B. Sc. Biotechnology Course
Veer Narmad South Gujarat University, Surat

Semester	Semester-I (24 Credits)						Total Credits
Subject	Theory			Laboratory Work			
	Course	Credit	hours	Course	Credit	Hours	
Foundation Compulsory	1	2	2	-	-	-	2
Generic Elective	1	2	2	-	-	-	2
Core 1	2	4	4	1	2	4	6
Core 2	2	4	4	1	2	4	6
Core 3	2	4	4	1	2	4	6
Foundation Elective	1	2	2	-	-	-	2
Total	**9**	**18**	**18**	**3**	**6**	**12**	**24**

Semester-I

[Academic Year of Implementation: 2018-2019]

Core 1: Biotechnology

Course 1: BT-01: Introduction to Biotechnology
Course 2: BT-02: Cell Biology

Practical Core 1: BTP-01: Biotechnology Practical

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

B. Sc. Biotechnology Semester-I

BT-01: INTRODUCTION TO BIOTECHNOLOGY

UNIT-1: UDERSTANDING BIOTECHNOLOGY:

1.1 What is Biotechnology?
1.2 Biotechnology-an interdisciplinary pursuit
1.3 Biotechnology- a three-component central core
1.4 Product safety
1.5 Public perception of Biotechnology
1.6 Biotechnology and developing world

UNIT-2: SCOPE OF BIOTECHNOLOGY-I:

2.1 Recombinant DNA and genetic engineering
2.2 Mammalian cell culture
2.3 Plants and plant cell culture
2.4 Bio-fuels
2.5 Bio-catalysis
2.6 Waste Water and Sewage treatment

UNIT-3: SCOPE OF BIOTECHNOLOGY-II:

3.1 Fermentation
3.2 Bio-fertilizer
3.3 Bio-pesticides
3.4 Vaccines
3.5 Monoclonal antibodies
3.6 Diagnostics in developing countries

UNIT-4: BIOTECHNOLOGY IN INDIA:

4.1 Introduction to DBT
4.2 Autonomous institutions of DBT
4.3 Public sector undertakings of DBT
4.4 BTIS-NET
4.5 Introduction to ABLE
4.6 Biotechnology- Current status of industrial growth in India

REFERENCES:

1. Ratledge, C. & Kristiansen, B. (2006) *Basic Biotechnology*, Cambridge University Press.
2. Gupta, P. K. (2005) *Elements of Biotechnology*, Rastogi Publications.

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B. Sc. Biotechnology Semester-I

BT-02: CELL BIOLOGY

UNIT-1: FUNDAMENTALS OF CELL:

- 1.1 Discovery of cells
- 1.2 Basic properties of cells
- 1.3 Fundamental classes of cells: (Ultra structure and functions)
  - 1.3.1 Prokaryotic cell
  - 1.3.2 Eukaryotic cells (Plant and Animal)
- 1.4 Viruses

UNIT-2: CELLULAR MEMBRANES: STRUCTURE

- 2.1 Brief history of studies on plasma membrane structure
- 2.2 Chemical composition of membranes
- 2.3 Structure and functions of membrane proteins
- 2.4 Membrane lipids & membrane fluidity

UNIT-3: CELLULAR MEMBRANES: FUNCTIONS

- 3.1 An overview of membrane functions
- 3.2 Dynamic nature of plasma membrane
- 3.3 Movement of substances across cell membrane
- 3.4 Membrane potentials & nerve impulses

UNIT-4: CELL CYCLE, MITOSIS AND MEIOSIS:

- 4.1 **The Cell Cycle:**
  - 4.1.1 Cell cycle *in vivo*
  - 4.1.2 Control of cell cycle
- 4.2 **M Phase: Mitosis & Cytokinesis:**
  - 4.2.1 Prophase
  - 4.2.2 Pro-metaphase
  - 4.2.3 Metaphase
  - 4.2.4 Anaphase
  - 4.2.5 Telophase
  - 4.2.6 Forces required for mitotic movements
  - 4.2.7 Cytokinesis
- 4.3 **Meiosis:**
  - 4.3.1 The stages of meiosis
  - 4.3.2 Genetic recombination during meiosis

REFERENCES:

1. Karp, G. (2014) *Cell Biology*, 7th Edition, International Student Version, Wiley.
2. Willey, J. M., Sherwood, L. M. & Woolverton, C. J. (2017) *Prescott, Harley & Klein's Microbiology*, 10th Edition, The McGraw-Hill Companies, Inc.

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VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

B. Sc. Biotechnology Semester-I

BTP-01: Biotechnology Practical

1. Principle, working and uses of laboratory instruments:
   [Microscope, Incubator, pH meter, Centrifuge, Colony counter]

2. Principle, working and uses of various types of sterilizers:
   [Hot air oven, Steam sterilizer, Inspissator, Bacteriological filters]

3. Introduction to Bioprocess, Animal Cell Culture and Plant Tissue Culture laboratories

4. General laboratory safety and instructions

5. Preparation and sterilization of glassware's and media, disposals of media and cultures

6. DNA staining by Schiff's reagent using onion peel

7. Study of various stages of meiosis using permanent slides

8. Study of various stages of mitotic cell division using onion root tips

9. Barr body from buccal smear

10. Geimsa staining of Blood cells

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VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

B.Sc. MICROBIOLOGY

Teaching & Evaluation Scheme

Semester – I

Paper No.	Paper Title	Theory	Practical	External	Internal	Total	Credit
		(Hrs/Wk)					
MB 101	History and scope of microbiology	2	-	50	20	140	**4**
MB 102	Fundamentals of microscopy	2	-	50	20		
MBP 103	Practicals	-	4	40	20	60	**2**

F.Y.B.SC. SEMESTER I

MB: 101 HISTORY AND SCOPE OF MICROBIOLOGY

Student Learning Objective: The main aspect of this paper is to study and understand the scope of microbiology with major groups of microorganisms, ancient history and discovery of microbial world. An aim of this paper is to present existing development of the microbiology in diversified area.

	UNIT 1	SCOPE OF MICROBIOLOGY – I
		Teaching Duration: 07 Lectures
1.1	An introduction to Microbiology	
1.2	Microbiology: A multifaceted Science	
1.3	Position of Microorganisms in living world	
1.4	Taxonomic status of Viruses	

	UNIT 2	SCOPE OF MICROBIOLOGY- II
		Teaching Duration: 07 Lectures
2.1	Major groups of Microorganisms	
2.2	Distribution of Microorganisms in nature	
2.3	Applied areas of Microbiology	

	UNIT 3	ANCIENT HISTORY OF MICROBIOLOGY
		Teaching Duration: 08 Lectures
3.1	The discovery of Microbial World and Microscope	
3.2	The spontaneous generation controversy	
3.3	Discovery of microbial effects on organic matter	
3.4	Discovery of the role of Microbes in causation of Disease	
3.5	History of Virology	

	UNIT 4	DEVELOPMENT IN MICROBIOLOGY
		Teaching Duration: 08 Lectures
4.1	Development of pure culture techniques	
4.2	Development of Foundation for immunology	
4.3	Development of Agricultural microbiology	
4.4	Development of Chemotherapy	
4.5	Development of Modern immunology	
4.6	Molecular Biology and Biotechnology	

REFERENCES:

- Modi. H. A. (2014) A Handbook of Elementary Microbiology, Shanti Prakashan, (ISBN: 978-93-5070-1010)

Further Reading:

- Pommerville J.C. (2014) Alcamo's Fundamental of Microbiology, 10th Edition, Jones & Barlett Pvt. Ltd., **(**ISBN: 978-0-07-462320-6)
- Medigan M., et al., (2015) Brock Biology of Microorganisms, 14th Edition, Pearson education Ltd., (ISBN: 978-1-292-01831-7)

MB 102: FUNDAMENTALS OF MICROSCOPY

Student Learning Objective: The main aspect of this paper is to study and understand the Basic principle of microscopy. It focused on different type of fundamental and advanced microscopy techniques. Also provide knowledge related to different types of dyes, staining and staining theories of bacteria.

	UNIT 1	BASIC PRINCIPLE OF MICROSCOPY
		Teaching duration: 08 lectures
1.1 1.2 1.3 1.4 1.5 1.6	General Principles of optics Structure of light Objectives – Numerical Aperture , Resolving power Immersion objectives - Depth of focus, Equivalent focus, Working distance of uncovered objects & covered objects, Chromatic aberrations in objectives. Oculars – Huygens, Compensating, Flat-field. Condenser	

	UNIT 2	LIGHT MICROSCOPY
		Teaching duration: 07 lectures
2.1	Bright field microscope	
2.2	Dark field microscope	
2.3	Phase contrast microscope	
2.4	Differential Interference Contrast Microscope	
2.5	Fluorescence microscope	
2.6	Confocal microscopy	

	UNIT 3	ELECTRON MICROSCOPY
		Teaching duration: 08 lectures
3.1	Transmission Electron microscope	
3.2	Scanning Electron microscope	
3.3	Electron cryotomography	
3.4	Scanning probe microscopy	
	3.4.1 Scanning tunneling microscope	
	3.4.2 Atomic force microscope	

	UNIT 4	DYES & STAINS
		Teaching duration: 07 lectures
4.1	Dyes – Acidic & Basic dyes, Chromophore, Classification of biological stains	
4.2	Staining solution – Intensifier , Mordants	
4.3	Theories of staining	
4.4	Staining of bacteria	

REFERENCES:

- Willey J.M., Sherwood L.M. and Woolverton C.J., (2017) Prescott's Microbiology, 10th Edition McGraw - Hill Education, , (ISBN: 978-981-3151-26-0)
- Salle A. J., (1984) Fundamental Principles of Bacteriology, 7th Edition,Tata McGraw – Hill, (ISBN:0-07-099-562-1)

Further Reading:

- Pelczar, Chan and Krieg, (2001), Microbiology-Concepts and Application, 5th Edition, McGraw-Hill, (ISBN: 9780074623206)

F.Y B.Sc. Microbiology
Semester I Practicals

(Time duration: 04 hours/ week)
MBP-103: Practicals

1. Study of bright field compound microscope: Components, use and care.
2. Microscopic examination of living microorganisms:
   (a) Observation of hay infusion by Wet Mount Technique.
   (b) Observation of bacterial Motility by Hanging Drop technique
3. Measurement of microorganisms (Micrometry) using Ocular and Stage Micrometer.
4. Introduction to common instruments/equipments in microbiology laboratory:
   Autoclave, Incubator, Hot air oven, Laminar air flow, Centrifuge, Bacteriological Filter, pH meter, Colorimeter, Anaerobic jar, Colony counter.
5. Observation of morphological characteristics of Yeast / Fungi / Protozoa by Dark Field and Phase Contrast Microscopy.
6. Preparation of Nutrient broth / agar medium and cultivation of bacteria.
7. pH measurement and adjustment using Lovibond / Hellige's comparator (Phenol red and Bromothymol blue disc).
8. Preparation of standard solutions:
   a) Percent solutions
   b) Part dilutions
   c) Molar solutions
   d) Normal solutions
   e) Molal solutions
   f) PPM and PPB solutions
9. Monochrome staining by Acidic and Basic dye.
10. Gram staining.
11. Acid fast staining.
12. Observation of spirochaete by negative staining.

REFERENCES:

- Patel R.J. and Patel R.K. (2016) Experimental microbiology Volume I, 9th Edition. Aditya,
- Patel R.J. and Patel R.K. (2017) Experimental microbiology Volume II, 9th Edition. Aditya,
- Cappuccino J.G. (2016) Microbiology; A Laboratory Manual, 11th Edition**.** Pearson Edication (Singapore) Pvt. Ltd., (ISBN: 978-9332535190)
- Aneja K.R. (2001) Experiments in Microbiology, Plant Pathology, Tissue culture and Mushroom production technology, 3rd Edition. New Age International Publishers, (ISBN: 978-9386418302)

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT.
SYLLABUS FOR F. Y. B. Sc. SEMESTER- I
Z – 101: ZOOLOGY-THEORY
(Effective from JUNE-2019)
(Systematics and Animal Diversity)

UNIT- I: Systematics

Salient features of Non-chordates, structural organization in different phylum of Non-chordates with examples.
Kingdom – Animalia;
Phylum – Protozoa- Locomotory Organelles and locomotion
Porifera-Canal System in sycon
Cnidaria-Polymorphism in Hydrozoa
Platyhelminthes, Nemathelminthes-parasitic adaptations
Annelida-Metamerism
Arthropoda -Metamorphosis in Insects
Mollusca-Torsion in gastropods
Echinodermata-Water-vascular system in Asteroidea, Protochordata- General features and Phylogeny

UNIT- II: Non-Chordate Animal Diversity

Type study – *Fasciola hepatica* (Liver fluke)

- Systematic position, Habit and habitat
- External features, Body wall
- Digestive system, Respiratory System, Excretory system, Nervous system
- Reproductive system, Life cycle and development
- Pathogenesis, Parasitic Adaptations

UNIT-III: Systematics

Salient features of Chordate classes with examples.
Agnatha, Pisces, Amphibia, Reptiles, Aves, Mammals.

UNIT- IV: Chordate Animal Diversity

Pisces-Difference between Osteichthyes and Chondrichthyes, osmoregulation
Amphibia- Parental care
Reptiles- Poisonous and non-poisonous snakes
Aves- Flight adaptations in birds
Mammals- Origin of mammals

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT.
SYLLABUS FOR F. Y. B. Sc. SEM- I
Z – 101: ZOOLOGY-PRACTICALS
(Effective from JUNE-2019)
(Systematics and Animal Diversity)

The following practicals are to be taught/studied only with the help of charts, models, videos, photographs, permanent slides, working models etc.

1. Study of the following specimens:
Amoeba, Euglena, Paramecium, Sycon, Hyalonema, Physalia, Aurelia, Metridium, Taenia solium, Male and female *Ascaris lumbricoides, , Nereis, Pheretima, Hirudinaria*

2. *Carcinus, Scolopendra, Limulus, Lepisma, Periplaneta, Butterfly, Chiton, Dentalium, Pila, Ostrea, Octopus, Pentaceros, Ophioderma, Echinus, Cucumaria*.

3. *Balanoglossus, Herdmania, Branchiostoma, Petromyzon, Sphyrna, Pristis, Torpedo, Labeo, Exocoetus, Ichthyophis, Salamandra, Bufo, Hyla,*

4. *Chelone,Hemidactylus, Chamaeleon, Vipera, Naja, Crocodylus, Gavialis, Koel*, Peacock, Sparrow, *Ornithorhynchus*, Macropus, Bat, Dolphin

5. Study of the following permanent slides:
T.S. and L.S. of *Sycon*,
Liver fluke: Larval stages: miracidium, sporocyst, redia, cercaria

6. Key for Identification of poisonous and non-poisonous snakes
An "**animal album**" containing photographs, cut outs, with appropriate write up about the above mentioned taxa. Different taxa/ topics may be given to different sets of students for this purpose.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT.
SYLLABUS FOR F. Y. B. Sc. SEMESTER- I
Z – 102: ZOOLOGY-THEORY
(Effective from JUNE-2019)
(Cytogenetic, Ecology and Ethology)

UNIT-I:

Cytology: Structural organization of cells- Prokaryotes and Eukaryotes Introduction to cell organelles (Golgi body, E.R., Mitochondria, Nucleus, Lysosome, Ribosome, Nucleolus, Cell wall) and cell inclusions.

UNIT-II :Genetics

Types,structures and functions of chromosomes

i. Principles of inheritance, Mendel's law, deviation from Mendelian inheritance, incomplete dominance and co-dominance, Complementary genes, Epistasis genes, Supplementary genes.
ii. Concept of gene, multiple alleles (ABO blood groups) lethal alleles, pseudo alleles.

UNIT-III : Ecology

- Introduction to Ecology
- Marine Ecosystem
- Wetland Ecosystem
- Fresh water – Pond Ecosystem
- Desert ecosystem

Ecological Adaptations

- Terrestrial, Fossorial, Aquatic, Arboreal, Volant, Desert

UNIT- IV :Ethology

- Introduction, Scope and patterns of behavior.
- Nesting behavior (Weaver bird, Horn bill) and social behavior (honeybee)
- Behavioral disorders- Alzheimer's and Dementia

VEER NARMADSOUTH GUJARAT UNIVERSITY, SURAT.
SYLLABUS FOR F. Y. B. Sc. SEMESTER- I
Z – 102: ZOOLOGY-PRACTICALS
(Effective from JUNE-2019)
(Cytogenetic, Ecology and Ethology)

The following practicals are to be taught/studied **only** with the help of charts, models, videos, photographs, permanent slides, working models etc.

(1) Ecological adaptations.
   (a) Terrestrial: Elephant, Jackal
   (b) Arboreal: Chameleon, Squirrel
   (c) Fossorial: Armadillo, Naked mole rat
   (d) Volant: Flying fish, Crow
   (e) Desert: Camel, Phrynosoma

(2) To study structure of typical animal cell and cell organelles: Golgi body, E.R., Mitochondria, Nucleus, Lysosome, Ribosome, Nucleolus, Cell wall.

(3) To study nesting behaviour (Weaver bird, Horn bill) and social behaviour (Honey bees).

(4) Blood groups and Rh factor.

(5) Complementary genes, Epistasis genes, Suplemetary genes & Lethal genes.

Reference Books:

(1) Ruppert and Barnes, R.D. (2006). *Invertebrate Zoology*, VIII Edition. Holt Saunders International Edition.
(2) Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002). *The Invertebrates: A New Synthesis*, III Edition, Blackwell Science
(3)Kardong, K.V. (2005) *Vertebrates' Comparative Anatomy, Function and Evolution*. IV
Edition.McGraw-Hill Higher Education.
(4) Kent, G.C. and Carr R.K. (2000). *Comparative Anatomy of the Vertebrates*.IX Edition.
The McGraw-Hill Companies.
(5) Young, J. Z. (2004). *The Life of Vertebrates*.III Edition.Oxford University press.
(6) Modern Text Book of Zoology (vertebrate) R.L.Kotpal, Rastogi Publication, Meerut, India.
(7) Modern Text Book of Zoology (invertebrate) R.L.Kotpal,Rastogi Publication, Meerut, India.
(8) Invertebrate Zoology- E.L.Jordan & P.S.Verma
(9) Invertebrate Zoology- T.C. Majupuria, Pradeep Publication, Jalandhar, India.
(10) Intruduction to Chordates- T.C. Majupuria, Pradeep Publication, Jalandhar, India.
(9) A manual of Practical Zoology Invertebrates- P.S.Verma, S. Chand & Co. Ltd. New Delhi, India.
(10) A manual of Practical Zoology Chordates- P.S.Verma, S. Chand & Co. Ltd. New Delhi, India.
(11) Cell biology, Genetics and Molecular Biology- V.B. Rastogi, Rastogi Publication, Meerut- India
(12) Modern zoology –Dr. Ramesh Gupta,Prakash Publication,12th Edition,Muzaffarnagar(UP)
(13) A Text Book of Zoology- Dr. Alkesh I. Shah & Dr. Krishna R. Rajput, New Popular Prakashan, Surat, India.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

SYLLABUS FOR B.Sc. SEMESTER - I

BOTANY PAPER - 101

(Effective from June 2018)

BOT – 101 : PLANT DIVERSITY

Unit - I **Introduction to Plant Diversity**

- Concept, Plant Kingdom (Eichler system)- cryptogams and phanerogams, diversity in plant kingdom, position of plants in five kingdom system.
- Prokaryotic and Eukaryotic cell structure

Unit - II **Microbes**

- Bacteria : Discovery, general character, structure and importance
- Virus: Discovery, general character, structure and importance

Unit - III **Algal diversity**

- Occurrence,classification,thallus, cell structure, pigments, reserve food material and reproduction of *Nostoc* and *Spirogyra*

Unit - IV **Fungal diversity**

- Occurrence,classification, thallus, cell structure, nutrition and reproduction of *Mucor*and*Agaricus*

Unit - V **Lichen**

- Classification, general characters, external and internal characters, reproduction and economic importance of *Lichen*

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

SYLLABUS FOR B.Sc. SEMESTER - I

BOTANY PAPER - 102

(Effective from June 2018)

BOT – 102 : PLANT DIVERSITY, NURSERY MANAGEMENT AND UTILIZATION

Unit - I **Bryophytes**

- Study of life history, occurrence, thallus structure, reproduction and sporophyte diversity (external and internal) of *Funaria*.

Unit - II **Pteridophytes**

- Study of life history, sporophyte, gametophyte (external and internal) and reproduction of *Nephrolepis*.

Unit - III **Nursery Management**

- Introduction, types of nurseries
- Plant propagation- cutting, budding, grafting and layering
- Fertilizer and pesticides
- Methods of irrigation: drip and sprinkler,

Unit - IV **Plant Morphology**

- **Root:** Definition, parts of root, types of root, functions and modification of root.
- **Stem:** Definition, characters of stem, shape and surface of stem, types of stem, functions& modification of stem,
- **Leaf:** Definition, characters & parts of leaf, types of stipules, venation, types of leaf, functions and modification of leaf.
- **Flower:** Definition, structure of typical flower, arrangement of floral leaf, types of flower.

Unit - V **Food plants**

- Cultivation of the following crops in relation to their origin, distribution, climate, soil, propagation, method of cultivation and uses.
- Sugar cane, Paddy, Mango, Brinjal

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

SYLLABUS FOR B.Sc. SEMESTER - I

BOTANY PRACTICAL - 103

(Effective from June 2018)

BOT – 103 : PLANT DIVERSITY, NURSERY MANAGEMENT AND UTILIZATION

- The candidates should study the typical vegetation in natural condition and should recordtheir observation in journals. Excursion should be arranged during the year to local places.
- Every candidate shall complete laboratory course in accordance with the regulations issuedfrom time to time by Academic Council on the recommendation of the Board of Studies.
- Every candidate shall record observation directly in the laboratory journal. Every journalshall be signed periodically. At the end of the semester candidate shall produce certified journal during the practical examination.

Practical :1 T0 study microscopic examination of curd.

Permanent slides of Bacteria

Chart/Specimen of different types of Virus.

Practical :2 **Nostoc:**

To study thallus structure and akinets in Nostoc.

Practical :3 **Spirogyra:**
To study the thallus structure, Scalariform conjugation and Lateral conjugation in Spirogyra.
(Permanent slides of thallus W.M, Scalariform conjugation, Lateral Conjugation.)

Practical :4 **Mucor :**
To study the thallus structure and reproductive structure.
Permanent slides of Mucor vegetative W.M., Mucor sporangia, MucorZygospore.

Practical :5 **Agaricus:**
To study the vegetative structure, basidiocarp, gills, basidia and basidiospores.
Permanent slides : Stipe T.S.; Pileus T.S.

Practical :6 **Lichen:**
To study external features and internal structures of Usnea
(Permanent slides of Lichen thallus T.S., Lichen apothecium V.S., Lichen soridia)

Practical :7 **Moss (Funaria):**
To study the external features of gametophyte and sporophyte.
(Permanent slides of Funaria antheridia W.M.; Funaria archegonia W.M.)

Practical :8 **Nephrolepis :**
Preparation of slides from the fresh material of T.S of Stolon & T.S. of Rachis by the students.
(Permanent slides: T.S. of Stolon, T.S. of Rachis, T.S. of leaflet passing through sori, Nephrolepisprothallus, Fern sori W.M.,prothallus with antheridia, prothallus with archegonia, prothallus with sporophyte.)

Practical :9 **Nursery Management**

i) Study of methods of propagation with the help of suitable materials - tubers, bulbs, rhizomes, corms, suckers and runners.

ii) Propagation of horticultural plants by stem cuttings, air layering,grafting and 'T' budding.

Practical :10 **Roots:**

- To study different types of roots:
  - Tap root- *Vinca*
  - Fibrous- *Grass*
  - Advantitious- *Sugarcane*
- To study modification of root:
  - Prop root- *Banyan tree*
  - Stilt root- *Maize*
  - Pneumatophores- *Avicennia*
  - Storage root- *Carrot, sweet potato*

Practical :11 To study different types of stem

- To study Aerial stem
  - Cudex-*Palms,*
  - Clum-*Bamboo,*
  - Scape- *Canna and Onion*
  - Excurrent- *Polyalthialongifolia, Casurina*
  - Deliquescent- *Mango*
  - Weak stem: *Ipomoea*
- To study underground stem
  - Rhizome- *Ginger, Turmeric*
  - Tuber- *Potato*
  - Bulb- *Onion*
  - Corm- *Amorphophollus*
- To study Specialized stem
  - Phylloclade- *Opuntia*
  - Cladode- *Asparagus*

Practical :12 Leaf:

- To study different types of leaf:
  - Simple leaf: Banyan, *Mango*
  - Pinnate Compound Leaf:
    - ✓ Unipinnate: *Cassia, Rose*
    - ✓ Bipinnate: *Mimosa, Caesalpinia*
    - ✓ Tripinnate:*Moringa*
    - ✓ Decompound: *Coriander*
  - Palmately Compound Leaf
    - ✓ Unifoliote: *Citrus*
    - ✓ Bifoliate: *Balanites, Bauhinia*
    - ✓ Trifoliate: *Crotalaria, Oxalis*
    - ✓ Quadrifoliate: *Marsilea*
    - ✓ Multifoliate: *Bombax*

Practical :13 Flower:

- To study different types of flower:
  - Regular flower: *Ipomoea*
  - Irregular flower: *Clitoria, Caesalpinia*
  - Unisexual flower: *Coccinia*
  - Bisexual flower: *Hibiscus*

Practical :14 Botanical name, family, origin, distribution and uses of the followingcrops.

- *Sugarcane*
- *Paddy*
- *Mango*
- *Sapota(Chikoo)*
- *Brinjal*
- *Tomato*

References:

1. College Botany Vol. I - III Gangulee, etal. 5th Edi. 1990 New central book agency Calcute

2. College Botany A. C. Datta 3rd Edi. 1989 Oxford Bombay

3. Taxonomy of Angiosperms V. Singh 1st Edi. 1981 Rastogi pub.

4. Cryptogamic Botany Vol. I - II G.M.Smith 2nd Edi. 1955 Tata MCGrow Hill Bombay

5. Vansptishaastra paper 1 (Semester I) Dr. T.G.Gohil and Dr. Alpesh B. Thakor 1st Edi. 2011 Popular prakashan, Surat

6. Vansptishaastra J.V.Joshi & H.K.Patel 4th edi. 2002 Popular prakashan, Surat

7. A text book of Botany vol. I (Algae, Fungi, Bacteria, Viruses, Lichen & Plant pathology) Pandey etal. - Vikash publishing House pvt. Ltd., New Delhi

8. A text book of Botany vol. II (Bryophyta, Pteridophyta, Gymnosperms & Paleo Botany) Pandey etal. - Vikash publishing House pvt. Ltd., New Delhi

9. A text Book of Botany paper III Dr. T.G.Gohil and Dr. Alpesh B. Thakor 1st Edi. 2007 - 2008 Popular prakashan, Surat

10. A Brief Course in Algae K.P.Saxena 1965 Prakashan Kendra, Lucknow.

11. Introduction to Fungi S.Sundara Rajan 1st Edi. 2001 Anmol Publication, New Delhi

12. Botany for Degree Student- P.C. Vashishta 1st Edi.

13 .Modern Practical Botany Vol. II B.P. Pandey 1995 S. Chand & Company, New delhi.

14. Economic Botany Albert F. Hill 2nd Edi. 1976 Tata McGRAW Hill, New Delhi

15. Taxonomy of Angiosperms V. Singh 1st Edi. 1981 Rastogi pub.

16. Modern Practical Botany Vol. II B.P. Pandey 1995 S. Chand & Company, New delhi.

17. A text book of Botany: The Algae by Brahma Prakash Pandey; Jai Prakash Nath and Co.

18. A class book of Algae by G.L. Chopra; S. Hagin and Co.

19. A text book on Algae by H.D. Kumar and H.S. Singh; East-west press.

20. Fungi, Bacteria and Viruses by H.C. Dube; Vikas publishing house

21. The fungi, bacteria and viruses by Lokendra Singh; Rastogi Publications

22. Botany [for degree students] Bryophyta by B.R. vashishta; S.Chand and Co.

23. Botany for degree students: Pteridophyta by P. C. Vasishta; S. Chand and Co (Pvt.) Ltd.

FACULTY OF ARTS/SCIENCE/COMMERCE

CBCS SYLABI FOR SEMESTER 1 AND 2(FIRST YEAR B. A./B.Sc./B.Com.)

FOUNDATION ELECTIVE COURSE

(A COMMON COURSE FOR ALL FACULTIES)

NAME OF THE COURSE: ENVIRONMENTAL STUDIES

(FOR ENGLISH MEDIUM STUDENTS)

SEMESTER 1

TEXT PRESCRIBED: Textbook of Environmental Studies for Undergraduate Courses- by Erach Bharucha (Universities Press)

Unit 1: The Multidisciplinary Nature of Environmental Studies

Unit 2: Natural Resources

Unit 3: Ecosystems

Unit 4: Biodiversity

Unit 8: Field Work(for Assignments Only)

DISTRIBUTION OF MARKS

Q1. Objective type questions (10 out of 10).	**10 Marks**
Q2. Short-Answer questions (4 out of 6).	**12 Marks**
Q3. Short-Notes (2 out of 4).	**16 Marks**
Q4. Essay type question (1 out of 2).	**16 Marks**
Q5. Essay type question (1 out of 2).	**16 Marks**

TOTAL: 70 Marks

SYLLABUS FOR FOUNDATION COURSE IN ENGLISH FOR B.SC. SEM 1&2 (REGULAR STUDENTS) FOR THE ACADEMIC YEARS- 2019-20, 2020-21 & 2021-22.

