types of Infectious disease.
- Disorder: blood, muscle, bone, eye and skin. (Examples and general features)

Unit 2: Molecular tools for diagnostics (10 hrs)

- Bacterial diagnosis: PCR based method, Identification of strain by 16SrRNA sequencing.
- Viral diagnosis: DNA/RNA detection, Serological tests.
- Microarray technique: Principle and applications
- Neonatal diagnosis: overview, screening parameters and techniques available
- Cancer diagnosis: role of molecular markers

Unit 3: Immuno and Biochemical Diagnosis (9 hrs)

- Immunoassays for diagnosis
- Principles of Immuno-histochemistry
- Biochemical tests for diagnosis of diseases (e.g. sugar, urea, creatinin etc)
- Principles of Kit based diagnosis tests

Unit 4: Genetic tools and Quality system (10 hrs)

- Genetic testing: Principles and practices
- Karyotyping: principles and application
- Detection of mutation, diagnosis of syndromes.
- QA/QC of molecular diagnosis
- Good Clinical Practices (GCP): Basic concept and framework.

Unit 5: Drug Designing (10 hrs)

- Current approach and philosophy of drug designing
- Various targets for drug
- Target validation: Bioinformatics approach

- Molecular docking: Principle and applications
- Bimolecular interaction

Text books:

1. Molecular Diagnostics for the Clinical Laboratorian 2Ed. 2006, W.B. Coleman. Humana Press.
2. Medical Microbiology (1997), Edited by Greenwood, D, Slack, R and Peutherer, J, ELST Publishers.

Reference books:

1. Fundamentals of Molecular Diagnostics (2007). David E. Bruns, Edward R. Ashwood, Carl A. Burtis. Saunders Group.
2. Bailey & Scott's Diagnostic Microbiology (2002), Betty A. Forbes , Daniel F. Sahm, Alice S. Weissfeld , Ernest A. Trevino, Published by C.V. Mos.

16UBTDC08	DSE Core 4: Biosafety and IPR	4hrs/week	4 Credits

Objectives:

After completion of the course the student will be able to

1. To identify different types of Intellectual Properties (IPs), the right of ownership, scope of protection as well as the ways to create and to extract value from IP
2. To recognize the crucial role of different organization for the purposes of product and technology development.
3. To identify activities and constitute IP infringements and the remedies.
4. To get knowledge of the safety regulation, biosafety level and legal requirements and best practice for the disposal of all types of biological / health care waste.
5. To develop capacity and excellence in the ethical & legal analysis of issues arising in research.

Unit: Intellectual property (9 hrs)

- Intellectual property rights-History, Types of Intellectual Property.
- Overview of Intellectual property rights (Patents, trade secret, copy right, trademarks.
- Important organization (GATT, WTO, WIPO and TRIPS)
- International conventions.
- Legal development, patentable subjects and protection.

Unit 2: Industrial property & Patent (9 hrs)

- Introduction to Patent Law: Rights under Patent Law & limitation, Patent requirements.
- Patents Application Process, Patent Infringement
- Patent Litigation - International Patent Law, Patent Searching.
- Patenting of Biological Materials: Current issues on patenting live forms with special reference, Patenting of higher plants and animals.
- Patenting of genes and DNA sequences, plant breeder's rights and farmer's right.

Unit 3: Trademark, Trade secret and Copyright (10 hrs)

- Trade mark & Trade Secret: Registration Process & maintenance ,Infringement,
- International Trade mark Law
- Trade Secret: Physical Security, Trade Secret Litigation.
- Copyrights & Geographical indication – Introduction, The subjects Matter of Copy right – The Rights Afforded by Copyright Law, Right & Limitations,
- Overview of geographical indication.

Unit 4: Biosafety and Societal Concern: (10 hrs)

- Introduction to Biological Safety Cabinets; Primary Containment for Biohazards.
- Biosafety Levels; Recommended Biosafety Levels for Infectious Agents and Infected Animals
- Biosafety guidelines - Government of India; Biosafety in relation to transgenic research of applications, Definition of GMOs; Roles of Institutional Biosafety Committee for GMO applications in food and agriculture.
- Environmental release of GMOs; Risk Analysis; Risk Assessment; Risk management.
- Overview of National Regulations and relevant International Agreements including Cartegana Protocol.