- **WRITTEN AND SPOKEN COMMUNICATION SKILLS (W&S)**

Semester 1

Total credit- 02 : 02 hours per week

TEXT—*The Spectrum* (Macmillan)

***Prose :**

1. On Saying Please
2. Go Kiss the World
3. The Night Train at Deoli

***Poetry :**

1. Sonnet 116
2. All Things Will Die

*** Functional Writing.**

1. Writing Business E- Mails. (Enquiries, Replies and orders)
2. Dialogue Writing. (Inter-Personal Conversation : Congratulating and Responding to congratulations ; Compliments; Appreciation; Encouragement ;Asking for , giving and refusing permission)
3. Paragraph Writing

- **The teachers and question- setters are instructed to strictly adhere to the paper style and the distribution of marks.**

Distribution of Marks for the University Exams:

1) Short answer type questions from poems only 5 out of 7 (answer in about 2 to 3 sentences)	10 marks
2) Long answer questions from prose only (1/2)	12 marks
3) Business E- Mails (1/2)	12 marks
4) A- Dialogue Writing (1/2) (8 marks)	16 marks
B- Paragraph Writing (1/2) (8 marks)	
TOTAL	50 marks

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
B. Sc. Biotechnology Semester-II

BT-03: Basic Biochemistry

UNIT-1: EVOLUTIONARY FOUNDATIONS:

1.1 Changes in the hereditary instructions
1.2 Appearance of bio-molecules
1.3 A possible "RNA world" scenario
1.4 Biological evolution
1.5 Synthetic cells
1.6 Evolution of eukaryotic cells
1.7 Functional genomics and its importance in human biology & medicine

UNIT-2: PHYSICAL FOUNDATIONS:

2.1 Dynamic steady state of living organisms
2.2 Energy transformation in living organisms
2.3 Flow of electrons as source of energy
2.4 Requirement of work and energy for creation and maintenance
2.5 Energy coupling links reactions in biology
2.6 Enzymes promote sequences of chemical reactions
2.7 Regulation to achieve balance and economy

UNIT-3: WATER:

3.1 Non-covalent interactions among bio-molecules in aqueous solvent
  3.1.1 Hydrogen bonds
  3.1.2 Ionic interactions
  3.1.3 Hydrophobic interactions
  3.1.4 Van der Waals interactions
3.2 Water as a reactant
3.3 Fitness of the aqueous environment for living organisms

UNIT-4: BUFFERS & pH:

4.1 Ionization of water, weak acids and weak bases
4.2 pH scale
4.3 Types of buffers

REFERENCES:

1. Cox, M. M., & Nelson, D. L., (2017). *Lehninger: Principles of Biochemistry*, 7th Edition, W. H. Freeman, New York.
2. Powar, C. B., & Chatwal, G. R., (2011). *Biochemistry,* Himalaya Publishing House, India.

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VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

B. Sc. Biotechnology Semester-II

BT-04: Fundamentals of Genetics

UNIT-1: CONCEPT OF GENOME AND ITS ORGANIZATION:

1.1 Mendel's discoveries
1.2 History of genetics
1.3 DNA as genetic material
1.3.1 Griffith's Transformation Experiment
1.3.2 Avery's experiment
1.3.3 Hershey-Chase Experiment

UNIT-2: CHROMOSOMES & NUCLEOSOMES:

2.1 Euchromatin and Heterochromatin
2.2 Nucleosome-subunit of all chromatin
2.3 Banding Patterns in chromosomes
2.4 Lampbrush & Polytene chromosomes

UNIT-3: LARGE-SCALE CHROMOSOMAL CHANGES:

3.1 Euploids & Aneuploids
3.2 The concept of gene balance
3.3 Deletions & Duplications
3.4 Reciprocal & Robertsonian translocations

UNIT-4: PATTERNS OF INHERITANCE IN HUMANS:

4.1 Pedigree analysis of autosomal recessive disorders
4.2 Pedigree analysis of autosomal dominant disorders
4.3 Pedigree analysis of X-linked dominant and recessive disorders
4.4 Y-linked inheritance
4.5 The Hardy-Weinberg Law

REFERENCES:

1. Griffiths, A. F., Wessler, S. R., Lewontin, R. C. and Carroll, S. B. (2008) *Introduction to Genetic Analysis*, 9th Edition, W. H. Freeman and Company, New York.
2. Klug, W. S. and Cummings, M. R. (2007) *Concepts of Genetics*, 7th Edition, Pearson Education.

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VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

B. Sc. Biotechnology Semester-II

Practical Core 1: BTP-02: Biotechnology

1. Preparation of normal, molar and molal solutions
2. Preparation of stock and working solutions
3. Preparation of buffer (Phosphate, Glycine-NaOH, Glycine-HCl)
4. Determination of acid value of fats and oils by titration with KOH
5. Calibration of pH meter
6. Identification of eye colour in Drosophila
7. Contribution of scientists in the field of genetics
8. Study of permanent slides/photographs of banding techniques
9. Problems related to Mendelian genetics
10. Pedigree analysis of human genetic disorders

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B.Sc. MICROBIOLOGY

Teaching & Evaluation Scheme

Semester – II

Paper No.	Paper Title	Theory (Hrs/Wk)	Practical (Hrs/Wk)	External	Internal	Total	Credit
MB 201	Procaryotic and archaeal cell structure	2	-	50	20	140	**4**
MB 202	Nutrition and growth of bacteria	2	-	50	20		
MBP 203	Practicals	-	4	40	20	60	**2**

MB 201: PROCARYOTIC AND ARCHAEAL CELL STRUCTURE

Student Learning Objective: The main aspects of this paper are to describe the basic structure of typical procaryotes and archaea. It focuses on important differences in structure between bacteria and Archaea.

	UNIT 1	**CELL MORPHOLOGY & CYTOPLASMIC MEMBRANE**
		Teaching Duration: 07 Lectures
1.1	Cell Morphology	
1.2	Cell Size and the significance of being Small	
1.3	Membrane Structure	
1.4	Membrane Function	

	UNIT 2	**CELL WALL AND GENETIC ELEMENTS OF PROKARYOTES**
		Teaching Duration:08Lectures
2.1	Peptidoglycan	
2.2	LPS: The Outer Membrane	
2.3	Archaeal Cell Wall	
2.4	Nucleoid and Ribosomes	

	UNIT 3	**CELL SURFACE STRUCTURE AND INCLUSIONS**
		Teaching Duration: 07 Lectures
3.1	Cell Surface Structures	
3.2	Cell Inclusions	
3.3	Gas Vesicles	
3.4	Endospore	

	UNIT 4	MICROBIAL LOCOMOTION
		Teaching Duration: 08 Lectures
4.1 4.2 4.3	Flagella and Swimming Motility Gliding Motility Chemotaxis and Other Taxes	

REFERENCE:

- Medigan M., et al., (2015) Brock Biology of Microorganisms, 14th Edition, Pearson education Ltd., (ISBN: 978-1-292-01831-7)
- Willey J.M., Sherwood L.M. and Woolverton C.J., (2017) Prescott's Microbiology, 10th Edition, McGraw - Hill Education, (ISBN: 978-981-3151-26-0)

Further Reading:

- Pommerville J.C. (2014) Alcamo's Fundamental of Microbiology, 10th Edition , Jones & Barlett Pvt. Ltd., (ISBN: 978-0-07-462320-6)

MB 202: NUTRITION AND GROWTH OF BACTERIA

Student Learning Objective: The main objective of this paper is to understand diversified nutritional requirements of microorganisms and their cultivation using various different media. It also focuses on bacterial and archaeal reproduction, cell cycle, growth curve and effect of various environmental factors on growth of microorganisms.

	UNIT 1	BACTERIAL NUTRITION
		Teaching Duration: 07 Lectures
1.1 1.2 1.3 1.4 1.5	Common nutritional requirements Requirements of carbon, hydrogen, oxygen and electrons Nutritional types of microorganisms Requirements of Nitrogen, Phosphorus, sulphur and growth factors Uptake of nutrients	

	UNIT 2	BACTERIAL GROWTH
		Teaching Duration: 08 Lectures
2.1 2.2 2.3 2.4 2.5	Bacterial and Archaeal reproduction by binary fission Bacterial cell cycle Bacterial Growth curve Microbial population size measurement Chemostat and turbidostat for Continuous culture	

	UNIT 3	CULTIVATION OF BACTERIA
		Teaching Duration: 08 Lectures
3.1 3.2 3.3 3.4	Culture media Cultivation of aerobes and anaerobes Enrichment and isolation of pure culture Microbial growth on solid media	

	UNIT 4	ENVIRONMENTAL FACTORS AND GROWTH
		Teaching Duration: 07 Lectures
4.1 4.2 4.3 4.4 4.5 4.6	Solutes and water activity pH Temperature Oxygen concentration Pressure Radiation	

References:

- Willey J.M., Sherwood L.M. and Woolverton C.J., (2017) Prescott's Microbiology, 10th Edition, McGraw - Hill Education, **(**ISBN: 978-981-3151-26-0)
- Willey J.M., Sherwood L.M. and Woolverton C.J., (2008) Prescott, Harley and Klein's Microbiology, 7th Edition, McGraw - Hill Education, (ISBN: 978-007-126727-4)

Further Reading:

- Pelczar, Chan and Krieg, (2001), Microbiology-Concepts and Application, 5th Edition, McGraw-Hill, **(**ISBN: 9780074623206**)**

F.Y B.Sc. Microbiology
Semester II Practicals

(Time duration: 04 hours/ week)

MBP-203: Practicals

1. Cell wall staining – Dyar's method.
2. Flagella staining – Leifson's method.
3. Cytoplasmic membrane staining by victoria blue stain.
4. Endospore staining – Snyder's modification of Dorner's method.
5. Nucleus staining- Feulgen's method.
6. Observation of capsule in bacteria by Maneval's method.
7. Metachromatic granules staining-Albert's method.
8. Techniques for Cultivation of bacteria:
   a) Broth culture
   b) Slant culture
   c) Stab culture.
9. Techniques for Isolation of bacteria:
   a) Streak plate method
   b) Pour plate method
   c) Spread plate method.
10. Influence of oxygen on growth of bacteria and Cultivation of Anaerobic bacteria (Thioglycollate medium).
11. Maintenance and preservation of bacteria.
12. Influence of Environmental factors on microbial growth:
    a) Temperature
    b) pH of media
    c) Osmotic pressure

REFERENCES:

- Patel R.J. and Patel R.K. (2016) Experimental microbiology Volume I, 9th Edition. Aditya,
- Patel R.J. and Patel R.K. (2017) Experimental microbiology Volume II, 9th Edition. Aditya,
- Cappuccino J.G. (2016) Microbiology; A Laboratory Manual, 11th Edition Pearson Edication (Singapore) Pvt. Ltd.(ISBN: 978-9332535190)
- Aneja K.R. (2001) Experiments in Microbiology, Plant Pathology, Tissue culture and Mushroom production technology, 3rd Edition, New Age International Publishers, (ISBN: 978-9386418302)

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VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
SYLLABUS FOR F. Y. B. Sc. SEMESTER- II
Z – 201: ZOOLOGY- THEORY
(Effective from JUNE-2019)
(COMPARATIVE ANATOMY OF CHORDATES, APPLIED ZOOLOGY, WILDLIFE BIOLOGY)

Unit-1: Integumentary System :

Derivatives of integument w.r.t. glands and digital tips
Digestive System : Brief comparative account of alimentary canal and digestive glands of vertebrates (Pisces to mammals).
Respiratory System : Brief account of Gills, lungs, air sacs and swim bladder

Unit-2: Circulatory System : Evolution of heart.

Sense Organs : Types of receptors- eyes, ears, tongue, skin and nose.

Unit-3:

(a) **Human diseases**: Causes, symptoms, prevention and cure:
Dengue, Leptospirosis, Chikungunya, Swine flu
(b) **Applied Zoology**: Importance of poultry farming-Breeds of poultry, Cage system and deep litter system of bird keeping, Egg as food, Care of egg laying hen, poultry appliances and excreta as manure.

Unit-4:Wildlife Biology:

- Introduction, causes of depletion of wild life, Importance of conservation of wild life
- Difference between National Parks and Sanctuaries
- **Wildlife in Gujarat:**

National Parks
(1) Gir National Park (2) Marine National Park

Sanctuaries
(1) Wild ass sanctuary (2) Thol wildlife sanctuary (3) Velavadar black buck Sanctuary (this is national park)

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
SYLLABUS FOR F. Y. B. Sc. SEMESTER- II
Z – 201: ZOOLOGY- PRACTICALS
(Effective from JUNE-2019)

(COMPARATIVE ANATOMY OF CHORDATES, APPLIED ZOOLOGY, WILDLIFE BIOLOGY)

The following practicals are to be taught/studied **only** with the help of charts, models, videos, photographs, permanent slides, working models etc.

(1) Integumentary System: Derivatives of integument w.r.t. glands and Digital tips.

(2) Digestive System: Brief account of alimentary canal and digestive glands

(3) Respiratory System: Brief account of Gills, lungs, air sacs and swim bladder

(4) Circulatory System: Evolution of vertebrate heart.

(5) Sense Organs: Types of receptors- eyes, ears, tongue, skin and nose

(6) Study of national parks and Sanctuaries

Gir N.P., Marine N.P., Wild ass W.L.S., Thol W.L.S.and Velavadar W.L.S

(7) To study the causes, symptoms, cure and prevention of

Dengue, leptospirosis, chikungunya and swine flu.

(8) To study poultry appliances- hover canopy type brooder, modern hangingfeeder (plastic), modern hanging water appliance (plastic) and box type candling appliance.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
SYLLABUS FOR F. Y. B. Sc.
. SEMESTER- II
Z – 202: ZOOLOGY- THEORY
(Effective from JUNE-2019)

(LIFE PROCESSES, BIOCHEMISTRY, IMMUNOLOGY AND TISSUE SYSTEM)

UNIT-1 Life Processes:

Nutrition/ Digestion in Human –

- Buccal digestion: Salivary secretion and digestion.
- Gastric digestion: Gastric secretion and digestion
- Intestinal digestion: Pancreatic secretion, bile secretion, digestion in small intestine, digestion and absorption in large intestine.
- Reproduction and its types.

UNIT-2 Biological Chemistry:

- pH and Buffers in Biological Systems.
- Control and regulation of metabolism at cell, gene and hormonal level
- Introduction to constituents of balanced diet-Sources, functions and deficiency status.

UNIT-3 Immunology:

- Introduction and basic concepts of immunology.
- Cells and organs of immune system.
- Humoral and cellular immune response.
- Innate and acquired immunity.

UNIT-4 Tissue systems:

To Study various types, their structure and functions.
Epithelial, connective, nervous and muscular tissue

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
SYLLABUS FOR F. Y. B. Sc. SEMESTER- II
Z – 202: ZOOLOGY- PRACTICALS
(Effective from JUNE-2019)

LIFE PROCESSES, BIOCHEMISTRY, IMMUNOLOGY AND TISSUE SYSTEM

The following practicals are to be taught/studied **only** with the help of charts, models, videos, photographs, permanent slides, working models etc.

(1) To study the control of food ingestion in animals and T.S. of intestine of mammals to show villi for absorption.

(2) To study different salivary glands and their functions in human.

(3) Diseases due to vitamin deficiency: Xerophthalmia, nyctalopia (Night blindness), rickets, scurvy, beriberi, pellagra.

(4) To study Different types of reproduction.

(5) Tissue System: Study of various types of tissues with the help of permanent slides- areolar tissue, adipose tissue, Hyaline Cartilage, Mammalian bone, Medulated and non Medulated nerve fiber.

Reference Books :

(1) Shukla, G.S. & Upadhyay, V.B. Economic Zoology. Rastogi Publi. 2005, 487 pages.(For Poultry)
(2) JawaidAhsan, Sinha, S. P. 2008. A Handbook of Economic Zoology. S. Chand and Co. Publ. 272 pages.(For Poultry)
(3) Ruppert and Barnes, R.D. (2006). *Invertebrate Zoology*, VIII Edition. Holt Saunders International Edition.
(4)Kardong, K.V. (2005) *Vertebrates' Comparative Anatomy, Function and Evolution*.IVthEdition.McGraw-Hill Higher Education.
(5) Kent, G.C. and Carr R.K. (2000). *Comparative Anatomy of the Vertebrates*. IX Edition.The McGraw-Hill Companies
(6) Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002). *The Invertebrates: A New Synthesis*, III Edition, Blackwell Science
(7) Young, J. Z. (2004). *The Life of Vertebrates*.III Edition.Oxford University press.
(8) Modern Text Book of Zoology (vertebrate) R.L. Kotpal, Rastogi Publication, Meerut, India.
(9) Modern Text Book of Zoology (invertebrate) R.L. Kotpal, Rastogi Publication, Meerut, India.
(10) Invertebrate Zoology- E.L. Jordan & P.S.Verma
(11) Invertebrate Zoology- T.C. Majupuria, Pradeep Publication, Jalandhar, India.
(12) A Text Book of Histology – Leslie P. Gartner-4thedi.-Amazone
(13) Intruduction to Chordates- T.C. Majupuria, Pradeep Publication, Jalandhar, India.
(14) A manual of Practical Zoology Invertebrates- P.S.Verma, S. Chand & Co. Ltd. New Delhi, India.
(15) A manual of Practical Zoology Chordates- P.S.Verma, S. Chand & Co. Ltd. New Delhi, India.
(16)Prani Auotiki (Gujarati)- Desai and Akhunji – University Granth nirman Board- Ahmedabad- India.
(17) Poultry vigyan- Mehta and Ghasura- University Granth nirman Board- Ahmedabad- India.
(18) Vanyajiv Vidya ane Vanyajiv Vyavasthapan- Prof, V.C.Soni - University Granth nirman Board- Ahmedabad- India.
(19) Ecology, Cell biology, Genetics, Animal diversity, Animal Physiology, Immunology, Chordates and Invertebrates- Titles by N.Arumugam, Saras Publi., Kanyakumari, India.
(20) A Text Book of Zoology- Dr. Alkesh I. Shah & Dr. Krishna R. Rajput, New Popular Prakashan, Surat, India.

Web references:

(1) Comparative Anatomy - Digestive System
https://www.slideshare.net/emsicipriano/comparative-anatomy-digestive-system
(2)Comparative Anatomy - Respiratory System
https://www.slideshare.net/emsicipriano/comparative-anatomy-respiratory-system
(3)Urogenital system chap
https://www.slideshare.net/CharmHernandez/urogenital-system-chap

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BOT – 201 :PLANT PHYSIOLOGY, PLANT ECOLOGY, PLANT ANATOMY, MEDICINAL PLANTS AND PLANT PATHOLOGY

Unit - I **Plant Physiology**

- Imbibition and Osmosis
- Plant Movement: Definition and types of movements
- Photosynthesis: Definition, pigments, light and dark reaction, C_3 and C_4 cycle, factors affecting photosynthesis

Unit - II **Plant Ecology**

- Ecological adaptations, morphological and anatomical characters of Hydrophytes, Mesophytes and Xerophytes with appropriate examples

Unit - III **Plant Anatomy**

- Tissue system: Meristematic and Permanent tissue
- Vascular Bundle: Definition and types
- Stele: Definition and types
- Ergastic matters: starch grain, raphides, sphaerephides, aleurone grain and cystolith

Unit - IV **Medicinal Plants**

- Scientific name, family, part use and medicinal uses of following:
  - *Ocimum sanctum*
  - *Adhatodavasica*
  - *Aloe barbedense*
  - *Azadirachtaindica*
  - *Abrusprecatorius*
  - *Zingiberofficinale*

Unit - V **Plant Pathology**

- Causal organisms, symptoms and control measures of the following plant diseases:
  - Leaf spot of Mango
  - Red rot of Sugarcane
  - Bacterial blight of Paddy
  - Little leaf of Brinjal
  - Citrus canker

BOT – 202 :PLANT DIVERSITY AND WEED MANAGEMENT

Unit - I **Weed management**

- Introduction
- Invasive weeds: concept and causes of their dominance
- Weed control: Physical, chemical and biological methods
- Sustainable use of weeds

Unit - II **Gymnosperm**

- Classification, external morphology, internal structure, reproduction and alternation of generation in Cycas.

Unit - III **Morphology**

- Phyllotaxy: Definition and Types with examples.
- Aestivation: Definition and types with examples
- Inflorescence: Definition and Types: Racemose and Cymose
- Placentation: Definition and Types with examples.

Unit - IV **ANGIOSPERMS**

- Classification as per Bentham & Hooker's system of Classification, generalcharacters, economic and medicinal importance, Botanical name of commonimportant plants of the following families.
  - Malvaceae
  - Apocynaceae
  - Convolvulaceae
  - Nyctaginaceae
  - Amarillidaceae

Unit - V **Conservation of plant diversity**

- Concept and need, Methods of in-situ and Ex-situ conservation
- Botanical garden
- Forests: Importance of forests and their conservation.

BOT – 203 :PLANT PHYSIOLOGY, PLANT ECOLOGY, PLANT ANATOMY, MEDICINAL PLANTS AND PLANT PATHOLOGY, PLANT DIVERSITY AND WEED MANAGEMENT

- The candidates should study the typical vegetation in natural condition and should record their observation in journals. Excursion should be arranged during the year to local places.
- Every candidate shall complete laboratory course in accordance with the regulations issuedfrom time to time by Academic Council on the recommendation of the Board of Studies.
- Every candidate shall record observation directly in the laboratory journal. Every journalshall be signed periodically. At the end of the semester candidate shall produce certified journal during the practical examination.

Practical :1 **Plant physiology** (Experiment to be demonstrated)

- (i) Imbibition and Imbibition force
  - Test tube experiment.
  - Indicator experiment
- (ii) Plant movements
  - Geotropism
  - Phototropism
  - Hydrotropism
- (iii) Photosynthesis
  - Mohl's half leaf experiment
  - Light is necessary for photosynthesis

Practical :2 **Plant ecology** (Fresh specimens to be shown to the students):

- Hydrophytes:
  - Hydrilla, Vallisneria, Eichhornia, Pistia, Nymphaea, Marsilea.
- Mesophytes:
  - Coriander, Trigonella, Garlic (Entire plants)
- Xerophytes:
  - Solanumxanthocarpum, Casuarina, Aloe vera, Opuntia, Euphorbia tiruculli

Practical :3 **Tissue:**To study following permanent slides:

i Root apex

ii Shoot apex

iii Parenchyma

iv Aerenchyma

v Chlorenchyma

vi Collenchyma

vii Sclerenchyma

viii Xylem- Spiral vessels, Pitted vessels

ix Phloem elements

Practical :4 **Stele**: Study of stele from permanent slides:

- Actinostele
- Plectostele
- Amphiphloicsiphonostele
- Eustele
- Atactostele

Practical :5 **Vascular Bundles**:Study of various types of Vascular bundles from Permanent slides.

- Radial
- Amphicribral (Hadrocentric)
- Collateral and open
- Collateral and closed
- Bicollateral

Practical :6 **Non living cell contents:** Slides are to be prepared by the students from given materials.

- Starch grains: Potato tuber, Wheat or Rice, Euphorbia tiruculli.
- Mineral Crystals:

(a) Raphides: Pothos, Colocasia petiole

(b) Sphaeraphides: Opuntia, Nerium leaf

Practical :7 **Medicinal plants**: Scientific name, family, part use and medicinal uses of following:

- Ocimum sanctum
- Adhatodavasica
- Aloe barbedense
- Azadirachtaindica
- Abrusprecatorius
- Zingiberofficinale

Practical :8 **Plant pathology**:Causal organisms, symptoms and control measures of the following plant diseases

- Leaf spot of Mango
- Red rot of Sugarcane
- Bacterial blight of Paddy
- Little leaf of Brinjal
- Citrus Canker

Practical :9 **Weed Management:**Observation of weeds with reference to Botanical Name, Family, Morphologicalpeculiarities:

- Native – Cynadon , Cyprus, Amaranthus, Panicum
- Exotic/Invasive – Alternanthera, Desmostachya, Euphorbia, Malachara

Practical :10 Gymnosperms (Cycas)

- Preparation of slides from the fresh material by the students -:
  - T.S. of Rachis
  - T.S. of Leaflet
- Permanent Slides: T.S. of Leaflet, T.S. of Rachis, T.S. of Coralloid root, T.S. ofMicrosporophyll, T.S. of Megasporophull, L.S. of Ovule
- Preserve Specimen: Coralloid root, Microsporophyll and Megasporophyll

Practical :11 **Phyllotaxy:**

(i) Distichous phyllotaxy

(ii)Tristichous

(iii) Pentastichous

(iv) Opposite superpose

(v) Opposite decussate

(vi) Verticillate or Whorled

(vii) Leaf mosaic

(viii) Hetrophylly

Practical :12 **Aestivation**

- Valvate: Calyx of *Hibiscus rosasinensis*
- Twisted: Corolla of *Hibiscus rosasinensis*
- Imbricate: Corolla of *Caesalpiniapulcherrima*
- Quincuncial : Corolla of *Antigononleptopus*
- Vexillary : Corolla of *Clitoriaternatea*

Practical :13 **Inflorescence:**

- RACEMOSE

  (a) Raceme: Caesalpiniapulcherrima, Brassica juncea

  (b) Spike: Achyranthusaspera, Polianthestuberosa

  (c) Spadix: Colocasia

(d) Catkin: Acalyphahispida

(e) Spikelets: Poaceae (any plant)

(f) Corymb: Cassia, Ixora

(g) Umbel: Coriandrum

(h) Capitate: Acacia, Albizzia

(i) Capitulum: Helianthus, Tridax

- CYMOSE

Unbranched:

(a) Solitary Terminal: Datura

(b) Solitary Axillary: Hibiscus

Branched:

(c) Helicoid: Hamelia

(d) Scorpioid: Heliotropium

(e) Dichasial or Biparous: Clerodendrum, Nyctanthus, Jasminum

(f) Polychasial or Multiparous: Nerium, Calotropis

Practical :14 **Placentation**: Study of Placentation to be demonstrated by permanent slides.

(i) Marginal

(ii) Axile

(iii) Free central

(iv) Parietal

(v) Superficial

(vi) Basal

Practical :15 **Angiosperm: (Families)**

- Study of Morphological characters, floral dissection, T.S. of Ovary and floral formulae of following families.

(i) Malvaceae : *Hibiscus rosasinensis, Thespesia, Gossypium*

(ii) Convolvulaceae: *Ipomeapalmeta*

(iii) Apocynaceae : *Nerium, Allamanda, Catharanthusroseus*

(iv) Nyctaginaceae : *Bougainvallia, Mirabilis*

(v) Amaryllidaceae : *Crinum, Polianthes*

References:

1. College Botany Vol. I - III Gangulee, etal. 5th Edi. 1990 New central book agency Calcute

2. College Botany A. C. Datta 3rd Edi. 1989 Oxford Bombay

3. Taxonomy of Angiosperms V. Singh 1st Edi. 1981 Rastogi pub.

4. Plant Physiology by Frank B. Salisbury.

5. Plant Pathology by R.S. Mahrotra

6. Vansptishaastra J.V.Joshi & H.K.Patel 4th edi. 2002 Popular prakashan, Surat

7. Plant pathology R.S. Mehrotra 4th Edi. 1987 Tata McGRAW Hill, New Delhi

8. A text book of Botany vol. II (Bryophyta, Pteridophyta, Gymnosperms & Paleo Botany) Pandey etal. - Vikash publishing House pvt. Ltd., New Delhi

9. A text Book of Botany paper III Dr. T.G.Gohil and Dr. Alpesh B. Thakor 1st Edi. 2007 - 2008 Popular prakashan, Surat

10. A text book of Plant Ecology R.S. Ambasht 1st Edi. 1969 Students friends & co., Varanasi

12. Botany for Degree Student- P.C. Vashishta 1st Edi.

13 .Modern Practical Botany Vol. II B.P. Pandey 1995 S. Chand & Company, New delhi.

14. Plant Anatomy B.P. Pandey 1st Edi 1978 S. Chand & Company, New delhi.

15. Taxonomy of Angiosperms V. Singh 1st Edi. 1981 Rastogi pub.

16. Modern Practical Botany Vol. II B.P. Pandey 1995 S. Chand & Company, New delhi.

17. Vansptishaastra paper 1 (Semester II) Dr. T.G.Gohil and Dr. Alpesh B. Thakor 1st Edi. 2011 Popular prakashan, Surat

18. Economic Botany Albert F. Hill 2nd Edi. 1976 Tata McGRAW Hill, New Delhi

19. Plant Physiology Susbeela M. Das 1st Edi. 2003 Dominant publisher, New Delhi

20. Plant Physiology by Taiz and ZeigerSinauer Associates inc. publishers21. Fundamentals of Ecology by E P Odum and G W Barrett. Thompson Asia Pvt Ltd. Singapore.

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WRITTEN AND SPOKEN COMMUNICATION SKILLS (W & S)

Semester 2

Total credit- 02: 02 classes per week

TEXT—*The Spectrum* (Macmillan)

*** Prose :**

1. The Scientific Point of View
2. Karma
3. If You Are Wrong , Admit It

***Poetry :**

1. My Grandmother
2. Refugee Mother and Child

*** Functional Writing.**

1. Description (Person, Place ,etc.)
2. Narration
3. Dialogue Writing (Casual Conversation, Talking about the weather; Describing daily routine; talking about current activities ;Telephonic Conversation ; Answering the telephone and asking for someone ; taking and leaving messages; making inquiries on the phone)

- **The teachers and question-setters are instructed to strictly adhere to the paper style and the distribution of marks .**

Distribution of Marks for the University Exams

1)Short answer type questions from poems only (answer in about 2 to 3 sentences) (5 / 7)	10 marks
2)Long answer questions from prose only (1/2)	12marks
3)Description / Narration (1/2)	12marks
4) A. Dialogue Writing (Casual: 1 /2) 8 marks	16 marks
B. Dialogue Writing (Telephonic: 1 /2) 8 marks	
TOTAL	50 marks

SEMESTER 2

TEXT PRESCRIBED: Textbook of Environmental Studies for Undergraduate Courses- by Erach Bharucha (Universities Press)

Unit 5: Pollution

Unit 6: Social Issues and the Environment

Unit 7: Human Population and the Environment

Unit 8: Field Work(for Assignments Only)

DISTRIBUTION OF MARKS

Q1. Objective type questions (10 out of 10).	**10 Marks**
Q2. Short-Answer questions (4 out of 6).	**12 Marks**
Q3. Short-Notes (2 out of 4).	**16 Marks**
Q4. Essay type question (1 out of 2).	**16 Marks**
Q5. Essay type question (1 out of 2).	**16 Marks**
	TOTAL: 70 Marks

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
B. Sc. Biotechnology Semester-III

BT-05: INSTRUMENTATION & TECHNIQUES

UNIT-1: POTENTIOMETRY

1.1 pH Electrode: Reference electrode, Glass electrode, Combine electrode
1.2 Construction, operation and use of pH meter
1.3 Maintenance of electrodes
1.4 Ion selective meter and electrode for Ca^{+2}, F^{-}, Biomembrane electrode

UNIT-2: SEPARATION & MEASUREMENT TECHNIQUES

2.1 Classification of chromatography & general principles
2.2 Principles of Paper chromatography and Thin Layer Chromatography
2.3 Development methods
2.4 Detection, measurement and use of radioactivity in Biology:
- 2.4.1 Geiger-Muller counter: working principle and application
- 2.4.2 Scintillation counter: working principle and application
- 2.4.3 Autoradiography: Techniques and applications

UNIT-3: CENTRIFUGATION

3.1 Basic principles of sedimentation, Types of centrifuges and rotors
3.2 Separation methods in preparative ultracentrifuges:
- 3.2.1 Differential centrifugation
- 3.2.2 Density gradient centrifugation
- 3.2.3 Analysis of sub cellular fractions

3.3 Application of analytical ultracentrifuge:
- 3.3.1 Determination of relative molecular mass
- 3.3.2 Estimation of purity of macromolecules
- 3.3.3 Conformational changes in macromolecules

3.4 Safety aspects in use of centrifuge

UNIT-4: SPECTROPHOTOMETRY

4.1 Molecular absorption spectroscopy and Laws of photometry
4.2 Colorimeter : Components of the instrument and applications
4.3 Spectrophotometer: Single beam and double beam instrument and applications
4.4 Quantitative analysis by spectrophotometer-manual and automated

REFERENCES:

1. Keith Wilson &john walker (ED) (2000): Practical biochemistry-principle & Techniques. Cambridge university press.
2. Skoog , Holler and Nieman, Industrial analysis-Saunders college publication
3. Skoog, West and Holler, fundamentals of analytical chemistry- Saunders college publication
4. James S. Fritz & George H. Schenk, Jr. (1969): Quantitative analytical chemistry (2nd edition). Allyn &Bacon, Inc., Boston.
5. Brown S.B (1980): An Introduction to spectroscopy for biochemists. Academic press London.
6. E.D.P.De Robertis& E.M.F. De Robertis Jr.(2001): Cell and Molecular Biology (8th edn) Lippincott Williams & Wilkins, London
7. Robards K. Haddad P. R. & Jackson P.E. (1994): Principles and Practice of modern chromatographic methods. Academic press London

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VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
B. Sc. Biotechnology Semester-III

BT-06: MAMMALIAN ANATOMY AND PHYSIOLOGY

UNIT-1: MUSCLE PHYSIOLOGY & CARDIO-VASCULAR SYSTEM

1.1 Structure & Types of Muscles
1.2 Structure & Internal Anatomy of Heart
1.3 Organization & Microscopic anatomy of Skeletal Muscle Fiber
1.4 Sliding Filament Mechanism of Skeletal Muscle Fibers
1.5 Cardiac cycle & Cardiac Output

UNIT-2: NEUROPHYSIOLOGY

2.1 Structure & types of Neurons & Nerve Fibers
2.2 Neurotransmitters
2.3 Reflex Activities
2.4 Electrical Signals in Neurons
2.5 Synapse & Signal transmission at Synapse

UNIT-3: EMBRYOLOGY & REPRODUCTIVE SYSTEM

3.1 Structure of Testis & Ovary with role of their hormones
3.2 Spermatogenesis & Oogenesis
3.3 Fertilization
3.4 Characteristics, Planes, Physiology & Products (Morula, Blastula & Gastrula) Of Cleavage
3.5 Female Reproductive Cycle

UNIT-4: ENDOCRINOLOGY

4.1 Introduction to Endocrine Glands & Hormones
4.2 Pituitary Gland – Structure, Hormones & their functions
4.3 Thyroid & Parathyroid Glands - Structure, Hormones & their functions
4.4 Adrenal Gland – Structure, Hormones & their functions
4.5 Pancreas – Structure, Hormones & their functions

REFERENCES:

1. Anatomy & Physiology – G. J. Tortora & B. Derrickson, Wiley Pub.
2. Medical Physiology – Guyton & Hall, Saunders Elsevier Pub.
3. Essentials of Medical Physiology – K. Sembulingam & P. Sembulingam, Jaypee Brothers Medical Pub.
4. Chordate Embryology - P. S. Verma & V. K. Agarwal, S. Chand Pub.
5. Developmental Biology – S. F. Gilbert, Palgrave Macmillan Pub.

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VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
B. Sc. Biotechnology Semester-III

BT-07: PLANT MORPHOLOGY AND PHYSIOLOGY

UNIT-1: PLANT MORPHOLOGY

1.1 Shoot system - Parts and functions
1.2 Root system- types, functions and modifications
1.3 Flower- Parts, functions, types of fertilizations, fruit formation.
1.4 Seed-Types, basic structure. Germination- types, factors necessary for germination.

UNIT-2: PLANT-WATER RELATIONS

2.1 Water relations- Diffusion, Osmosis, water potential and its components
2.2 Turgor pressure, Wall pressure and interrelationship.
2.3 Ascent of sap-Theories
2.4 Transpiration - types, Mechanism of opening and closing of stomata, factors influencing transpiration rate.

UNIT-3: METABOLIC PROCESSES

3.1 Structure of chloroplast; Action spectra, Photophosphorylation.
3.2 Pathways of carbon fixation- C_3, C_4, CAM pathway; Significance of Carbon fixation.
3.3 Photorespiration and its significance
3.4 Mineral salt absorption- Passive absorption and active absorption.

UNIT-4: GROWTH AND REGULATION

4.1 Mineral nutrition: Macro, and micronutrients, their role, deficiency symptoms.
4.2 Growth pattern and kinetics, Physiological role of Phytohormones- Auxins, Kinetin, Gibberellins, ABA and Ethylene: Their applications.
4.3 Concept of photomorphogenesis -Phytochrome system, Photoperiodism.
4.4 Vernalization, Florigen concept.

REFERENCES:

1. A. C. Dutta 6th Edition, Botany for Degree Students *Publisher*: Oxford.
2. Frank B. Salisbury and Cleon W. Ross (2010), Plant Physiology, Cengage learning products, India Edition.
3. S. K. Verma and Mohit Verma (1999) Plant Physiology Biochemistry and Biotechnology, S. Chand.
4. Lincoln Taiz and Eduardo Zaiger (4th Edition), Plant Physiology, Sinqaur Associates Inc. Publishers.
5. S. N. Pandey and K. K. Singh, Plant physiology, Vikas Pub.

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VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
B. Sc. Biotechnology Semester-III

BTP-03: Biotechnology Practical

1. Preparation of working solutions as well as different buffers and calibration of pH meter.
2. Study of Binocular Microscope and cell count by Haemocytometer.
3. To study the working of Centrifuge.
4. To study the working of Spectrophotometer.
5. Paper chromatography for separation of amino acids.
6. To study use & working of Electrocardiogram (ECG), Electroencephalogram (EEG), Sphygmomanometer, Electromyogram & Kymograph Apparatus.
7. To study Reaction Time & Reflex Action.
8. To study planes of cleavage, morula, blastula & gastrula with the help of permanent slides/charts/photographs.
9. Determination of osmotic potential of cell sap by plasmolytic method.
10. Comparatively anatomical studies of C_3 and C_4 plants.
11. Experiment to show that oxygen is evolved during photosynthesis.
12. To compare the loss of water from two surfaces of leaf by:
    a) $CoCl_2$ method b) Four leaf method

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VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
B. Sc. MICROBIOLOGY

Teaching & Evaluation Scheme
S. Y. B. Sc. Semester III

Paper No.	Paper Title	Theory	Practical	External	Internal	Total	Credit
		(Hrs/Week)					
MB-301	Principles of bacterial systematics	02	-	50	20	70	06
MB-302	Control of microorganisms in the environment	02	-	50	20	70	
MB-303	Virology	02	-	50	20	70	
MBP-304	Practicals	-	06	60	30	90	03
Total		**06**	**06**	**210**	90	300	09

MB 301: Principles of Bacterial Systematics

Course description

Course code: MB 301
Course title: Principles of Bacterial Systematics
Course type: Core
Course credit: 02
Course overview:
The paper explores microbial taxonomy and classification of bacteria using an evolutionary framework. Bacterial taxonomy and phylogeny gives an understanding regarding degree of prokaryotic diversity unmatched by eukaryotic unicellular and multicellular organisms.

Course Objectives

- To understand taxonomic ranks and taxonomic phlogeny
- To study classical and molecular characteristics for microbial taxonomy
- To understand Bergey's manual of systematic bacteriology
- To study arachea and its classification
- To aquire knowledge of taxonomy of proteobacteria

Course Content

	UNIT 1	Microbial Taxonomy and the Evolution of Diversity
		Teaching Duration: Lectures 07
1.1	Microbial Taxonomy	
1.2	Taxonomic Ranks	
1.3	Microbial taxonomy and phylogeny 1.3.1 Classical Characteristics 1.3.2 Molecular Characteristics: Nucleic acid hybridization, Nucleic acid base composition	
1.4	Evolutionary process and the concept of microbial species	
1.5	Bergey's Manual of systematic bacteriology	

	UNIT 2	Taxonomy of Archaea
		Teaching Duration:Lectures 07
2.1	Overview of Archaea	
2.2	Major groups of *Archaea*	
2.3	Phylum *Crenarchaeota*	
2.4	Phylum *Euryarchaeota* 2.4.1 Methanogens and Methanotrophs 2.4.2 Haloarchaea	

	UNIT 3	Taxonomy of Proteobacteria
		Teaching Duration:Lectures 08
3.1	Class *Alphaproteobacteria*: Order *Rhizobiales*	
3.2	Class *Beta Proteobacteria*: Order *Hydrogenophiales*	
3.3	Class *Gamma Proteobacteria*: Order *Enterobacteriales*	
3.4	Class Delta *Proteobacteria*: Order *Bdellovibrionales*	
3.5	Class *Epsiloneproteobacteria*	

	UNIT 4	Important groups of bacteria
		Teaching Duration:Lectures 08
4.1	Class *Bacilli*: Aerobic endospore forming bacteria	
4.2	Class *Mollicutes*	
4.3	Phylum *Cyanobacteria*	
4.4	Phylum *Spirochaetes*	
4.5	Phylum *Bacteroidetes*	

Student learning Outcome

Unit 1: Student will learn evolutionary process of microorganisms.
Student will be able to classify microorganisms based on their cultural and molecular characteristics.

Unit 2: Students will gain knowledge of the unique characteristics of archea, its adaptation

and importance.

Unit 3: Students shall understand the major classes of proteobacteria and important phyla

Unit 4: Shall enable the students to understand aerobic endospore former, bacteroidetes, Spirohaetes and cyanobacteria.

Recommended References:

- Lory, S., Perry, J. J., Gunsalus, R. P., Staley, J. T. (2007). Microbial Life. 2nd Edition, United Kingdom: Sinauer Associates. ISBN: 9780878936854, 0878936858
- Pelczar, Chan and Krieg, (1993), *Microbiology-Concepts and Application*, International Edition, McGraw-Hill. ISBN: 9780071129145
- Sherwood, L., Willey, J. M., Woolverton, C. J. (2017). Prescott'sMicrobiology. Singapore: McGraw-Hill Education.10th Edition, 2017. ISBN: 9789813151260, 9813151269.
- Tortora G.J., and Funke B.R. (2016), *Microbiology an Introduction*, 12th Ed., Pearson, ISBN: 9781292099149

MB 302: Control of Microorganisms in the environment

Course description

Course code: MB 302
Course title: Control of Microorganisms in the environment
Course type: Core
Course credit: 02
Course overview:
The paper includes the study of the control and destruction of microorganisms. It includes the physical and chemical methods to control pathogens and prevent their transmission and to reduce or eliminate microbes responsible for the contamination of food, water and other substances.

Course Objectives

- To understand the principle of controlling the presence of microorganisms.
- To study the physical agents and mechanisms used for the control.
- To learn the effect of various chemical agents used for the microbial control.
- To understand the mechanism of control of chemical agents.
- To acquire the ability to select the control agent in the environment.

Course Content

	UNIT 1	Basic Principles of Microbial Control
		Teaching Duration: Lectures 07
1.1	Terminology of Microbial Control	
1.2	Microbial Death Rates	
1.3	Action of Antimicrobial Agents	
1.4	The Selection of Microbial Control Methods	
1.5	Situational Considerations	

	UNIT 2	Mechanical and Physical Methods for Microbial Control
		Teaching Duration: Lectures 08
2.1	Filtration	
2.2	Heat Related Methods	
2.3	Refrigeration and Freezing	
2.4	Desiccation and Lyophilization	
2.5	Osmotic Pressure	
2.6	Radiation	

	UNIT 3	Chemical Methods for Microbial Control – I
		Teaching Duration: Lectures 07
3.1	Choosing a Microbicidal Chemical	
3.2	Factors Affecting Germicidal Activity of Chemicals	
3.3	The Halogens Antimicrobial Chemical	
3.4	Phenols: Its derivatives and Applications	
3.5	Alcohols	

	UNIT 4	Chemical Methods for Microbial Control - II
		Teaching Duration: Lectures 08
4.1	Hydrogen Peroxide and related Germicides	
4.2	Chemicals with Surface Action: Detergents	
4.3	Heavy Metals	
4.4	Aldehydes	
4.5	Gaseous Sterilants and Disinfectants	
4.6	Dyes	
4.7	Acid and Alkalies	

Student learning Outcome

Unit 1: Student will understand the role of microbial control in disease transmission
Students will be enabled to select the suitable microbial control agents.

Unit 2: Gain knowledge of physical and mechanical of microbial control and mode of action of each.

Unit 3: Student shall understand the major chemical agents and its microbicidal effect.

Unit 4: Shall enable the students to understand the mechanism of chemical control.

Recommended References:

- Bauman R. W., (2003), *Microbiology, Pearson/Benjamin-Cummings*, (ISBN: 0-8-53-7590-2)
- Cowan M. K. and Talaro K. P., (2006), *Microbiology: A Systems Approac*h, Mc-Graw Hill Higher Education, (ISBN: 0-07-291804-7)
- Nester E. W., Anderson D. G., Roberts Jr. C. E., Pearsall N. N. and Nester T. M., *Microbiology,* International Edition, Mc-Graw Hill Higher Education, (ISBN: 0-07-121493-3)

Further Reading:

- Pommerville J. C., (2014), *Alcamo's Fundamentals of Microbiology*, 10th edition, Jones and Bartlett Learning, (ISBN: 978-93-80853-5374-1)
- Willey J. M., Sherwood L. M. and Woolverton C. J., (2017), *Prescott's Microbiology*, 10th edition, Mc-Graw Hill Education, (ISBN: 978-981-3151-26-0)

MB 303: Virology

Course description

Course code: MB 303
Course title: Virology
Course type: Core
Course credit: 02
Course overview:

The aim of the paper is to realize the increasing importance of virology. Students shall learn the origin, basic structure of virus and its classification. It teaches the cultivation and reproduction of virus. The paper also includes the role of virus in disease as well as cancer but also a study on viruses associated with plant, animal, insects and archaeal viruses.

Course Objectives

- To give an overview of medically important virus families.
- To describe the structure, classification and cultivation of viruses.
- To understand the replication strategies of viruses.
- To study virus like infectious particles
- To study the role of virus and virus host.

Course Content

	UNIT 1	Basics of Viral Structure
		Teaching Duration: Lectures 07
1.1	Origin of Virus	
1.2	Viron Structure is defined by Capsid Symmetry or presence and absence of Envelope	
1.3	Host Range and Specificity of Virus	

	UNIT 2	Viral Taxonomy and Cultivation
		Teaching Duration:Lectures 07
2.1	Classification of Viruses	
2.2	Emerging Viruses	
2.3	Cultivation of viruses in Laboratory	

	UNIT 3	Replication of Viruses
		Teaching Duration: Lectures 08
3.1	General Characteristic of Replication	
3.2	Replication of T – even phages (Lytic cycle)	
3.3	Lysogeny	
3.4	Replication of Animal Viruses	
3.5	Latent Virus infection	

	UNIT 4	Viruses and Sub Viral Infectious Particles
		Teaching Duration: Lectures 08
4.1	Viruses and Tertotogenesis	
4.2	Viruses like Agents	
4.3	Viruses and Cancer, Human Cancer Viruses	
4.4	Plant Viruses	
4.5	Viruses of Fungi and Protist	
4.6	Insect Viruses	
4.7	Archaeal Viruses	

Student learning Outcome

Unit 1: Students shall get insights about viruses, its structure, its symmetry and origin.
Unit 2: Students shall learn about classification of virus.
Acquire knowledge of emerging viruses threatening the world.
Unit 3: Enable the students to understand virus replication.
Students shall understand the differences between lytic and lysogenic cycles.
Unit 4: Students gain insights about viruses and virus like infectious particles.
Students shall understand the role of virus in cancer.

Recommended References:

- Black, J. G. (2012). Microbiology: Principles and explorations. Hoboken, NJ: Wiley. ISBN: 9780470541098, 0470541091.
- Sherwood, L., Willey, J. M., Woolverton, C. J. (2008). Prescott's Microbiology. Singapore: McGraw-Hill Education.7th Edition and 10th edition. 2017. ISBN: 0073302082, 9780073302089 and ISBN: 9789813151260, 9813151269.

Syllabus of B.Sc. (Statistics) Semester III & Semester IV Syllabus effective from June 2012-2013

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

B.Sc. Semester III

STATISTICAL METHODS – I (I.D.)

UNIT I: Definitions, Limitations and functions of statistics. 10%

UNIT II: Probability: **3**0%

Definitions: Sample space, mutually exclusive, equally likely and exhaustive events, independent events. Addition and multiplication theorem of probability, conditional probability (Without proof), simple examples.

UNIT III: Random Variable: **3**0%

Definition & types of Random Variables. Properties of discrete random variables only. Definition of expected value. Addition and multiplication rules of expected value. (only for discrete random variables.) Definition of raw and central moments. Relation between central moments and raw moments. Definition of moment generating function about origin and its properties (without proof), simple examples.

UNIT IV: Measures of Central Tendency and Dispersion: **3**0%

Definition of mean, median, mode, harmonic mean and geometric mean.

Range, standard deviation, mean deviation from mean, quartiles and quartile deviation, examples for ungroup data, discrete and continuous data.

References:

1. Introduction to mathematical statistics : P.G.Hoel
2. Introduction to mathematical statistics : Goon Gupta, Das Gupta
3. Fundamental of Statistics : D.N.Elhance
4. Advanced Practical Statistics : S.P.Gupta
5. Applied Statistics : Kapoor & Gupta
6. Fundamental of mathematical Statistics : S.G.Gupta & V.K.kapoor
7. Elements of statistical method : S.P.gupta.
8. Introduction to theory of Statistics : Mood, Graybill and Boes.

SYLLABUS FOR FOUNDATION COURSE IN ENGLISH- SEMESTER 3 & 4- B.SC. (REGULAR STUDENTS) FOR THE ACADEMIC YEARS- 2019-20, 2020-21& 2021 -2022

WRITTEN AND SPOKEN COMMUNICATION SKILLS (W & S)

SEMESTER 3

Total credit- 02 : 02 classes per week

TEXT : *English in Use* (Macmillan)

***Prose**

1. A Wrong Man in Worker`s Paradise
2. Toasted English
3. Grammar of Anarchy

***Poetry**

1. Punishment in Kindergarten
2. As I Grew Older

***Functional Writing**

1. Questionnaire (Academic, Socio – economic, Commercial)
2. Report Writing (Business , Media)

- **The teachers and question- setters are instructed to strictly adhere to the paper style and the distribution of marks.**

Distribution of Marks for the University Exams:

1. Short Answer Questions (5/7) from Poetry Only (answer in about 2 to3 sentences)	10 MARKS
2. Long Answer Questions (1/2) from Prose Only	14 MARKS
3. Questionnaire (MCQ : At least 10 questions) (1/2)	14 MARKS
4. Report Writing (Business / Media) (1/2)	12 MARKS

TOTAL	50 MARKS

B. Sc. Biotechnology Course
Veer Narmad South Gujarat University, Surat

Semester	Semester V & VI (24+24 Credits)						Total Credits
Subject	Theory			Laboratory Work			
	Course	Credit	hours	Course	Credit	Hours	
Foundation Compulsory	1	2	2	-	-	-	2
Generic Elective	1	2	2	-	-	-	2
Core 1	6	12	12	1	6	12	18
Foundation Elective	1	2	2	-	-	-	2
Total	9	**18**	**18**	1	**6**	**12**	**24+24**

Semester-V

[Academic Year of Implementation: 2020-2021]

Core 1: Biotechnology

Course 1: BT-11: Immunotechnology
Course 2: BT-12: Clinical Hematology
Course 3: BT-13: Introduction to Nanobiotechnology
Course 4: BT-14: Introduction to Molecular Biology-II
Course 5: BT-15: Genetic Engineering
Course 6: BT-16: Bioethics, Biosafety and IPR

Practical Core 1: BTP-05: Biotechnology Practical

Semester-VI

[Academic Year of Implementation: 2020-2021]

Core 1: Biotechnology

Course 1: BT-17: Pharmaceutical Biotechnology
Course 2: BT-18: Introduction to Bioinformatics
Course 3: BT-19: Microbial Biotechnology
Course 4: BT-20: Environmental Biotechnology
Course 5: BT-21: Plant Biotechnology
Course 6: BT-22: Animal Biotechnology

Practical Core 1: BTP-06: Biotechnology Practical

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
B. Sc. Biotechnology Semester-VI

BT-17: Pharmaceutical Biotechnology

1. Course Code & Title

Course Code: BT-17 **Course Title:** Pharmaceutical Biotechnology

No. of Credits:	2
Subject:	Biotechnology
Faculty:	Science
Learning Hours/Week:	2
Course Type:	Core

2. Course Overview & Course Objectives

Pharmaceutical Biotechnology is intended to provide the student with a working knowledge of the preparation, stability and formulation of different protein and peptide drugs such as antisense agents, transgenic therapeutics etc. Current FDA approved biotechnology drugs such as human insulin; growth hormones etc. will be discussed.

Course Objectives

- The knowledge gained in this course would be used to understand and evaluate the different pharmaceutical parameters of the current and future biotechnology related drugs and products on the market.
- Novel formulation approaches for better delivery of biotechnology derived drugs, such as nasal sprays, liposomes and biodegradable polymer will be addressed.
- The delivery of peptides and proteins by the parenteral, oral, transdermal and nasal routes of administration will also be discussed.
- Drug Designing and development will be discussed. The process of Pharmacokinetics and Pharmacodynamics will also be discussed.
- The field of Regulatory affairs will also be addressed.

3. Course Content

UNIT-1: PHARMACEUTICALS, BIOLOGICS & BIOPHARMACEUTICALS

1.1 Introduction to pharmaceutical products
1.2 Biopharmaceuticals and pharmaceutical biotechnology
1.3 History of the pharmaceutical industry
1.4 The age of biopharmaceuticals
1.5 Biopharmaceuticals: Current status and future prospects

UNIT-2: DRUG DELIVERY & THERAPEUTICS

2.1 Drug delivery
    2.1.1 Liposome
    2.1.2 Nasal spray
    2.1.3 Biodegradable polymer
    2.1.4 Osmotic
2.2 RNAi Therapeutics
2.3 Antisense Technology

2.4 Enzyme of Therapeutic value- Superoxide dismutase, DNAse
2.5 Hormone as therapy- Insulin

UNIT-3: DRUG DISCOVERY & DEVELOPMENT
3.1 Drug discovery and development
3.2 Clinical pharmacology
3.3 Pharmakokinetics
3.4 Pharmacodynamics
3.5 Toxicology studies- Reproductive toxicity, Teratogenicity, Carcinogenicity

UNIT-4: REGULATORY AFFAIRS
4.1 Food & Drug Administration
4.2 The investigational new drug application
4.4 Regulatory procedure
4.5 Role of regulatory affairs department
4.6 ICH guidelines

4. Course Learning Outcomes/Students' Learning Outcomes (SLO)

UNIT	SLO
1	Students will able to gain basic idea of Drugs, Bio-Pharmaceuticals and role of Biotechnology.
2	Students will get an idea on drug delivery methods and mechanism.
3.	Students will come across understanding effect of drug on body is and how it metabolized.
4.	Able to understand aim of regulatory concept, its scope and methodology of approval of drug along with the ICH guidelines.

5. Recommended Learning Resources

- Walsh G. Pharmaceutical biotechnology: concepts and applications. John Wiley & Sons; 2013 Apr 25.
- Rang HP. Drug Discovery and Development. Technology in Transition. 2012 Jul 20:3.
- Ho RJ, Gibaldi M. Biotechnology and Biopharmaceuticals. Transforming Proteins and Genes into Drugs. 2003.
- Jogdand SN. Medical biotechnology. Himalaya Publishing House; 2008.
- Sobti RC, Pachouri SS. Essentials of biotechnology. Ane Books Pvt. Limited; 2009.

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VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
B. Sc. Biotechnology Semester-VI

BT-18: Introduction to Bioinformatics

1. Course Code & Title

Course Code: BT-18 **Course Title:** Introduction to Bioinformatics

No. of Credits:	2
Subject:	Biotechnology
Faculty:	Science
Learning Hours/Week:	2
Course Type:	Core

2. Course Overview & Course Objectives

This course will give students an introduction to the basic techniques of Bioinformatics. Emphasis will be given to the application of bioinformatics and biological databases. The students will become familiar with the use of a wide variety of internet applications using sequence alignment tools, biological database and will be able to apply these methods in future studies and research work.

Course Objectives

- To make students more familiar with Bioinformatics.
- To provide basic idea of Biological database and its types for the studies.
- To study Homology, pairwise alignment and multiple sequence alignment and provide insight to perform comparative analysis of known and unknown sequences.
- To create zest of learning and utilize NCBI web portal and Bioinformatics for better understanding of Biotechnology.

3. Course Content

UNIT-1: INTRODUCTION TO BIOINFORMATICS

1.1 A word on Bioinformatics
- 1.1.1 Branches of Bioinformatics
- 1.1.2 Aims of Bioinformatics
- 1.1.3 Scope and Research area of Bioinformatics

1.2 Organization of Bioinformatics in India
- 1.2.1 BTIS
- 1.2.2 Bioinformatics Server in India
- 1.2.2.1 Protein structure prediction server
- 1.2.2.2 Genomics and Proteomics server
- 1.2.2.3 Conformational epitope prediction server

1.3 Indian IT Companies involved in Bioinformatics Initiatives

UNIT-2: BIOLOGICAL DATABASE

2.1 Primary Database- Nucleotide sequence databases (EMBL, DDBJ, GenBank), Protein sequence databases (Swiss Prot, TrEMBL)

2.2 Secondary Database- Nucleotide sequence-TIGR, Protein sequence-PROSITE.

2.3 Structure Database- PDB, SCOPE, CATH

2.4 Metabolic Pathway Database- KEGG
2.5 Database retrieval tool- SRS, Entrez
2.6 Literature Database- PubMed

UNIT-3: PAIRWISE SEQUENCE ALIGNMENT

3.1 Concept of Alignment - Global alignment, Local Alignment, Gap Penalty
3.2 Methods for sequence alignment: Dot matrix method, Dynamic Programming algorithm (Smith waterman & Needlemen Wunch algorithm).
3.3 Basic Local Alignment Search Tool
3.4 FASTA

UNIT-4: MULTIPLE SEQUENCE ALIGNMENT

4.1 Introduction to Multiple sequence alignment.
4.2 Methods of Multiple sequence alignment (Sum of Pairs, Progressive, Iterative),
4.3 Application of Multiple sequence alignment.
4.4 Tools for Multiple sequence alignment: Clustal Omega.

4. Course Learning Outcomes/Students' Learning Outcomes (SLO)

UNIT	SLO
1	The unit convey students about understanding of Bioinformatics and its component along with its utility in Biotechnology.
2	The unit will explore students towards biological database and its scope for study of literature and as well as metabolic pathway database.
3.	The unit consider the pairwise sequence alignment and explain the analysis of concept of similarity along with tools.
4.	The unit consider the multiple sequence alignment and explain the analysis of concept of checking similarity along with tools.

5. Recommended Learning Resources

- Ghosh Z, Mallick B. Bioinformatics: Principles and Applications. Oxford University Press; 2008.
- Attwood TK, Parry-Smith DJ. Introduction to bioinformatics. Essex, GB: Pearson Education; 1999.
- Bosu O, Thukral SK. Bioinformatics: Experiments, Tools, Databases, and Algorithms. Oxford University Press, Inc.; 2007 Sep 6.
- Murthy CSV. Bioinformatics. Himalaya Publishing House; 2016.
- Rastogi SC, Rastogi P, Mendiratta N. Bioinformatics Methods And Applications: Genomics Proteomics And Drug Discovery 3Rd Ed. PHI Learning Pvt. Ltd.; 2008.

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VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
B. Sc. Biotechnology Semester-VI

BT-19: Microbial Biotechnology

1. Course Code & Title

Course Code: BT-19 **Course Title:** Microbial Biotechnology

No. of Credits:	2
Subject:	Biotechnology
Faculty:	Science
Learning Hours/Week:	2
Course Type:	Core

2. Course Overview & Course Objectives

Microbial Biotechnology is intended to provide the student with a working knowledge of the Microorganisms and their role in biotechnological process such as Fermentation. The course involved discussion from designing of fermenter to strain improvement for fermentation industries.