Unit 5: Bioethics (9 hrs)

- Bioethics: definition, ethical criteria in biotechnology, animal ethics.
- Guidelines for use of lab animals,
- Human cloning: Ethical issues, Ethical clearance norms for conducting studies on human subjects.
- Bioethics of Embryonic cell
- Stem cell research & gene therapy.

Text books:

1 Murray T M and Mehlman,M J (2000) Encyclopedia of Ethical, Legal and Policy issues in Biotechnology, John Wiley & Sons

2 Wadehra, B L (2000) Law Relating to Patents, Trade Marks, Copyright, Designs &Geographical Indications; Universal law Publishing Pvt. Ltd., India

3 Narayanan, P(2010) Law of Copyright and Industrial Designs; Eastern law House, Delhi .

4 Gopalakrishnan, N S & Ajitha, T Z (2014) Principles of Intellectual Property, 2nd Edition, Eastern Book Company.

5 Biosafety, Traylor, Fredric & Koch (2002) Michigan state University pub.

6 Contemporary issues in Bioethics, Beauchamp & Leroy, 1999. Wardsworth PuCo. Belmont, California

Reference books:

1 Watal, J (2001) Intellectual Property Rights in the WTO and Developing Countries, Oxford University Press.

2 Kaul, A K & Ahuja,V K(2001) Law of Copyright: From Gutenberg's Invention to Internet, University of Delhi.

3 Khader, F A (2011) The Law of Patents-With a Special Focus on Pharmaceuticals in India LexisNexis, 2nd Edition.

4 www.patentoffice.nic.in/ipr/patent/patents.htm

5 www.bangalorebio.com/GovtInfo/ipr.htm

6 Thomas J A and Fuchs, R (2004) Biotechnology and safety assessment, Academic Press

7 Twin, R. (2015), Animals as Biotechnology: Ethics, Sustainability and Critical Animal Studies, Routledge Publishers

16UBTDC09	DSE Core 4: Animal Biotechnology	4hrs/week	4 Credits

Objectives:

1 To prepare skill for future careers in the areas of animal Biotechnology.

2 To provide research opportunities in areas of immunology, infectious disease, developmental biology, reproductive biology and toxicology.

3 To provide students with a scientific and technical understanding of animal biotechnology.

4 To introduce students to the commercial aspects of the Biotechnology industry.

Unit 1: Introduction of Animal cell culture (09 hrs)

- Animal tissue culture: History, Scope & importance
- Laboratory requirements & aseptic techniques
- Types of tissue culture, advantages and limitations
- Culture environment, Balance salt solution
- Culture medium: Requirements and Types

Unit 2: Cell culture technique & cell line (10 hrs)

- Basic techniques of animal cell culture
- Tissue disaggregation: Mechanical & Enzymatic, Trypsinization
- Primary cultures: Isolation of tissue, secondary culture
- Cell line, type, general characteristics
- Growth kinetic and cell lines.

Unit 3: Stem cell culture (10 hrs)

- Characteristics of stem cells. Different types of stem cell
- The methods for stem cells differentiations.
- Potential of stem cell research in treatment of different genetic disorder.
- Hematopoietic stem cell
- Stem cell engineering

Unit 4: Methods of gene transfer in animals (10 hrs)

- Introduction of genes.
- Direct method of gene transfer: Lipofusion, Electroporation, Microinjection etc
- Important vector and its feature used in animal cell transformation
- Selection of transformed animal cell.

- Expression of cloned protein in animal cell.

Unit 5: Applications of transgenic animal (9 hrs)

- Molecular pharming.
- Transgenic animals and their applications
- Transgenic Mice, Transgenic Sheep, Transgenic Fish.
- Gene therapy: Overview, strategy and Application
- Application of Gene therapy in different genetic disorder and cancer.