Course Objectives

- To understand the commercial applications of microorganisms.
- To learn concept of isolating enzyme and antibiotic producing microorganisms.
- Acquire the ability and knowledge to isolate and screen the commercially important bacteria from different sources.
- Understand how microbes are useful to human beings and how their products are commercialized.
- The designing of fermenter and role of each component will be explored.

3. Course Content

UNIT-1: INTRODUCTION TO MICROBIAL FERMENTATION

1.1 Concept of fermentation technology
1.2 Chronological development of industrial fermentation technology
1.3 Range of fermentation processes and products
1.4 Fermentation process outline
1.5 Fermentative production of Citric acid, Ethanol and Penicillin (Outline)

UNIT-2: MICROBIAL SCREENING AND PRESERVATION

2.1 Concept of microbial screening
2.2 Primary and Secondary screening
2.3 Isolation of industrially important microorganisms:
  2.3.1 Methods utilizing selection of desired characteristics
  2.3.2 Methods not utilizing selection of desired characteristics
2.4 Future potential and needs of microbial screening
2.5 Maintenance and Preservation of Microbial cultures

UNIT-3: IMPROVEMENT OF MICROORGANISMS

3.1 Types of Microbial mutants and their practical implications
3.2 Isolation of microbial mutants (Outline).
3.3 Selection of mutants producing high yield of primary & secondary metabolites
3.4 Parasexual cycle
3.5 Protoplast fusion

UNIT-4: FERMENTOR DESIGN

4.1 Basic functions of fermentor
4.2 Aseptic operation and Containment
4.3 Factors involved in fermentor design
4.4 Typical batch fermentor
4.5 Air-lift bioreactor and CSTF

4. Course Learning Outcomes/Students' Learning Outcomes (SLO)

UNIT	SLO
1	This unit explain students about basics of fermentation technology.
2	Through this unit students will get knowledge on microbial culture preservation and screening.
3.	Students will come across understanding how to improve microbial strain for the better production of product.
4.	By studying this unit students are able to understand design of fermenter for microbial biotechnology perspective.

5. Recommended Learning Resources

- Stanbury PF, Whitaker A, Hall SJ. Principles of fermentation technology. Elsevier; 2013 Oct 22.
- Crueger W, Crueger A. Biotechnology: A Textbook of Industrial Microbiology. Madison: Sinauer Tech.; 1989.
- Patel AH. Industrial microbiology. Macmillan India; 1984.

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VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
B. Sc. Biotechnology Semester-VI

BT-20: Environmental Biotechnology

1. Course Code & Title

Course Code: BT-20 **Course Title:** Environmental Biotechnology

No. of Credits:	2
Subject:	Biotechnology
Faculty:	Science
Learning Hours/Week:	2
Course Type:	Core

2. Course Overview & Course Objectives

It is a course of Environmental Biotechnology combining biology with professional engineering wherein students are made aware of protecting and save environment; with use of bioremediation techniques using microbes, waste disposal into the environment and energy production using microorganisms.

Course Objectives

- To provide basic knowledge related to energy production using varieties of microorganisms.
- To understand the concept of environmental bioremediation techniques and different microbes and plants that can be used for the same purpose.
- To understand the role of microorganisms in waste treatment, characterize waste according to its hazardous nature and accordingly manage and dispose it.
- To learn about bioleaching, metal precipitation and biopolymers and their uses.
- Syllabus will help the students for making their career in the field of Environmental biotechnology, help in the research for using varieties of different organisms for bioremediation and waste treatment technologies.

3. Course Content

UNIT-1: BIOENERGY

1.1 Energy resources
1.2 Biogas technology
1.3 Bioethanol production from cellulosic waste
1.4 Microbial Hydrogen production
1.5 Biodiesel from Jatropha

UNIT-2: BIOREMEDIATION

2.1 Principles of bioremediation
2.2 Factors responsible for bioremediation
2.3 Bioremediation strategies: *In situ* & *Ex situ*
2.5 Metal & Organic Phytoremediation

UNIT-3: WASTE MANAGEMENT

3.1 Characteristics of waste water
3.2 Aerobic biological waste water treatment: Activated sludge and Oxidation ponds
3.3 Anaerobic biological waste water treatment: UASB and Anaerobic baffled reactor
3.4 Conventional solid waste treatment technologies
3.5 Municipal waste management rules
3.6 Composting: Design aspects and process
3.7 Vermicomposting

UNIT-4: SOME SPECIAL PROCESSES

4.1 Abatement of Air pollution
4.2 Bioleaching: Types and Methods
4.3 Metal Precipitation
4.4 Biopolymers: Types and Preparation
4.5 Properties and Practical applications of PHA

4. Course Learning Outcomes/Students' Learning Outcomes (SLO)

UNIT	SLO
1	Students will learn about the organism's metabolic processes and their byproducts which can be used as energy sources.
2	Students will develop an understanding related to bioremediation, how it is helpful in treating environmental pollution problems and various bioremediation techniques.
3	Students will learn about the waste characterization based on their nature, use of aerobic and anaerobic techniques for waste treatment, and use of earthworms in increasing soil fertility by complete degradation of waste
4	This unit covers the processes such as Bioleaching, metal precipitation and biopolymers where students will learn about various microbes which can be used for bioleaching, metal precipitation and their removal from effluents and thereby from leaking into the environment and production of biopolymers and their uses.

5. Recommended Learning Resources

- Fulekar MH. Environmental biotechnology. CRC Press; 2010 Jul 19.
- Thakur IS. Environmental Biotechnology. IK International, New Delhi. 2006.
- Pepper IL, Gerba CP, Gentry TJ, Maier RM, editors. Environmental microbiology. Academic press; 2011 Oct 13.

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VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
B. Sc. Biotechnology Semester-VI

BT-21: Plant Biotechnology

1. Course Code & Title

Course Code: BT-21 **Course Title:** Plant Biotechnology

No. of Credits:	2
Subject:	Biotechnology
Faculty:	Science
Learning Hours/Week:	2
Course Type:	Core

2. Course Overview & Course Objectives

It is a fundamental course to understand the core concepts and fundamentals of plant biotechnology specifically plant tissue culture in order to promote in-vitro cultivation of different plant parts. This course will further augment student knowledge about different techniques utilized for conservation and mass propagation of rare and endangered plant species and medicinal plants.

Course Objectives

- Key concept and understanding of media and nutrients, plant growth regulators needed to propagate tissue culture derived plants.
- Thorough knowledge to grow, maintain and manipulate plant material in a laboratory setting for research and breeding purposes
- To understand possible applications and limitations of different techniques utilized in plant tissue culture.

3. Course Content

UNIT-1:

1.1 Introduction and History of Plant tissue culture.
1.2 Laboratory Requirement and General Techniques.
1.3 Tissue culture Media (Murashiage and Skoog, Gamborg, Rosinni) Preparation, role of different media constituents and natural extracts.
1.4 Cellular Differentiation and Totipotency.

UNIT-2:

2.1 Micropropagation- Introduction, advantages and limitations.
2.2 Micropropagation (Direct organogenesis).
2.3 Micropropagation (Indirect organogenesis).

UNIT-3:

3.1 *In vitro* Embryogenesis: Somatic and Zygotic embryo culture conditions and practical applications.
3.2 Synthetic seeds – Classification, Encapsulation, Advantages limitations and Applications.
3.3 Cryopreservation and Germplasm conservation.

UNIT-4:

4.1 Haploid Production- Anther, Pollen, Ovary and Ovule Culture.
4.2 Factors affecting androgenesis and gynogenesis, Applications and Limitations.
4.3 Protoplast isolation and Culture-Methods of Isolation, Factors affecting Isolation, Purification and steps involved in culture.
4.4 Single cell culture.

4. Course Learning Outcomes/Students' Learning Outcomes (SLO)

UNIT	SLO
1	Students will learn about historical perspective of plant tissue culture, plant tissue culture laboratory requirements and basic plant tissue culture media preparation and its significance.
2	Whole unit focuses on one of the most important method of plant tissue culture i.e. Micropropagation, its types, advantages and limitations.
3	Students will learn about types of *in vitro* embryogenesis, its culture conditions and its practical applications. They also learn about new other means of plant tissue culture i.e. synthetic seed technology and few preservation techniques.
4	The unit focuses on different tissue culture techniques for haploid plant production in detail.

5. Recommended Learning Resources

- Chawla H. Introduction to plant biotechnology (3/e). CRC Press; 2011 May 24.
- Bhojwani SS, Razdan MK. Plant tissue culture: theory and practice. Elsevier; 1986 Jul 1.
- Jha TB. Plant tissue culture: basic and applied. Universities Press; 2005.
- Veeresham C, Kokate CK. Medicinal plant biotechnology. CBS Publishers and Distributers; 2006.
- Razdan MK. Introduction To Plant Tissue Culture, 2/E. Oxford and IBH publishing; 2002.

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VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
B. Sc. Biotechnology Semester-VI

BT-22: Animal Biotechnology

1. Course Code & Title

Course Code: BT-22 **Course Title:** Animal Biotechnology

No. of Credits:	2
Subject:	Biotechnology
Faculty:	Science
Learning Hours/Week:	2
Course Type:	Core

2. Course Overview & Course Objectives

- This course includes knowledge about techniques used in culturing of Animal cells in *in vitro* environment.
- It is designed to give basic information about Animal Biotechnology subject, use of animal cell culture methods, various laboratory Equipments and procedures.
- It gives the basic understanding of the way cell performs in the cultural environment and applications of cultured cells.
- The syllabus also focuses on different tools and techniques applied in the field of assisted reproduction and in vitro fertilization.

3. Course Content

UNIT-1: Introduction to Animal Biotechnology:

1.1 Application of animal biotechnology
1.2 Advantages and limitations of animal tissue culture
1.3 Types of tissue culture
1.4 Equipments for cell culture

UNIT-2: Biology of Cultured Cells:

2.1 Cell adhesion
2.2 Cell proliferation
2.3 Cell differentiation

UNIT-3: Aseptic Techniques and Animal Cell Culture Media:

3.1 Aseptic environment and sterile handling
3.2 Defined media – Physical properties of media, complete media and serum free media
3.3 Sterilization of media

UNIT-4: Animal Reproductive Biology:

4.1 Artificial insemination
4.2 Super ovulation
4.3 *In vitro* fertilization
4.4 Embryo transfer technology

4. Course Learning Outcomes/ Students Learning Outcomes (SLOs)

UNIT	SLO
1	• This covers an introductory part of Animal Biotechnology where students get familiar with the basics of animal cell and tissue culture also the equipments used while culturing animal cells. • The unit focuses on various advantages of studying Animal Biotechnology like – way to control the culture environment, characterization and homogenization of cultured cells etc. • One can also learn different types of Animal cell culture techniques used in laboratory like – Adherent culture, Suspension culture and many more.
2	• Students will learn the general biological features of cells inside culture environment, their behaviour, metabolism and proliferation in *in vitro* conditions. • Students gets familiar with cell – cell adhesion properties, how cells will proliferate under *in vivo* and *in vitro* conditions, how cell differentiates in variety of other forms.
3	• This unit gives training to setup an animal biotechnology laboratory. • An overview is explained here for the techniques to carry out primary and secondary cell lines. • It also covers the various types of culture media used in culturing of animal cells in *in vitro* environment like – Defined media, Complete medium, Serum free medium etc. as well as techniques used in sterilization of media – autoclaving and filter sterilization.
4	• This unit is an introductory part of Artificial Insemination and *in vitro* fertilization (IVF) technology. • Students will learn about methods used for assisted reproduction like – intra uterine sperm transfer for Artificial insemination. • The unit also covers the methods used in production of multiple egg cells used in artificial insemination technologies like IVF. • Also students can learn the techniques used for intra uterine embryo transfer as a part of assisted reproductive biology.

5. Recommended Learning Resources

- Freshney RI. Culture of animal cells: a manual of basic technique and specialized applications. John Wiley & Sons; 2015 Dec 23.
- Gordon I, editor. Reproductive technologies in farm animals. CABi; 2017 Jun 23.

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VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
B. Sc. Biotechnology Semester-VI

BTP-06: Biotechnology Practical

1. **Course Code:** BTP 06
2. **Course Title:** Biotechnology Practicals
3. **Course Overview & Course Objectives**

Syllabus includes the practical aspects of major fields like bioinformatics, plant biotechnology, animal biotechnology and microbiology. The students will become familiar with the use of a wide variety of internet applications, biological database, online tools for in silico analysis and will be able to apply these methods to basic research problems. Emphasis will be given to the application of bioinformatics and biological databases to problem solving in real research problems.

Students can learn various bioinformatics tools for sequence retrieval or to study protein structure. They also learn the tissue culture techniques and basic microbiological techniques which may be associated with production of antibiotics and organic acids or determination of water contamination.

Course Objectives

- To provide basic knowledge of bioinformatics tools for sequence retrieval both for nucleotides and proteins followed by the alignment and sequence prediction respectively.
- To teach the concept of primary and secondary screening of microorganisms for the production of primary and secondary metabolites.
- To teach basic tissue culture techniques like different media preparation for in vitro establishment of various plant parts.
- To provide basic knowledge of buffers and media and to explain its importance in culture.

4. **Course Content**

1. Nucleotide and protein Sequence retrieval from NCBI/EMBL
2. Protein Structure retrieval from Protein Data Bank (PDB)
3. Exploring information from metabolic pathway database
4. Protein structure visualization by RasMol
5. Pairwise sequence alignment using BLAST/FASTA
6. Multiple sequence alignment using Clustal Omega/Clustal X
7. Sterility testing of pharmaceutical products
8. Determine MIC of commercially available antibiotics
9. Isolation and screening of antibiotic producing microorganisms:
   (a) Crowded Plate Technique (b) Wilkin's Technique
10. Isolation and screening of Extracellular enzyme producing microorganisms:
    (a) Amylase producer
    (b) Protease producer
    (c) Cellulase producer
    (d) Lipase producer
11. Fermentation by eukaryotic microorganisms:
    (a) Aerobic- Citric acid (b) Anaerobic- Ethanol

12. Isolation of antibiotic resistant mutants by GPT and RPT
13. Determination of COD and BOD of given waste water
14. Detection of faecal coliforms in drinking water by defined substrate test
15. Isolation of mesophyll cell by different methods.
16. Media preparation (Murashiage and Skoog, Gamborg B5) and explants inoculation.
17. Callus culture from different explants (node, internode and leaf).
18. Preparation of buffers and media for animal cell culture:
    (a) PBS & HBSS (b) RPMI-1640/DMEM
19. Sterilization of buffers and animal cell culture media by autoclave and filtration techniques
20. Isolation of cells from Spleen / Liver / Chick fibroblast

5. Course Learning Outcomes/Students' Learning Outcomes (SLO)

Practical	SLO
Practical 1-6 (Bioinformatics)	The major aim is to provide them basic level training in bioinformatics methods including accessing the major public sequence databases, use of the different computational tools to find sequences, perform text and sequence based searches analysis of protein and nucleic acid sequences using various software packages. Students will learn major tools of bioinformatics which may allow them to determine the degree of homology between sequences and prove helpful in predicting putative structure of proteins.
Practical 7-14 (Applied Microbiology)	Students will develop understanding related to the industrial screening and fermentation process. They will also learn the basic techniques for detection of coliforms which are associated with water contamination.
Practical 15-17 (Plant Tissue Culture)	Students will get the idea related to specific media and growth condition for the development of callus from explants.
Practical18-20 (Animal Cell Culture)	Practical skills of students will be enhanced as they learn the preparation of media for culturing animal cells, sterilization techniques and isolation of specific cells.

6. Recommended Learning Resources

- Bhojwani SS, Razdan MK. Plant tissue culture: theory and practice. Elsevier; 1986 Jul 1.
- Razdan MK. Introduction To Plant Tissue Culture, 2/E. Oxford and IBH publishing; 2002.
- Patel RJ, Patel KR. Experimental microbiology Part II. Aditya Publication, Ahmedabad. 2016.

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Syllabus of B. Sc. (Biotechnology) Semester-V & Semester-VI Effective from Academic Year: 2013-2014
VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

B. Sc. Semester-V/VI (Generic Elective Course)

FOOD TECHNOLOGY

UNIT 1: FOOD BIOTECHNOLOGY

1.1 History of food biotechnology
1.2 Traditional fermentation technology
1.3 Enzyme technology
1.4 Modern biotechnology
1.5 Future prospects

UNIT 2: FOOD PROCESSING

2.1 Processing concepts
2.2 General processing concepts
2.3 Pasteurization process
2.4 Blanching process
2.5 flocculation and clearing

UNIT 3: FOOD PRESERVATION

3.1 General principles of food preservation.
3.2 Preservation by use of High temperature
3.3 Preservation by use of low temperature
3.4 Preservation by drying
3.5 Preservation by food additives
3.6 Preservation by radiation

UNIT 4: FOOD SPOILAGE

4.1 Spoilage of fresh and frozen vegetables
4.2 Spoilage of fruits
4.3 Spoilage of fresh and processed meats, poultry and seafood
4.4 Spoilage of miscellaneous foods

REFERENCES:

1. Campbell-Platt, G. (Ed.). (2011). *Food science and technology*. Wiley-Blackwell.
2. Frazier, W. C., & Westhoff, D. C. (1988). Food Microbiology. McGraw-Hill.
3. Jay, J. M. (1996). *Modern food microbiology*. Chapman & Hall..
4. Heldman, D. R., & Hartel, R. W. (1999). *Principles of food processing*. Aspen Pub.

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WRITTEN AND SPOKEN COMMUNICATION SKILLS (W & S)

Semester -6

Total credit- 02 : 02 hours per week

TEXT : *Gems of Wisdom* (Macmillan)

***Prose :**

1. Professions for Women
2. Draupadi

*** Poetry :**

1. Night of the Scorpion
2. Mother to Son **:**

***Functional Writing :**

1. Speeches (Academic ,Social ,Commercial)
2. Group Discussion (Current Affairs)

- **The teachers and question- setters are instructed to strictly adhere to the paper style and the distribution of marks.**

Distribution of Marks for the University Exams

1. Short Answer Questions (5/7) from Poetry only (answer in about 2 to 3 sentences)	10 MARKS
2. Two short notes from Prose only (2/4)	14 MARKS
3. Speech Writing (Academic ,Social ,Commercial) (1/2)	12 MARKS
4. Group Discussion (Current Affairs) (1/2)	14 MARKS

TOTAL	50 MARKS

B. Sc. Biotechnology Course
Veer Narmad South Gujarat University, Surat

Semester	Semester V & VI (24+24 Credits)						Total Credits
Subject	Theory			Laboratory Work			
	Course	Credit	hours	Course	Credit	Hours	
Foundation Compulsory	1	2	2	-	-	-	2
Generic Elective	1	2	2	-	-	-	2
Core 1	6	12	12	1	6	12	18
Foundation Elective	1	2	2	-	-	-	2
Total	9	**18**	**18**	1	**6**	**12**	**24+24**

Semester-V

[Academic Year of Implementation: 2020-2021]

Core 1: Biotechnology

Course 1: BT-11: Immunotechnology
Course 2: BT-12: Clinical Hematology
Course 3: BT-13: Introduction to Nanobiotechnology
Course 4: BT-14: Introduction to Molecular Biology-II
Course 5: BT-15: Genetic Engineering
Course 6: BT-16: Bioethics, Biosafety and IPR

Practical Core 1: BTP-05: Biotechnology Practical

Semester-VI

[Academic Year of Implementation: 2020-2021]

Core 1: Biotechnology

Course 1: BT-17: Pharmaceutical Biotechnology
Course 2: BT-18: Introduction to Bioinformatics
Course 3: BT-19: Microbial Biotechnology
Course 4: BT-20: Environmental Biotechnology
Course 5: BT-21: Plant Biotechnology
Course 6: BT-22: Animal Biotechnology

Practical Core 1: BTP-06: Biotechnology Practical

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
B. Sc. Biotechnology Semester-V

BT-11: Immunotechnology

1. Course Code & Title

Course Code: BT-11 **Course Title:** Immunotechnology

No. of Credits:	2
Subject:	Biotechnology
Faculty:	Science
Learning Hours/Week:	2
Course Type:	Core

2. Course Overview & Course Objectives

The course of immunotechnology aims at the application of basic aspects of the immune system for diagnostics and therapeutics as well as the generation of vaccines for different diseases of mankind.

Course Objectives

- To learn about the production of various diagnostic tools like monoclonal antibodies and other methods that involves the immune system for disease detection.
- To learn about various types of autoimmune disorders and a variety of vaccines.

3. Course Content

UNIT-1: MONOCLONAL ANTIBODIES

1.1 Hybridoma Technology
1.2 Myeloma tumours
1.3 Procedure for generation of hybridomas
1.4 Human monoclonal antibodies
1.5 Chimeric Monoclonal Antibodies
1.6 Application of monoclonal antibodies
1.7 Monoclonal antibodies as Abzymes

UNIT-2: TECHNIQUES USED IN DIAGNOSIS

2.1 Precipitation
2.2 Agglutination
  2.2.1 Haemaglutination
  2.2.2 Bacterial agglutination
  2.2.3 Passive agglutination
  2.2.4 Agglutination inhibition
2.3 ELISA
2.4 Radioimmunoassay
2.5 Immunofluorescence
2.6 Immunochromatography

UNIT-3: HYPERSENSITIVITY & IMMUNE DISEASES

3.1 Hypersensitivity Type I, II, III & IV
3.2 Autoimmune diseases: Introduction, Types, Insulin Dependent Diabetes Mellitus and Rheumatoid Arthritis
3.3 Immunodeficiency: Introduction, Types, Severe Combined Immunodeficiency

UNIT-4: VACCINES

4.1 Attenuated and killed vaccines
4.2 Subunit vaccine (Toxoids, Capsule polysaccharides, Glycoproteins)
4.3 Multivalent subunit vaccine
4.4 DNA vaccine
4.5 Recombinant vector vaccine

4. Course Learning Outcomes/Students' Learning Outcomes (SLO)

UNIT	SLO
1	The unit covers techniques used in the generation and application of monoclonal antibodies for disease diagnosis and therapeutic purposes.
2	Students will learn about various types of antigen-antibody reactions as well as analytical techniques used in the field of clinical/serological diagnosis.
3	The unit gives a brief account of various types of hypersensitivity reactions, various types of disorders generating due to hypersensitivity reactions, autoimmune diseases types and examples, immunodeficiency disorders.
4	This unit focuses on different types of vaccines: their production and application as a preventive means against various infections.

5. Recommended Learning Resources

- Kuby Immunology –Janis Kuby, Kindst, Gatsby And Osborne, 6th Edition, W. H. Freeman Publications.
- Immunology And Immunotechnology- Ashim Chakravarty, Oxford University Press, ISBN-13: 978-0-19-567688-4
- Microbiology- Lansing Prescott, John P. Harley, Donald A. Klein, 8th Edition, Mcgraw Hill Publication.
- Principles and Techniques of Biochemistry and Molecular Biology, Keith Wilson and John Walker, 7th Edition, Cambridge University Press.

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VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
B. Sc. Biotechnology Semester-V

BT-12: Clinical Hematology

1. Course Code & Title

Course Code: BT-12 **Course Title:** Clinical Hematology

No. of Credits:	2
Subject:	Biotechnology
Faculty:	Science
Learning Hours/Week:	2
Course Type:	Core

2. Course Overview & Course Objectives

This course will introduce the study of the hematopoietic system including the relationship of hematologic diseases to diagnostic characteristics.

Course Objectives

- Fundamental understanding of blood and related diseases.
- Explain the importance of cellular or morphological characteristics of blood cells.
- Differentiate and enumerate cells on a peripheral blood smear.
- Explain the principles and methods of each test performed in the laboratory and the clinical significance.

3. Course Content

UNIT-1: Introduction to Hematology

1.1 Introduction to hematology and blood
1.2 Hematopoietic system
1.3 Hemoglobin derivatives
1.4 Classification of Anemia
1.5 Laboratory tests in iron deficiencies
1.6 The Thalassemia

UNIT-2: Methods in Clinical Hematology

2.1 Complete blood count
2.2 Complete hemogram
2.3 Collection of blood and anticoagulants
2.4 Routine hematology laboratory experiments
2.5 Hematology histograms

UNIT-3: Immunohaematology

3.1 Routine ABO Testing and ABO Antibodies
3.2 Inheritance of ABO Blood Groups
3.3 The Bombay Phenotype
3.4 Rh System: History, Molecular genetics and Clinical considerations
3.5 Introduction to ISBT blood group systems
3.6 The Cross matching tube test

UNIT-4: Blood Banking

4.1 Introduction to blood transfusion
4.2 Collection of blood from donor
4.3 Transfusion medicine
4.4 Selection of blood components
4.5 Use of blood derivatives; blood and blood component transfusions
4.6 Techniques used for the separation of blood constituents

4. Course Learning Outcomes/Students' Learning Outcomes (SLO)

UNIT	SLO
1	Students will understand the cause, prognosis, treatment and prevention of diseases related to study.
2	Students can focus on study of various tests of blood. For example, CBC (Complete Blood Count) test, this gives information on red blood cells, white blood cells and platelets. To make the proper functioning of the body, each type of blood cells need to perform well, and they have their own set of functions.
3	The unit immunohematology, ABO blood groups, its types and importance of blood grouping specially for blood transfusion.
4	The unit focuses on blood banking- it is the process that takes place in the laboratory to make sure that donated blood or its products which are safe before they are used in blood transfusions. Students will study about various components of blood, blood donors and various tests done in blood banking.

5. Recommended Learning Resources

- Godkar P, Godkar D. Textbook of Medical Laboratory Technology. 3rd Edition. Mumbai: Bhalani Publishing House; 2014.
- Harmening D. Modern blood banking & transfusion practices. New Delhi: Jaypee; 2013.

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VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
B. Sc. Biotechnology Semester-V

BT-13: Nanobiotechnology

1. Course Code & Title

Course Code: BT-13 **Course Title:** Nanobiotechnology

No. of Credits:	2
Subject:	Biotechnology
Faculty:	Science
Learning Hours/Week:	2
Course Type:	Core

2. Course Overview & Course Objectives

This is fundamental course to bridge areas in physics, chemistry and biology. It provides an introduction to the emerging field of bio-nanotechnology. It introduces concepts in nano-materials and their use with bio-components to synthesize and address larger systems.

Course Objectives:

- To equip the students with the concepts of biotechnology required for understanding the behaviour of nano-materials and biomaterials.
- To foster the knowledge, how modern research is harnessing biological systems to further nanotechnological endeavour.
- How modern science is gaining knowledge from natural systems that construct and control at the nanoscale.
- How general principles of structure and function within biological systems are used to construct functional devices within nanotechnology.

3. Course Content

UNIT-1: INTRODUCTION TO NANOTECHNOLOGY & NANOBIOTECHNOLOGY

1.1 Introduction to Nano-world
1.2 Types and properties of nanomaterials
1.3 Introduction to nanobiotechnology
1.4 Dominion of biological machines

UNIT-2: SYNTHESIS OF NANOMATERIALS

2.1 Approaches for synthesis of nanoparticles
2.2 Techniques for synthesis of nanostructures
2.3 Self-assembly techniques
2.4 Introduction to biosynthesis
2.5 What is biosynthesis? Why biosynthesis?

UNIT-3: MOLECULAR NANOTECHNOLOGY

3.1 Mastering the complex DNA nanostructure
3.2 DNA tweezers
3.3 DNA actuators
3.4 DNA scissors
3.5 Self-assembly of protein nanoarchitecture
3.6 Applications of protein nanostructures

UNIT-4: APPLICATIONS OF NANOBIOTECHNOLOGY

4.1 Application of carbon nanotubes in:
- 4.1.1 Diagnostic equipment
- 4.1.2 Surgical supplements
- 4.1.3 Tissue engineering
- 4.1.4 Gene delivery
- 4.1.5 Anti-carcinogenic activity
- 4.1.6 Drug delivery
- 4.1.7 Neurodegenerative disorder therapy

4.2 Use of liposomes

4.3 Photocatalysis of pollutants

4.4 Application in food and agriculture

4. Course Learning Outcomes/Students' Learning Outcomes (SLO)

Unit	SLO
1	• Comprehend the concept of "nanotechnology" and its interdisciplinary aspects • Learn basic properties of nanomaterials • Identify different types of nano materials and its applications
2	• Learn various approaches of synthesizing nanomaterials, their advantages and limitations • Understand the mechanism of preparation of variety of nanomaterial • Choose the suitable method of synthesis for further applications
3	• Analyze different types of DNA based Nanostructures • Know the importance of bio-mimicry to fabricate protein based nanoarchitecture
4	• Learn about recent development in the area of devices and therapy • Learn about nano diagnostics • Identify the application of carbon nanostructure for different day-to-day applications

5. Recommended Learning Resources

- Goodsell, David S. Bionanotechnology: Lessons from Nature. John Wiley & Sons, 2004.
- Pradeep, T. A textbook of Nanoscience and Nanotechnology. Tata McGraw-Hill Education, 2003.
- Sharon Madhuri et al Bio-nanotechnology, Ane Books Pvt. Ltd., 2012.
- Kulkarni, Sulabha K. Nanotechnology: Principles and Practices. Springer, 2014.
- Marulanda, Jose Mauricio, ed. Carbon Nanotubes: Applications on Electron Devices. BoD–Books on Demand, 2011.

- MOOC Programmes:
  a. https://nptel.ac.in/courses/118/107/118107015/
  b. https://nptel.ac.in/courses/118/106/118106019/

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VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
B. Sc. Biotechnology Semester-V

BT-14: Introduction to Molecular Biology-II

1. Course Code & Title

Course Code: BT-14 **Course Title:** Molecular Biology-II

No. of Credits:	2
Subject:	Biotechnology
Faculty:	Science
Learning Hours/Week:	2
Course Type:	Core

2. Course Overview & Course Objectives

It is an advanced level course for the graduate students which gives a detailed account on transcription and translation with their regulatory aspects and also includes content imparting knowledge about protein maturation and post translational modifications.

Course objectives:

- ✓ To fetch knowledge about fundamental processes in detail at Molecular level.
- ✓ To understand the biochemistry of regulatory mechanisms controlling these fundamental processes.
- ✓ To get an idea on post-translational modifications and global regulatory networks.

3. Course Content

UNIT-1: TRANSCRIPTION AND GENETIC CODE

1.1 Transcription in Bacteria
1.2 Transcription in Eukaryotes
1.3 Transcription in Archaea
1.4 Establishment of Genetic Code
1.5 Characteristics of Genetic Code

UNIT-2: TRANSLATION

2.1 tRNA and amino acid activation
2.2 Ribosome Structure
2.3 Initiation of Protein Synthesis
2.4 Elongation and Termination of Protein Synthesis
2.5 Protein maturation and secretion

UNIT-3: REGULATION OF GENE EXPRESSION-I

3.1 Levels of Regulation
3.2 Regulation of Transcription initiation
3.3 Regulation of Transcription elongation
3.4 Regulation of Translation

UNIT 4: REGULATION OF GENE EXPRESSION-II

4.1 Post-translational Regulation
4.2 Global regulatory systems
4.3 Regulation of gene expression in Eukarya and Archaea
4.4 Gene regulation in Bacteriophage λ

4. Course Learning Outcomes/Students' Learning Outcomes (SLO)

UNIT	SLO
1	This unit covers the concept of genetic codes and their features. It explains more about the transcription occurring in Bacteria, Eukaryotes and Archaea.
2	This unit emphasizes on synthesis of proteins, how are these proteins modeled to give a correct form. It also explains further about protein maturation and how these proteins are targeted to their destination on secretion.
3	The unit highlights about the levels of regulation involved in RNA and protein synthesis. It gives information on processes like splicing and RNA editing. It explains about the role of ubiquitylation and chaperon mediated protein folding
4	This unit provides information about regulation of genes in viruses additionally. It talks more about global regulatory systems.

5. Recommended Learning Resources

- Willey, J. M., Sherwood, L. M. and Woolverton, C. J. (2008). Prescott, Harley and Klein's Microbiology, 7th Edition, McGraw Hill International Edition.

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VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
B. Sc. Biotechnology Semester-V

BT-15: Genetic Engineering

1. Course Code & Title

Course Code: BT-15 **Course Title:** Genetic Engineering

No. of Credits:	2
Subject:	Biotechnology
Faculty:	Science
Learning Hours/Week:	2
Course Type:	Core

2. Course Overview & Course Objectives

It is an entry-level course imparting knowledge of genetic engineering to use different molecular biology techniques in order to create genetic modifications in different kind of organisms.

Course Objectives

- Fundamental understanding of importance, need and implication of rDNA technology
- To understand know-how's of rDNA technology, its tools and techniques.
- To understand generation, insertion, identification, and confirmation of cloned genes into different organisms.

3. Course Content

UNIT-1: RECOMBINANT DNA TECHNOLOGY AND ENZYMES

1.1 What is gene cloning and its importance
1.2 Range of DNA manipulative enzymes
1.3 Restriction Endonucleases
1.4 Ligation enzymes

UNIT-2: CLONING VECTORS

2.1 Vectors based on Plasmids.
2.2 Vectors based on M13
2.3 Vectors based on Phage Lambda
2.4 Vectors for Yeasts and other Fungi
2.5 Vectors for higher plants
2.6 Vectors for animals

UNIT-3: TECHNIQUES USED IN GENETIC ENGINEERING-I

3.1 Transformation
3.2 Identification of recombinants
3.3 Insertion of phage DNA
3.4 Introduction of DNA to non-bacterial cells

UNIT-4: TECHNIQUES USED IN GENETIC ENGINEERING-II

4.1 Colony and Plaque Hybridization
4.2 Practical uses of hybridization probing
4.3 Polymerase Chain Reaction: Outline, Details, Studying products, Real-Time PCR
4.4 DNA Sequencing: Chain termination, Shotgun, Clone Contig methods

4. Course Learning Outcomes/Students' Learning Outcomes (SLO)

UNIT	SLO
1	Students will develop an understanding on basic idea of gene cloning, its importance, types of enzymes used as tools in gene cloning as being prime players.
2	As being carriers of genes of interest, students will understand about different types of vectors and comparative advantages offered by each of them so that proper choice of vector can be done.
3	Students will gain knowledge about techniques to insert prepared clones into different organisms and identification of recombinants.
4	The unit focuses on and thus provides knowledge of different techniques to, first, identify and then further validation of recombinants.

5. Recommended Learning Resources

- Brown TA. Gene cloning and DNA analysis: an introduction. John Wiley & Sons; 2016 Jan 19.

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VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
B. Sc. Biotechnology Semester-V

BT-16: Bioethics, Biosafety and IPR

1. Course Code & Title

Course Code: BT-16 **Course Title:** Bioethics, Biosafety and IPR

No. of Credits:	2
Subject:	Biotechnology
Faculty:	Science
Learning Hours/Week:	2
Course Type:	Core

2. Course Overview & Course Objectives

- ✓ To acquaint, introduce & emphases students about Bioethics, Biosafety & IPR.
- ✓ They will acquire adequate knowledge in the use of genetically modified organisms and its effect on human health, Stem cells, organ transplant etc.
- ✓ They will gain more insights into the regulatory affairs & see the ethical side of scientific research.
- ✓ They will be able to implement good lab practices & biosafety mechanisms.

3. Course Contents

UNIT-1: INTRODUCTION TO BIOETHICS AND BIOSAFETY

1.1 Introduction and need of Bioethics and Biosafety
1.2 Applications of Bioethics
1.3 Applications of Biosafety
1.4 Bioethics and its relationship with other sciences
1.5 Levels of Biosafety (I to IV with respect to plant, animal and microbiology laboratories)

UNIT-2: INTRODUCTION TO ETHICAL, LEGAL AND SOCIAL IMPLICATIONS

2.1 Human Genome Project
2.2 GMO: Foods & Crop
2.3 Stem Cell Research
2.4 Drug testing on Human volunteers
2.5 Organ transplantation

UNIT-3: BIOSAFETY

3.1 Risk assessment
3.2 Containment
3.3 Handling and disposal of chemical hazardous waste
3.4 Handling and disposal of biological hazardous waste
3.5 Immunization and first aid for biotech laboratory workers

UNIT-4: INTELLECTUAL PROPERTY RIGHTS

4.1 Introduction to IPR
4.2 Types of IPR
4.3 International framework for IP protection
4.4 GATT, WTO, WIPO and TRIPS
4.5 PVP and Farmers' Right
4.6 Prior Art
4.7 Patent Database: USPTO, EPO and IPO

4. Course Learning Outcomes/Students Learning Outcomes (SLOs)

UNIT	SLO
1	To provide basic knowledge about concepts of Bioethics & Bio safety, their applications & significance.
2	To provide awareness & understanding regarding ELSI of few of the latest research, technologies & advances of science & their impact on human life & society.
3	Students will be made aware of different preventive methods & good biosafety practices.
4	To inform students about IPR's basic & provide knowledge about different Acts, regulations, laws, policies etc

5. Recommended Learning Resources

- Sateesh MK. Bioethics and biosafety. IK International Pvt Ltd; 2008 Aug 25.
- Singh BD. Biotechnology expanding horizons. Kalyani publishers; 2007.
- Ganguli P. Intellectual Property Rights: Unleashing the Knowledge Economy. Tata McGraw-Hill Publishing Company; 2001.
- National IPR Policy | Department for Promotion of Industry and Internal Trade | MoCI | GoI [Internet]. Dipp.gov.in. 2020 [cited 19 June 2020]. Available from: https://dipp.gov.in/policies-rules-and-acts/policies/national-ipr-policy

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VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
B. Sc. Biotechnology Semester-V

BTP-05: Biotechnology Practical

1. **Course Code:** BTP 05
2. **Course Title:** Biotechnology Practicals
3. **Course Overview & Course Objectives**
   Practicals are designed to address laboratory skills relevant to the fields of biochemistry, genetic engineering, clinical serology and hematology.

   - ✓ To equip students with essential skills for the further explorations of bioterchnology research.
   - ✓ To teach clincial laboratory skills of serology and hematology.

4. **Course Content**

1. Estimation of reducing sugars by Cole's method
2. Estimation of reducing sugars by DNSA method
3. Estimation of proteins by Folin-Lowry method
4. Seperation of amino acids by TLC
5. Radial precipitation test (Mancini's)
6. Detection of HIV by ELISA.
7. Detection of Hepatitis B surface antigen by direct ELISA.
8. Dreyer's Tube test for diagnosis of Typhoid
9. Immunochromatography for diagnosis of Malaria/Typhoid.
10. Synthesis of AgNPs by using sodium citrate.
11. Synthesis of AgNPs by using fungal/bacterial methods.
12. *In vitro* study of antimicrobial activity of AgNPs against bacteria.
13. Isolation of plasmid DNA from E. coli.
14. Extraction and Purification of bacterial DNA using spin column.
15. Restriction digestion of plasmid vector.
16. Transformation of bacterial cells by $CaCl_2$ method.
17. Blood Crossmatching test (Tube method)
18. Coombs Test (Indirect)
19. Study of milk quality by Methylene Blue Reduction Test
20. Enrichment and isolation of coliphages from sewage

5. **Course Learning Outcomes/ Students Learning Outcomes (SLOs)**

Practicals	SLO
Practical No. 1 to 4	Fundametnal analytical skills for the assay of common biomolecules
Practical No. 5 to 9	Learning routine diagnostic methods in clinical serology
Practical No. 10 to 12	Learning common methods for the synthesis of metal nanoparticles and study their effect on cells
Practical No. 13 to 16	Learning essential laboratroy skills for genetic engineering
Practical No. 17 and 18	Skill of important tests performed in clinical haematology
Practical No. 19 and 20	Important experimental knowhow of dairy microbiology and virology experiments.

5. <u>Recommended learning Resources</u>

- Patel R J, Patel KR. Experimental microbiology Part II. Aditya Publication, Ahmedabad. 2016.
- Mu P, Plummer DT. Introduction to practical biochemistry. Tata McGraw-Hill Education; 2001.
- Sambrook J, Fritsch EF, Maniatis T. Molecular cloning: a laboratory manual. Cold spring harbor laboratory press; 1989.

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Syllabus of B. Sc. (Biotechnology) Semester-V & Semester-VI
Effective from Academic Year: 2013-2014
VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

B. Sc. Semester-V/VI (Generic Elective Course)

DAIRY TECHNOLOGY

UNIT 1: Milk Collection and Processing

1.1 Composition and Components of milk.
1.2 Methods of testing and grading of milk.
1.3 Milk collection and transport.
1.4 Milk pasteurization.

UNIT 2: Preservation and Sterilization of Dairy Products

2.1 Sources of microorganisms in milk.
2.2 Contamination of milk.
2.3 Spoilage of milk and milk products.
2.4 Preservation of milk and milk products.
2.5 UHT sterilization of milk.

UNIT 3: Fermented Dairy Products

3.1 Lactic Acid Bacteria.
3.2 Biochemical types of milk fermentation.
3.3 Different types of fermented milk beverages.
3.4 Yogurt.
3.5 Cheese.

UNIT 4: Prebiotics and Probiotics

4.1 Health benefits of prebiotics and probiotics.
4.2 Probiotics: Criteria for microorganisms used.
4.3 Biochemistry of prebiotics.
4.4 Popular prebiotics and probiotics products.

REFERENCES:

1. Frazier, W. C., & Westhoff, D. C. (1988). Food Microbiology. McGraw-Hill.
2. Wiley, J. & Sherwood, L. (2011). *Prescott's Microbiology*, 8th Ed., McGraw-Hill.
3. Modi, H. A. (2009). Dairy Microbiology, Aavishkar Publishers, Jaipur.

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SYLLABUS FOR FOUNDATION COURSE IN ENGLISH—B.SC. SEM 5 & 6 (REGULAR STUDENTS) FOR THE ACADEMIC YEARS-2019-20, 2020-21 & 2021-22.

WRITTEN AND SPOKEN COMMUNICATION SKILLS (W & S)

Semester- 5

Total credit- 02 : 02 hours per week

TEXT : *Gems of Wisdom* (Macmillan)

***Prose :**

1. I have Three Visions for India
2. A Devoted Son
3. With the Photographer

*** Poetry :**

1. Song: Go and catch a Falling Star
2. Stopping by Woods on a Snowy Evening

*** Functional Writing:**

1. Presentation Skills
2. Interview Skills (with questions and answers)

- **The teachers and question- setters are instructed to strictly adhere to the paper style and the distribution of marks.**

Distribution of Marks for the University Exams

1. Short Answer Questions (5/7) from Poetry only (answer in about 2 to 3 sentences)	10 MARKS
2. Two short notes from Prose only (in about 200 words) (2/4)	14 MARKS
3. Presentation (1/2)	14MARKS
4. Interview (at least 10 sets of questions & answers)	12 MARKS

TOTAL	50 MARKS

B. Sc. Biotechnology Course
Veer Narmad South Gujarat University, Surat

Semester	Semester III & IV (24+24 Credits)						Total Credits
Subject	Theory			Laboratory Work			
	Course	Credit	hours	Course	Credit	Hours	
Foundation Compulsory	1	2	2	-	-	-	2
Generic Elective	1	2	2	-	-	-	2
Core 1	3	6	6	1	3	6	9
Core 2	3	6	6	1	3	6	9
Foundation Elective	1	2	2	-	-	-	2
Total	9	**18**	**18**	2	**6**	**12**	**24+24**

Semester-III

[Academic Year of Implementation: 2019-2020]

Core 1: Biotechnology

Course 1: BT 05: Instrumentation and Techniques
Course 2: BT 06: Mammalian Anatomy and Physiology
Course 3: BT 07: Plant Morphology and Physiology

Practical Core 1: BTP 03: Biotechnology Practical

Semester-IV

[Academic Year of Implementation: 2019-2020]

Core 1: Biotechnology

Course 1: BT 08: Fundamentals of Mycology
Course 2: BT 09: Fundamentals of Immunology
Course 3: BT 10: Introduction to Molecular Biology-I

Practical Core 1: BTP 04: Biotechnology Practical

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
B. Sc. Biotechnology Semester-IV

BT-08: FUNDAMENTALS OF MYCOLOGY

UNIT-1: INTRODUCTION

- **1.1** Place of fungi in 'tree of life'.
- **1.2** Characteristics of fungi.
- **1.3** Morphology of yeasts and filamentous fungi.
- **1.4** Classification of fungi.
- **1.5** Life cycle of the yeast *Saccharomyces* and filamentous Ascomycete.

UNIT-2: FUNGAL PHYSIOLOGY & DIFFERENTIATION

- **2.1** Physical & Chemical requirements for growth.
- **2.2** Fungal cultivation media.
- **2.3** Cellular reproduction.
- **2.4** Mould-yeast dimorphism.
- **2.5** Sclerotia & Nutrient –translocating organs.

UNIT-3: CONTROL OF FUNGAL GROWTH

- **3.1** Management of environmental and biological factors.
- **3.2** Biological and chemical control.
- **3.3** Cellular targets of antifungal agents.
- **3.4** Fungicides for plant disease control.
- **3.5** Control of fungal infections of humans.

UNIT-4: APPLIED MYCOLOGY

- **4.1** Fungal parasites and symbionts of plants.
- **4.2** Fungal pathogens of humans.
- **4.3** Fungal parasites as biological control.
- **4.4** Fungal saprotrophs.
- **4.5** Fungi in Biotechnology and Case study-Hepatitis B vaccine.

REFERENCES:

1. Deacon, J. (2007). *Fungal Biology*. 4th Ed., Blackwell Publishing.
2. Kavanagh, K. Ed. (2006). *Fungi: Biology and Applications*. Wiley.
3. Wiley, J., & Sherwood, L. (2011). *Prescott's Microbiology*, 8th Ed., McGraw-Hill Science/Engineering/Math.

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VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

B. Sc. Biotechnology Semester-IV

BT-09: FUNDAMENTALS OF IMMUNOLOGY

UNIT 1: INTRODUCTION TO IMMUNE SYSTEM

- 1.1 Overview of host resistance
- 1.2 Cells of the immune system
- 1.3 Organs and Tissues of the immune system
- 1.4 Physical barriers in non-specific resistance

UNIT 2: NON-SPECIFIC HOST RESISTANCE

- 2.1 Phagocytosis
- 2.2 Inflammation
- 2.3 Chemical mediators in non-specific (Innate) resistance
  - 2.3.1 Antimicrobial peptides
  - 2.3.2 Complement
  - 2.3.3 Cytokines
  - 2.3.4 Acute-Phase proteins

UNIT 3: SPECIFIC HOST RESISTANCE-I

- 3.1 Overview of specific immunity
- 3.2 Antigens
- 3.3 Types of specific immunity
- 3.4 Recognition of Foreignness
- 3.5 T Cell Biology

UNIT 4: SPECIFIC HOST RESISTANCE-II

- 4.1 B cell Biology
- 4.2 Immunoglobulin Structure, Function and Classes
- 4.3 Generation of Anitbody Diversity
- 4.4 Antibody kinetics
- 4.5 Action of Antibodies

REFERENCES:

1. Willey, J. M., Sherwood, L. M., & Woolverton, C. J., (2008). *Prescott, Harley & Klein's Microbiology*, 7Ed, The McGraw-Hill Companies, Inc.

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VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

B. Sc. Biotechnology Semester-IV

BT-10: INTRODUCTION TO MOLECULAR BIOLOGY

UNIT-1: DNA REPLICATION

1.1 General features of DNA replication
1.2 Replication in prokaryotes
1.3 Replication in eukaryotes
1.4 Termination of replication
1.5 Regulation of replication

UNIT-2: DNA MUTATIONS AND REPAIR

2.1 Chemical basis of mutations
2.2 Spontaneous and Induced mutations
2.3 Effect of mutations
2.4 Detection and Isolation of mutants
2.5 DNA repair

UNIT-3: MOLECULAR RECOMBINATION AND GENE TRANSFER-I

3.1 Introduction to recombination and recombination in eukaryotes
3.2 Horizontal gene transfer in prokaryotes
3.3 Recombination at molecular level
3.4 Transposable elements
3.5 Bacterial plasmids

UNIT-4: MOLECULAR RECOMBINATION AND GENE TRANSFER-II

4.1 Bacterial Conjugation
4.2 Bacterial Transformation
4.3 Transduction
4.4 Development of antibiotic resistance in bacteria
4.5 Mapping the genome

REFERENCES:

1. Willey, J. M., Sherwood, L. M. and Woolverton, C. J. (2008). Prescott, Harley and Klein's Microbiology, 7th Edition, McGraw Hill International Edition.
2. Pal, J. K. and Ghaskadbi, S. S. (2009). Fundamentals of Molecular Biology, Oxford University Press.

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VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
B. Sc. Biotechnology Semester-IV

BTP-04: Biotechnology Practical

1. Cultivation and identification of moulds on different mycological media.
2. Isolation and cultivation of yeast.
3. Study of different spores produced by *Puccinia graminis* using permanent slides.
4. Isolation of plant pathogenic fungi from the Red Rot of Sugarcane.
5. Differential Count of blood leucocytes.
6. Diagnosis of Syphilis by Rapid Plasma Reagin (RPR) Test.
7. Study of Haemagglutination in blood grouping.
8. Extraction of bacterial plasmid by alkaline lysis method.
9. Isolation of Prokaryotic DNA.
10. Estimation of DNA by DPA method.
11. Estimation of RNA by Orcinol method.
12. Study of pigmentation mutation in *Serratia marcescens*.

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B. Sc. MICROBIOLOGY

Teaching & Evaluation Scheme
S. Y. B. Sc. Semester IV

Paper No.	Paper Title	Theory	Practical	External	Internal	Total	Credit
		(Hrs/Week)					
MB-401	Biological molecules	02	-	50	20	70	06
MB-402	Mycology, Phycology and protozoology	02	-	50	20	70	
MB-403	Microbial ecosystems	02	-	50	20	70	
MBP-404	Practicals	-	06	60	30	90	03
Total		**06**	**06**	**210**	**90**	**300**	09

MB 401: Biological molecules

Course description

Course code: MB 401
Course title: Biological molecules
Course type: Core
Course credit: 02
Course overview:
The paper gives an understanding of biomolecules found in all living organisms including microbes. Students shall learn important biomolecules such as proteins, enzymes, carbohydrates, lipids and nucleic acids. They shall become aware of the structure, types and the important functions of biomolecules.

Course Objectives

- To study the structure and properties of amino acids and proteins.
- To understand classification of enzymes and enzyme activity.
- To understand types of carbohydrates and its importance.

- To gain knowledge of lipids, its structure and functions.
- To enable students to understand DNA and RNA.

Course Content

	UNIT 1	**Amino Acids, Proteins and enzymes**
		Teaching Duration:Lectures 08
1.1	Amino Acids Exist in a Three-Dimensional world	
1.2	Individual Amino Acids: Their Structures and Properties	
1.3	The Peptide Bond	
1.4	Protein Structure and Function	
1.5	Chemical nature of enzymes	
1.6	Nomenclature and classification of enzymes	
1.7	Factor affecting enzyme activity	
1.8	Isoenzymes	

	UNIT 2	**Carbohydrates**
		Teaching Duration: Lectures 07
2.1	Sugars: Their structures and stereochemistry	
2.2	Reactions of monosaccharides	
2.3	Some Important oligosaccharides	
2.4	Structures and functions of polysaccharides	

	UNIT 3	**Lipids**
		Teaching Duration: Lectures 08
3.1	Classification lipids	
3.2	Fatty acids	
3.3	Glycerol lipid	
3.4	Lipid devoid of glycerol	
3.5	Complex lipids	
3.6	Lipids and biological membranes	

	UNIT 4	**Nucleic Acid**
		Teaching Duration:Lectures 07
4.1	Levels of Structure in Nucleic Acids	
4.2	The Covalent Structure of Polynucleotides	
4.3	The Structure of DNA	
4.4	Denaturation of DNA	
4.5	Types of RNA and their Structures	

Student learning Outcome

Unit 1: Student shall understand structure of amino acids and its role in peptide bond formation.

Student shall gain knowledge about structure and functions of proteins and enzymes.

Unit 2: Enable the students to understand the stereochemistry of carbohydrates and its functions.

Unit 3: Student shall acquire knowledge about lipids, their classification and its importance.

Unit 4: Acquire knowledge of structure of nucleic acids and its denaturation.
Student shall know about RNA and its types.

Recommended References:

- Campbell, M. K., & Farrell, S. O. (2012). *Biochemistry*. Belmont, CA: Brooks/Cole, Cengage Learning. ISBN: 9780840068583 0840068581.
- Rastogi, S. C., *Biochemistry* (2015), 2nd Edi. ISBN:9788171339389.

Further reading:

- Berg and Stryer, (2007) *Biochemistry*, 6th Ed. W H Freeman pub., ISBN: 9780716746843
- Murray, R. K., Granner, D. K., Mayes, P. A., & Rodwell, V. W. (2015). *Harper Biochemistry*, 30th Edi. Appleton and Lange.
- Voet and Voet, (2008) *Fundamentals of biochemistry*, 3rd Ed, Johns Wiley & Sons, Asia ISBN: 978-0470129302

MB 402: Mycology, Phycology and protozoology

Course description

Course code: MB 402
Course title: Mycology, Phycology and protozoology
Course type: Core
Course credit: 02
Course overview:
This paper includes the study of eukaryotic microorganisms such as fungi, algae and protozoa. The student shall learn the diversity of eukaryotic microbes and its differences in terms of morphology, reproduction and cultivation. The objective of the paper is to give an understanding of the ecological and economic impact of eukaryotic microbial population.

Course Objectives

- To understand eukaryotic microorganisms and its importance.
- To study distinguishing characteristics, reproduction and cultivation of fungi.
- To understand major classes of fungi.
- To give understanding of characteristics of algae and its economic importance.
- To gain knowledge of occurrence, importance and reproduction of protozoa

Course Content

	UNIT 1	Mycology
		Teaching Duration: Lectures 07
1.1	Importance of fungi	
1.2	Distinguishing characteristics of fungi	
1.3	Morphology of fungi	
1.4	Reproduction of fungi	
1.5	Cultivation of fungi	

	UNIT 2	Classification of fungi
		Teaching Duration: Lectures 08
2.1	The Chytridiomycota	
2.2	The Zygomycota	
2.3	The Ascomycota	
2.4	The Basidiomycota	
2.5	The Microsporidia	
2.6	The Glomeromycota	

	UNIT 3	Phycology
		Teaching Duration: Lectures 08
3.1	Occurrence of algae	
3.2	Characteristics of algae	
3.3	Algae and diseases	
3.4	Biological and economic importance of algae	
3.5	Lichen	

	UNIT 4	Protozoology
		Teaching Duration: Lectures 07
4.1	Occurrence of protozoa	
4.2	Ecology of protozoa	
4.3	The importance of protozoa	
4.4	Morphology of protozoa	
4.5	Reproduction of protozoa	

Student learning Outcome

Unit 1: Enable the students to understand the structural differences of prokaryotic and eukaryotic microorganisms.
Shall understand fungal structure, reproduction, cultivation and importance.
Unit 2: Give an insight of different fungal groups and its importance.
Unit 3: Students shall learn algal ecology, its characteristic and importance.
Unit 4: Gain knowledge of occurrence, importance and reproduction of protozoa.

Recommended References:

- Pelczar M. J. and Chan E. C. S., (1998), *Microbiology*, 5th Ed., Tata-Mc Graw Hill.
- Sherwood, L., Willey, J. M., Woolverton, C. J. (2017). *Prescott Microbiology*. Singapore: McGraw-Hill Education.10th Edition, 2017. ISBN: 9789813151260, 9813151269.

Further reading:

- Tortora G.J., and Funke B.R. (2016), *Microbiology: an Introduction*, 12 Ed., Benjamin Cummings.

MB 403: Microbial ecosystems

Course description

Course code: MB 403
Course title: Microbial ecosystems
Course type: Core
Course credit: 02
Course overview:
Microbial ecology is concerned with microbial processes that occur in ecosystem. It explains how nutrient availability and environmental factors influence microbial growth in various ecosystems. Student shall understand the role of microorganisms in evolution of life and balance of ecosystem. The objective of the paper is to give an understanding of the varied microbial interactions and its impact in sustenance of ecosystem.

Course Objectives

- To understand the role of microbial evolution in ecological development.
- To learn the methods to study microbial ecology.
- To gain an understanding of biogeochemical cycling and effect of global climate change.
- To develop insight about microbial interactions.
- To understand the role of microorganisms in ecosystem.

Course Content

UNIT 1	MICROBIAL EVOLUTION AND ECOLOGY	
		Teaching Duration: Lectures 08
1.1	The origin of life	
1.2	Chemical evolution	
1.3	Cellular Evolution	
1.4	Ribosomal RNA analysis for tracing microbial evolution	
1.5	Genetic basis of evolution	

1.6	Methods in microbial ecology

	UNIT 2	BIOGEOCHEMICAL CYCLING AND GLOBAL CLIMATE CHANGE
		Teaching Duration: Lectures 08
2.1	Global Climate Change; Global Infectious Disease Change	
2.2	Biogeochemical Cycling 2.2.1 Carbon cycle 2.2.2 Nitrogen Cycle 2.2.3 Phosphorus Cycle 2.2.4 Sulfur Cycle	
2.3	Interaction between Elemental Cycles	
2.4	Global Climate Change: Biogeochemical cycling out of balance	

	UNIT 3	MICROBIAL INTERACTIONS
		Teaching Duration: Lectures 07
3.1	Mutualism	
3.2	Cooperation	
3.3	Commensalism	
3.4	Predation	
3.5	Parasitism	
3.6	Amensalism	
3.7	Competition	

	UNIT 4	MICROORGANISMS AND ECOSYSTEMS
		Teaching Duration: Lectures 07
4.1	Microorganisms in terrestrial environments 4.1.1 Soils as an important microbial habitat 4.1.2 Microbe-plant interactions	
4.2	Microorganisms in marine and freshwater ecosystems 4.2.1 Water as a microbial habitat 4.2.2 Microorganisms in marine ecosystems 4.2.3 Microorganisms in freshwater ecosystems	

Student learning Outcome

Unit 1: Shall give an insight of microbial role in evolution of life.
Shall learn methods to study evolution.
Unit 2: Give an understanding of biogeochemical cycling.
Unit 3: Students shall gain knowledge of microbial interactions and its significance.
Unit 4: Gain knowledge of distribution and role of microorganisms in different habitats and ecosystems.

Sharma

Recommended References:

- Ronald M. Atlas & Richard Bartha (2005) *Microbial Ecology: Fundamentals and Applications*, 4thEd., Pearson Education. ISBN: 81-297-0771-3.
- Wiley, J., & Sherwood, L. (2013). *Prescott, Harley, and Klein's Microbiology*, 10th Ed., McGraw-Hill Science/Engineering/Math, ISBN: 9780073402406.

Further reading:

- McArthur, J. Vaun (2006). *Microbial Ecology: An Evolutionary Approach*, Academic Press. 416 pp. ISBN 0123694914.
- Mitchell R., Gu Pelczar Ji Dang, Chan and Krieg, (1993), *Microbiology-Concepts and Application*, International Edition, McGraw-Hill.
- Tortora G.J., and Funke B.R. (2016), *Microbiology an Introduction*, 12 Ed., Benjamin Cummings.