Text book:

1 Freshney R I (2016) Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications, 7th Edition,Wiley .

2 Ranga M M (2007), Animal Biotechnology, Agrobios India,3rd Edition, Jodhpur

3 Mathur S (2006), Animal Cell and Tissue Culture, Agrobios India, Jodhpur, 2006

4 Singh, B. and Gautam, S K (2013),Textbook of Animal Biotechnology, Publisher, The Energy and Resources Institute, TERI,

Reference book:

1. Leach, C K (1993), In vitro cultivation of animal cell, Biotol series, Publisher Butterworth-Heinemann.

2. Butler, M (2004), Animal Cell Culture and Technology, BIOS Scientific Publishers

3. Adams, R.L.P. (1990) Cell Culture for Biochemists, Volume 8 2nd Edition, Elsevier Science

16UBTCC27	Core Practical 10: rDNA Technology and Environmental Biotechnology Practical	3hrs/week	1 Credits

Objectives:

After completion of this course, student will be able to:

1. Learn the use of basic tools involved in r- DNA technology
2. Understand the principles and handling of laboratory instruments in molecular biology lab.
3. Develop technical skills to analyze various parameters of Waste water
4. Learn qualitative analysis of drinking water

List of Experiments:

1. Restriction endonuclease digestion of Lambda DNA by EcoRI.
2. Isolation of Genomic DNA from Plants
3. NH_4-N Estimation
4. Chloride Estimation
5. Ca-Mg Hardness
6. Phosphorus Phosphate Estimation
7. Dissolved oxygen (DO)
8. Biochemical Oxygen Demand (BOD)
9. Chemical Oxygen Demand (COD)
10. Isolation of Nitrogen fixing bacteria from root nodules and soil.

References:

1. Sambrook, J., Fritsch, E. F., & Maniatis, T. (1989). Molecular cloning: a laboratory manual (No. Ed. 2). Cold spring harbor laboratory press.
2. Federation, W. E., & American Public Health Association. (2005). Standard methods for the examination of water and wastewater. American Public Health Association (APHA): Washington, DC, USA.
3. Maiti, S. K. (2004). Handbook of methods in environmental studies: water and wastewater analysis. ABD publishers.
4. Ramteke, D. S., &Moghe, C. A. (1988). Manual on water and wastewater analysis. National Environmental Engineering Research Institute (NEERI), Nagpur.

16UBTCC28	Core Practical 11: Bioinformatics Practical	2hrs/week	1 Credits

Objectives:

Upon successful completion of this course students will be able to

1. Explore popular bioinformatics databases.
2. Use bioinformatics search tools on the internet for retrieval of biological data, pairwise and multiple sequence alignments.
3. Analyse the protein structure.
4. Carry out phylogenetic analysis.

List of Practicals:

1. Exploring the integrated database system at NCBI server and querying the PUBMED and GenBank databases using the ENTREZ search engine.
2. Conversion of sequence formats.
3. Alignment of protein and DNA sequences using Needleman-Wunsch and Smith-Waterman algorithm
4. Retrieval of protein sequences from SWISSPROT/TREMBL.
5. Retrieval of protein structure from PDB.
6. Analysis of structural features of proteins using protein visualization tools.
7. Database (homology) searches using different versions of BLAST and interpretation of the results to derive the biologically significant relationships of the query sequences.
8. Multiple sequence alignments of sets of sequences using Clustal.
9. Construction of phylogenetic trees.
10. PCR Primer designing

References:

1. Michael Agostino, “Practical Bioinformatics”, Garland Science, 2012.
2. Satish Kumar Sinha and Ashok Kumar Sharma, "Practical Bioinformatics", Oxford Book Company, 2012.
3. Andreas D. Baxevanis, Current Protocals in Bioinformatics, John Wiley & Sons
4. David W. Mount “Bioinformatics sequence and genome analysis”, Cold spring harbor laboratory press, 2004.