S.Y.B.Sc. Microbiology

Semester– IV Practicals

(Time Duration: 06 Hours/week)

MBP 404: Practicals

1. Qualitative analysis of carbohydrate (Any four sugar)
2. Qualitative analysis of proteins (Any three protein)
3. Study of extracellular enzymatic activity: Amylase, Caseinase, Gelatinase, Lipase
4. Study of intracellular enzymatic activity: Deaminase, Decarboxylase, Catalase, Dehydrogenase, Oxidase.
5. Cultivation and identification of economical important fungi. (9 genera) (*Aspergillus, Penicillium, Mucor, Rhizopus, Curvularia, Helminthosporium, Cunninghamella, Fusarium*, *Alternaria*)
6. Study of permanent slides of algae (*Volvox, Spirogyra*, Diatoms)
7. Study of permanent slides of algae Cyanobacteria (*Nostoc, Anabena*)
8. Study of permanent slides of Protozoa (*Amoeba, Paramoecium, Euglena*).
9. Isolation of nonsymbiotic nitrogen fixing aerobic bacteria- *Azotobacter* spp.
10. Isolation of *Rhizobium* spp. from root nodules of legume plants.
11. Isolation and identification of Actinomycetes from soil.
12. Isolation of protozoa from soil

References:

- Aneja, K.R., (2003). *Experiments in Microbiology, Plant Pathology, Tissue Culture and Mushroom Production Technology,* 4th edition., New Age International Publishers.
- Cappuccino, J.G., (2016). *Microbiology: A Laboratory Manual,* 11th ed., Pearson Education (Singapore) Pvt. Ltd.
- Patel, R. J., & Patel, K. R., (2011). *Experimental Microbiology,* Vol. 2, 8th ed., Aditya.
- Patel, R. J., & Patel, K. R., (2015). *Experimental Microbiology*, Vol. 1, 9th ed., Aditya.

Syllabus of B.Sc. (Statistics) Semester III & Semester IV Syllabus effective from June 2012-2013

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

B.Sc. Semester IV

STATISTICAL METHODS – II (I.D.)

UNIT I: Distributions: 25%

Binomial distribution, Poisson distribution and Normal distribution, their properties (without proof) and examples based on them.

UNIT II: Correlation and Regression: 30%

Definition of correlation and correlation Coefficient. Scatter diagram method, Karl Pearsion's correlation coefficient, Rank correlation method, Examples for these methods.

Regression and regression lines. Properties of Regression Coefficient, Examples for obtaining two regression lines.

UNIT III: Time Series: 20%

Meaning of time series, methods of finding trend (method of moving average only 3 years and 5 years), Method of least square (fitting of only straight line).

UNIT IV: Index Numbers: 25%

Definition and meaning of index number, Contruction, uses and limitations of index number. Methods of finding the index number by (fixed base method, chain base method, cost of living index number method, Paasches method, Laspeyr's method, Drobish and Bowley's method, Marshell-Edgeworth method, Fishers' index number method).

Time reversal test, factor reversal test, examples based on above methods.

References:

1. Introduction to mathematical statistics : P.G.Hoel
2. Introduction to mathematical statistics : Goon Gupta, Das Gupta
3. Fundamental of Statistics : D.N.Elhance
4. Advanced Practical Statistics : S.P.Gupta
5. Applied Statistics : Kapoor & Gupta
6. Fundamental of mathematical Statistics : S.G.Gupta & V.K.kapoor
7. Elements of statistical method : S.P.gupta.
8. Introduction to theory of Statistics : Mood, Graybill and Boes.

WRITTEN AND SPOKEN COMMUNICATION SKILLS (W & S)

Semester 4.

Total credit- 02 : 02 classes per week

TEXT : *English in Use* (Macmillan)

* **Prose:**

1. The Kite Maker
2. What`s the Language of the Future?
3. The Fringe Benefits of Failure, and the Importance of Imagination

***Poetry :**

1. Ecology
2. Television

***Functional Writing:**

1. Review Writing: Film Review , Book Review
2. CV Writing : Chronological CV , Functional CV

- **The teachers and question- setters are instructed to strictly adhere to the paper style and the distribution of marks.**

Distribution of Marks for the University Exams

1. Short answer type questions from poems only (answer in about 2 to 3 sentences) (5/ 7)	10 marks
2. Long answer questions from prose only (1/2)	14 marks
3. CV with Cover letter (1/2)	14 marks
4. Review Writing (Film Review /Book Review) (1/2)	12 marks
TOTAL	50 marks

M. Sc. Integrated Biotechnology VII to VIII

<table>
<tr><td>Name of Program</td><td>M. Sc. Integrated Biotechnology</td></tr>
<tr><td>Abbreviation</td><td>BT</td></tr>
<tr><td>Duration</td><td>2 Years</td></tr>
<tr><td>Eligibility Criteria</td><td>B.Sc Biotechnology/Microbiology/Biochemistry</td></tr>
<tr><td>Objective of Program</td><td>To convey scientific and technological knowledge and information with modern age orientation. To help young learners and realize that science and technology, both hand in hand can enrich and develop a personality, thus promising a life of success and achievement.</td></tr>
<tr><td>Program Outcome</td><td>PO1 Students are expected to know fundamental concepts in manipulations and applications of Plant, Animal and Microbial systems while pursuing biotechnology as degree course.

PO2 Trained students in Biotechnology principles could be used to probe biological questions or to develop technologies, devices and systems that require substantive expertise in Biology, Agriculture, Pharmaceutical, Industrial, as well as Clinical Research components.</td></tr>
<tr><td>Program Specific Outcomes</td><td>Students will be able to appear and qualify for competitive exams like NET, GSET, and GATE. They will be skilled enough to join any research institute, Biopharma industry or even start ventures of their own.

PSO1: Postgraduate students will be able to demonstrate and apply the principles of bioprocess engineering in the design, analysis, optimization and simulation of bioprocess operations.

PSO2: Students will be able to gain fundamental knowledge in animal and plant biotechnology and their applications
.
PSO3: Students will be able to (a) To elaborate concepts of biochemistry with easy to run experiments; (b) To familiarize with basic laboratory instruments and understand the principle of measurements using those instruments with experiments in biochemistry.

PSO4: Students will be able to understand various facets of molecular procedures and basics of genomics, proteomics and metabolomics that could be employed in early diagnosis and prognosis of human diseases.

PSO5: Students will be able to gain hands on experience in gene cloning, protein expression and purification.

PSO6: This experience would enable them to begin a career in industry that engages in genetic engineering as well as in research laboratories conducting fundamental research.</td></tr>
<tr><td>Mapping between POs and PSOs</td><td><table><tr><td></td><td>PSO1</td><td>PSO2</td><td>PSO3</td><td>PSO4</td><td>PSO5</td><td>PSO6</td></tr><tr><td>PO1</td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>PO2</td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table></td></tr>
<tr><td>Medium of Instruction</td><td>English</td></tr>
<tr><td>Program Structure</td><td>Semester VII</td></tr>
</table>

Course Code	Title	Teaching per week		Course Credits	University Examination		Internal Marks	Total Marks
		Theory	Practical		Duration	Marks		
1001	**Bioprocess Technology-I**	4	0	4	3 Hrs	70	30	100
1002	**Enzyme Technology**	4	0	4	3 Hrs	70	30	100
1003	**Advances in Instrumentation and Techniques**	4	0	4	3 Hrs	70	30	100
1004	**Cell and Tissue Culture Technology-I**	4	0	4	3 Hrs	70	30	100
1005	**Enzyme and Bioprocess Technology**	0	8	4	3 × 5 Hrs	70	30	100
1006	**Cell Culture Technology-I**	0	8	4	3 × 5 Hrs	70	30	100
	Total	16	16	24		420	180	600

Program Structure | Semester VIII

Course Code	Title	Teaching per week		Course Credits	University Examination		Internal Marks	Total Marks
		Theory	Practical		Duration	Marks		
2001	**Bioprocess Technology-II**	4	0	4	3 Hrs	70	30	100
2002	**Genomics and Proteomics**	4	0	4	3 Hrs	70	30	100
2003	**Aquaculture Technology**	4	0	4	3 Hrs	70	30	100
2004	**Agriculture Biotechnology**	4	0	4	3 Hrs	70	30	100
2005	**Genomics and Bioprocess Technology**	0	8	4	3 × 5 Hrs	70	30	100
2006	**Agriculture Biotechnology & Aquaculture Technology**	0	8	4	3 × 5 Hrs	70	30	100
	Total	16	16	24		420	180	600

M.Sc. 7th Semester

Course: BT-1001: Bioprocess Technology-I

Course Code	**1001**
Course Title	**Bioprocess Technology-I**
Credit	4
Teaching per Week	4 Hrs
Minimum weeks per Semester	15 (Including Classwork, examination, preparation, holidays etc.)
Effective From	2018-2019
Purpose of Course	The purpose of the course is to provide insights about basics of fermentation technology including concepts, methods and applications.
Course Objective	To acquaint students with the concepts of bioprocess technology.
Course Outcomes	CO1: To acquaint students with basics of sterilisation in fermentation technology. Inculcate the fundamentals of process monitoring, validation and sterility audit. Conceptualise the inoculum development and nutritional requirement at industrial scale fermentation process and provides insights about RSM technology.

<table>
<tr><td></td><td>CO2: To elaborate on gas mass transfer and heat mass transfer concepts to the students. Students will gain insights on fundamentals of process control including control loops and measured elements.

CO3: Students will acquire concepts of cell separation techniques. Inculcate the concepts of sample pretreatment, CGMP and regulatory considerations in bioprocess technology. Provide insights of cross-flow filtration, cell disruption techniques and centrifugation.

CO4: Students will gain fundamentals of product recovery/downstream processing at the industrial scale fermentation. Students will acquire knowledge pertaining to product isolation, precipitation, chromatography, membrane separations, and electrophoresis. Also, provide illustration of product recovery trains of polysaccharides, proteins and glycolic acid at industrial scale.</td></tr>
<tr><td>Mapping between COs with PSOs</td><td><table>
<tr><td></td><td>PSO1</td><td>PSO2</td><td>PSO3</td><td>PSO4</td><td>PSO5</td><td>PSO6</td></tr>
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<tr><td>CO3</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO4</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
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<tr><td>Pre-requisite</td><td>Basics of Biology, Biotechnology, Biochemistry, Microbiology</td></tr>
</table>

Course Content	**UNIT-1: Unit Operations in Bioprocess Technology:** 1.1 Introduction to sterilization in bioprocess industry 1.2 Equipment sterilization 1.3 Monitoring &Validation of sterilization 1.4 Sterility audit and automation 1.5 Introduction to the development of inoculums for industrial process 1.6 Nutritional requirements in fermentation processes 1.7 Introduction to Response Surface Methodology (RSM) **UNIT-2: Mass Transfer and Instrument Control:** 2.1 Gas-liquid mass transfer in cellular systems 2.2 Determination of Oxygen Transfer Rates (OTR) 2.3 Introduction to Heat Transfer 2.4 Fundamentals of Process Control 2.5 Control loops 2.6 Additional forms of Control 2.7 Measurement Elements **UNIT-3: Cell Separation Systems:** 3.1 Introduction to Cell Separation Systems. 3.2 Criteria for Decision. 3.3 Pre-treatment's. 3.4 CGMP and Regulatory Considerations. 3.5 Conventional Filtration & Cross flow Microfiltration. 3.7 Centrifugation. 3.7 Cell Disruption: Physical and Chemical Methods. **UNIT-4: Product Recovery:** 4.1 Product Isolation: Extraction and Sorption 4.2 Precipitation 4.3 Chromatography and fixed bed adsorption 4.4 Membrane Separation: RO and UF 4.5 Electrophoresis 4.6 Product Recovery Trains (General Concepts) 4.7 Recovery of: Polysaccharides, Proteins & Gluconic Acid

Reference Books	1. James, B. & Ollis David, F. (2010). Biochemical Engineering Fundamentals. Tata McGraw-Hill. 2. Lydersen, B. K., D'Elia, N. A. & Nelson, K. L. (2010). Bioprocess Engineering: Systems, Equipment and Facilities. Wiley India Pvt. Ltd. 3. Stanbury, P. F. & Whitaker, A. (1984). Principles of Fermentation Technology. Pergamon Press. 4. Vogel, H. C. & Todaro, C. M. (1996). Fermentation and biochemical engineering handbook: principles, process design and equipment. William Andrew.
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment

Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

Course: BT-1002: Enzyme Technology

Course Code	**1002**
Course Title	**Enzyme Technology**
Credit	4
Teaching per Week	4 Hrs
Minimum weeks per Semester	15 (Including Classwork, examination, preparation, holidays etc.)
Effective From	2018-2019
Purpose of Course	The purpose of the course is to provide the theory and knowledge relevant to the enzymology principles including fundamental properties of enzymes, enzyme catalytic mechanisms and enzyme kinetics.
Course Objective	Students will be introduced to the theory as well as applications of enzyme technology in food, medical, and household industries. Finally, this course serves to provide an awareness of the current and possible future applications of enzyme technologies.
Course Outcomes	CO1: To acquaint students with the fundamentals of enzyme properties, nomenclatures, characteristics and mechanisms and apply biochemical calculation for enzyme kinetics. CO2: Students will compare methods for production, purification, characterization and immobilization of enzymes that can benefit human life and plot graphs based on kinetics data. CO3: To discuss various application of enzymes that can benefit human life. CO4: Discover the current and future trends of applying enzyme technology for the commercialization purpose of biotechnological products.
Mapping between COs with PSOs	
Pre-requisite	Basic

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						
CO4						

Course Content	**UNIT – 1: Enzyme Preparation:** 1.1 Potential Sources of Enzymes 1.2 Screening for novel Enzymes 1.3 Media for enzyme production 1.4 Extraction and large scale purification of Enzymes 1.4.1 Extraction of soluble and membrane-bound enzymes, Nature of the extraction medium 1.4.2 Preliminary and Advanced purification procedures, Criteria of purity 1.4.3 Determination of molecular weights of enzymes **UNIT – 2: Immobilized Enzymes and Biosensors:** 2.1 Preparation and properties of immobilized enzymes 2.2 Application of Immobilized enzymes: General principles 2.3 Genetic immobilization of enzymes on yeast cell surface 2.4 Biosensors: Calorimetric, Potentiometric and Optical **UNIT – 3: Large Scale/ Industrial Uses of Enzymes:** 3.1 Use of enzymes in detergents 3.2 Enzymes in the fruit juices, wine, brewing and distillation industries 3.3 Use of proteases in the leather and wool industry 3.4 Applications of glucose oxidase and catalase in the food industry 3.5 Use of enzymes in cellulose and starch hydrolysis 3.6 Use of lactases in the dairy industry 3.7 Medical applications of enzymes **UNIT – 4: Recent advances and future prospects in Enzyme Technology:** 4.1 Enzymes and recombinant DNA technology. 4.2 Synthesis of artificial enzymes- Enzyme engineering. 4.3 Use of 'unnatural' substrates. 4.4 Coenzyme-regenerating systems. 4.5 Enzymes and Bioinformatics.

Reference Books	1. Enzymes: Biochemistry, Biotechnology and Clinical Chemistry Trevor Palmer, Horwood Publishing Chichester, England. 2. Enzymes and Immobilized Cells in Biotechnology. Allen I. Laskin, The Benjamin/Cummings Publishing Company, INC., California. 3. Fermentation Microbiology and Biotechnology. Mansi El-Mansi & Charlie Bryce, Taylor & Francis Ltd, London. 4. Industrial Biotechnology. S. N. Jogdand, Himalaya Publishing House, Mumbai. 5. Fundamentals of Enzymology: Nicholes C. Price and Lewis Stevens, Oxford Univ. Press.
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

Course: BT-1003: Advances in Instrumentation and Techniques

<table>
<tr><td>Course Code</td><td>1003</td></tr>
<tr><td>Course Title</td><td>Advances in Instrumentation and Techniques</td></tr>
<tr><td>Credit</td><td>4</td></tr>
<tr><td>Teaching per Week</td><td>4 Hrs</td></tr>
<tr><td>Minimum weeks per Semester</td><td>15 (Including Classwork, examination, preparation, holidays etc.)</td></tr>
<tr><td>Effective From</td><td>2018-2019</td></tr>
<tr><td>Purpose of Course</td><td>To impart the knowledge of advance instrument and techniques so students can utilize it in their research or dissertation work.</td></tr>
<tr><td>Course Objective</td><td>It makes student able to understand the advance instrument and their application in their future research or dissertation.</td></tr>
<tr><td>Course Outcomes</td><td>CO1: Students learn about various types of advanced spectroscopy.

CO2: Students learn about various electrophoretic techniques to be used in their molecular Biology research/dissertation.

CO3: Students learn about various chromatographic techniques to be used in Biotechnology research/dissertation.

CO4: Student also learn about sample preparation operation and application of various instruments and techniques.</td></tr>
<tr><td>Mapping between COs with PSOs</td><td>
<table>
<tr><th></th><th>PSO1</th><th>PSO2</th><th>PSO3</th><th>PSO4</th><th>PSO5</th><th>PSO6</th></tr>
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</td></tr>
<tr><td>Pre-requisite</td><td>Basics of Biology, Biotechnology, Biochemistry, Microbiology</td></tr>
</table>

Course Content	**UNIT – 1: Advances in Spectroscopy:** 1.1 Principle, Instrumentation, Interpretation of results in IR spectroscopy 1.2 FT-IR: Principle and application 1.3 Working principle of NMR 1.4 Mass spectrometry and their applications 1.5 Atomic spectroscopy 1.5.1 Atomic absorption spectroscopy: Principle, atomizers, sources and applications 1.5.2 X-ray diffraction/crystallography: Principle and application **UNIT – 2: Electrophoretic Techniques:** 2.1 Electrophoresis of proteins 2.1.1 SDS-PAGE 2.1.2 Native gels and Gradient gels 2.1.3 Isoelectric focusing 2.1.4 Two dimensional electrophoresis 2.1.5 Western blotting 2.2 Electrophoresis of nucleic acids 2.2.1 Agarose gel of DNA and RNA 2.2.2 DNA sequencing gels 2.2.3 Southern Blotting 2.2.4 PFGE, DGGE and TGGE **UNIT – 3: GC and HPTLC:** 3.1 HPTLC: Methods of development and spot detection 3.2 GC: Principle, stationary and mobile phases 3.2.1 Detectors: FID, TCD, ECD 3.2.2 Quantitative analysis and qualitative analysis 3.2.3 GC-MS combinations 3.2.4 Limitations of GC **UNIT – 4: Advances in Liquid Chromatography:** 4.1 HPLC 4.1.1 Components of Instrumentation 4.1.2 Isocratic, binary and quaternary system 4.1.3 Types of columns 4.1.4 Stationary and mobile phases 4.1.5 Detectors: UV absorption, PDA, RI and fluorescence 4.2 Ion exchange chromatography: Types of resins, principles of separation, detection and applications 4.3 Gel filtration chromatography: Principles and applications

Reference Books	1. Skoog D. Skoog and West's Fundamentals of Analytical Chemistry. Andover: Cengage Learning EMEA; 2014.
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

Course: BT-1004: Cell and Tissue Culture Technology-I

<table>
<tr><td>Course Code</td><td>1004</td></tr>
<tr><td>Course Title</td><td>BT-1004: Cell and Tissue Culture Technology-I</td></tr>
<tr><td>Credit</td><td>4</td></tr>
<tr><td>Teaching per Week</td><td>4 Hrs</td></tr>
<tr><td>Minimum weeks per Semester</td><td>15 (Including Classwork, examination, preparation, holidays etc.)</td></tr>
<tr><td>Effective From</td><td>2018-2019</td></tr>
<tr><td>Purpose of Course</td><td>The purpose of this course is to learn the details of Cell culture Technology.</td></tr>
<tr><td>Course Objective</td><td>The objective of this course is to acquaint students with Tissue culture technology utilized for plant and animal cell.</td></tr>
<tr><td>Course Outcomes</td><td>CO1: First unit deals with Plant Genomes and Plant Tissue culture where the details of eukaryotic gene systems along with the plant tissue culture techniques to be dealt.

CO2: Second unit is Secondary metabolites isolation and identification. Here students would learn about the different aspects related to secondary metabolites from plants.

CO3: Third unit is about Immortalization and Cell Separation Techniques. The outcome would be the knowledge of Immortalization with viral genes Telomerase-Induced immortalization, tumorigenicity and various techniques used in animal cell culture.

CO4: Fourth unit is Cell culture, cryopreservation and Cell viability. Expected outcome of the unit would be the knowledge about importance of different important parameters in Cell culture technique.</td></tr>
<tr><td>Mapping between COs with PSOs</td><td>
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</table>
</td></tr>
<tr><td>Pre-requisite</td><td>Basics of Biology, Biotechnology, Biochemistry, Microbiology</td></tr>
</table>

Course Content	**UNIT-1: Plant Genomes and Plant Tissue Culture:** 1.1 Eukaryotic Gene structure and gene expression-regulation, Protein targeting 1.2 Types of plant promoters, enhancer and reporter system 1.3 Plant tissue culture: Culture environment and growth regulators 1.4 Types of culture **UNIT-2: Secondary Metabolites Isolation and Identification:** 2.1 Classification, Biosynthetic pathway of secondary metabolites production, factorsaffecting production of secondary metabolites in plant tissue culture 2.2 Methods of extraction and isolation 2.3 Methods of separation 2.4 Methods of identification 2.5 Applications **UNIT-3: Immortalization and Cell Separation Techniques:** 3.1 Control of senescence 3.2 Immortalization with viral genes 3.3 Telomerase-Induced immortalization 3.4 Tumorigenicity 3.5 Cell density and isopycnic sedimentation 3.6 Antibody based cell separation techniques 3.7 Fluorescence-Activated Cell Sorting (FACS) **UNIT-4: Cell culture, Cryopreservation and Cell Viability:** 4.1 Primary culture 4.2 Criteria for subculture, subculture of cells growing in suspension and in monolayer 4.3 Cryopreservation, principles of cryopreservation 4.4 Cell viability

Reference Books	1. Plant Biotechnology: An Introduction to Genetic Engineering by Adrian Slater, Nigel W. Scott, Mark R. Fowler. Oxford University Press, 2008. 2. Phytochemical Methods A Guide to Modern Techniques of Plant Analysis by JB Harborne. Springer, 1998. 3. Introduction to Plant Biotechnology. 2nd edition. By H. S. Chawla. Oxford & IBH publishing Co. Pvt. Ltd. New Delhi. 4. Plant Tissue culture: Theory and Practice, a revised Edition, S. S. Bhojwani and M.K. Razdan, Elsevier. 5. Ian R. Freshney, Culture of animal cells: a manual of basic technique and specialized applications, 6th Ed., Willey Blackwell pub.
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination.

Course: BTP-1005: Enzyme and Bioprocess Technology

<table>
<tr><td>Course Code</td><td>1005</td></tr>
<tr><td>Course Title</td><td>Enzyme and Bioprocess Technology</td></tr>
<tr><td>Credit</td><td>4</td></tr>
<tr><td>Teaching per Week</td><td>4 Hrs</td></tr>
<tr><td>Minimum weeks per Semester</td><td>15 (Including Classwork, examination, preparation, holidays etc.)</td></tr>
<tr><td>Effective From</td><td>2018-2019</td></tr>
<tr><td>Purpose of Course</td><td>The purpose of the course is to provide hands on training on the enzyme and bioprocess technology.</td></tr>
<tr><td>Course Objective</td><td>To acquaint students with the practicals related to bioprocess and enzyme technology</td></tr>
<tr><td>Course Outcomes</td><td>CO1: To perform time course/temperature optima of alkaline phosphatase.

CO2: To determine double reciprocal curve and enzyme inhibition kinetics of alkaline phosphatase.

CO3: To determine TDP/TDT of microorganism for design of a fermenter.

CO4: to estimate OTR by sulphide oxidation method and to investigate the thermal stability of the HRP enzyme.

CO5……CO10: To perform immobilisation of the whole cells by calcium alginate
method to carry out fermentation for production and purification of amylase and to demonstrate basic fermenter process in a bioreactor.</td></tr>
<tr><td>Mapping between COs with PSOs</td><td>
<table>
<tr><th></th><th>PSO1</th><th>PSO2</th><th>PSO3</th><th>PSO4</th><th>PSO5</th><th>PSO6</th></tr>
<tr><td>CO1</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
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<tr><td>CO4</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
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<tr><td>CO9</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO10</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
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<tr><td>Pre-requisite</td><td>Basics of Biology, Biotechnology, Biochemistry, Microbiology</td></tr>
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Course Content	1. To study time, course of the reaction catalyzed by alkaline phosphatase. 2. To determine temperature optima for alkaline phosphatase. 3. To investigate the thermal stability of horseradish peroxidase. 4. Preparation of double reciprocal curve. 5. Study of enzyme inhibition kinetics. 6. Estimation of oxygen transfer rate (OTR) by sulphite oxidation method. 7. Immobilization of whole cells (Yeast/Bacteria) by calcium alginate method. 8. Production, estimation and purification of amylase/lipase/protease. 9. Determination of thermal death point (TDP) and thermal death time (TDT) ofmicroorganism for design of a sterilizer. 10. Demonstration of fermentation process in a bioreactor.

Reference Books	1.Pricea, N and Newman, L. (2000) Demonstration of the principles of enzyme-catalysed reactions using alkaline phosphatase. Biochemistry and Molecular Biology Education. 28; 207-210. 2. McComb R.B., Bowers G.N., Posen S. (1979) Measurement of Alkaline Phosphatase Activity. In: Alkaline Phosphatase. Springer, Boston, MA. 3. Dean, R.L. (2002), Kinetic studies with alkaline phosphatase in the presence and absence of inhibitors and divalent cations. Biochem. Mol. Biol. Educ., 30: 401-407. 4. Copeland WH, Nealon DA, Rej R. Effects of temperature on measurement of alkaline phosphatase activity. Clin Chem. 1985 Feb;31(2):185-90. PMID: 3967347. 5. Experimental Microbiology by Rakesh Patel, Volume 1 and 2
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

Course: BTP-1006: Cell Culture Technology-I

Course Code	**1006**
Course Title	**Cell Culture Technology-I**
Credit	4
Teaching per Week	4 Hrs
Minimum weeks per Semester	15 (Including Classwork, examination, preparation, holidays etc.)
Effective From	2018-2019

<table>
<tr><td>Purpose of Course</td><td>To equip students with the practicals of Cell and tissue culture technology used in both plants and animal kingdom</td></tr>
<tr><td>Course Objective</td><td>To familiarize students on how to perform tissue culture of plants with different techniques as well as to learn the isolation of different cell types from animal system.</td></tr>
<tr><td>Course Outcomes</td><td>CO1, CO2, CO3, CO4 & CO5: This group of practical is related to Plant Tissue Culture. Outcome would be to learn how to perform tissue culture with various explants and also to isolate protoplast used in transformation studies.

CO6, CO7, CO8, CO9 & CO10: This set of experiment is related to Animal Cell Culture studies. Outcome of the practicals would be to know how to isolate Mononuclear cells from Blood, banding patterns, metaphase plate as well Cell culture maintenance.</td></tr>
<tr><td>Mapping between COs with PSOs</td><td>
<table>
<tr><th></th><th>PSO1</th><th>PSO2</th><th>PSO3</th><th>PSO4</th><th>PSO5</th><th>PSO6</th></tr>
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<tr><td>CO10</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
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<tr><td>Pre-requisite</td><td>Basics of Biology, Biotechnology, Biochemistry, Microbiology</td></tr>
</table>

Course Content	1. Preparation of commonly used Plant Tissue culture media (MS and Gamborg's B5 media) forplantlet regeneration. 2. Anther culture. 3. Embryo culture. 4. Qualitative analysis of important phytochemicals. 5. Isolation of protoplast. 6. To perform suspension culture (PBLC) and prepare metaphase plate. 7. To perform GTG banding and learn Karyotyping of prepared metaphase plates. 8. Isolation of Peripheral Blood Mononuclear Cells (PBMC). 9. Assessment of cell viability by Trypan blue. 10. Cell Culture: Cell revival and Cell maintenance.

Reference Books	1. Pricea, N and Newman, L. (2000) Demonstration of the principles of enzyme-catalysed reactions using alkaline phosphatase. Biochemistry and Molecular Biology Education. 28; 207-210. 2. McComb R.B., Bowers G.N., Posen S. (1979) Measurement of Alkaline Phosphatase Activity. In: Alkaline Phosphatase. Springer, Boston, MA. 3. Dean, R.L. (2002), Kinetic studies with alkaline phosphatase in the presence and absence of inhibitors and divalent cations. Biochem. Mol. Biol. Educ., 30: 401-407. 4. Copeland WH, Nealon DA, Rej R. Effects of temperature on measurement of alkaline phosphatase activity. Clin Chem. 1985 Feb;31(2):185-90. PMID: 3967347. 5. Experimental Microbiology by Rakesh Patel, Volume 1 and 2
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

Course: BT-2001: Bioprocess Technology-II

Course Code	**2001**
Course Title	**Bioprocess Technology-II**
Credit	4
Teaching per Week	4 Hrs
Minimum weeks per Semester	15 (Including Classwork, examination, preparation, holidays etc.)
Effective From	2018-2019

<table>
<tr><td>Purpose of Course</td><td>The purpose of the course is to provide basics of fermentation of food/feed products and fine chemicals. To conceptualise industrial production in animal and plant cells and of process economics/validation</td></tr>
<tr><td>Course Objective</td><td>To acquaint students with fundamentals of large scale cultivation of microbial, animal and plant cells.</td></tr>
<tr><td>Course Outcomes</td><td>CO1: Provide in depth understanding about fermentation of various food/feed products like wine, beer, vinegar. To provide insights about single cell proteins and gluconic acid production at industrial scale.

CO2: Provide in depth understanding about fermentation of various fine chemicals like Penicillin, citric acid, ethanol, L-Lysine and Human Recombinant insulin.

CO3: Students will gain understanding related to large scale animal cell culture and bioreactor technology. Provide insights about stirred tank characteristics, support systems and downstream processing. Also, provides fundamentals of non-traditional cell culture approaches like spin filter bioreactor, ceramic matrix and fluidised bed reactor and regulatory affairs.
Students will gain basic concepts about biopharmaceutical validation including need and occurrence, structure, resources and validation of systems and processes.

CO4: Inculcate the basics of plant cell cultivation on the large scale including the type of reactor commonly employed, difficulties in downstream processing and control parameters.

Students shall gain the concepts of nine stages of process economics in general fermentation at industrial scale. Acquire the generalise concepts of economic related o fine chemicals and bulk oxygenates and SCP production. Also, provide information regarding bioproduct regulatory bodies like FDA, USDA, OSHA etc.</td></tr>
<tr><td>Mapping between COs with PSOs</td><td>
<table>
<tr><th></th><th>PSO1</th><th>PSO2</th><th>PSO3</th><th>PSO4</th><th>PSO5</th><th>PSO6</th></tr>
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<tr><td>CO4</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
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<tr><td>Pre-requisite</td><td>Basics of Biology, Biotechnology, Biochemistry, Microbiology</td></tr>
</table>

Course Content	**UNIT-1: Fermentation of Food and Feed Products:** 1.1 Fermentation of Wine 1.2 Fermentation of Beer 1.3 Fermentation of Vinegar 1.4 Production Single Cell Proteins 1.5 Fermentation of Gluconic acid **UNIT-2: Fermentation of Fine Chemicals:** 2.1 Penicillin 2.2 Citric acid 2.3 Ethanol 2.4 L-lysine 2.5 Human Recombinant Insulin **UNIT-3: Industrial Production in Animal and Plant Cells:** 3.1 Introduction to Large Scale Animal Cell Culture 3.2 Animal Cells and Bioreactor Technology 3.3 Stirred Tank Characteristics 3.4 Support Systems 3.5 Downstream Processing 3.6 Non-traditional cell culture processes & Regulatory issues 3.7 Cell culture production runs (example) & Plant cell cultivation **UNIT-4: Bioprocess Industry-Economics and Validation:** 4.1 General Fermentation Process Economics 4.2 Economics of Fine Chemicals, Bulk Oxygenates and SCP Production 4.3 Bioproduct Regulation 4.4 Introduction to Biopharmaceutical Validation 4.5 Need for Validation and Occurrence of Validation 4.6 Validation Structure and Resources for Validation 4.7 Validation of Systems and Processes

Reference Books	1. Reed G. (2004). Prescott and Dunn's Industrial microbiology. CBS Publishers & Distributors 2. Peppler, H. J., & Perlman, D. (1979). Microbial technology. Vol. 1 and 2. Academic Press Inc. 3. Vogel, H. C., & Todaro, C. M. (1996). Fermentation and Biochemical Engineering Handbook: Principles, Process Design and Equipment. William Andrew. 4. James, B., &Ollis David, F. (2010). Biochemical engineering fundamentals. Tata McGraw-Hill. 5. Lydersen, B. K., D'Elia, N. A., & Nelson, K. L. (Eds.). (2010). Bioprocess engineering: systems, equipment and facilities. Wiley India Pvt. Ltd.
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

Course: BT-2002: Genomics and Proteomics

<table>
<tr><td>Course Code</td><td>2002</td></tr>
<tr><td>Course Title</td><td>Genomics and Proteomics</td></tr>
<tr><td>Credit</td><td>4</td></tr>
<tr><td>Teaching per Week</td><td>4 Hrs</td></tr>
<tr><td>Minimum weeks per Semester</td><td>15 (Including Classwork, examination, preparation, holidays etc.)</td></tr>
<tr><td>Effective From</td><td>2018-2019</td></tr>
<tr><td>Purpose of Course</td><td>The purpose of the course is to make the student capable of implementing the knowledge related to Genes, proteins and their interdisciplinary with bioinformatics tools and to acquaint students with concepts of genomics and proteomics and its applications.</td></tr>
<tr><td>Course Objective</td><td>To make students acquainted with concepts of genomics and proteomics and its applications.</td></tr>
<tr><td>Course Outcomes</td><td>CO1: Explain students the basics of mapping using genetic and physical features of genes. To brief them about next generation sequencing tools and methods.

CO2: To help students gain knowledge regarding annotation of genes, to elaborate on comparative genomics so that they can make comparisons between genomes of microbes, organelles and eukaryotes and explore the study for the application.

CO3: To train students regarding different techniques used to study the basic structure of proteins, the techniques used for isolation of proteins and the platforms that are available for the identification of the proteins.

CO4: To acquaint students about purification of proteins and their interactions with other proteins. To explain them about various projects related to microbial and biochemical network.</td></tr>
<tr><td>Mapping between COs with PSOs</td><td>
<table>
<tr><th></th><th>PSO1</th><th>PSO2</th><th>PSO3</th><th>PSO4</th><th>PSO5</th><th>PSO6</th></tr>
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<tr><td>CO4</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
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</td></tr>
<tr><td>Pre-requisite</td><td>Basics of Biology, Biotechnology, Biochemistry, Microbiology</td></tr>
</table>

Course Content	**UNIT-1: Methods of Studying Genomes:** 1.1 Genetic mapping: DNA Markers and Linkage mapping 1.2 Physical mapping: Restriction mapping, FISH, STS mapping 1.3 Chain termination sequencing: Traditional and Alternative methodology 1.4 NGS Techniques: Template preparation, Sequencing and Imaging, EmulsionPCR 1.5 NGS Platforms: Pyro-sequencing, SOLiD, Illumina, Ion Torrent, Helicose,PacBio, Nanopore 1.6 Assembly of a contiguous DNA sequence **UNIT-2: Annotation& Functional Genomics:** 2.1 Locating genes in sequence 2.2 Determining function of individual genes 2.3 Global gene expression profiling: Microbial genes and Human diseases *2.4* Annotation case study of *Sachharomyces cerevisiae* 2.5 Comparative genomics: Bacteria, Organelles and Eukaryotes **UNIT-3: Proteomics-I:** 3.1 2-D PAGE for proteome analysis 3.2 Detection of proteins in 2D gels 3.3 Mass Spectroscopy: Introduction, background and *de novo* sequencing usingMS data 3.4 Use of protein microarrays 3.5 Structural proteomics: X-ray crystallography and NMR 3.6 International structural proteomics initiatives **UNIT-4: Proteomics-II & International Collaborative Projects:** 4.1 Methods for studying protein interactions 4.2 Use of affinity purification 4.3 Bioinformatics support to study protein interaction 4.4 Metabolomics and global biochemical networks 4.5 Human Genome Project: Mapping phase, Sequencing phase and future 4.6 Other projects: ENCODE, HapMap, Human Microbiome Project

Reference Books	1. Brown T. Genomes 3. New York and London: Garland Science; 2007. 2. Primrose S, Twyman R. Principles of genome analysis and genomics. Malden, Mass.: Blackwell Pub.; 2003. 3. Pennington, S. and Dunn M. Proteomics from protein sequence to function. New Delhi: Viva Books Private Limited; 2002.
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

Course: BT-2003: Aquaculture Technology

<table>
<tr><td>Course Code</td><td>2003</td></tr>
<tr><td>Course Title</td><td>Aquaculture Technology</td></tr>
<tr><td>Credit</td><td>4</td></tr>
<tr><td>Teaching per Week</td><td>4 Hrs</td></tr>
<tr><td>Minimum weeks per Semester</td><td>15 (Including Classwork, examination, preparation, holidays etc.)</td></tr>
<tr><td>Effective From</td><td>2018-2019</td></tr>
<tr><td>Purpose of Course</td><td>The Purpose of Course is to make Students aware regarding the various aspects of Aquaculture, its history, its scopes, different systems and its applications.</td></tr>
<tr><td>Course Objective</td><td>The Objective of this paper is to give information to students regarding – How to start an Aquaculture and its various requirements. The students study about different Aquaculture systems, how to start it and how to sustain it as a profitable income source.</td></tr>
<tr><td>Course Outcomes</td><td>CO1: Explains students about the history, scope and importance of Aquaculture.

CO2: Students gets the information regarding general characteristics of fishes and its economic importance.

CO3: Students gets knowledge about different types of Aquaculture systems, type of Hatcheries and its designs.

CO4: Explains regarding the different types of feed and its formulations, used for Aquatic animals.
The course also explains the new concept involved in Aquaculture like use of Probiotics and Prebiotics. Students gets information about Marine Toxins and Biofouling which helps in overall understanding of Aquaculture.

Explains various diseases affecting the fishes, its symptoms and its Diagnostic methods. Knowledge regarding new diagnostic techniques like PCR, ELISA, etc., is also included.</td></tr>
<tr><td>Mapping between COs with PSOs</td><td>
<table>
<tr><td></td><td>PSO1</td><td>PSO2</td><td>PSO3</td><td>PSO4</td><td>PSO5</td><td>PSO6</td></tr>
<tr><td>CO1</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO2</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO3</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO4</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
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<tr><td>Pre-requisite</td><td>Basics of Mathematics, Data Structures</td></tr>
</table>

Course Content	**UNIT-1: Introduction to Aquaculture:** 1.1. Definition, scope & significance of aquaculture 1.2. General characteristics and economic importance of fishes 1.3. Sustainable aquaculture 1.4. Fish culture process 1.5. Components, design & types of Hatcheries 1.6. Different Aquaculture Systems **UNIT-2: Aqua-Feed& Diseases:** 1.1. Importance and types of feeds 1.2. Feed formulations & feed developmental process 1.3. Prebiotics & Probiotics in Aqua-feed 1.4. Bacterial, Viral, Fungal diseases of fishes and their diagnosis 1.5. Fish spoilage & marine toxins 1.6. Bio-fouling **UNIT-3: Aquaculture Biotechnology:** 1.1. Transgenic fish production 1.2. Chromosomal manipulation – Triploidy, Polyploidy, Androgenesis & Gynogenesis 1.3. Applications of recombinant hormone & growth factors in aquaculture 1.4. Fish vaccines and its development 1.5. Cryopreservation **UNIT-4: Algal Biotechnology:** 1.1. Economic importance of seaweeds& algae 1.2. Seaweed & microalgae culture methods 1.3. Bioactive compounds from marine organisms 1.4. Molecular farming of microalgae 1.5. Enhancement of protein production by microalgae

Reference Books	1. General & Applied Ichthyology (Fish & Fisheries) by S. K. Gupta & P. C. Gupta, S. Chand Publication, New Delhi. 2. Aquaculture Technology & environment by Ujwala Jadhav, Prentice Hall of India Pvt. Ltd., New Delhi. 3. Biotechnology & Genetics in Fisheries & Aquaculture by Andy Beaumont, Pierre Boudry, Kathrin Hoare. 4. Aquaculture - Farming aquatic animals & plants – Edited by John S. Lucas, Paul C. Southgate, Blackwell publishing Company. 5. Fisheries & Aquaculture Biotechnology by Varun Mehta, Book International Pub. 6. A Textbook of Fish Biology & Fisheries by S. S. Khanna & H. R. Singh. 7. Fish Health & Diseases by B. R. Selvamani & R. K. Mahadevan, Campus books Int., New Delhi.
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

Course: BT-2004: Agriculture Biotechnology

<table>
<tr><td>Course Code</td><td>2004</td></tr>
<tr><td>Course Title</td><td>Agriculture Biotechnology</td></tr>
<tr><td>Credit</td><td>4</td></tr>
<tr><td>Teaching per Week</td><td>4 Hrs</td></tr>
<tr><td>Minimum weeks per Semester</td><td>15 (Including Classwork, examination, preparation, holidays etc.)</td></tr>
<tr><td>Effective From</td><td>June 2020</td></tr>
<tr><td>Purpose of Course</td><td>The purpose of the course is to provide concepts of plant tissue culture technologies and stress resistance crops production., molecular breeding and molecular farming in plants.</td></tr>
<tr><td>Course Objective</td><td>To make students acquainted with basics concepts of transgenic plant technologies, molecular breeding and molecular farming.</td></tr>
<tr><td>Course Outcomes</td><td>CO1: Students will gain in depth understanding of role and molecular actions of plant growth regulators in tissue culture. Acquire fundamentals of direct transformation of protoplasts and indirect transformation using Agrobacterium based vectors.

CO2: Students shall gain insights into physiological and molecular responses of plant to water, salinity and temperature stress. Also, provides concepts of stress signalling pathways in plants. Students will gain in depth understating of plant interaction with plant pathogens and molecular and biochemical basis of host plant resistance.

CO3: Students will learn about various strategies to develop herbicide tolerant plants and basic methods to develop pest tolerant (BT toxin) plants.

CO4: Students will acquire knowledge about various molecular markers technologies like RFLP, RAPD, AFLP, SSR, STS, SCAR, CAPS, SNP and ISSR. Also, students will learn about QTL linkage mapping and MAS.

Students shall gain insights into the basic fundamentals of molecular farming and will sight some examples of production of bio products using plant as bioreactors.

Students shall gain the concepts of edible vaccines and plantibodies. Also, elaborate on the oleosin system- Hirudin and insulin production.</td></tr>
<tr><td>Mapping between COs with PSOs</td><td>
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<tr><td>CO4</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
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<tr><td>Pre-requisite</td><td>Basics of Biology, Biotechnology, Biochemistry, Microbiology</td></tr>
</table>

Course Content	**UNIT-1: Tissue Culture & Transgenic Technologies:** 1.1 Role and molecular action of growth regulators in tissue culture 1.2 Direct transformation of protoplasts using PEG, electroporation, particlebombardment 1.3 *Agrobacterium* biology (Ti plasmids, Ri plasmids) 1.4 Ti plasmid based transformation **UNIT-2: Abiotic & Biotic Stress and Resistance of Crops:** 2.1 Abiotic stress: Physiological and molecular responses of plants to water stress,salinity stress, temperature stress 2.2 Stress perception and stress signaling pathways 2.3 Plant interaction with bacterial, viral and fungal pathogens, biochemical andmolecular basis of host plant resistance 2.4 Herbicide (glyphosate, phosphinothricin) and Pest (Bt toxin) resistance **UNIT-3: Molecular Breeding:** 3.1 Restriction based and PCR based markers; RFLP: methodology and applications,RAPD and AFLP: Principles, methodology and advantages, disadvantages and applications 3.2 Development of SCAR and SSR, ISSR markers 3.3 Other markers: CAPS, SNP, Comparison of different marker systems 3.4 QTL and MAS **UNIT-4: Molecular Farming & Applications:** 4.1 Definition and common perception of molecular farming 4.2 Transgenic plants as bioreactors 4.3 Relevance and advantages of plant based molecular farming 4.4 Edible vaccine; medicinally related proteins-antibodies (plantibodies), the oleosinsystem –Hirudinand Insulin production

Reference Books	1. Plant Biotechnology: An Introduction to Genetic Engineering by Adrian Slater, Nigel W. Scott, Mark R. Fowler. Oxford University Press, 2008. 2. Introduction to Plant Biotechnology. 2nd edition. By H. S. Chawla. Oxford & IBH publishing Co. Pvt. Ltd. New Delhi. 3. Plant Tissue culture: Theory and Practice, A revised Edition, S.S. Bhojwani and M.K. Razdan, Elsevier. 4. An Introduction to Plant Tissue Culture. 2nd Edition, by M. K. Razdan. Oxford & IBH Publishing Co. Pvt. Ltd.
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment

Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

Course: BTP-2005: Genomics and Bioprocess Technology

Course Code	**2005**
Course Title	**Genomics and Bioprocess Technology**
Credit	4
Teaching per Week	4 Hrs
Minimum weeks per Semester	15 (Including Classwork, examination, preparation, holidays etc.)
Effective From	2018-2019
Purpose of Course	The purpose of the course is to make students recognize the basic principles of bioprocess technology and to understand bioprocesses for industrial applications and ways in which industrial productivity can be enhanced
Course Objective	To gain a hands-on experience in techniques used in bioprocess technology and their applications, principles involved in transport mechanisms and techniques involved in Upstream and downstream bioprocessing.
Course Outcomes	CO1: To learn the concepts of screening, optimization and maintenance of cultures and to introduce the students to the various concepts of microbial growth kinetics, fermentation and bioprocess engineering CO2: Understanding the different processes involved in bioprocess technology CO3: Integrating scientific and technological knowledge on the use of bioprocesses for industrial products on the cell and process level CO4……CO10: Developing and assessing the conditions for efficient and sustainable design of bioprocesses
Mapping between COs with PSOs	
Pre-requisite	Basics of Biology, Biotechnology, Biochemistry, Microbiology

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	■	■	■	■	■	
CO2	■	■	■	■	■	
CO3	■	■	■	■	■	
CO4		■	■	■	■	■
CO5	■	■	■	■	■	■
CO6	■	■	■	■	■	■
CO7	■	■	■	■	■	■
CO8	■	■		■		■
CO9	■	■		■		■
CO10	■	■		■		■

Course Content	**1.** Preparation of standard curve for estimation of antibiotic Penicillin. **2.** Preparation of standard curve for estimation of Citric acid **3.** Preparation of standard curve for estimation of Ethanol. **4.** Microbial fermentation of Penicillin 4.1. Determination of optimum pH for production of Penicillin. 4.2. Determination of optimum inoculum size for Penicillin production. **5.** Microbial fermentation of Citric acid 5.1. Determination of optimum pH for production of Citric acid. 5.2. Determination of optimum inoculum size for Citric acid production. **6.** Fermentative production of Ethanol using different substrates. **7.** Recovery of Citric acid and Ethanol from fermented broth/medium. **8.** Bioassay of antibiotic Penicillin. **9.** Soil DNA extraction by spin column method **10.** Total bacterial RNA extraction and separation by electrophoresis

Reference Books	1.Experimental Microbiology by Rakesh Patel, Volume 1 and 2 2. Lydersen, B. K., D'Elia, N. A., & Nelson, K. L. (Eds.). (2010). Bioprocess engineering: systems, equipment and facilities. Wiley India Pvt. Ltd. 3. Pricea, N and Newman, L. (2000) Demonstration of the principles of enzyme-catalysed reactions using alkaline phosphatase. Biochemistry and Molecular Biology Education. 28; 207-210 4. Vogel, H. C., & Todaro, C. M. (1996). Fermentation and Biochemical Engineering Handbook: Principles, Process Design and Equipment. William Andrew.
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

Course: BTP-2006: Agriculture Biotechnology & Aquaculture Technology

Course Code	**2006**
Course Title	**Agriculture Biotechnology & Aquaculture Technology**
Credit	4
Teaching per Week	4 Hrs
Minimum weeks per Semester	15 (Including Classwork, examination, preparation, holidays etc.)
Effective From	2018-2019

<table>
<tr><td>Purpose of Course</td><td>The purpose of the course is to provide hands on experience in the practicals related to aquaculture and agriculture technology.</td></tr>
<tr><td>Course Objective</td><td>The course objective is to provide training to the students for the basics of animal and plant tissue culture based techniques.</td></tr>
<tr><td>Course Outcomes</td><td>CO1: To study commercially important fish and fresh water algae / Seaweeds and conduct proximate analysis of fish feed including crude proteins, crude lipids, carbohydrates, fibres, moisture and ash).

CO2: To understand the basic guidelines for preparing review article.

CO3: To gain experience on preparation and standardisation of plant tissue culture media (MS/B5).

CO4: To perform the quantitative analysis of phenolic compounds and Flavonoids.

CO5: To perform anti-oxidant assays like DPPH and ABTS and anti-oxidant enzyme assays like SOD, catalase, peroxidase and ascorbate peroxidase.

CO6: To conduct in vitro screening tests for salinity and drought stress in plants and isolate DNA from plant source.</td></tr>
<tr><td>Mapping between COs with PSOs</td><td>
<table>
<tr><th></th><th>PSO1</th><th>PSO2</th><th>PSO3</th><th>PSO4</th><th>PSO5</th><th>PSO6</th></tr>
<tr><td>CO1</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO2</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO3</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO4</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO5</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO6</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
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</td></tr>
<tr><td>Pre-requisite</td><td>Basics of Biology, Biotechnology, Biochemistry, Microbiology</td></tr>
</table>

Course Content	**Aquaculture Technology:** 1. To study commercially important fishes of South Gujarat region (Any 10 specimen) 2. To study fresh water algae & sea weeds (Any 10 specimen) 3. Proximate analysis of fish feed (Crude Proteins, Crude Lipids, Carbohydrates, Fibers,Moisture & Ash) 4. Detection of White Spot Syndrome Virus in shrimps by PCR technique(Demonstration). 5. Review Article on any recent/emerging areas of aquaculture **(OR)** Field Visit to any one place – Processing Unit (Fish/Prawn), Culture Farm (Fish/Prawn), Fish Feed development industry, Fisheries/Aquaculture Educational/Research Institute, Seaweed/Algal Culture facility, Fish/Algal Product development industry **Agriculture Biotechnology:** 1. Standardization and preparation of commonly used Plant Tissue culture media (MS and Gamborg's B5) for *in vitro* regeneration of agriculturally important plants media. 2. Quantitative analysis of important phytochemicals. 3. Estimation of antioxidants and antioxidant enzymes - Ascorbate peroxidase,Superoxide dismutase, Catalase and Peroxidase. 4. Rapid *in vitro* screening tests for abiotic stress tolerance (drought and salinity). 5. Isolation of DNA from suitable plant source.

Reference Books	1. Dhindsa, Rajinder & PLUMB-DHINDSA, PAMELA & Thorpe, Trevor. (1981). Leaf Senescence: Correlated with Increased Levels of Membrane Permeability and Lipid Peroxidation, and Decreased Levels of Superoxide Dismutase and Catalase. Journal of Experimental Botany - J EXP BOT. 32. 93-101. 10.1093/jxb/32.1.93. 2. Senthilkumar M., Amaresan N., Sankaranarayanan A. (2021) Estimation of Catalase. In: Plant-Microbe Interactions. Springer Protocols Handbooks. Humana, New York, NY. 3. Reference: Re R, Pellegrini N, Proteggente A, Yang M, Rice-Evans C. Antioxidant activity applying an improved ABTS radical cationdecolorization assay. Free RadicBiol Med 1999;26:1231-7. 4. Blois, M.S. 1958. Antioxidant determination by the use of a stable free radical. Nat. 181: 1199-1200 5. Plant Tissue culture: Theory and Practice, A revised Edition, S.S. Bhojwani and M.K. Razdan, Elsevier. 6. Abraham Edit, Erdei Lasziv, Cabassa Cecile and Szabados Laszio. Methods for determination of proline in plants. Methods in molecular biology (Clifton, N.J.), March 2010. 7. The Fishes of India by Francis and Day

Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

M. Sc. Second Year

Name of Program	M. Sc. Integrated Biotechnology
Abbreviation	BT
Duration	2 Years
Eligibility Criteria	B. Sc. In Biotechnology/Microbiology/Biochemistry
Objective of Program	To convey scientific and technological knowledge and information with modern age orientation. To help young learners and realize that science and technology, both hand in hand can enrich and develop a personality, thus promising a life of success and achievement.
Program Outcome	PO1 Students are expected to know fundamental concepts in manipulations and applications of Plant, Animal and Microbial systems while pursuing biotechnology as degree course. PO2 Trained students in Biotechnology principles could be used to probe biological questions or to develop technologies, devices and systems that require substantive expertise in Biology, Agriculture, Pharmaceutical, Industrial, as well as Clinical Research components.
Program Specific Outcomes	Students will be able to appear and qualify for competitive exams like NET, GSET, and GATE. They will be skilled enough to join any research institute, Biopharma industry or even start ventures of their own. PSO1: Postgraduate students will be able to demonstrate and apply the principles of bioprocess engineering in the design, analysis, optimization and simulation of bioprocess operations. PSO2: Students will be able to gain fundamental knowledge in animal and plant biotechnology and their applications . PSO3: Students will be able to (a) To elaborate concepts of biochemistry with easy to run experiments; (b) To familiarize with basic laboratory instruments and understand the principle of measurements using those instruments with experiments in biochemistry. PSO4: Students will be able to understand various facets of molecular procedures and basics of genomics, proteomics and metabolomics that could be employed in early diagnosis and prognosis of human diseases. PSO5: Students will be able to gain hands on experience in gene cloning, protein expression and purification.

	PSO6: This experience would enable them to begin a career in industry that engages in genetic engineering as well as in research laboratories conducting fundamental research.
Mapping between POs and PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
PO1						
PO2						

Medium of Instruction	English
Program Structure	Semester IX

Course Code	Title	Teaching per week		Course Credits	University Examination		Internal Marks	Total Marks
		Theory	Practical		Duration (Hours)	Marks		
BT: 3001	Advances in Bioinformatics	4	0	4	3	70	30	100
BT: 3002	Advances in Molecular Biology	4	0	4	3	70	30	100
BT: 3003	Biotechnology Entrepreneurship Development	4	0	4	3	70	30	100
BT: 3004	Cell and Tissue Culture Technology-II	4	0	4	3	70	30	100
	Practical							
BTP: 3005	Bioinformatics and Molecular Biology	0	8	4	3x5	70	30	100
BTP: 3006	Cell Culture Technology-II	0	8	4	3x5	70	30	100
	Total	16	16	24		420	180	600

Program Structure	Semester X A: Research Based

Course Code	Title	Teaching per week		Course Credits	University Examination		Internal Marks	Total Marks
		Theory	Practical		Duration (Hours)	Marks		
BT: R-4001	Seminar Presentation	0	0	4	*	70	30	100
BT: R-4002	Review of Published Research Paper/Article	0	0	4	*	70	30	100
BT: R-4003	Poster Presentation	0	0	4	*	70	30	100
BT: R-4004	Dissertation on Biotechnology	0	18	12	*	200	100	300
* Power Point Presentation should be done using 25-30 slides and total time period allotted to candidate shall be 15 minutes which will include time for viva-voce.								
	Total	0	18	24		410	190	600

Program Structure	Semester X B: Skill Based

Course Code	Title	Teaching per week		Course Credits	University Examination		Internal Marks	Total Marks
		Theory	Practical		Duration	Marks		
BT: S-4001	**Essential Skills for Biopharmaceutical Industry**	4	0	4	3	70	30	100
BT: S-4002	**Essential Skills for Bio-services and Bio-Agri Industries**	4	0	4	3	70	30	100
BT: S-4003	**Essential Skills for Clinical Laboratories**	4	0	4	3	70	30	100
BT: S-4004	**Skill Enhancement Laboratory Work**	0	18	12	3x5	200	100	300
	Total	12	18	24		410	190	600

M. Sc. Biotechnology 1st Semester

<table>
<tr><td>Course Code</td><td>BT: 3001</td></tr>
<tr><td>Course Title</td><td>Advances in Bioinformatics</td></tr>
<tr><td>Credit</td><td>4</td></tr>
<tr><td>Teaching per Week</td><td>4 Hours/week</td></tr>
<tr><td>Minimum weeks per Semester</td><td>15 (Including Classwork, examination, preparation, holidays etc.)</td></tr>
<tr><td>Effective From</td><td>2019</td></tr>
<tr><td>Purpose of Course</td><td>The purpose of the course is to make the student capable of implementing the knowledge related to drug designing, primer designing, secondary structure prediction and modelling, gene prediction and phylogenetic analysis.</td></tr>
<tr><td>Course Objective</td><td>To study introduction of structural bioinformatics, conformational analysis of proteins and nucleic acids
To understand the protein structure prediction, and molecular interactions.
To understand the drug stereochemistry drug design and molecular modelling in drug design.</td></tr>
<tr><td>Course Outcomes</td><td>CO1: Understand the basic concepts on macromolecular structures and their interactions with special emphasis on computational biology.
CO2: Decipher the methods involved for protein structure prediction.
CO3: Recognize the principles and methods of macromolecular interactions.
CO4: Understand the aspects of the steps involved in homology modelling. Grasp the knowledge on the basic concepts of QSAR.</td></tr>
<tr><td>Mapping between COs with PSOs</td><td>
<table>
<tr><td></td><td>PSO1</td><td>PSO2</td><td>PSO3</td><td>PSO4</td><td>PSO5</td><td>PSO6</td></tr>
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<tr><td>CO3</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO4</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
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</td></tr>
<tr><td>Pre-requisite</td><td>Basic Fundamental of Science, Computer skill</td></tr>
</table>

Course Content	UNIT-1: MOLECULAR PHYLOGENY 1.1 Phenotypic & Molecular Phylogeny, Mechanism of Molecular Phylogeny 1.2 Representation of Phylogeny 1.3 Molecular Clocks 1.4 Methods of Phylogeny – UPGMA and NJ 1.5 Tools for Phylogentic analysis (PHYLIP) UNIT-2: GENE PREDICTION 2.1 Introduction to Gene Prediction (Finding of Genes, Finding of Exons, Exon to prediction of genes) 2.2 Types of Gene Prediction Programs (Splice site Prediction, Homology based gene prediction & Ab initio gene prediction) 2.3 Type of gene Prediction Methods-Laboratory based approach, Feature based approach, Homology based approach & Statistical & HMM based approach 2.4 Tools for Gene Prediction – GLIMMER, GENSCAN, ORF Finder UNIT-3: SECONDARY STRUCTURE PREDICTION & MODELLING 3.1 Methods for Secondary structure prediction: Chou Fasman, GOR 3.2 Softwares for Secondary structure prediction – GORIV, JPred4, APSSP2, CFSSP 3.3 Methods of Protein Modelling - Homology Modelling, Threading or fold recognition and Ab-initio structure prediction methods 3.4 Tools for protein structure modelling – Swiss Model 3.5 Ramachandran Plot for evaluation of predicted structure (Concept & Tool – RAMPAGE) UNIT-4: ADVANCES IN BIOINFORMATICS 4.1 Bioinformatics in Drug Designing: 4.1.1 Structural bioinformatics in drug designing 4.1.2 Application of QSAR in computer aided drug designing 4.2 Primer Designing: 4.2.1 Primer Selection, Primer Length, Melting Temperature (Tm), Specificity, Complementary Primer Sequence, G/C content, 3'end sequence 4.2.2 Designing a sequencing primer 4.2.2 Software for in silico primer designing: Primer Blast, Primer 3