16UBTDC10	DSE Core Practical 4: Molecular Diagnosis and Drug Designing Practical	2hrs/week	1 Credits

Objectives:

1. To learn the various molecular and biochemical techniques used in disease diagnosis.
2. To analyze and interpret the data obtained by performing different molecular and biochemical techniques
3. To learn online tools for visualization of 2D and 3D structure of drug targets.

List of Practicals:

1. PCR Technique: Determination of disease specific gene.
2. Immunoassay:
   i) ELISA
   ii) ODD
   iii) RID etc
3. Biochemical tests:
   i) Determination of Blood Glucose level
   ii) Determination of Urea/ Creatinin
4. Retrieval of target proteins and ligands from suitable databases.
5. Visualization (2D and 3D) of target and small molecules using online tool.

References:

1. Nigam, A., Ayyagari, A. (2008) Lab Manual in Biochemistry, Immunology and Biotechnology. McGraw-Hill Education (India).
2. Chawla, R. (2013) Practical Clinical Biochemistry: Methods and Interpretations. 4th Edition. Jaypee Brothers Medical Publishers.
3. Wilson, K., Walker, J. (2010). Principles and Techniques of Biochemistry and Molecular Biology. Cambridge University Press.

16UBTDC11	DSE Core Practical 5 : Biosafety and IPR Practical	2hrs/week	1 Credits

Objectives:

1. To understand the process of patenting
2. Learning the procedure of writing a patent
3. Understand the patent law and patent infringement cases
4. Understand the different levels of biosafety.

List of Practicals:

1. Patent Application and its Contents.
2. Writing of the Patent Document.
3. Case study of patent on few important discoveries.
4. Procedure to filing Trademark.
5. Legal search of patent.
6. Study of original Bitechnological patent.
7. Risk analysis & assessment of biological contaminant.
8. Study and analysis of few famous patent litigation.
9. Patent informatics

References:

1 Manual of patent practice and procedure, IPR India, 2005. Ministry of commerce and industry, New Delhi.

2 Puri, R.S., Viswanathan, A. (2009). Practical Approach to Intellectual Property Rights. I.K. International Publishing House Pvt. Ltd. New Delhi, India.

3 Bansal, P. (2008) IPR Handbook for Pharma Students and Researchers. Pharma Book Syndicate/BSP Books, New Delhi.

16UBTDC12	DSE Core Practical 6: Animal Biotechnology Practical	2hrs/week	1 Credits

Objectives:

1 To understand principals of growth and development of cells and tissues.

2 To understand the behaviour of cell.

3 To understanding the possibilities and obstacles during cell growth and development manipulation

4 To develop ability of independent work on establishment of cell culture growth.

List of Practicals:

1 Laboratory organization and maintenance of Animal Cell Culture Laboratory.

2 Basic aseptic technique and sterilization in animal cell culture.

3 Preparation of media for animal cells & tissues.

4 Trypsinization of monolayer and sub culturing of established cell line

5 Cryopreservation of given/sub cultured cell line.

6 Cell Revival of cryopreserved cell suspension.

7 Cell counting by haemocytometer.

8 Morphological characterization of cell death.

9 Study of cell viability by Trypan blue assay.

References:

1. Culture of Animal Cells. Freshney R. I., and Alan, R. (1987). Microcarrier culture: Principles and Methods, Pharmacia Fine chemicals.
2. Pollack, R. and Pfeiffer, S. (1971). Animal Cell Culture, Cold Spring Harbour Laboratory
3. Pollack, R. (1981) Readings in Mammalian cell culture., Cold Spring Harbour Laboratory.
4. Merchant, D. J., Kahn, R.H. and Murphy, W. H. (1969),Hand Book of cell and organ culture, Burgess Publishing Company.
5. Sambrook J., Fritsch, E. F. & Maniatis , T(1989).Molecular cloning: A laboratory Manual. Cold Spring Harbour Laboratory
6. Spier, R.E. and Griffiths, J. B. (1985). Animal cell biotechnology. Vol. I and II , Academic Press.