Reference Books	REFERENCES: 1. Zhumur Gosh and Bibekan and Mallick "Bioinformatics: Principle and Application", Oxford University Press, 2008. 2. Simminder Kaur Thukral and OrpitaBosu, Pap/Cdr edition, "Bioinformatics: Database, Tools and Algorithms", Oxford University Press, USA, 2007. 3. S. C. Rastogi, N. Mendiratta and P. Rastogi, 2nd Edition "Bioinformatics: Concepts, Skill & Applications", CBS publisher & Distributor, 2009. 4. N. J. Chikhale and V.S. Gomase, 1st Edition, "Bioinformatics: Theory & Practices", Himalaya Publishing House Limited, 2007. 5. Lesk, A. K., "Introduction to Bioinformatics" 4th Edition, Oxford University Press, 2013. 6. Rukam S. Tomar, Manoj, V. Parakhia, Sunil V. Patel, B. A. Golakiya, "Molecular Markers and Plant Biotechnology" New India Publishing Agency, 2010.
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment

Course Code	BT-3002
Course Title	Advances in Molecular Biology
Credit	4
Teaching per Week	4 Hours/week
Minimum weeks per Semester	15 (Including Classwork, examination, preparation, holidays etc.)
Effective From	2019
Purpose of Course	The purpose of the course is to make the student capable of implementing the knowledge related to molecular biology and to use thesame for therapeutics and health research.
Course Objective	To make students acquainted with concepts of Molecular biology andtheir applications
Course Outcomes	CO1: Explain students about the structure and function of genes. To explain them about the number of genes, their location, distribution of genes and to gain idea about mini satellites and micro satellites. CO2: To help students gain knowledge regarding advances in RNA and RNA based technology that includes RNA interference study and its mechanism, different types of RNA and splicing mechanisms. CO3: To train students about PCR based technology, different types of PCR, DNA microarray technology and their application in medicine and diagnosis. CO4: To acquaint students about protein based molecular techniquesthat can be used for peptide synthesis in vitro, use of nano-based quantum dots and their application in field of diagnostics.
Mapping between COs with PSOs	
Pre-requisite	Basics of Mathematics, Data Structures

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						
CO4						

Course Content	UNIT-1: ADVANCES IN GENE STRUCTURE AND FUNCTIONS 1.1 Total Gene Numbers: In Bacteria and Eukaryotes 1.2 Gene number in Humans and the Y Chromosome 1.3 Distribution of genes and other sequences in genome 1.4 Introduction to Gene clusters and repeated sequences 1.5 Essential genes and study of expressed genes 1.6 Satellite and Mini-satellite DNA: In Arthropods and Mammals UNIT-2: ADVANCES IN RNA BIOLOGY 2.1 Riboswitches and noncoding RNAs 2.2 Bacterial Regulator RNAs: CRISPR-CAS system 2.3 miRNA, siRNA and piRNA 2.4 Mechanism of RNAi 2.5 Mechanism of splicing in Group I and Group II introns 2.6 Catalysis by RNase P and Viroid RNA UNIT-3: DNA BASED MOLECULAR BIOLOGY TECHNIQUES 3.1 PCR and its applications 3.2 Real-time Quantitative PCR 3.3 Southern blotting as diagnostic tool 3.4 Analysis of Repeatitive DNA Sequences 3.5 cDNA Microarrays and its medical applications 3.6 Analysis of SNPs UNIT-4: PROTEIN BASED MOLECULAR BIOLOGY TECHNIQUES 4.1 Introduction to peptide synthesis on solid-phase 4.2 Protein Microarray Technology 4.3 Epitope mapping 4.4 Recombinant Monoclonal Antibodies 4.5 Quantum dots 4.6 Overview of Antibody Phage Display

Reference Books	REFERENCES: 1. Krebs J, Goldstein E, Kilpatrick S, Lewin B. Lewin's Genes XI. Burlington, MA: Jones and Bartlett; 2014. 2. Walker J, Rapley, R. Molecular Biomethods Handbook, 2nd Ed., Humana Press; 2008.
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

Course Code	BT-3003
Course Title	Biotechnology Entrepreneurship Development
Credit	4
Teaching per Week	4 Hours/week
Minimum weeks per Semester	15 (Including Classwork, examination, preparation, holidays etc.)
Effective From	2019
Purpose of Course	To understand the concepts of Entrepreneurial traits and recollect the biotechnological approaches to project design to project appraisal and development through entrepreneurship
Course Objective	To understand the concepts of Entrepreneurial traits.
Course Outcomes	CO1: Introducing the basic concepts in Bio entrepreneurship CO2: Updating the role of business ideas Bio products. CO3: Motivating the entrepreneurial development in life science CO4: To understand the concepts of business idea to project design to project appraisal. To understand the concepts of bioethics, product planning and development through entrepreneurship
Mapping between COs with PSOs	
Pre-requisite	Basics of Mathematics, Data Structures

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						
CO4						

Course Content	UNIT-1: BIOTECHNOLOGY ENTREPRENEURSHIP 1.1 Introduction: Significance of the Biotechnology Entrepreneur, Integration of two distinctly different disciplines: Science & Business, Biotechnology entrepreneurship versus general entrepreneurship, Essential biotechnology versus entrepreneurial characteristics, Backgrounds of biotechnology entrepreneurs, Driving forces in decision making and learning from failure. 1.2 Fuel, Feed and Heal the world through Biotechnology Entrepreneurship: Industrial and Environmental Biotechnology, Food and Agricultural Biotechnology, Health Biotechnology. UNIT-2: FINANCE 2.1 Sources of Finance: Source of development finance, Project financing, Institutional financing to Entrepreneurs, Financial institutions, Role of consultancy organizations. 2.2 Financial Analysis: Ratio analysis, Investment process, Break even analysis, Profitability analysis, Budget and planning process. UNIT-3: MARKETING 3.1 Marketing Channels: Methods of marketing, Marketing channels, Marketing Institutions and Assistance, E-commerce: Benefits of E-commerce brand and Opportunities in India. 3.2 Setting up a Small Scale Industry: Location of an enterprise, Steps for starting a Small Industry, Incentives and Subsidies, Exploring Export Possibilities, Scheme of Assistance for Biotech Industry under existing Gujarat Biotech Policy. UNIT-4: BREAKTHROUGH-WHO MADE IT-GAME CHANGERS 4.1 Shantha Biotech: Unleashing Biotechnology in India. 4.2 Aravind Eye Hospital: Making a Dent in Global Blindness. 4.3 Centocor: Diagnostics Company on Monoclonal Antibodies. 4.4 Suguna Poultry Farm Ltd: Hard work, No compromise, No excuse. 4.5 The Surat Transformation: Urban Renewal.

Reference Books	REFERENCES: 1. Biotechnology Entrepreneurship (2014) Craig Shimasaki, Academic Press, USA. 2. Dynamics of Entrepreneurial Development and Management (2005) Vasant Desai, Himalaya Publishing House. 3. Making Breakthrough Innovation Happen: How Eleven Indians Pulled of the Impossible (2009) Porus Mushi, Harper Collins Publishers India. 4. The CII Entrepreneur Hand Book: Practical Advice for Starting a New Business (2010) Sushila Ravindranath, Westland Ltd. 5. The Game Changers: 20 extraordinary success stories of Entrepreneurs (2013) Y. Modi, R. Kumar & A. Kothari, Random House Publishers India Pvt. Ltd.
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

Course Code	BT-3004
Course Title	Cell & Tissue Culture Technology-II
Credit	4
Teaching per Week	4 Hours/week
Minimum weeks per Semester	15 (Including Classwork, examination, preparation, holidays etc.)
Effective From	2019
Purpose of Course	The purpose of the course is to provide information about recent technological advancements in the area of cell and tissue culture technology
Course Objective	The objective of the course is to acquaint students about the gene expression and regulation in plants including various application of plant cell culture system. Also, to conceptualise about transgenic animals and cancer cell biology.
Course Outcomes	CO1: Students will gain understanding regarding the promoter-reporter contract in the plant cell culture and will also acquire knowledge of various bioinformatics tools for promoter identification and analysis. In-depth understanding of DNA foot printing, finger printing and gel shift analysis, ribozwitches and telomerase. CO2: Students shall gain understanding about recent techniques like Gateway technology, Activation tagging, Yeast complementation/two hybrid system, pull down assay, BiFC, tilling and eco tilling. CO3: Students shall develop basic concepts of chloroplast gene expression and chloroplast transformation. Also, get basic concepts of genome editing techniques like TALENS, Zinc finger nucleases, CRISPR/CAS9 etc. CO4: Students shall learn fundamentals of cell cytotoxicity assays and genotoxicity assays. Students shall have in-depth understanding of cell death pathways and regulation, stem cells and application, organ culture,

<table>
<tr><td></td><td>histotypic culture, and transgenic animals.

Students will gain basic concepts of cancer biology including oncogenes, tumor suppressor genes, immunotherapy and inhibition of cancer promoting proteins/angiogenesis.</td></tr>
<tr><td>Mapping between COs with PSOs</td><td>
<table>
<tr><th></th><th>PSO1</th><th>PSO2</th><th>PSO3</th><th>PSO4</th><th>PSO5</th><th>PSO6</th></tr>
<tr><td>CO1</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO2</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
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<tr><td>CO4</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>
</td></tr>
<tr><td>Pre-requisite</td><td>Basics of Science, Computer skill</td></tr>
</table>

Course Content	UNIT-1: GENE EXPRESSION AND REGULATION IN PLANTS 1.1 In-silico analysis of the promoter to find out cis-acting elements, Promoterreporter construct to validate promoters in-vivo, DNA Foot Printing, Finger Printing, Gel Shift Analysis. 1.2 Inducible Expression System and Control of Transgene Expression through Inducible Promoters. 1.3 Ribozwitches, Aptamers and their Applications. 1.4 Telomerase Structure and Function. UNIT-2: APPLICATION OF PLANT CELL CULTURE SYSTEM 2.1 Plant Expression Vectors: Advantages of Conventional cloning Vs site specific recombination based cloning methods (Gateway Technology) 2.2 Functional analysis of genes: Activation tagging: A tool for plant gene discovery; Plant protein-protein interaction: Yeast Complementation, Yeast two hybrid, Pull down assay, BiFC; Tilling and eco-tilling. 2.3 Chloroplast Genes Expression, Chloroplast Transformation, 2.4 Genome editing and its applications. UNIT-3: ANIMAL CELL CULTURE TECHNOLOGY & TRANSGENIC ANIMALS 3.1 Cytotoxicity and Genotoxicity 3.2 Cell death and its regulation 3.3 Stem cells: Embryonic stem cells, adult stem cells, Induced pluripotent stem cells and regenerative therapy 3.4 Cell synchrony, organ culture, Histotypic culture 3.5 Introduction to transgenic animals; Techniques and Applications of animal Transgenesis UNIT-4: CANCER BIOLOGY 4.1 Basic properties of a cancer cell 4.2 The causes of cancer 4.3 Tumor-suppressor genes and oncogenes 4.4 Immunotherapy and Inhibition of cancer promoting proteins 4.5 Angiogenesis

Reference Books	REFERENCES: 1. Primrose S. B. and Twyman R. M. Principles of Gene Manipulation and Genomics; (7th Edition) Blackwell Publishing 2. Genomes, T. A. Brown, Oxford: Wiley-Liss; 2002 3. Old R. W. and Primrose S.B. Principles of Gene Manipulation: An Introduction to Genetic Engineering. University of California Press. 4. Gene IX by B. Lewin. Jones & Bartlett Learning, 2008. 5. Adrain Slater, Nigel Scott and Mark Flower A.Plant Biotechnology – The Genetic manipulation of Plants, Oxford University Press. 6. Ian R. Freshney, Culture of animal cells: a manual of basic technique and specialized applications, 6th Ed., Willey Blackwell pub. 7. Houdebine L.M., 2003, Animal Transgenesis and Cloning, John Wiley and Sons, Ltd. 8. Karp G., Cell and Molecular Biology: concepts and experiments, 7th Ed.
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

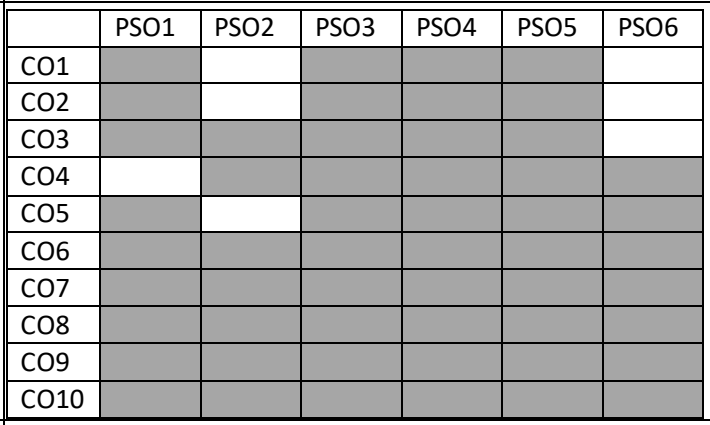
Course Code	BTP-3005
Course Title	Bioinformatics & Molecular Biology
Credit	4
Teaching per Week	4 Hours/week
Minimum weeks per Semester	15 (Including Classwork, examination, preparation, holidays etc.)
Effective From	2019
Purpose of Course	To provide practical knowledge to the students related to Bioinformatics software and Molecular biology.
Course Objective	To help them gain hands on and skill training related to bioinformatics tool and applicable techniques of molecular biology.
Course Outcomes	CO1: Students will able perform practicals on phylogenetic analysis using NJ Plot CO2-CO6: To perform secondary structure prediction and homology modeling, also analysis the protein by Ramachandran plot. CO7-CO10: Students will be given the hands-on training for molecular biology-based techniques like DNA extraction, protein extraction. To provide them hands on training for the advanced techniques like SDS-PAGE and PCR, that have future application in medicine and therapeutics.
Mapping between COs with PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						
CO4						
CO5						
CO6						

	CO7						
	CO8						
	CO9						
	CO10						
Pre-requisite	Basics of Science, Computer skill						

Course Content	1.Creation of Cladogram/Phylogram using Simple Phylogeny/NJPLOT. 2. Predict ORF using ORF Finder. 3. Predict secondary structure using GORIV/JPred4. 4. Perform Homology modelling using Swiss model. 5. Perform evaluation of predicted protein by Rampage. 6. Perform Primer designing using Primer 3 / Blast Primer. 7. Separation of λ DNA digests using low-melting agarose electrophoresis, postelectrophoretic DNA elution from gel and purification by solvent /agarase enzyme method. 8. Isolation of chromosomal DNA from Saccharomyces cerevisiae / *Aspergillus niger.* 9. In vitro amplification of specific DNA fragments by Polymerase Chain Reaction. 10. SDS-PAGE separation of protein mixture, Silver/Coomassie staining of SDS-PAGE gel.

Reference Books	1. MOLECULAR CLONING: A LABORATORY MANUAL by Michael R.Green and Joseph Sambrook. 2. Himedia guide manual for conventional Polymerase chain reaction.
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

Course Code	BTP-3006
Course Title	Cell Culture Technology-II
Credit	4
Teaching per Week	4 Hours/week
Minimum weeks per Semester	15
Effective From	
Purpose of Course	The purpose of the course is to provide hands on experience to students to the plant and animal cell culture practicals
Course Objective	The course objective is to provide training to the students for the basics of animal and plant tissue culture based techniques.
Course Outcomes	CO1: To perform direct/indirect organogenesis of agriculturally important plant/crops CO2: To conduct assay for GST/PPO/TAC for the plants CO3: To gain hands-on experience on plant RNA isolation CO4: To perform genotoxicity assay like micronucleas/DNA fragmentation assay CO5: To determine GST activity in serum CO6-CO10: To determine SOD/Catalase/LDH activity to evaluate cytotoxicity Chemicals
Mapping between COs with PSOs	
Pre-requisite	Basics of Sciences

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						
CO4						
CO5						
CO6						
CO7						
CO8						
CO9						
CO10						

Course Content	1. Direct organogenesis (In vitro clonal Propagation) of any plant of agriculture/medicinal/horticultural importance. 2. Indirect organogenesis of plant of commercial importance. 3. Isolation of RNA from suitable plant source. 4. Assay of glutathione s-transferase (GST) and polyphenol oxidase (PPO). 5. Evaluation of Total antioxidant Capacity (TAC) of plants. 6. To perform Genotoxicity by Micronucleus assay and DNA fragmentation assay. 7. To perform Cytotoxicity by MTT/XTT or MTS assay. 8. Estimation of GST activity in serum/cell lysates. 9. Study of effect of cytotoxic chemicals on cells by different marker parameters (Super Oxide Dismutase and Catalase). 10. To estimate Lactate Dehydrogenase activity from cells.

Reference Books	1. EZcountTM Lactate Dehydrogenase Cell Assay Kit, CCK036, Himedia 2. Marc D. Anderson', Tottempudi K. Prasad*, and Ceci1 R. Stewart. Changes in lsozyme Profiles of Catalase, Peroxidase, and Glutathione Reductase during Acclimation to Chilling in Mesocotyls of Maize Seedlings'. Plant Physiol. (1 995) 109: 1247-1 257 3. Sylwester Sommer 1,*, Iwona Buraczewska 1 and Marcin Kruszewski. Micronucleus Assay: The State of Art, and Future Directions. International journal of Molecular sciences. 2020, 21, 1534. 4. Arul P, Shetty Smitha, Suresh Masilamani, Akshatha C. Micronucleus Assay in Exfoliated Buccal Epithelial Cells Using Liquid Based Cytology Preparations in Building Construction Workers. Iranian Journal of Pathology. 2018, 13.1. 5. Guha P, Das A, Dutta S, Chaudhuri TK. A rapid and efficient DNA extraction protocol from fresh and frozen human blood samples. J Clin Lab Anal. 2018;32:e22181.
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

Semester X

Course Content	BT: R-4001: Seminar Presentation: A seminar presentation will be made during the external examination by the candidates before the examiners based on the theme area or recent developments in Animal/Microbial/Plant Biotechnology. Power point presentation should be done using 25-30 slides and total time period allotted to candidate shall be 15 minutes which will include time for viva-voce. BT: R-4002: Review of Published Research Paper/Article: Oral presentation will have to be made on a selected research paper from the reputed Journal by the candidate before external examiners. List of 10 research articles shall be recommended by Board of Studies in Biotechnology every year and to be provided to all affiliated colleges running M. Sc. Biotechnology course. BT: R-4003: Poster Presentation: One poster related to research work done by the students is to be presented before external examiners. Size of the research poster prepared for external evaluation shall be 2 ft X 3 ft (portrait or landscape) and screen/digital/flex printing is allowed. Poster already prepared for participation in any seminar/conference/symposium during Semester-X can also be considered for evaluation in external examination. Student is required to produce certificate of participation as a proof that he/she has participated during Semester-X and work presented is his/her own work. BT: R-4004: Dissertation on Biotechnology (Duration for work: Minimum 3 Months) A project work should be done individually on topic related to any one of the following area justifying Animal, Microbial or Plant Biotechnology. The candidate may be allowed to work at some outside institutions as specified in rules and guidelines. Thesis will be sent for evaluation by college as per directions given by Chairman/Chairperson appointed for BT: R-4004 to external examiner for assessment. Candidate has to present his/her work in the form of presentation in external examination.

Semester X
B: Skill Based

Course Code	BT: S-4001
Course Title	ESSENTIAL SKILLS FOR BIOPHARMACEUTICAL INDUSTRY
Credit	4
Teaching per Week	4 Hours/week
Minimum weeks per Semester	15 (Including Classwork, examination, preparation, holidays etc.)
Effective From	2019
Purpose of Course	The course aims to impart the knowledge of theoretical aspects of Biopharmaceuticals, their production, downstream processing and product analysis.
Course Objective	To make students understand the applications, production and analysis of the Biopharmaceuticals.
Course Outcomes	CO1: The first unit of the course covers the introduction and classes of biopharmaceuticals, use of biopharmaceuticals for gene therapy and manufacture of Biopharmaceuticals. Additionally, it also covers the aspects related to pharmacokinetic, toxicological, and drug delivery issues. CO2: The second unit of the course allow the students to understand about heproduction of the Biopharmaceuticals. Within this segment, students will be able to understand about the sources of the biopharmaceuticals as wellas upstream process methodologies involved in biopharmaceutical production. CO3: Once the upstream processes are completed, next step in biopharmaceutical production is downstream processes. The course alsocovers this aspect where students will be able to understand the theoretical aspects of cell disruption, product concentration, chromatographic purifications and final product formulation, etc. CO4: The last segment of the course focuses on final product analysis which includes identification of product impurities by using different approaches. It also covers the aspects why and how the endotoxin and pyogenic contamination should be avoided in final pharmaceutical product.
Mapping between COs with PSOs	
Pre-requisite	Basics of Sciences

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						
CO4						

Course Content	UNIT-1: BIOPHARMACEUTICALS 1.1 Introduction and classes of biopharmaceuticals 1.2 Gene Therapy 1.3 Manufacture of Biopharmaceuticals 1.4 Pharmacokinetic, toxicological and drug delivery issues 1.5 Case Study of Biopharmaceuticals: Insulin Lispro (Humalog) and Monoclonal Antibodies UNIT-2: PRODUCTION OF BIOPHARMACEUTICALS 2.1 Sources of biopharmaceuticals 2.1.1 Escherichia coli 2.1.2 Animal cell culture systems 2.1.3 Additional systems 2.2 Upstream Processing for biopharmaceutical production: 2.2.1 Cell banking system 2.2.2 Microbial cell fermentation 2.2.3 Mammalian cell culture system UNIT-3: DOWNSTREAM PROCESSING OF BIOPHARMACEUTICALS 3.1 Cell disruption and Initial recovery 3.2 Product concentration 3.3 Chromatographic Purification 3.4 HPLC of proteins and recombinant proteins 3.5 Final product formulation UNIT-4: PRODUCT ANALYSIS 4.1 Protein based contaminants 4.2 Removal of altered forms of proteins 4.3 Detection of protein based impurities 4.4 Immunological approaches of detection 4.5 Endotoxins and other pyrogenic contaminants

Reference Books	REFERENCES: 1. Rang, H. P., Drug Discovery and development. Churchill Livingstone Elsevier, 2006. 2. Crommelin, D.J.A., Sindelar, R.D. and Meibohm. B., Pharmaceutical Biotechnology: fundamentals and applications. Informa Helthcare, 2008. 3. Walsh, G., Pharmaceutical Biotechnology: Concepts and Applications. John Wiley & Sons, 2007. 4. Walsh, Gary, and Brendan Murphy, eds. Biopharmaceuticals, an Industrial Perspective. Springer Science & Business Media, 1999.
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

Course Code	BT: S-4002
Course Title	ESSENTIAL SKILLS FOR BIO-SERVICES AND BIO-AGRI INDUSTRIES
Credit	4
Teaching per Week	4 Hours/week
Minimum weeks per Semester	15 (Including Classwork, examination, preparation, holidays etc.)
Effective From	2019
Purpose of Course	The purpose of the course is to make the student capable of implementing the knowledge related to Assisted reproductive technology and IVF.
Course Objective	To make students acquainted with concepts of IVF and the protocols related to the same.
Course Outcomes	CO1: Explain students the basics of fertilization. To explain them how to investigate couples for IVF treatment and use of fertilization basics in assisted reproduction. CO2: To help students gain knowledge regarding in vitro maturation, types of media used in embryo culture, composition of media used in embryo culture. The basics of Gamete micromanipulation. CO3: To train students regarding different techniques used to study the basics of ICSI, preparation methods for sperm retrieval and maintenance. To make them aware about the protocols for cryopreservation of sperms and eggs. CO4: To acquaint students about seed technology, to explain them different seed types, process for hybrid production, characterization of hybrids, application of CRISPR/Cas9 in crop improvement.
Mapping between COs with PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						
CO4						

Pre-requisite	Basics of Sciences

Course Content	UNIT-1: INTRODUCTION OF IN VITRO FERTILIZATION 1.1 Biological basis of fertilization 1.2 Indications for IVF treatment 1.3 Initial investigation of the infertile couple 1.4 Fertilization in assisted reproduction 1.5 Role of Assistant reproduction technology nurse UNIT-2: OOCYTE AND EMBRYO HANDLING IN A. R. T. 2.1 In vitro Maturation in treatment 2.2 Outline of IVM treatment cycle 2.3 Types of media for embryo culture 2.4 Composition of embryo culture media 2.5 Gamete micromanipulation UNIT-3: SPERM PROCESSING IN A. R. T. 3.1 Sperm collection 3.2 Sperm preparation methods 3.3 Post-separation treatment of spermatozoa 3.4 Intracytoplasmic sperm injection 3.5 Protocols of cryopreservation UNIT-4: PRACTICAL SEED TECHNOLOGY 4.1 Types of seeds: Nucleus seed, Breeder seed, Foundation seed, Registered seed and certified seed 4.2 Role of male sterility in hybrid production 4.3 Assessment of genetic purity of lines and hybrids 4.4 Characterization of Lines and Hybrids for Intellectual Property Rights Protection 4.5 Recent advancement in crop improvement via genome editing: a case study for application of CRISPR- Cas9/Cpf1 in crop improvement

Reference Books	REFERENCES: 1. Gardner DK, Weissman A, Howles CM, Shoham Z, editors. Textbook of assisted reproductive techniques 5th Ed: Volume 2: Clinical perspectives. CRC press; 2018. 2. Gardner DK, editor. In vitro fertilization: a practical approach. CRC Press; 2006 Sep 29.
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

Course Code	BT: S-4003
Course Title	ESSENTIAL SKILLS FOR CLINICAL LABORATORIES
Credit	4
Teaching per Week	4 Hours/week
Minimum weeks per Semester	15 (Including Classwork, examination, preparation, holidays etc.)
Effective From	2019
Purpose of Course	The purpose of the course is to provide insights about basics knowledge and skills for clinical laboratories.
Course Objective	To make student aware about various clinical methods for analysis of various samples and organisms.
Course Outcomes	CO-1-to give students basic knowledge of culture media and analysis of various samples CO-2-it will provide students insight of various marker test which make them able to differentiate between the disease. CO-3-it will give knowledge of various diagnostic methods for different disease CO-4-it helps students for cytogenetic study and automation of clinical laboratories.
Mapping between COs with PSOs	
Pre-requisite	Basics of Sciences

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						
CO4						

Course Content	UNIT-1: CLINICAL MICROBIOLOGY 1.1 Culture media: Composition, types and forms 1.2 Study of Escherichia, Salmonella, Leptospira and Mycobacterium 1.3 Routine urine examination 1.4 Routine examination of faeces 1.5 Routine examination of semen and semen washing 1.6 Routine examination of sputum UNIT-2: CLINICAL BIOCHEMISTRY 2.1 Cardiac profile tests 2.2 Kidney function tests 2.3 Liver function tests 2.4 Laboratory determination of lipids in serum 2.5 Determination of hormones 2.6 Determination of glucose and glycosylated haemoglobin UNIT-3: DIAGNOSTIC SEROLOGY 3.1 Widal test and Immunological pregnancy test 3.2 Detection of rheumatoid factor and CRP 3.3 Detection of HBsAg 3.4 Detection of Dengue Fever and Leptospira IgM 3.5 Detection of malarial parasite by strip test and microscopy 3.6 Detection of allergens and antinuclear antibodies UNIT-4: CYTOGENETICS AND AUTOMATION IN CLINICAL LABORATORIES 4.1 Cell culture, Karyotyping and FISH 4.2 Prenatal chromosomal diagnosis 4.3 Molecular diagnosis of genetic diseases 4.4 Automation in bacteriology 4.5 Discrete autoanalyzers 4.6 Introduction to working of semi-autoanalyzer

Reference Books	REFERENCES: 1. Godkar P, Godkar D. Textbook of Medical Laboratory Technology. 3rd Ed. Mumbai: Bhalani Publishing House; 2014. 2. Murray P. Manual of Clinical Microbiology. Washington, DC: ASM Press; 2011.
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

Course Code	BT: S-4004
Course Title	SKILL ENHANCEMENT LABORATORY WORK
Credit	4
Teaching per Week	4 Hours/week
Minimum weeks per Semester	15 (Including Classwork, examination, preparation, holidays etc.)
Effective From	2019
Purpose of Course	The purpose of the course is to make the student capable of performing skill-based experiments related to IVF.
Course Objective	To allow students to fetch the practical knowledge and hands on training related to IVF.
Course Outcomes	CO1: To provide them hands on training related to IVF based techniques, identification of problems related to urinary tract infection and diagnosis of suspected diseases. CO2: To help students gain practical knowledge related to handling of sperms, measuring viability of sperms, their motility. CO3: To train students about use of PCR for disease diagnosis and purification of different recombinant proteins using chromatography techniques. CO4-CO9: To acquaint students about role of cryopreservation in storage of gametes. To teach them estimation of blood sugar and urea level. CO10-CO14: Students will learn applications by Demonstration method.
Mapping between COs with PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1						
CO2						
CO3						
CO4						

	CO5						
	CO6						
	CO7						
	CO8						
	CO9						
	CO10						
	CO11						
	CO12						
	CO13						
	CO14						
Pre-requisite	Basics of Sciences						

Course Content	1. Purification his-tagged recombinant proteins from bacterial hosts. 2. Detection of Endotoxins in pharmaceutical products by LAL test. 3. Routine chemical and microscopic examination of urine. 4. Microbiological diagnosis of suspected infection of Salmonella. 5. Microbiological diagnosis of Urinary Tract Infection. 6. Estimation of blood sugar by GOD method. 7. Estimation of blood urea by DAM method. 8. PCR based diagnosis of tuberculosis. 9. Identification and differentiation of Bt-cotton and Non Bt-cotton. 10. Microscopic examination of semen to study spermatozoa abnormalities (Demonstration). 11. Dilution and washing of spermatozoa (Demonstration). 12. Study of Intracytoplasmic sperm injection process (Demonstration). 13. Study of the Cryopreservation, Thawing and Vitrification of embryo (Demonstration). 14. Visit to the Assisted Reproduction Treatment (ART) centre / Clinical diagnostic laboratory / Seed research facility or Agriculture biotechnology research laboratory.

Reference Books	Experimental Microbiology volume 1 and 2 by Rakesh Patel.
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment