THE ASSAM
ROYAL GLOBAL UNIVERSITY
GUWAHATI

ROYAL SCHOOL OF BIO-SCIENCES

(RSBSC)

DEPARTMENT OF BIOTECHNOLOGY

COURSE STRUCTURE AND SYLLABUS

FOR

B.SC. IN BIOTECHNOLOGY

(4 YEARS SINGLE MAJOR)

W.E.F.

AY-2026-27

(BASED ON NATIONAL EDUCATION POLICY 2020)

Outline of the syllabus for B.Sc. in Biotechnology (Royal School of Bio-Sciences)

1ST SEMESTER					
COMPONENT	**COURSE CODE**	**COURSE TITLE**	**LEVEL**	**CREDIT**	**L-T-P**
Major (Core)	BTC152M101	Biochemistry	100	3	2-1-0
	BTC152M112	Practical on Biochemistry	100	3	0-0-6
Minor *	BTC152N101	Biotechnology and Human Welfare	100	3	3-0-0
Interdisciplinary (IDC)	IKS992K101	Indian Knowledge System – I	100	3	3-0-0
Ability Enhancement Course (AEC)	CEN982A101	Communicative English – I	100	1	1-0-0
	BHS982A102	BHS – I	100	1	1-0-0
Skill Enhancement Course (SEC)	BTC152S111	Compost Preparation and Applications	100	3	0-0-6
Value Added Course (VAC) **	VAC992V101	Basic Bioinformatics	100	3	
SWAYAM				3/ 4	
			TOTAL CREDIT FOR 1ST SEMESTER	**20+3/4**	
2ND SEMESTER					
COMPONENT	**COURSE CODE**	**COURSE TITLE**	**LEVEL**	**CREDIT**	**L-T-P**
Major (Core)	BTC152M201	Microbiology	100	2	2-0-0
	BTC152M211	Practical in Microbiology	100	1	0-0-2
Major (Core)	BTC152M202	Cell Biology	100	2	2-0-0
	BTC152M212	Practical in Cell Biology	100	1	0-0-2
Minor	BTC152N201	Basic Instrumentation in Biology	100	3	3-0-0
IDC	IKS992K201	Indian Knowledge System – II	100	3	3-0-0
AEC	CEN982A201	Communicative English – II	100	1	1-0-0
	BHS982A202	BHS – II	100	1	1-0-0
SEC	BTC152S211	Biochemical Analysis of Food	100	3	0-0-6
VAC	VAC992V2---	To be chosen from a pool of courses	100	3	
SWAYAM				3/ 4	
			TOTAL CREDIT FOR 2ND SEMESTER	**20+3/4**	
Exit 1 – UG Certificate in Biotechnology (with 40 credits + a vocational course of 4 credits in summer break)					
3RD SEMESTER					
COMPONENT	**COURSE CODE**	**COURSE TITLE**	**LEVEL**	**CREDIT**	**L-T-P**
Major (Core)	BTC152M301	Genetics	200	3	2-1-0
	BTC152M311	Practical in Genetics	200	1	0-0-2
Major (Core)	BTC152M302	Biophysical Chemistry	200	4	3-1-0
Minor	BTC152N301	Introduction to IPR	200	4	3-1-0
IDC #	BTC152I301	Health and Hygiene	200	3	3-0-0
AEC	CEN982A301	Communicative English – III	200	1	1-0-0
	BHS982A302	BHS – III	200	1	1-0-0
SEC	BTC152S311	Clinical Biochemistry	200	3	0-0-6
SWAYAM				3/ 4	
			TOTAL CREDIT 3RD SEMESTER	**20+3/4**	
4TH SEMESTER					
COMPONENT	**COURSE CODE**	**COURSE TITLE**	**LEVEL**	**CREDIT**	**L-T-P**
Major (Core)	BTC152M401	Molecular Biology	200	3	2-1-0
	BTC152M411	Practical in Molecular Biology	200	1	0-0-2
Major (Core)	BTC152M402	Immunology	200	3	2-1-0
	BTC152M412	Practical in Immunology	200	1	0-0-2

Outline of the syllabus for B.Sc. in Biotechnology (Royal School of Bio-Sciences)

Major (Core)	BTC152M403	Bioethics, Biosafety and IPR	200	4	3-1-0
Minor	BTC152N401	Biofertilizer and Its Application	200	3	3-0-0
	BTC152N402	Food Biotechnology	200	3	3-0-0
AEC	CEN982A401	Communicative English – IV	200	1	1-0-0
	BHS982A402	BHS – IV	200	1	1-0-0
SWAYAM				3/ 4	
			TOTAL CREDIT 4TH SEMESTER	**20+3/4**	
Exit 2 – UG Diploma in Biotechnology (with 80 credits + a vocational course of 4 credits in summer break of 2nd year)					
5TH SEMESTER					
COMPONENT	**COURSE CODE**	**COURSE TITLE**	**LEVEL**	**CREDIT**	**L-T-P**
Major (Core)	BTC152M501	Genomics and Proteomics	300	4	4-0-0
	BTC152M502	Plant and Animal Biotechnology	300	4	4-0-0
	BTC152M513	Practical – Vᵠ	300	4	0-0-8
Minor	BTC152N501	Basics of Molecular Biology	300	4	4-0-0
		INTERNSHIP	300	4	
			TOTAL CREDIT FOR 5TH SEMESTER	**20**	
6TH SEMESTER					
COMPONENT	**COURSE CODE**	**COURSE TITLE**	**LEVEL**	**CREDIT**	**L-T-P**
Major (Core)	BTC152M601	Genetic Engineering	300	4	4-0-0
	BTC152M602	Bioinformatics and Biostatistics	300	4	4-0-0
	BTC152M603	Bioprocess Engineering	300	4	4-0-0
	BTC152M614	Practical – VIᵠ	300	4	0-0-8
Minor	BTC152N601	Entrepreneurship Development	300	4	4-0-0
			TOTAL CREDIT FOR 6TH SEMESTER	**20**	
Course completion Option 1 – UG Degree (B.Sc.) in Biotechnology (with 120 credits)					
7TH SEMESTER					
COMPONENT	**COURSE CODE**	**COURSE TITLE**	**LEVEL**	**CREDIT**	**L-T-P**
Major (Core)	BTC152M701	Environmental Biotechnology	400	4	3-1-0
	BTC152M702	Techniques in Molecular Biology	400	4	3-1-0
	BTC152M703	Experimental design and data analysis for researchers	400	4	3-1-0
	BTC152M714/ BTC152M724	Practical – VIIᵠ **(only for honours)** / Research Component 1 **(only for honours with research)**	400	4	0-0-8
Minor	BTC152N701	Pharmaceutical Biotechnology	400	4	4-0-0
			TOTAL CREDIT 7TH SEMESTER	**20**	
8TH SEMESTER					
COMPONENT	**COURSE CODE**	**COURSE TITLE**	**LEVEL**	**CREDIT**	**L-T-P**
Major (Core)	BTC152M801	Instruments and Techniques	400	4	3-1-0
Minor	BTC152N801	Medical Biotechnology	400	4	4-0-0
Project/Dissertation§	**BTC152M823**	**Research Component 2 (*Students with ≥ 75% till the 6th semester*)**	400	12	
(Major courses for the rest of the students in lieu of Project/ Dissertation)					
Major (Core)	BTC152M802	Research Component 2	400	4	3-1-0
	BTC152M803	Developmental Biology	400	4	3-1-0
	BTC152M804	Ecosystem degradation and intervention	400	4	3-1-0
			TOTAL CREDIT 8TH SEMESTER	**20**	
Course completion Option 2 – B.Sc. (Honours) in Biotechnology (with 160 credits)					

Outline of the syllabus for B.Sc. in Biotechnology (Royal School of Bio-Sciences)

Course completion Option 3 – B.Sc. (Honours with Research) in Biotechnology (with 160 credits)

**** Students must choose a minor course outside their major course (a separate department) and are expected to continue with the same department in subsequent semesters. As such the minor papers offered by Department of Biotechnology are for students from other departments only.***

***** Students must choose a VAC outside their major course (a separate department) and are free to choose a course offered by the same or differentdepartments in subsequent semesters.***

#Students must choose an IDC outside their major course (a separate department).

φPractical – V will include practical components from the major theory papers 'Genomics and Proteomics' and 'Plant and Animal Biotechnology'

ψPractical – VI will include practical components from the major theory papers 'Genetic Engineering', 'Bioinformatics and Biostatistics' and 'Bioprocess Engineering'

ωPractical – VII will include practical components from the major theory papers 'Environmental Biotechnology, 'Medical Biotechnology' and 'Plant and Animal Physiology'

§ This option is available only to the students securing ≥ 75% (cumulative) till the 6th semester.

SYLLABUS (1st SEMESTER)

Course Title: Biochemistry	**Course Component: Major**
Course code: BTC152M101	**Credit: 3**
Level of course: 100	**L-T-P-C: 2-1-0-3**
Scheme of Evaluation: Theory (T)	

Course Objectives: The main objective of the course is to provide basic foundation on biomolecules of life with reference to their properties, and biological functions.

Course Outcome:

On successful completion of the course the students will be able to:		
Course Outcome		**Blooms Taxonomy Level**
CO 1	**Recall the** structure of atoms, biomolecules and chemical bonds	**BT 1**
CO 2	**Understand** the concepts of enzyme kinetics, bio-polymers etc.	**BT 2**
CO 3	**Develop** the knowledge gained in solving practical experiments.	**BT 3**
CO 4	**Analyze** the metabolic processes.	**BT 4**

Detailed Syllabus:

Modules	**Topics & Course Contents**	**Periods**
I.	**Introduction to Biochemistry:** A historical prospective. **Amino acids & Proteins:** Structure & Function. Structure and properties of Amino acids, Types of proteins and their classification, Forces stabilizing protein structure and shape. Different Level of structural organization of proteins, Protein Purification. Denaturation and renaturation of proteins. Fibrous and globular proteins. **Carbohydrates**: Structure, Function and properties of Monosaccharides, Disaccharides and Polysaccharides. Homo & Hetero Polysaccharides, Mucopolysaccharides, Bacterial cell wall polysaccharides, Glycoproteins and their biological functions	**16**
II.	**Lipids**: Structure and functions –Classification, nomenclature and properties of fatty acids, essential fatty acids. Phospholipids, sphingolipids, glycolipids, cerebrosides, gangliosides, Prostaglandins, Cholesterol. **Nucleic acids**: Structure and functions: Physical & chemical properties of Nucleic acids, Nucleosides & Nucleotides, purines &pyrimidines, biologically important	**16**

	nucleotides, Double helical model of DNA structure and forces responsible for A, B & Z – DNA, denaturation andrenaturation of DNA.	
III.	**Enzymes**: Nomenclature and classification of Enzymes, Holoenzyme, apoenzyme, Cofactors, coenzyme, prosthetic groups, metalloenzymes, monomeric &oligomeric enzymes, activation energy and transition state, enzyme activity, specific activity, common features of active sites, enzyme specificity: types & theories, Biocatalysts from extreme thermophilic and hyperthermophilicarchaea and bacteria. Role of: NAD+, NADP+, FMN/FAD, coenzymes A, Thiamine pyrophosphate, Pyridoxalphosphate,lipoic-acid, Biotin vitamin B12, Tetrahydrofolate and metallic ions	**16**
IV	**Carbohydrates Metabolism**: Reactions, energetics and regulation. Glycolysis: Fate of pyruvate under aerobic and anaerobic conditions. Pentose phosphate pathway and its significance, Gluconeogenesis, Glycogenolysis and glycogen synthesis. TCA cycle, Electron Transport Chain, Oxidative phosphorylation. ß-oxidation of fatty acids, glyoxylate cycle.	**16**
	TOTAL	**64**
Pedagogy: Lectures, Assignments, Seminars		

Credit distribution:

3 credits: 3 × 30= 90 Notional Credit Hours (80 class hours + 10 Experiential learning)

Experiential learning activities may include:

- undergraduate research
- participation in a student design team
- completion of an internship
- student teaching
- classroom presentation *etc.*

Text Books

1. Nelson, D.L., Cox, M.M., *Lehninger Principles of Biochemistry* 4th Edition, 2004, WH Freeman and Company, New York, USA

Reference Books

1. Berg, J. M., Tymoczko, J. L. and Stryer., *Biochemistry*, 6th Edition,2006, W.H Freeman and Co.
2. Buchanan, B., Gruissem, W. and Jones, R., *Biochemistry and Molecular Biology of Plants*, 2nd Edition, 2015, American Society of Plant Biologists, USA.

Course Title: Practical on Biochemistry	**Course Component: Major**
Course code: BTC152M112	**Credit: 3**
Level of course: 100	**L-T-P-C: 0-0-6-3**
Scheme of Evaluation: Practical (P)	

Course Objective: The main objective of the course is toperform the experiments associated with the subjects taught and understand the underlying principles.

Course Outcomes:

On successful completion of the course the students will be able to:		
Course Outcome		**Blooms Taxonomy Level**
CO 1	**Learn** and **remember** about the process of preparation of buffers and calculate the same.	**BT 1**
CO 2	**Understand** about pH and its importance, enzyme kinetics.	**BT 2**
CO 3	**Apply** the knowledge of microscopy in identifying various stages of cell division.	**BT 3**
CO 4	**Categorize** the equipment's used and the underlying safety measures in a laboratory.	**BT 4**

Detailed Practical:

Module	Topics & Course Contents	Periods
I	• Safety measures in Biochemistry laboratory. • Effect of α-amylase on starch • Determination of K_m and V_{max} of α-amylase activity	20
II	• pH meter and buffers • Preparation of phosphate buffer • Preparation citrate buffer	20
III	• Principles of Colorimetry and Verification of Beer's law • Separation of Amino acids by paper chromatography. • Separation of various biomolecules by using TLC	20
IV	• Estimation of carbohydrates (glucose, maltose, lactose) present in a sample solution by DNS method • Estimation of protein by Lowry's method • Extraction and estimation of cellular protein from animal tissue by ammonium salt precipitation method.	20
	TOTAL	80

Credit distribution:

3 credits: 3 × 30= 90 Notional Credit Hours (80 lab hours + 10 Experiential learning)

Experiential learning activities may include:

- undergraduate research
- participation in a student design team
- completion of an internship
- student teaching
- classroom presentation *etc.*

Reference Books:
As suggested under the theory papers.

Course Title: Biotechnology and Human Welfare	**Course Component: Minor**
Course code: BTC152N101	**Credit: 3**
Level of course: 100	**L-T-P-C: 3-0-0-3**
Scheme of Evaluation: Theory (T)	

Course Objective: The main objective of the course is to provide a detailed description of the organization of the cell, the structure and functions of various organelles. The course also focuses on cell-cell communication and the importance of cell division. The content of this course is aligned with SDG3: Good health and well – being.

Course Outcomes

On successful completion of the course the students will be able to:		
Course Outcome		**Blooms Taxonomy Level**
CO 1	**Remember** the various roles played by Biotechnology.	**BT 1**
CO 2	**Understand** the role of Biotechnology in solving environmental issues.	**BT 2**
CO 3	**Employ** the theoretical knowledge in future studies.	**BT 3**
CO 4	**Analyze** the role of the techniques learnt in development of society	**BT 4**

Detailed Syllabus

Modules	**Topics & Course Contents**	**Periods**
I.	Biotechnology in Industries: Development of protein products, development of recombinant proteins, modification and application of enzymes, antibiotic production, alcohol production.	**12**

	Biotechnology in Agriculture: Production of new crops, genetically modified crops, development of stress/flood/drought tolerant crops. Better production of resistant crops. Improvement of livestock.	
II.	Biotechnology in Environment: Development of products which can degrade organic and inorganic pollutant, degradation of hydrocarbons and agriculture wastes, development of biodegradable polymers.	**12**
III.	Biotechnology in Food: Development of better-quality food products, development of innovative food products, development of new microbial strains, new beverages, quality preservation in foods, development of nutraceuticals and their role in health.	**12**
IV	Biotechnology in Forensics: Biotechnological interventions in solving crimes, DNA fingerprinting-Principles and applications, serology tools and role in solving crimes, biological solutions to solving crimes. Biotechnology in Pharmaceutical and Health: Development of new therapeutic agents, vaccines, genetherapy techniques, new diagnostic techniques for detection of viral disease, e.g. Covid-19,HIV, etc. Role of Human Genome Project.	**12**
	TOTAL	**48**
Pedagogy: Lectures, Assignments, Seminars		

Credit distribution:

3 credits: 3 × 30= 90 Notional Credit Hours (48 class hours + 42 Experiential learning)

Experiential learning activities may include:

- undergraduate research
- participation in a student design team
- completion of an internship
- student teaching
- classroom presentation *etc.*

Text Books

1. S.M.Reddy,S.R. Reddy,G.N. Babu,BasicindustrialBiotechnology, 2012,NewAgePublishers.

Reference Books

1. Ratledge,C.,Kristiansen,B.,BasicBiotechnology,3rdedition,2006, Cambridge University Press;
2. Das,H.K.,TextbookofBiotechnology,5thedition,2017, WileyPublishers.

Course Title: Introduction to Indian Knowledge System– I	Course component: IDC
Course Code: IKS992K101	Credits: 3
Course Level: 100L-T-P-C: 3-0-0-3	
Scheme of Evaluation: Theory (SummativeAssessment-70% + FormativeAssessment-30%)	

Credit Distribution (NCH)		
Lecture/Tutorial(Hours)	**Practical (Hours)**	**Experiential Learning (Hours)**
60	0	30

Course objectives:

This Foundation course is designed to present an overall introduction to all the streams of IKS relevant to the UG program. It would enable students to explore the most fundamental ideas that have shaped Indian Knowledge Traditions over the centuries.

Course Outcomes:

On completion of this course students will be able to:

CO	Contents	BT Level
CO_1	Recall the rich heritage of Indian knowledge systems	1
CO2	Describe the contribution of Indian knowledge systems to the	2
CO_3	Demonstrate knowledge of socio-cultural and ethnolinguistic diversity that constitutes the soul of Bharatvarsha	3
CO_4	Apply traditional knowledge and techniques in day-to-day life	4
CO_5	Distinguish knowledge traditions that originated in the Indian subcontinent	5

Detailed syllabus

Module	Course Contents	Periods
I	**Introduction to Indian Knowledge Systems (IKS):** About Indian Knowledge System; Definition of Indigenous/Traditional Knowledge; Scope, and Importance of Traditional Knowledge. **Ancient India-Bharat Varsha:** People of Ancient Bharat Varsha; Our great natural heritage: The great Himalayas and the rivers; The civilizations of the Sindhu-Ganga valley, and the Brahmaputra valley; Our coastal plains; Our Nature: Forests and Minerals; Ancient Indian Traditional Knowledge and Wisdom about nature and climate.	15

II	**Indian Heritage of Knowledge:** Ancient Indian Knowledge: The *Vedas* and its components-the *Vedangas* Ancient Indian books and treaties: The *Sastras*.; The Great Indian Epics: The Ramayana and The Mahabharata Epics and religious treaties of ancient Assam: Introduction to Madhav Kandali's *Ramayan* and Srimanta Sankardev's *Dasam Skandha Bhagavat* of the Puranas; Ancient Traditional Knowledge-The *Agamas;* The ancient Buddhist knowledge: *Tripitaka: Vinaya, Sutta* and *Abhidhamma Pitaka* **Languages and language studies in India**: What is linguistics?; Script and Language; Alphabet of the Indian; languages *Varnamala:* Origin, Evolution, and phonetic features; Languages of India; Important texts of Indian languages: Skills *Siksha,* Expression/Prounciation-*Nirukta,* Grammer-*Vyakarana,* Poetic rhythm- *Chandas;* Paninian Grammar: A Brief Introduction **Introduction to Fine Arts and Performing Arts of India:** Ancient Indian classical music and dance forms: The Science of Dramas-*Natyasastra* and the Science of Music-*Gandharva-Veda;* Aesthetics in Indian Art and Culture; Folk music and traditional dance forms of the Northeast.	
III	**Indian Science & Technology:** Ancient India's contribution to Mathematics - Number System. Algebra and Arithmetic, Geometry and Trigonometry; Origin of Decimal systemin India; nomenclature of numbers in the Vedas. Zero and Infinity. Sulba-sutras. Contribution of Brahmagupta and Sridhar Acharya to Mathematics. Important texts of Indian mathematics. **Indian Astronomy:** Planetary System. Motion of the Planets; Velocity of Light; Eclipse. Astronomy. Navagrahas. Important works in Indian Astronomy. Aryabhata and Nilakantha: Contribution to Astronomical Studies **Indian Metal Works:** Mining Techniques. Types of Metals. Tools & Techniques for Metal Smelting with examples. Metal works in pre- modern India: Special reference to NE India.	15
IV	**Contribution of Ancient India to Health Sciences:** Traditional Indigenous systems of medicines in India: -*Ayurveda* and *Yoga;* Elements of *Ayurveda: Gunas* and *Doshas*, *Pancha Mahabhuta* and *Sapta-dhatu;* Concept of disease in Ayurveda; Ayurvedic lifestyle practices: *Dinacharya and Ritucharya;* Important Ayurvedic Texts; Hospitals in Ancient India; *Ayurveda*: Gift of India to the modern world.	15
Total		**60**

Text Books

1. Mahadevan, B., Bhat Vinayak Rajat, Nagendra Pavan RN. (2022), *Introduction to Indian Knowledge System: Concepts and Applications.* PHI Learning Private Ltd.
2. Mukul Chandra Bora, Foundations of Bharatiya Knowledge System. Khanna Book Publishing

ReferenceBooks

1. Baladev Upadhyaya,*Samskrta Śāstrom ka Itihās*,Chowkhambha,Varanasi, 2010.
2. D.M.Bose,S.N.SenandB.V.Subbarayappa,Eds.,*AConciseHistoryofScienceinIndia*, 2nd Ed., Universities Press, Hyderabad, 2010.
3. Astāngahrdaya,Vol.I,*SūtrasthānaandŚarīrasthāna*,TranslatedbyK.R.SrikanthaMurthy,Vol. I, KrishnadasAcademy,Varanasi, 1991.
4. Dharampal, *TheBeautifulTree: Indian Indigenous Education in the EighteenthCentury*, Dharampal Classics Series, RashtrotthanaSahitya, Bengaluru, 2021.
5. J.K.BajajandM.D.Srinivas,*IndianEconomy,andPolityinEighteenth-century Chengalpattu*,inJ.K.Bajajed.,IndianEconomyandPolity,CentreforPolicyStudies, Chennai, 1995, pp. 63-84.

The experiential learning sessions may include:

- Field Visits: Organizing visits to historical sites, museums, traditional craft centers, and other places relevant to Indian knowledge systems.
- Interactive Sessions: Engaging students in discussions with experts and practitioners in various fields of Indian knowledge systems to gain insights and practical knowledge.
- Online Lecture Series: Providing the students with online lectures by distinguished experts in the field of the Indian Knowledge System.
- Hands-on Activities: Providing opportunities for students to participate in activities related to traditional arts, crafts, music, dance, agriculture, etc., to understand the practical aspects of Indian knowledge systems.
- Practical Demonstrations: Conducting workshops or sessions to demonstrate traditional practices, such as yoga, Ayurveda, Vastu Shastra, etc., for the students.

Course Title: CEN I: Introduction to Effective Communication	**Course Component: AEC**
Course code: CEN982A101Credit: 1	
Level of course: 100	**L-T-P-C: 1-0-0-1**
Scheme of Evaluation: Theory (T)	

Course Objective: To understand the four major aspects of communication by closely examining the processes and outlining the most effective ways to communicate with interactive activities.

Course Outcomes: On successful completion of the course the students will be able to

CO	Course Outcome	Blooms TaxonomyLevel
CO1	**List** the elements and processes that make for successful communication and **recognize** everyday activities that deserve closer attention in order to improve communication skills	**BT1**
CO2	**Contrast** situations that create barriers to effective communication and **relate** them to methods that are consciously devised to overcome such hindrance	**BT2**
CO3	**Apply** language, gestures, and para-language effectively to avoid miscommunication and **articulate** one's thoughts and build arguments more effectively	**BT3**

Detailed Syllabus		
Units	**Course Contents**	**Periods**
I	Introduction to Effective Communication • Listening Skills o The Art of Listening o Factors that affect Listening o Characteristics of Effective Listening o Guidelines for improving Listening skills	**5**
II	• Speaking Skills o The Art of Speaking o Styles of Speaking o Guidelines for improving Speaking skills o Oral Communication: importance, guidelines ,and barriers	**5**
III	• Reading Skills o The Art of Reading o Styles of Reading:skimming, surveying, scanning o Guidelines for developing Reading skills	**5**

IV	• Writing Skills o The Art of Writing o Purpose and Clarityin Writing o Principles of Effective Writing	**5**

Credit Distribution		
Lecture/Tutorial	**Practicum**	**Experiential Learning**
15hours	-	10hours - Movie/Documentary /Podcasts screening - Peer teaching

Text Books

1. Rizvi,M.Ashraf.(2017).*EffectiveTechnicalCommunication*. McGraw-Hill.
2. Chaturvedi,P. D.and Chaturvedi,Mukesh. (2014).*BusinessCommunication.* Pearson.
3. Raman,MeenakshiandSharma,Sangeeta.(2011).*TechnicalCommunication: Principles and Practice* (2nd Edition): Oxford University Press.

Course Title: Behavioural Sciences - 1Course Component: AEC

Course code: BHS982A102Credit: 1

Level of course: 100 **L-T-P-C: 1-0-0-1**

Scheme of Evaluation: Theory (T)

Course objectives: To increase one's ability to draw conclusions and develop inferences about attitudes and behaviour, when confronted with different situations that are common in modern organizations.

Course Outcomes: On completion of the course the students will be able to –
CO1: Understand self & process of self-exploration
CO2: Learn about strategies for development of a healthy self esteem
CO3: Apply the concepts to build emotional competencies.

Detailed syllabus

Module	CourseContents	Periods
I	**Introduction to Behavioral Science** Definition and need of Behavioral Science, Self: Definition components, Importance of knowing self, Identity Crisis, Gender and Identity, Peer Pressure,Self-image:Self Esteem, Johari Window, Erikson's model.	**4**

II	**Foundations of individual behavior** Personality-structure, determinants, types of personalities. Perception: Attribution, Errors in perception. Learning-Theories of learning: Classical, Operant and Social	**4**
III	**Behaviour and communication.** Defining Communication, types of communication, barriers to communication, ways to overcome barriers to Communication, Importance of Non-Verbal Communication/Kinesics, Understanding Kinesics, Relation between behavior and communication.	**4**
IV	**Time and Stress Management** Time management: Introduction-the 80:20, sense of time management, Secrets of time management, Effective scheduling. Stress management: effects of stress, kinds of stress-sources of stress, Coping Mechanisms. Relation between Time and Stress.	**4**
Total		**16**

Text Books

1. J William Pfeiffer (ed.) Theories and Models in Applied Behavioural Science, Vol 3, Management; Pfeiffer &Company
2. Blair J. Kolasa, Introduction to Behavioural Science for Business, John Wiley & Sons Inc.
3. K.Alex, Soft skills; S.Chand.

Course Title: Compost Preparation and Applications	**Course Component: SEC**
Course code: BTC152S111	**Credit: 3**
Level of course: 100	**L-T-P-C: 0-0-6-3**
Scheme of Evaluation: P	

Course Objective: The main objective of the course is toprovide the graduates with the knowledge of biofertilizers and their applications in agriculture.

Course Outcome:

On successful completion of the course the students will be able to:		
Course Outcome		**Blooms Taxonomy Level**
CO 1	**Remember** the various techniques in production of biofertilizer	**BT 1**
CO 2	**Understand** the principles and applications biofertilizer	**BT 2**
CO 3	**Apply** the theoretical knowledge in practical applications.	**BT 3**

CO 4	**Analyze** the role of biofertilizers in agricultural production.	**BT 4**

Detailed Syllabus

Modules	Topics & Course Contents	Periods
I.	Earthworms:Introduction, classification and types of earthworms. The behavior of earthworms as indicators of soil fertility, plant growth and promoters & soil health regulators. Role of Earthworms to protect Environment. Starter culture of compost. Its preparation.	**15**
II	Vermicomposting: Vermiculture and Vermicomposting, Advantages of Vermicomposting, Chemical composition of vermicompost. Vermicomposting in everyday life earthworms and vermicomposting at commercial scale. Vermicomposting and Sustainable agriculture, restoration of degraded soil systems, vermicomposting and its effect on the greenhouse effect. Vermicomposting and its economic viability.	**15**
III	Definition, science and classification of compost, role of microbes in composting, carbon-nitrogen balance, C:N ratio, Moisture content, availability of temperature and oxygen,	**15**
IV	Methods of composting: Indore method, activated compost, NADEP method, Coimbatore method, Windrows composting. Coir pith, flyash, Sewage and sewage sludge, sugar cane waste, compost of animal waste, phosphorous compost, weed composting	**15**
	TOTAL	**60**
Pedagogy: Lectures, Experiments, Laboratory sessions		

Credit distribution:

3 credits: 3 × 30= 90 Notional Credit Hours (60 class hours + 20 Lab hours+ 10Experiential learning)

Experiential learning activities may include:

- undergraduate research
- participation in a student design team
- completion of an internship
- student teaching
- classroom presentation *etc.*

TextBook

1. Singh, K. A Textbook of Vermicompost: Vermiwash and Biopesticides, 2014, Biotech Books.

ReferenceBooks

1. Sreenivasan, E. Handbook of Vermicomposting Technology, 2018, The Western India Plywoods Ltd.
2. M. K. Rai., HandbookofMicrobialBiofertilizers,2006, Food Products Press

List of Practical Experiments

Modules	Topics & Course Contents	Periods
I.	1. Evaluation of various microbial species used in preparation of compost. 2. Assessment of earthworm species used in preparation of vermicompost 3. Determination of constituents in preparation of compost and vermicompost	**12**
II	1. Preparation of the soil structure used in vermicompost. 2. Analysis of composition of vermicompost bed. 3. Preparation of vermicompost shed	**12**
III	1. Assessment on the methods of preparation of compost. 2. Estimation on the organic constituents of compost 3. Evaluation on the growth patterns of earthworms on different feeds.	**12**
IV	1. Assessment of the quality of compost and vermicompost. 2. Estimation of the NPK content. 3. Study of market potential of compost	**12**
	TOTAL	**48**
Pedagogy: Lectures, Experiments, Laboratory sessions		

Course Title: Basic Bioinformatics Course Component: Value Addition Course	
Course code: BTC152V101	**Credit: 3**
Level of course: 100	**L-T-P-C: 3-0-0-3**
Scheme of Evaluation: Theory (T)	

Course Objective: The main objective of the course is toprovide the graduates with theoretical knowledge in the field of Bioinformatics and its application in Biotechnology

Course Outcome:

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	**Remember** the various biological databases and computational tools that can be used to retrieve data for biological studies	**BT 1**
CO 2	**Understand** the application of various bioinformatics softwares and databases for biological data analysis.	**BT 2**
CO 3	**Apply** the knowledge to analyse the results of biological experiments using various computational tools.	**BT 3**
CO 4	**Analyse** the various biological events and their possible outcome using computational tools.	**BT 4**

Detailed Syllabus:

Modules	**Topics & Course Contents**	**Periods**
I.	**Introduction to Bioinformatics:**General Introduction and history of bioinformatics, advanced internet search, overview of bio-informatic resources on the web, Interdisciplinary aspect of Bioinformatics, Application of Bioinformatics. **Data generation:**Generation of large-scale molecular biology data. (Through Genome sequencing, Protein sequencing, NMR Spectroscopy, X-Ray Diffraction, and microarray).	**12**
II	**Biological Database and its Types:** Introduction to data types and Source. Classification and Presentation of Data. Quality of data, private and public data sources. General Introduction of Biological Databases; Nucleic acid databases (NCBI, DDBJ, and EMBL). Protein databases (Primary, Composite, and Secondary). Specialized Genome databases: (SGD, TIGR, and ACeDB). Structure databases (CATH, SCOP, and PDB)	**12**
III	**Sequence submission:**Searching GenBank through Entrez search engine, sequence submission in Genbank, various file formats in bioinformatics. **Bibliographic resource and literature database:** Pubmed, Medline, preprints **Small molecule database:** ZINC, TCM, PUBCHEM, DrugBank	**12**

	Biochemical pathway database: KEGG, String	
IV	**Sequence Alignments:** Introduction to Sequences, alignments and Dynamic Programming; Local alignment and Global alignment (algorithm), Pairwise alignment (BLAST and FASTA Algorithm) and multiple sequence alignment (Clustal W algorithm). **3D Protein Structure Visualization tools:** Rasmol, Pymol, Chimera	**12**
	TOTAL	**48**
Pedagogy: Lectures, Assignments, Practical sessions		

Credit distribution:

3 credits: 3 × 30 = 90 Notional Credit Hours (48 class hours + 42 Experiential learning)

Experiential learning activities may include:

- undergraduate research
- participation in a student design team
- completion of an internship
- student teaching
- classroom presentation *etc.*

Text Books:

1. Lesk, A. (2019). Introduction to bioinformatics. Oxford university press.

2. Xiong, J. (2006). Essential bioinformatics. Cambridge University Press.

Reference Books:

1. David W. Mount. Bioinformatics: Sequence and Genome Analysis, Published CSHL Press.

2. Des Higgins, Willie R. Taylor. Bioinformatics: Sequence, Structure and Databanks: A Practical, Approach, Oxford University Press.

SYLLABUS (2nd SEMESTER)

Course Title: Microbiology	**Course Component: Major**
Course code: BTC152M201 Credit: 2	
Level of course: 100	**L-T-P-C: 2-0-0-2**
Scheme of Evaluation: Theory (T)	

Course Objective: The course aims to give a holistic theoretical and practical knowledge in field of general microbiology, its core concepts, scopes, applications and future prospects. The content of this course is aligned with SDG3: Good health and well – being.

Course Outcomes:

On successful completion of the course the students will be able to:		
Course Outcome		**Blooms Taxonomy Level**
CO 1	**Recall** the various types of microorganism and the roles played by them.	**BT 1**
CO 2	**Relate** the microbial world, their diversity and utilization.	**BT 2**
CO 3	**Apply** the knowledge gained in understanding the causative agents of various diseases and maintenance of sterility.	**BT 3**
CO 4	**Analyze** and **relate** the co-evolutionary pattern and relationship between microbes and the environment.	**BT 4**

Detailed Syllabus:

Modules	**Topics & Course Contents**	**Periods**
I.	**An introduction to microbiology**: History of microbiology, concepts of microbial diversity, scope and applications of microbiology. **Microscopy and specimen preparation**: Bright and dark field microscopy, TEM and SEM. Concepts of fixation and staining, Gram staining, acid fast staining, negative staining, capsule, flagellar and endospore staining. **Prokaryotic cellular architecture**: The cell wall and other constituents. Comparison between prokaryotic and eukaryotic organisms. Introduction to Eubacteria and Archaea, their major structural differences. General characteristics and classification of viruses, differences between bacteria and viruses. Bacteriophages; lytic and lysogenic cycles. Prions and viriods.	**12**
II.	**Eukaryotic microbial diversity**: Introduction to protists, bacteria, actinomycetes and fungi, Mycelia of fungi and Actinomycetes, cytoskeleton filament, heterocysts and akinets of Cyanobacteria.	**12**

	Microbial growth and nutrition: Principles of growth and growth curve, methods of growth determination and factors affecting growth. Mode of nutrition, growth mediums and pure culture techniques; isolation, preservation and maintenance of cultures, sterilization techniques.	
III.	**Microbial taxonomy**: Concept of microbial species and strains, classification of bacteria based on-morphology (shape flagella), staining reaction, mutation and extreme environment. **Microbial Reproduction and recombination**: Transformation, conjugation (cointegrate Formation and Hfr Cells, F-Plasmid) and transduction (generalized and specialized).	**12**
IV	**Microbial Metabolism**: Bacterial Photosynthesis, photophosphorylation, assimilation of inorganic nitrogen, phosphorus and sulphur, ED Pathway **Microorganisms and health:** Basics of host pathogen interaction, commensalism, colonization, infection and disease. Infections caused by Enterobacteriaceae, Mycobacteriaceae*, Candida, Aspergillus, Variola, Varicella-Zoster, HPV, EBV* **Plant microbe interactions**: Plant microbe interaction in the rhizosphere. Carbon and Nitrogen cycle, biological nitrogen fixation – symbiotic and non-symbiotic Plant Growth Promoting Rhizobacteria (PGPR) - Mycorrhizae -Blue Green Algae (BGA)	**12**
	TOTAL	**48**
Pedagogy: Lectures, Assignments, Seminars		

Credit distribution:

2credits: 2 × 30= 60 Notional Credit Hours (48 class hours + 12 Experiential learning)

Experiential learning activities may include:

- undergraduate research
- participation in a student design team
- completion of an internship
- student teaching
- classroom presentation *etc.*

Text Books

1. Gupta P.K., *Genetics*, ISBN-10 8171339328, ISBN-13 978-8171339328, Rastogi Publications, Meerut.
2. Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R.*Molecular Biology of the Gene*, 6thedition, 2008. Cold Spring Harbour Lab. Press, Pearson Pub.

Reference Books

1. Gardner, E. J., Simmons, M. J. &Snustad, D. P. (2013). Principles of Genetics, 8th Edition, JohnWiley and Sons.
2. Tamarin, R.H. (2002). Principles of Genetics, 7th Edition, Tata McGraw-Hill Publishing Company Ltd.

Course Title: Practical on Microbiology Course Component: Major
Course code: BTC152M211 Credit: 1
Level of course: 100 L-T-P-C: 0-0-2-1
Scheme of Evaluation: Practical (P)

Course Objective: The main objective of the course is toperform the experiments associated with the subjects taught and understand the underlying principles.

Course Outcomes

On successful completion of the course the students will be able to:		
Course Outcome		**Blooms Taxonomy Level**
CO 1	**Learn** and **remember** about the process of preparation of media and calculation of molarity and estimation of pH.	**BT 1**
CO 2	**Understand**the components of the various media and their roles in microbial culture	**BT 2**
CO 3	**Apply** the knowledge of microscopy in identifying the morphology of microbes	**BT 3**
CO 4	**Analyze** the equipment's used and the underlying safety measures in a laboratory.	**BT 4**

Detailed Practical

Module	**Topics & Course Contents**	**Periods**
I	• To study the various instruments used in a microbiology laboratory • To study the safety protocols to be followed in a microbiology laboratory	15
II	• To prepare media for growth of microorganisms • To isolate microbes from soil and water	15
III	• To perform pure culture techniques for isolation of microbes • To perform Gram's staining of microbes	15
IV	• To perform Growth curve analysis of microbes • To perform sliding motility test in bacteria	15
	TOTAL	60

Credit distribution:

1 credit: 1 × 30= 30 Notional Credit Hours (60 lab hours)

Experiential learning activities may include:

- undergraduate research
- participation in a student design team
- completion of an internship
- student teaching
- classroom presentation *etc.*

Reference Books

As suggested under the theory papers.

Course Title: Cell BiologyCourse Component: Major	
Course code: BTC152M202	**Credit: 2**
Level of course: 100	**L-T-P-C: 2-0-0-2**
Scheme of Evaluation: Theory (T)	

Course Objective: The main objective of the course is to provide a detailed description of theorganization of the cell, the structure and functions of various organelles. The course also focuses on cell-cell communication and the importance of cell division.

Course Outcomes

On successful completion of the course the students will be able to:		
Course Outcome		**Blooms Taxonomy Level**
CO 1	**Remember** the various components of the cell and their function.	**BT 1**
CO 2	**Understand** the function of the cells and their roles.	**BT 2**
CO 3	**Apply** the knowledge gained in solving of problems associated with the topic.	**BT 3**
CO 4	**Analyze** the components of the cellular structure in prokaryotes, eukaryotes and archaea.	**BT 4**

Detailed Syllabus

Module	**Topics & Course Contents**	**Periods**
I	Cell: Introduction and classification of organisms by cell structure, cytosol, compartmentalization of eukaryotic cells, cell fractionation. Cell Membrane and Permeability: Chemical components of biological membranes, organization and	**12**

	Fluid Mosaic Model, membrane as a dynamic entity, cell recognition and membrane transport. Extracellular matrix and its composition.	
II	Membrane Vacuolar system, cytoskeleton and cell motility: Structure and function of microtubules, Microfilaments, Intermediate filaments. Endoplasmic reticulum: Structure, function including role in protein segregation. Golgi complex: Structure, biogenesis and functions including role in protein secretion.	**12**
III	Lysosomes: Vacuoles and micro bodies: Structure and functions, Ribosomes: Structures and function including role in protein synthesis. Mitochondria: Structure and function, Genomes, biogenesis. Chloroplasts: Structure and function, genomes, biogenesis Nucleus: Structure and function, chromosomes and their structure. Signal transduction.	**12**
IV	Structure and function of prokaryotic cell and its components. Cell wall of bacteria, outer membrane of Gram-negative bacteria. Overview of the cell-cycle, Intracellular and extracellular control of cell division. Programme cell death, Cell cycle and cancer.	**12**
	TOTAL	**48**
Pedagogy: Lectures, Experiments, Laboratory sessions		

Credit distribution:

2credits: 2 × 30= 60 Notional Credit Hours (48class hours + 12 Experiential learning)

Experiential learning activities may include

- undergraduate research
- participation in a student design team
- completion of an internship
- student teaching
- classroom presentation *etc.*

Text Books

1. Karp, G.,*Cell and Molecular Biology: Concepts and Experiments,* 6th Edition, 2010 JohnWiley &SonsInc.

Reference Books

1. De Robertis, E.D.P. and De Robertis, E.M.F.,*Cell and Molecular Biology*,8th edition, 2006, Lippincott Williams and Wilkins, Philadelphia.
2. Cooper, G.M. &Hausman, R.E.*The Cell: A Molecular Approach*, 5th edition. 2009, ASM Press& Sunderland, Washington, D.C.; Sinauer Associates, MA.

Course Title: Practical on Cell BiologyCourse Component: Major	
Course code: BTC152M212Credit: 1	
Level of course: 100	**L-T-P-C: 0-0-2-1**
Scheme of Evaluation: Practical (P)	

Course Objective: The main objective of the course is toperform the experiments associated with the subjects taught and understand the underlying principles.

Course Outcomes

On successful completion of the course the students will be able to:		
Course Outcome		**BT Level**
CO 1	**Learn** and **remember**the different components of cells.	**BT 1**
CO 2	**Understand**the mechanism of cell division and differentiation.	**BT 2**
CO 3	**Apply** the knowledge identifying various mechanisms involved in cell growth and development	**BT 3**
CO 4	**Analyze** the equipment used and the underlying safety measures in a laboratory pertaining to cell biology.	**BT 4**

Detailed Practical

Module	**Topics & Course Contents**	**Periods**
I	● Study the effect of temperature and organic solvents on semi permeable membrane. ● Demonstration of dialysis.	15
II	● Study of plasmolysis and de-plasmolysis. ● Cell fractionation and determination of enzyme activity in organelles using sprouted seedor any other suitable source.	15
III	● Study of structure of any Prokaryotic and Eukaryotic cell. ● Study of cell counting and their viability	15
IV	● Cell division in onion root tip/ insect gonads. ● Identification of blood cells in human blood smear	15
	TOTAL	60

Credit distribution:

1credit: 1 × 30= 30 Notional Credit Hours (60 lab hours)

Experiential learning activities may include:

- undergraduate research
- participation in a student design team

- completion of an internship
- student teaching
- classroom presentation *etc.*

Reference Books
As suggested under the theory papers.

Course Title: Basic Instrumentation in BiologyCourse Component: Minor
Course code: BTC152N201Credit: 3
Level of course: 100 L-T-P-C: 3-0-0-3
Scheme of Evaluation: Theory (T)

Course Objective: The main objective of the course is toprovide the graduates with a strong foundation in the area of instrumentation's used in Biology.

Course Outcome:

On successful completion of the course the students will be able to:		
Course Outcome		**BT Level**
CO 1	**Remember** the various instruments that play a major role in the study of biology.	**BT 1**
CO 2	**Understand**the principles and applications of the instruments.	**BT 2**
CO 3	**Apply** the theoretical knowledge in practical applications.	**BT 3**
CO 4	**Analyze** the results of practical carried out using the instruments	**BT 4**

Detailed Syllabus:

Modules	**Topics & Course Contents**	**Periods**
I.	Microscopy and Imaging techniques: Principles and applications of Light microscopy, Phase contrast microscopy, fluorescence microscopy, electron microscopy- Scanning electron microscopy and Transmission electron microscopy	**12**
II	pH and Centrifugation: pH meter: Principles and application, Centrifugation: Principles, types of centrifuges, types of rotors, differential and density grad7ient centrifugation. Electrophoresis techniques: Gel electrophoresis, PAGE, Pulse field, 2DGE	**12**
III	Chromatography techniques: Principles and Application of Thin layer chromatography, Column chromatography, Gas Chromatography, High pressure liquid chromatography	**12**

	Preparation of Buffers, Molar solutions, Dilutions, Handling of chemicals, Good Laboratory Practices	
IV	Spectroscopy and other techniques: UV-Vis spectroscopy, Infra-Red spectroscopy, Mass Spectroscopy, Lyophilizer, Sonication, Freeze Drying, Micropipettes	**12**
	TOTAL	**48**
Pedagogy: Lectures, Experiments, Laboratory sessions		

Credit distribution:

3 credits: 3 × 30= 90 Notional Credit Hours (48 class hours + 42 Experiential learning)

Experiential learning activities may include:

- undergraduate research
- participation in a student design team
- completion of an internship
- student teaching
- classroom presentation *etc.*

Text Books

1. Bajpai, P.K., Biological Instrumentation andmethodology, 2006, S. Chand & Co. Ltd.

Reference Books

1. K. Wilson and J. Walker Eds. Biochemistry andMolecular Biology, 2005, Cambridge University Press.
2. F. Partibhan and S. Felix, Biochemical Techniques and Instrumentation, 2020, Daya Publishing House.

Course Tittle:Introduction to IndianKnowledgeSystem– I		**Course component: IDC**
CourseCode: IKS992K201		**Credits: 3**
Course Level: 100L-T-P-C: 3-0-0-3		
Schemeof Evaluation:Theory (SummativeAssessment-70% + FormativeAssessment-30%)		
Credit Distribution (NCH)		
Lecture/Tutorial(Hours)	**Practical (Hours)**	**Experiential Learning (Hours)**
60	0	30

Courseobjectives:

ThisFoundationcourseisdesignedto presentanoverallintroductionto allthestreamsofIKS relevanttotheUG program.Itwouldenablestudentstoexplore themostfundamentalideas that haveshapedIndianKnowledgeTraditions over thecenturies.

CourseOutcomes:

On completion ofthis course, students will be expected to–

CO	Contents	BTLevel
CO_1	Recalltraditional Indianknowledgetraditionsconstituting Indian culture	BTlevel 1
CO_2	Summarizedifferences betweenclassical literaturein Sanskrit and otherIndian languages	BTlevel 2
CO_3	Compareknowledgetraditions originating in NE India	BTlevel 2
CO_4	Appreciate the contribution ofIndian Knowledge Systems to the world	BTlevel 3

Detailed Syllabus

Module	CourseContents	Periods
I	**IndianClassical Literature** Indian Classical Literature: A Brief Introduction;AncientIndian Spiritual Poetics-*Kavya*: Contribution of Kalidasa **Diversity andIndianCulture**: Diversity andIndian Culture;Indigenous Faithand Religion;Preservation ofculture and indigenous knowledge **ThePurposeof Knowledge:** Understanding Self-Awareness and Spirituality; Indian concept and purpose ofKnowledgeandEducation;Understanding Spiritualityand Materialism: *Para* and *Apara Vidya*	15
II	**Methodology of IndianKnowledgeSystem**: *Shruti*and*Smriti*traditions;Introductionto*Shastras;*Manuscriptology: Theart and science ofdocumenting knowledge; Repositories of ancient manuscripts withspecial referencetothe NortheastIndia. **IndianArchitectureandTown Planning**: IntroductionancientIndianarchitecture;*Sthapatya-Veda*: An Introduction;Indigenoustools&techniques for townplanning&Temple Architecture.Lothal,MohanJoDaro;Temple Art:Lepakshi Temple,JagannathPuri Temple,KonarkSunTemple; Vernacular architectureofAssam: Special referenceto BrahmaputraValley	

III	**IndianAgriculture**: Agriculture:Significance inHumanCivilization;Sustainable Agriculture;Historicalsignificanceofagriculture andsustainable farminginIndia;StepCultivationofIndia:Specialreference to Northeast India;Wet ricecultivation ofAssam. **IndianTextiles**: Whatis Textile? Traditionofcottonandsilktextilesin India; The historicalcontributionoftextile andweavingtothe Indianeconomy; Varietiesof textilesanddyesdevelopedindifferentregions of India with special referencetoNortheastIndia.	15
IV	**IndianPolity andEconomy**: UnderstandingKingdomandChiefdom;Roleofaking;TheIndianidea ofawell-organizedpolityandflourishingeconomy; The *Chakravarti* System: Administrative System of Ancient Bharatvarsha;Village administrativesystem: NortheastIndia; *Arthashastra*: Brief synopsis.**Theoutreachof IndianKnowledgeSystemacrossGeographical Boundaries:** IndianLanguages;Scripts;Linguistics; Ayurveda;Yogaand Meditation; Textile;Decimalvaluebasesystem,basedarithmatic, AlgebraandAstronomy.	15
Total		**60**

Text Books

1. Mahadevan,B.,BhatVinayakRajat,NagendraPavanRN.(2022),*IntroductiontoIndian KnowledgeSystem:Concepts andApplications.*PHILearning Private Ltd.
2. MukulChandraBora*,FoundationsofBharatiyaKnowledgeSystem.*KhannaBook Publishing

Reference Books

1. Baladev Upadhyaya, Samskrta Śāstrom ka Itihās, Chowkhambha, Varanasi, 2010.
2. D. M. Bose, S. N. Sen and B. V. Subbarayappa, Eds., A Concise History of Science inIndia, 2nd Ed., Universities Press, Hyderabad, 2010.
3. Astāngahrdaya, Vol. I, Sūtrasthāna and Śarīrasthāna, Translated by K. R. SrikanthaMurthy, Vol. I, Krishnadas Academy, Varanasi, 1991.
4. Dharampal,The BeautifulTree: Indian Indigenous Education in the EighteenthCentury, Dharampal Classics Series, Rashtrotthana Sahitya, Bengaluru, 2021.
5. J. K. Bajaj and M. D. Srinivas, Indian Economy, and Polity in Eighteenth-century Chengalpattu, in J. K. Bajaj ed., Indian Economy and Polity, Centre for Policy Studies, Chennai, 1995, pp. 63-84.

Course Title: CEN II: Approaches to Verbal and Non-Verbal Communication

Course Component: AECCourse code: CEN982A201

Credit: 1L-T-P-C: 1-0-0-1

Scheme of Evaluation: Theory (T)Level of course: 100

Course Objectives

To introduce the students to the various forms of technical communication and enhance their knowledge in the application of both verbal and non-verbal skills in communicative processes.

Course Outcomes

On successful completionofthecoursethestudentswill beable to:		
Course Outcome		**BT Level**
CO1	**List**thedifferenttypesoftechnicalcommunication,their characteristics, theiradvantages anddisadvantages.	**BT1**
CO2	**Explain** the barrierstocommunication andwaysto overcome them.	**BT2**
CO3	**Identify**themeansto enhanceconversation skills.	**BT3**
CO4	**Determine**thedifferent typesofnon-verbalcommunication and their significance.	**BT 4**

Detailed Syllabus

Modules	**Topics(ifapplicable)& Course Contents**	**Periods**
I	**TechnologyEnabled Communication** Communicatingabouttechnicalorspecializedtopics, Differentforms of technology-enabled communication tools used in organizations Telephone, Teleconferencing, Fax, Email, Instant messaging, Blog, Podcast, Videos, videoconferencing, social media	**4**
II	**Communication Barriers** Typesofbarriers:Semantic,Psychological,Organisational,Cultural, Physical, Physiological, Methodstoovercome barrierstocommunication.	**4**
III	**Conversationskills/VerbalCommunication** Conversation – Types of Conversation, Strategies for Effectiveness, Conversation Practice, Persuasive Functions in Conversation, TelephonicConversationandEtiquetteDialogueWriting,Conversation Control.	**4**
IV	**Non-verbalCommunication** Bodylanguage-PersonalAppearance,Postures,Gestures, Eye Contact, Facial expressions Paralinguistic Features-Rate, Pause, Volume, Pitch/Intonation/ Voice/Modulation, Proxemics, Haptics, Artifacts, Chronemics,	**4**
	Total	**16**

Text Books

1. Rizvi,M.Ashraf.(2017).*EffectiveTechnicalCommunication*. McGraw-Hill.
2. Chaturvedi,P. D.and Chaturvedi,Mukesh. (2014).*BusinessCommunication.* Pearson.
3. Raman,MeenakshiandSharma,Sangeeta.(2011).*TechnicalCommunication: Principles and Practice* (2nd Edition): Oxford University Press.

Course Title: Behavioural Sciences - II

Course Component: AECCourse code: BHS982A202

Credit: 1L-T-P-C: 1-0-0-1

Scheme of Evaluation: Theory (T)Level of course: 100

Course objectives: To increase one's ability to draw conclusions and develop inferences about attitudes and behaviour, when confronted with different situations that are common in modern organizations.

Course outcomes: On completion of the course the students will be able to:
CO 1: Develop an elementary level of understanding of culture and its implications onpersonality of people.
CO2: Understand the concept of leadership spirit and to know its impact on performance of employees.
CO3: Understand and apply the concept of Motivation in real life.

Modules	CourseContents	Periods
I	**Culture andPersonality** Culture: Definition, Effect, relation with Personality,Cultural Iceberg,Overview ofHofstede's Framework, Discussion of thefourdimensions of Hofstede'sFramework.	4
II	**AttitudesandValues** Attitude's definition: changing our own attitudes, Process of cognitive dissonance Types of Values, Valueconflicts, Mergingpersonaland Organizationalvalues	4
III	**Motivation** Definition ofmotivation with example,Theories ofMotivation (Maslow,McClelland's theory&Theory XandY)	4
IV	**Leadership** Definitionof leadership,Leadershipcontinuum,typesof leadership,Importance of Leadership,Newageleaderships:Transformational& transactional Leadership,Leadersasrolemodels.	4
Total		**16**

Text Books

- J William Pfeiffer (ed.) Theories and Models in Applied Behavioural Science, Vol 3, Management; Pfeiffer &Company

- Blair J. Kolasa, Introduction to Behavioural Science for Business, John Wiley & Sons Inc.
- Organizational Behaviour by Kavita Singh (Vikas publishers, 3rd Edition).

Course Title: Biochemical Analysis of FoodCourse Component: SEC	
Course code: BTC152S211Credit: 3	
Level of course: 100	**L-T-P-C: 0-0-6-3**
Scheme of Evaluation: Practical (P)	

Course Objective: The main objective of the course is toprovide the graduates with a strong foundation in the area of instrumentation's used in Biology.

Course Outcome:

On successful completion of the course the students will be able to:		
Course Outcome		**BT Level**
CO 1	**Recall** the various theories taught and relate them to the analysis of food materials.	**BT 1**
CO 2	**Understand** the various theories and the practical in analysis of different food components.	**BT 2**
CO 3	**Apply** the knowledge of instruments in analysis of food products.	**BT 3**
CO 4	**Analyze** the components of food and relate them to health and wellness.	**BT 4**

Detailed List of Practical Experiments

Modules	**Topics & Course Contents**	**Periods**
I.	• Preparation of buffers and chemicals required in analysis of food. • Isolation and separation of food components by paper chromatography and TLC. • Extraction and estimation total sugar and reducing-sugar present in food.	**20**
II	• Biochemical analysis of different food components. • Analysis of protein and fats of cereals. • Analysis of lipid and lactose from milk and milk products. • Estimation of casein from milk.	**20**
III	• Assessment of microbial contamination in food products and water. • Estimation of sucrose and glucose in food products. • Estimation of starch in food samples.	**20**
IV	• Estimation cholesterol from egg yolk. • Milk adulteration analysis • Analysis of synthetic colours present in food.	**20**
	Total	**80**
Pedagogy: Lectures, Experiments, Laboratory sessions		

Credit distribution:

3 credits: 3 × 30= 90 Notional Credit Hours (80 lab hours + 10 Experiential learning)

Experiential learning activities may include:

- undergraduate research
- participation in a student design team
- completion of an internship
- student teaching
- classroom presentation *etc.*

Text Books

1. Pearson, D. Chemical analysis of foods, 1970 (6thEdn), London: TA Churchill.

Reference Books

1. Plummer DT. Introduction to practical Biochemistry. Bombay: 1979, Tata McGraw Hill Pub. Co. Ltd.
2. Sadasivan S, and Manickam A. Biochemical Methods, 2ndEdn., 2003, New Age International (P) Ltd., Publishers.

SYLLABUS (3rd SEMESTER)

Course Title: Genetics	**Course Component: Major**
Course code: BTC152M301	**Credit: 3**
Level of course: 200	**L-T-P-C: 2-1-0-3**
Scheme of Evaluation: Theory (T)	

Course Objective: The main objective of the course is to understand the structure and function of genes and chromosomes as well as the harmful effects of mutations which can cause various genetic disorders

Course Outcomes:

On successful completion of the course the students will be able to:		
Course Outcome		**BT Level**
CO 1	**Memorize** the various laws of genetics	**BT 1**
CO 2	**Understand** the concepts of the core areas	**BT 2**
CO 3	**Apply** the knowledge gained in solving of genetic problems.	**BT 3**
CO 4	**Analyze** the theoretical knowledge gained in solving inheritance pattern.	**BT 4**

Detailed Syllabus

Modules	Topics & Course Contents	Periods
I.	**Historical developments in the field of genetics**. Organisms suitable for genetic experimentation and their genetic significance. **Mendelian genetics:** Mendel's experimental design, monohybrid, di-hybrid and tri hybrid crosses, Law of segregation & Principle of independent assortment. Verification of segregates by test and back crosses, Chromosomal theory of inheritance, Allelic interactions: Concept of dominance, recessiveness, incomplete dominance, co-dominance, pleiotropy, multiple alleles, pseudo-allele, essential and lethal genes, penetrance, and expressivity.	**12**
II.	**Non-allelic interactions**: Interaction producing new phenotype complementary genes, epistasis (dominant & recessive), duplicate genes and inhibitory genes. **Linkage &crossing over** - Chromosome theory of Linkage, types of linkage, linkage groups, types of Crossing over, mechanism of Meiotic Crossing over.	**12**
III.	**Sex determination and sex linkage**: Mechanisms of sex determination in human, Environmental factors and sex determination, sex differentiation, sex limited traits, sex linked inheritance. **Human Genetics:** Concept, Human chromosomes and Mendelian pedigree pattern. Basic concept of Mutation and chromosome abnormalities.	**12**

IV	**Extra chromosomal inheritance**: Rules of extra nuclear inheritance, maternal effects, maternal inheritance, cytoplasmic inheritance, organelle heredity, genomic imprinting. **Evolution and population genetics**: Hardy Weinberg law (prediction, derivation), allelic and genotype frequencies, changes in allelic frequencies, systems of mating, in breeding and out breeding, evolutionary genetics, natural selection.	**12**
	TOTAL	**48**
Pedagogy: Lectures, Assignments, Seminars		

Credit distribution:

3 credits: 3 × 30= 90 Notional Credit Hours (60 class hours + 30 Experiential learning)

Experiential learning activities may include:

- undergraduate research
- participation in a student design team
- completion of an internship
- student teaching
- classroom presentation *etc.*

Text Books

1. Gupta P.K., *Genetics*, ISBN-10 8171339328, ISBN-13 978-8171339328, Rastogi Publications, Meerut.
2. Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R.,*Molecular Biology of the Gene*, 6thedition, 2008. Cold Spring Harbour Lab. Press, Pearson Pub.

Reference Books

1. Gardner, E. J., Simmons, M. J. &Snustad, D. P. (2013). Principles of Genetics, 8th Edition, JohnWiley and Sons.
2. Tamarin, R.H. (2002). Principles of Genetics, 7thEdition, Tata McGraw-Hill Publishing Company Ltd.

Course Title: Practical on GeneticsCourse Component: Major	
Course code: BTC152M311	**Credit: 1**
Level of course: 200	**L-T-P-C: 0-0-2-1**
Scheme of Evaluation: Practical (P)	

Course Objective: The main objective of the course is toperform the experiments associated with the subjects taught and understand the underlying principles.

Course Outcomes:

On successful completion of the course the students will be able to:		
Course Outcome		**BT Level**
CO 1	**Learn** and **remember**the different components of cells.	**BT 1**
CO 2	**Understand**the mechanism of mitotic and meiotic cell division.	**BT 2**
CO 3	**Apply** the knowledge identifying chromosomes at various stages of cell division	**BT 3**
CO 4	**Analyze** the equipment used and the underlying safety measures in a laboratory pertaining to genetics.	**BT 4**

Detailed Practical

Module	**Topics & Course Contents**	**Periods**
I	• Calibration of Microscope • To prepare the media for culturing *Drosophila melanogaster* • To clean and sterilize the Drosophila culture bottle	15
II	• Preparation of metaphase plate from mouse bone marrow. • Preparation of human karyotypes from well spread metaphase photographs	15
III	• Temporary slide preparation of buccal smear to study Barr-body. • Introduction of chromosome abnormalities in mammalian chromosomes.	15
IV	• Temporary slide preparation of Grasshopper testis to study the meiotic phases. • Temporary slide preparation of onion root tip to study the mitotic phases.	15

Credit distribution:

1 credit: 1 × 30= 30 Notional Credit Hours (60 lab hours)

Experiential learning activities may include:

- undergraduate research
- participation in a student design team
- completion of an internship
- student teaching
- classroom presentation *etc.*

Reference Books

As suggested under the theory papers.

Course Title: Biophysical Chemistry	**Course Component: Major**
Course Code: BTC152M302	**Credit: 4**
Level of course: 200	**L-T-P-C: 3-1-0-4**
Scheme of Evaluation: Theory (T)	

Course Objective: The course is designed to learn about the process of biophysical chemistry and understand the underlying phenomenon involved in protein structure and its composition.

Course Outcome:

On successful completion of the course the students will be able to:		
Course Outcome		**BT Level**
CO 1	**Remember**the basics of biophysical chemistry	**BT 1**
CO 2	**Understand** the principles of and processes of biophysical chemistry and its application in solving protein structure	**BT 2**
CO 3	**Apply** the basics in understanding the role of bioenergetics.	**BT 3**
CO 4	**Analyze** the role of equilibrium and study the properties of protein folding and refolding.	**BT 4**

Detailed Syllabus:

Modules	Topics & Course Contents	Periods
I.	**Structure and Bonding:** Structure of atoms, molecules and chemical bonds(Van der Waals, electrostatic, hydrogen bonding, hydrophobic interaction, Co-valent bonding, etc.). Composition, structure and function of biomolecules (carbohydrates, lipids, proteins, nucleic acids and vitamins).	**16**
II.	**Conformation and configuration of proteins:** Ramachandran plot, secondary, tertiary and quaternary structure; domains; motif and folds. Conformation of nucleic acids (A, B, Z-DNAforms), t-RNA structure, micro-RNA etc.)	**16**
III.	**Bioenergetics:** Concept of energy coupling in biological processors, Energy requirements in cell metabolism, high energy phosphate bond, energy currency of cell, biological oxidation, Electron-transport chain, Oxidative Phosphorylation including chemiosmotic hypothesis.	**16**
IV	**Multiple equilibrium:** Titration of proteins to evaluate total and net charge; Scatchard and hill plots; Protein stability, denaturation, unfolding equilibrium; Kinetics and thermodynamics of protein folding; Protein refolding and aggregation; Effect of solvent and temperatures on the protein stability and folding, Heat Shock Proteins	**16**

TOTAL	**64**
Pedagogy: Lectures, Assignments, Seminars	

Credit distribution:

4 credits: 4 × 30= 120 Notional Credit Hours (80 class hours + 40 Experiential learning)

Text Books

1. Nelson, D.L., Cox, M.M.*Lehninger Principles of Biochemistry*, 4th Edition, 2004, W. H. Freeman and Co., New York, USA

Reference Books

1. Berg, J. M., Tymoczko, J. L. and Stryer, L. *Biochemistry*, 6th Edition, 2006, W.H.Freeman and Co.
2. Buchanan, B., Gruissem, W. and Jones, R. *Biochemistry and Molecular Biology of Plants*, 2nd Edition, 2015, American Society of Plant Biologists, USA.

Course Title: Introduction to IPR	**Course Component: Minor**
Course code: BTC152N301 Credit: 4	
Level of course: 200	**L-T-P-C: 3-1-0-4**
Scheme of Evaluation: Theory (T)	

Course Objectives

This subject aims to introduce students to Intellectual Property Rights and apprise them of ethical issues in the biological sciences and the laws pertaining to these in both the global and national context and also to aware the students with ethical practices appropriate for various scientific disciplines at all times and to adopt safe working practices relevant to the different biotech industries & fields of research.

Course Outcome:

On successful completion of the course the students will be able to:		
Course Outcome		**BT Level**
CO 1	**Remember** intellectual property laws/principles (including copyright, patents, designs and trademarks) to real problems and to analyse the social impacts of intellectual property law and policy.	**BT 1**
CO 2	**Understand,**recognize, and distinguish an ethical issue from other issues	**BT 2**

CO 3	**Apply**the knowledge gained during the course in spreading IPR related awareness.	**BT 3**
CO 4	**Analyze**experimental results for their potential to file suitable IPR.	**BT 4**

Detailed Syllabus:

Modules	Topics & Course Contents	Periods
I	**Concept of Property:** Tangible and Intangible Property, Intellectual Property-Origin Development and Objectives, Classification of Intellectual Property-Patents, Copyright, Trademark, Industrial Design, Geographical Indications, *etc.*	**12**
II	**Patent Rights and Copyrights**- Origin, Meaning of Patent, Types, Patentability Criterion-Discovery and Invention, Patentable Subject Matters; Novelty, Utility (Industrial Applicability), Non-Obviousness (Inventive Step) and Written Description, Product Patents vis-à-vis Process Patents, Inventions which are not patentable. **Copyright**- Origin, Definition &Types of Copy Right, Registration procedure, Assignment &license, Terms of Copy Right, Piracy, Infringement, Remedies, Copy rights with special reference to software.	**12**
III	**Trademarks**-Origin, Meaning & Nature of Trade Marks, Types, Registration of Trade Marks, Infringement & Remedies, Offences relating to Trade Marks, Passing Off, Penalties. **Design**- Meaning, Definition, Object, Registration of Design, Cancellation of Registration, International convention on design, functions of Design. Semiconductor Integratedcircuits andlayout design Act-2000.	**12**
IV	Protection of Plant Varieties and Traditional Knowledge, Relevance of Intellectual Property Rights for Science and Technology; Patentability of Biotechnology Inventions; Patent Laws in Indian and International Perspective; Indian Patent Act 1970 (Patent Amendment Acts-1999, 2002 and 2005); International Conventions relating to Intellectual Property; General Agreement on Trade and Tariff (GATT); Trade Related Aspects of Intellectual Property Rights (TRIPS)	**12**
	TOTAL	**48**

Credit distribution:

4 credits: 4 × 30= 120 Notional Credit Hours (60 class hours + 60 Experiential learning)

Text books

1. Cornish, W. R., Intellectual Property (Latest Edition)

2. Intellectual Property Rights by Paul Goldstein
3. Intellectual Property Rights by K. R. G. Nair, Ashok Kumar, K. R. G. Nair

Reference Books

1. B.L. Wadera, Patents, Trademarks, Copyright, Designs and Geographical Indications
2. Matthew Rimmer, Intellectual Property and Biotechnology: Biological Inventions (2008)

Course Title: Health and Hygiene	**Course component: IDC**
Course Code: BTC152I301Credit: 3	
Level of course: 200	**L-T-P-C: 3-0-0-3**
Scheme of Evaluation: Theory (T)	

Course objective: The main objective of the course is to familiarize the students with different aspects of health like nutrition, the role of microorganisms, and good practice to ensure hygiene in day-to-day life. The content of this course is aligned with SDG3: Good health and well - being and SDG6: SDG6: Clean water and sanitation.

Course Outcome:

On successful completion of the course the students will be able to		
Course Outcome		**BT Level**
CO1	**Remembering** the basics of health and hygiene	BT1
CO2	**Understanding** the role of microbes in health	BT2
CO3	**Applying** the knowledge to maintain a hygienic life style	BT3
CO4	**Categorize** commonly encountered health problems due to hygiene issues	BT4

Detailed Syllabus:

Module	Topics & Course Contents	Periods
I	**Nutrition**– definition, importance, nutrition and malnutrition; Balanced Diet: Basics of Meal Planning; **Carbohydrates**, **Lipids**, **Proteins**: Sources and Deficiency,**Brief account of Vitamins**- functions, food sources, effects of deficiency, **Macro and micro minerals** –functions, effects of deficiency; food sources of Calcium, Potassium and Sodium; food sources of Iron, Iodine and Zinc; **Importance of water**– functions, sources, requirement and effects of deficiency; Types, Symptoms and Diagnosis of nutritional deficiencies: Iron deficiencies (Anemia) and Vitamins (Night Blindness, Beriberi, Pellagra, birth defects, Osteoporosis	**14**

II	**Microorganisms in health**: Basic concept of bacteria and viruses, Cellular morphology of bacteria, fungi and viruses, microorganisms in human health; Microbial toxins; Mechanism of host-pathogen interaction. Host immunity against infectious diseases	**10**
III	**Health hazards**: **Food poisoning**: Introduction, Organism involved, source of food contamination Causes and symptoms in food poisoning by: Clostridium, **water borne diseases**: jaundice, cholera, diarrhoea and typhoid; **Sexually transmitted infections**– AIDS, **Zoonotic diseases**: Bacterial zoonoses (anthrax, plague); Viral zoonoses (rabies, influenza), Rickettsialzoonoses (scrub typhus, Q-fever), Fungal zoonoses (histoplasmosis)	**16**
IV	**Hygiene** – Hygiene: Definition, personal hygiene- body odour, oral hygiene, grooming, feminine hygiene, sleep hygiene, hand washing, toiletry. Social hygiene – clean living movements, occupational hygiene, food and cooking hygiene, medical hygiene, excessive hygiene. **Rural Community Health**: Village health sanitation & Nutritional committee (Roles & Responsibilities); Accredited Social Health Activist (ASHA). **Public Awareness** – Introduction to antibiotic and their resistance; Importance of vaccine, Introduction to Mobile Apps of Government of India: NHP, Swasth Bharat, No More Tension, PradhanMantriSurakshitMantritvaAbhiyan (PM SumanYojana), My Hospital (Meraaspataal), India fights Dengue, JSK Helpline, AyushmanBhava, ArogyaSetu, Covid-19AP	**8**
	TOTAL	**48**

Credit distribution:

3 credits: 3 × 30= 90 Notional Credit Hours (48 class hours + 42 Experiential learning)

Text Books

1. Adams MR and Moss MO (2008) Food Microbiology (3rd Edition) RSC publications, UK.
2. GeoffreyCampbell-Platt (Editor) (2009) Food Science and Technology, Willey and Blackwell Publication, UK.

Reference Books

1. Lightfoot NF and Maier EA (Editor) (2003) Microbiological analysis of food and water, Elsevier Publication, Netherland.
2. Ray B and Bhunia A (2008) Fundamental food Microbiology (4th Edition) CRC publication, UK
3. Jatin V. Modi and Renjith S. Chawan. Essentials of Public Health and Sanitation – Part I- IV.

Course Title: CEN III – Fundamentals of Business Communication

Course Component: AECCourse code: CEN982A301

Credit: 1L-T-P-C: 1-0-0-1
Scheme of Evaluation: Theory (T)Level of course: 200

Course Objective: The aim of the course is to develop essential business communication skills, including effective writing, speaking, and interpersonal communication, to enhance professional interactions, collaboration, and successful communication strategies within diverse corporate environments.

Course Outcomes: On successful completion of the course the students will be able to:

Course Outcome		**BT Level**
CO1	**Defineandlist**businessdocumentsusingappropriateformatsand styles,demonstratingproficiencyinwrittencommunicationfor variousbusinesscontexts.	**BT1**
CO2	**Demonstrate** confident verbal communication skills through persuasivepresentations,activelistening,andcleararticulationto engageandinfluencediverse stakeholders.	**BT2**
CO3	**Apply** effective interpersonal communication strategies, including conflict resolution and active teamwork, to foster positive relationships and contribute to successful organizational communication dynamics	**BT3**

Detailed Syllabus		
Units	**Course Contents**	**Periods**
I	**BusinessCommunication:SpokenandWritten** • TheRoleofBusiness Communication • ClassificationandPurposeofBusinessCommunication • TheImportanceofCommunication inManagement • CommunicationTrainingforManagers • CommunicationStructuresinOrganizations • InformationtobeCommunicated attheWorkplace • WritingBusinessLetters,Notice, AgendaandMinutes	**5**

II	**NegotiationSkillsinBusiness Communication**
	• The Nature andNeedforNegotiation
	  o Situations requiringandnotrequiringnegotiations
	• FactorsAffectingNegotiation
	  o Location, Timing, SubjectiveFactors
	• Stagesinthe NegotiationProcess
	  o Preparation,Negotiation,Implementation
	• NegotiationStrategies
		5

III	**EthicsinBusiness Communication** • EthicalCommunication • Values,EthicsandCommunication • Ethical DilemmasFacingManagers • AStrategicApproachto Business Ethics • Ethical Communication on the Internet • Ethics inAdvertising	**5**
IV	**BusinessEtiquettesand Professionalism** • IntroductiontoBusiness Etiquette • InterviewEtiquette • SocialEtiquette • WorkplaceEtiquette • Netiquette	**5**

Text Books

1. Business Communication by Shalini Verma
2. Business Communication by P.D. Chaturvedi and Mukesh Chaturvedi
3. Technical Communication by Meenakshi Raman and Sangeeta Sharma

Course Title: Behavioural Sciences - III

Course Component: AECCourse code: BHS982A302

Credit: 1L-T-P-C: 1-0-0-1

Scheme of Evaluation: Theory (T)Level of course: 200

Course objectives: To increase one's ability to draw conclusions and develop inferences aboutattitudes and behaviour, when confronted with different situations that are common in modernorganizations. To enable the students to understand the process of problem solving and creative thinking.

Course outcomes: On completion of the course the students will be able to: CO1: Understand the process of problem solving and creative thinking. CO2: Develop and enhance of skills required for decision-making.

Modules	Course Contents	Periods
I	**Problem SolvingProcess** Defining problem, the process of problem solving, Barriers to problem Solving(Perception,Expression,Emotions,Intellect,surrounding environment)	4
II	**Thinkingas atoolfor Problem Solving** Whatisthinking:TheMind/Brain/BehaviourCriticalThinkingandLearning: -MakingPredictionsand Reasoning. -Memoryand CriticalThinking. -Emotions andCriticalThinking.	4
III	**Creative Thinking** - Definitionandmeaningof creativity, - Thenatureofcreativethinking:Convergentand Divergentthinking, - Ideagenerationandevaluation(Brain Storming) - Imagegenerationandevaluation. - Thesix-phase modelofCreative Thinking: ICEDIPmodel	4
IV	**BuildingEmotional Competence** EmotionalIntelligence–Meaning, components,ImportanceandRelevance PositiveandNegativeemotions HealthyandUnhealthyexpression ofemotions	4
Total		**16**

Text books

- J William Pfeiffer (ed.) Theories and Models in Applied Behavioural Science, Vol 3, Management; Pfeiffer &Company
- Blair J. Kolasa, Introduction to Behavioural Science for Business, John Wiley & Sons Inc.

Course Title: Clinical Biochemistry **Course Component: SEC**

Course Code: BTC152S311 **Credit: 3**
Level of Course: 200 **L-T-P-C: 0-0-6-3**
Scheme of Evaluation: Practical (P)

Course Objective: This subject aims to introduce students to Intellectual Property Rights and apprise them of ethical issues and practices.

Course Outcome:

On successful completion of the course the students will be able to:		
Course Outcome		**BT Level**
CO 1	**Remember** the principles of the experiments and apply them during their practical	BT 1
CO 2	**Understand**, the basic reaction mechanism of the chemical processes.	BT 2
CO 3	**Apply** the knowledge gained in carrying out experiments associated with the course of study.	BT 3
CO 4	**Analyse** the data and relate them with the experiments being conducted.	BT 4

Detailed List of Practical Experiments:

Modules	**Topics & Course Contents**	**Periods**
I.	1. Preparation of solutions of acid, base and buffers based on molarity and normality 2. Preparation of serial and simple dilutions of salt solutions 3. Measurement of pH of various solutions.	**20**
II.	1. Measurement of absorbance and transmittance 2. Determination of Beer-Lambert's equation 3. Estimation and separation of plasma proteins.	**20**
III.	1. Estimation of salivary amylase. 2. Estimation of glucose from blood sample. 3. Separation of amino acid using paper/ thin layer chromatography	**20**
IV	1. Estimation of cholesterol in blood. 2. Analysis of urine and its components 3. Determination of serum urea/ creatinine/ SGPT/SGOT/ALP/ALT	**20**
	TOTAL	**80**
Pedagogy: Lectures, Assignments, Seminars		

Credit distribution:

3 credits: 3 × 30= 90 Notional Credit Hours (80practical hours + 10 Experiential learning)

Text Books

1. Temple, V.J., Practical Manual in Biochemistry and Clinical Biochemistry, University of Papua New Guinea Press, 4th edition, 2013.

Reference Books

1. Mohanty, S. and Verma, A., Practical Clinical Biochemistry, Jaypee Publications, 5th edition, 2016.

SYLLABUS (4th SEMESTER)

Course Title: Molecular Biology	**Course Component: Major**
Course code: BTC152M401	**Credit: 3**
Level of course: 200	**L-T-P-C: 2-1-0-3**
Scheme of Evaluation: Theory (T)	

Course Objective: The main objective of the course is to allow the students to perceive the structure of the DNA molecule, understand the various mechanisms of molecular events and relate the role played in maintaining the biological system.

Course Outcomes:

On successful completion of the course the students will be able to:		
Course Outcome		**BT Level**
CO 1	**Remember** the basic concepts in molecular biology.	**BT 1**
CO 2	**Demonstrate** the concepts in understanding the formation of various	**BT 2**
CO 3	**Apply** the theoretical knowledge in carrying out the practical assigned.	**BT 3**
CO 4	**Analyze** and **categorize** the various molecular reactions involved in mutations and DNA repair	**BT 4**

Detailed Syllabus:

Modules	**Topics & Course Contents**	**Periods**
I.	Introduction to Molecular Biology, Types of genetic materials- Experiments of Griffith, Avery, MacLeod and McCarty, Hershey and chase, Lederberg and Tatum, Central dogma of life. Replication of DNA, Models of DNA replication, Mechanism of DNA replication in prokaryotes and eukaryotes (initiation, elongation, replication fork, replication machinery, termination), Enzymes and proteins involved in DNA replication (nucleases, DNA polymerases, DNA helicases, gyrases, SSCP, topoisomerase, primase).	**12**
II.	Mechanism of transcription in prokaryotes and eukaryotes. Enzymes and proteins involved in transcription, post transcriptional modification. Inhibitors of transcription. Translation initiation and elongation.	**12**
III.	Genetic code - characteristics and properties, Wobble hypothesis. Post translational modification, protein degradation, Inhibitors of protein synthesis. Regulation of gene expression (lac and trp operons).	**12**
IV	Mutation and its types- spontaneous, induced, reverse, suppressor mutations; chemical mutagens- alkylating agent, nitrous acid, hydroxylamine; physical mutagen- radiation (X-Ray, Gamma Ray and UV). Concept of DNA repair.	**12**
	TOTAL	**48**

Pedagogy: Lectures, Assignments, Seminars

Credit distribution:

3 credits: 3 × 30= 90 Notional Credit Hours (60 class hours + 30 Experiential learning)

Experiential learning activities may include:

- undergraduate research
- participation in a student design team
- completion of an internship
- student teaching
- classroom presentation *etc.*

Text books

1. Watson, J.D., Molecular Biology of the Gene, Pearsons, 8th edition

Reference books

1. Lodish. H, Berk. A, Lawrence, A, Matsudaira. A, Baltimore. D and Dernell. J. Molecular Cell Biology (Fourth Edition). Media Connected – W.H.Freeman and Company. 2009
2. Cell and Molecular Biology by De Robertis E.D.P and De Robertis E.M.F, 1987. Leaand Febiger International Edition, USA. 8th Ed. 2010.

Course Title: Practical on Molecular Biology	**Course Component: Major**
Course code: BTC152M411	**Credit: 1**
Level of course: 200	**L-T-P-C: 0-0-2-1**
Scheme of Evaluation: Practical (P)	

Course Objective: The main objective of the course is toperform the experiments associated with the subjects taught and understand the underlying principles.

Course Outcomes:

On successful completion of the course the students will be able to:		
	Course Outcome	**BT Level**
CO 1	**Learn** and **remember** about the process of preparation of chemicals and calculate the same.	**BT 1**
CO 2	**Understand** about the various molecular mechanisms.	**BT 2**
CO 3	**Apply** the knowledge about thestructure of DNA, its isolation and use of electrophoresis in isolation.	**BT 3**

CO 4	**Analyse** the role of bioinformatics and biostatistics in solving biological problems.	**BT 4**

Detailed Practical:

Module	Topics & Course Contents	Periods
I	1.Isolation of genomic DNA from plants/ microorganisms/ animal cells 2.Isolation of plasmid DNA by alkaline lysis method 3. Isolation of plasmid DNA by phenol method	15
II	1. To perform restriction digestion of DNA 2. Gel electrophoresis of DNA	15
III	1.To perform ligation of foreign DNA into cloning/ expression vector 2.Quantification and purity determination of isolated genomic DNA by UV-Spectrophotometry.	15
IV	1.To carry out polymerase chain reaction of genomic DNA 2. Gel electrophoresis of the PCR amplified product	15

Credit distribution:

1 credit: 1 × 30= 30 Notional Credit Hours (60 lab hours)

Experiential learning activities may include:

- undergraduate research
- participation in a student design team
- completion of an internship
- student teaching
- classroom presentation *etc.*

Reference Books: As suggested under the theory papers.

Course Title: Immunology	**Course Component: Major**
Course code: BTC152M402	**Credit: 3**
Level of course: 200	**L-T-P-C: 2-1-0-3**
Scheme of Evaluation: Theory (T)	

Course Objective: The course aims to provide knowledge in the field of immunology and demonstrate the various forms in relation to their purpose of defending the living system.

Course Outcomes:

On successful completion of the course the students will be able to:		
Course Outcome		**BT Level**
CO 1	**Remember** the basic forms of immune system present in the body.	**BT 1**
CO 2	**Understand** the mechanism of the immune system.	**BT 2**
CO 3	**Apply** the knowledge learnt in relating the same to the defence of the body during diseases.	**BT 3**
CO 4	**Analyse** the importance of the various molecules that play an important role in immune function.	**BT 4**

Detailed Syllabus:

Modules	**Topics & Course Contents**	**Periods**
I.	Immunology - History & Milestones, Microbial infections and host resistance. Immune response: Innate & Adaptive responses, Humoral and cell mediated Immune Responses. Structures, composition and functions of cells and organs of immune system.	**12**
II.	Antigens & Immunogenicity. Antigens - Types, properties, Haptens, Adjuvants, Toxoids, Immunoglobulins- structure, types and properties, Theories of antibody formation, Structural and genetic basis of antibody formation. Antigen and antibody reactions, Immunodiagnostic methods - Agglutination, precipitations, complement fixation, RIA, ELISA and its types, Immunofluorescence, Production of Monoclonal Antibodies and Hybridoma technique.	**12**
III.	Cytokines &Chemokines - Classification, types and its functions, Complement system: structure, properties, functions of complement components and its pathways. Hypersensitivity reactions: Type I, II, III and IV, MHC - Structure and function of class I and class II MHC molecules	**12**
IV	Immunity and tumors: Types of tumors, tumor antigens, immune response to tumors. Immunodeficiency and auto immune diseases, Vaccines, Transplantation immunology - types and mechanisms involved.	**12**
	TOTAL	**48**
Pedagogy: Lectures, Assignments, Seminars		

Credit distribution:

3 credits: 3 × 30= 90 Notional Credit Hours (60 class hours + 30 Experiential learning)

Experiential learning activities may include:

- undergraduate research
- participation in a student design team
- completion of an internship
- student teaching
- classroom presentation *etc.*

Text books:

1. Kuby, J., Immunology by (7th edition) W.H. Freeman and Company, New York, 2013

Reference books:

1. Khan. F.H. The Elements of Immunology, Pearson Education India, 2009

Course Title: Practical on Immunology	**Course Component: Major**
Course code: BTC152M412	**Credit: 1**
Level of course: 200	**L-T-P-C: 0-0-2-1**
Scheme of Evaluation: Practical (P)	

Course Objective: The main objective of the course is toperform the experiments associated with the subjects taught and understand the underlying principles.

Course Outcomes:

On successful completion of the course the students will be able to:		
Course Outcome		**BT Level**
CO 1	**Learn** and **remember** about the process of preparation of chemicals and calculate the same.	**BT 1**
CO 2	**Understand** about the various immunological cells and tissues.	**BT 2**
CO 3	**Apply** the knowledge about the role of immune molecules in organism defence.	**BT 3**
CO 4	**Analyse** the role of theinstrumentsand techniques used in immunology	**BT 4**

Detailed Practical:

Module	**Topics & Course Contents**	**Periods**
I	1. Isolation of lymphocytes from blood / spleen 2. Assays based on agglutination reactions - Blood typing (active) and passive Agglutination	15

II	1. Blood film preparation and identification of cells 2. Demonstration of ELISA	15
III	1. Estimation of RBCs in blood 2. Estimation of WBCs in blood 3. Widal test for determination of typhoid	15
IV	1.Blood Grouping assay 2. Determination of coagulation time of blood	15

Credit distribution:

1 credit: 1 × 30= 30 Notional Credit Hours (60 lab hours)

Experiential learning activities may include:

- undergraduate research
- participation in a student design team
- completion of an internship
- student teaching
- classroom presentation *etc.*

Reference Books: As suggested under the theory papers.

Course Title: Bioethics, Biosafety and IPR	**Course Component: Major**
Course code: BTC152M403	**Credit: 4**
Level of course: 200	**L-T-P-C:3-1-0-4**
Scheme of Evaluation: Theory (T)	

Course Objective: The course aims to provide knowledge in field of immunology and demonstrate the various forms in relation to their purpose of defending the living system. The content of this course is aligned with SDG9: Industry, innovation, and infrastructure.

Course Outcomes:

On successful completion of the course the students will be able to:		
	Course Outcome	**BT Level**
CO 1	**Remember** the basics of Bioethics, biosafety and IPR	**BT 1**
CO 2	**Understand** the principles of bioethics and biosafety and the importance of IPR	**BT 2**
CO 3	**Applying** the knowledge of IPR in applying for patent, copyrightetc.	**BT 3**
CO 4	**Analyzing** the rules and regulations involving biosafety, bioethics and	**BT 4**

Detailed Syllabus:

Modules	Topics & Course Contents	Periods
I.	**Concept of Property:** Intellectual Property Rights-Origin Development and Objectives, Classification of Intellectual Property-Patents, Copyright, Trademark, Industrial Design, Geographical Indications, Protection of Plant Varieties and Traditional Knowledge, Patentability Criterion, Product Patents vis-à-vis Process Patents	**16**
II.	Patentability of Biotechnology Inventions; Patent Laws in Indian and International Perspective; Indian Patent Act 1970 (Patent Amendment Acts-1999, 2002 and 2005); International Conventions relating to Intellectual Property; General Agreement on Trade and Tariff (GATT); Trade Related Aspects of Intellectual Property Rights (TRIPS)	**16**
III.	**Biosafety:** Definition and requirement; Important symbols and their meaning, Biosafety in relation to human health, environment, transgenic research and applications; International Legal Instruments on Biosafety Cartagena Protocol on Biosafety, Nagoya Protocol Laws relating to Biosafety in India: The Biological Diversity Act, 2002, Biosafety procedures, rules and guidelines under Environment (Protection) Act 1986 and Rules 1989;	**16**
IV	Nature, Concept and Relevance of Bioethics; Basic Principles of Bioethics; Legal, Social and Economic Impacts of the Products and Techniques in Biotechnology; Bioethics in Plants, Animals and Microbial Genetic Engineering; Ethical issues in Healthcare; Biopiracy and Bioethics, Institutional Bioethical Committees and Composition on Human and Animals.	**16**
	TOTAL	**64**
Pedagogy: Lectures, Assignments, Seminars		

Credit distribution:

4 credits: 4 × 30= 120 Notional Credit Hours (80 class hours + 40 Experiential learning)

Experiential learning activities may include:

- undergraduate research
- participation in a student design team
- completion of an internship
- student teaching
- classroom presentation *etc.*

Text books

1. Cornish, W. R., Intellectual Property (Latest Edition)
2. Intellectual Property Rights by Paul Goldstein
3. Intellectual Property Rights by K. R. G. Nair, Ashok Kumar, K. R. G. Nair
4. Kilner, John, et.al, eds., Cutting-Edge Bioethics. Eerdmans 2002.

Reference Books

1. B.L. Wadera, Patents, Trademarks, Copyright, Designs and Geographical Indications
2. S. Ignacimuthu, Bioethics, Alpha Science International, Limited (2009)
3. Matthew Rimmer, Intellectual Property and Biotechnology: Biological Inventions (2008)
4. Arthur L. Caplan, Robert Arp, Contemporary Issues in Bioethics (2014)

Course Title: Biofertilizer and Its Application	**Course Component: Minor**
Course code: BTC152N401	**Credit: 3**
Level of course: 200	**L-T-P-C: 3-0-0-3**
Scheme of Evaluation: Theory (T)	

Course Objective: The main objective of the course is toprovide the graduates with the knowledge of biofertilizers and their applications in agriculture.

Course Outcome:

On successful completion of the course the students will be able to:		
Course Outcome		**BT Level**
CO 1	**Remember** the various techniques in production of biofertilizer	**BT 1**
CO 2	**Understand** the principles and applications biofertilizer	**BT 2**
CO 3	**Apply** the theoretical knowledge in practical applications.	**BT 3**
CO 4	**Analyze** the role of biofertilizers in agricultural production.	**BT 4**

Detailed Syllabus:

Modules	**Topics & Course Contents**	**Periods**
I.	Soil Environment- microorganisms, soil structure, soil profile, physicochemical conditions, microbial composition, sampling techniques, role of microorganisms in organic matter decomposition (cellulose, Hemicellulose, Lignins). Bio-geochemical cycles: Carbon cycle, Nitrogen cycle	**12**
II	Biofertilizers-Introduction, biofertilizers using nitrogen fixing microbes, phosphate solubilization- Rhizobium, Azatobacter, Azospirillum, Azolla- Anabaena Symbiosis, bluegreen algae and Ecto- and Endomychorizae. Cultivation, mass production and inoculation of Rhizobium, Azotobacter, Azospirillum, Azolla and cyanobacteria, Carrier-based inoculants, methods of application, quality control, agronomic importance. Application methods for different biofertilizers.	**12**

III	Role of endophytic fungi in the production of biofertilizer: symbiotic and opportunistic associations, coevolution and loss of reproductive structures, Secondary metabolite production, toxins-importance, toxicity to herbivores and insects. Role of algae and lichens as biofertilizers.	**12**
IV	Solid wastes in the production of biofertilizers: Types and Concept of solid waste; solid waste management.	**12**
	TOTAL	**48**
Pedagogy: Lectures, Experiments, Laboratory sessions		

Credit distribution:

3 credits: 3 × 30= 90 Notional Credit Hours (60 class hours + 30Experiential learning)

Experiential learning activities may include:

- undergraduate research
- participation in a student design team
- completion of an internship
- student teaching
- classroom presentation *etc.*

TextBook

1. S. Kannaiyan, BiotechnologyofBiofertilizers,2002, Alpha Science International.

ReferenceBooks

1. TheCompleteTechnologyBook onBio-FertilizerandOrganicFarming.2004, NiirBoard.
2. M. K. Rai.HandbookofMicrobialBiofertilizers,2006, Food Products Press

Course Title: Food Biotechnology	**Course Component: Minor**
Course code: BTC152N402	**Credit: 3**
Level of course: 200	**L-T-P-C: 3-0-0-3**

Scheme of Evaluation: Theory (T)

Course Objective: The main objective of the course is toprovide the graduates with the knowledge of biofertilizers and their applications in agriculture. The content of the course is aligned with SDG2: Zero hunger.

Course Outcome:

On successful completion of the course the students will be able to:		
Course Outcome		**BT Level**
CO 1	**Remember** the various sources for production of food	**BT 1**
CO 2	**Understand** the principles and applications of enzymes and molecules	**BT 2**
CO 3	**Apply** the knowledge in practical applications for preparation of food	**BT 3**
CO 4	**Analyze** the role of biotechnology in food production.	**BT 4**

Detailed Syllabus:

Modules	**Topics & Course Contents**	**Periods**
I.	Micro-organisms important in biotechnology processes, Strain improvement; mutation, recombination, protoplast fusion. Microbial growth kinetics; principles of batch, fed-batch and continuous fermentation, processes; sterilization of culture media; stirring, mixing and aeration of fermentation cultures.	**12**
II	Bacteria-based products; dairy, meat, fish and vegetable products, vinegar and additives. Yeast-based products; food yeasts, alcoholic beverages and bread. Other microbial based products; enzymes, microbial biomass protein (MBP), additives and "smart foods."	**12**
III	Testing and analysis of genetically modified foods; protein-based methods to detect the transgene product and DNA-based methods to detect the transgene or associated marker or regulatory sequences. Safety evaluation of novel food products. Benefits and risks of GM foods.	**12**
IV	Plant cell and tissue culture, Genetic modification of agronomic traits in crops such as herbicide tolerance, pest and disease resistance, Laboratory generated meat, Animal nutrition and health. Generation of transgenic animals. Biotechnology in the animal feed industry, Regulations in production of GMO.	**12**
	TOTAL	**48**
Pedagogy: Lectures, Experiments, Laboratory sessions		

Credit distribution:

3 credits: 3 × 30= 90 Notional Credit Hours (60 class hours + 30 Experiential learning)

Experiential learning activities may include:

- undergraduate research
- participation in a student design team
- completion of an internship
- student teaching
- classroom presentation *etc.*

TextBook

1. Ratledge, C. and Kristiansen, B. (Eds.) (2006) Basic Biotechnology. 3rd Edition. Cambridge University
2. Johnson-Green, P. (2002). Introduction to Food Biotechnology

ReferenceBooks

1. Adams, M.R., and Moss, M.O. (2000). Food Microbiology.Second Edition.The Royal Society of Chemistry, UK.
2. Wood, B.J.B. (Editor) (1998). Microbiology of Fermented Foods, 2-Volumes, Second Edition.Blackie Academic & Professional, London.

Course Title: CEN IV – Business Communication: Concepts and Skills

Course Component: AECCourse code: CEN982A401
Credit: 1L-T-P-C: 1-0-0-1
Scheme of Evaluation: Theory (T)Level of course: 200

Course Objectives: This course is designed to enhance employability and maximize the students' potential by introducing them to the principles that determine personal and professional success, thereby helping them acquire the skills needed to apply these principles in their lives and careers.

Course Outcomes: After the successful completion of the course, the students will be able to

Course Outcome		BT Level
CO2	**Demonstrate**understandingtheimportanceofverbalandnon-verbal skillswhile deliveringaneffective presentation.	**BT2**
CO3	**Develop**professionaldocumentstomeettheobjectivesofthe workplace	**BT3**
CO3	**Identify**differentlifeskillsandinternetcompetencies required in personal and professional life.	**BT3**

Detailed Syllabus		
Units	**Course Contents**	**Periods**
I	**Presentation Skills** Importance of presentation skills,Essential characteristicsof a good presentation, Stages of a presentation, Visual aids in presentation, Effective delivery of a presentation	**5**
II	**BusinessWriting** Report writing: Importance of reports, Types of reports, Format of reports, Structure of formal reports Proposalwriting:Importanceofproposal,Typesofproposal, structure of formal proposals Technicalarticles: Typesand structure	**5**
III	**Preparing for jobs** Employability and Unemployability, Bridging the Industry-Academia GapKnowingthefour- step employment process, writing resumes, Guidelines for a good resume, Writing cover letters Interviews:Typesofinterviews,whatdoesajobinterviewassess, strategiesofsuccessatinterviews,participatingingroupdiscussions.	**5**

IV	**DigitalLiteracy and LifeSkills** **Digitalliteracy:**Digitalskillsforthe'21stcentury',Collegestudents andtechnology,informationmanagementusingWebspace,Dropbox, directory, and folder renaming conventions. Social Media Technology and Safety, Web 2.0. **LifeSkills**:OverviewofLifeSkills:Meaningandsignificanceoflife skills, Life skills identified by WHO: self-awareness, Empathy, Critical thinking, Creative thinking, Decision making, problem-solving,Effectivecommunication,interpersonalrelationship,coping with stress, coping with emotion. Application of life skills: opening and operating bank accounts, applying for PAN, Passport, online bill payments, ticket booking, gas booking	**5**

Text Books

1. *BusinessCommunication*by ShaliniVermaReferences:
2. *TechnicalCommunication*byMeenakshiRamanandSangeetaSharma

CreditDistribution		
Lecture/Tutorial	**Practicum**	**ExperientialLearning**
15hours	-	10hours - Movie/Documentary screening - Field visits - Peerteaching - Seminars - Library visits

Course Title: Behavioural Sciences - IV
Course Component: AECCourse code: BHS982A402
Credit: 1L-T-P-C: 1-0-0-1
Scheme of Evaluation: Theory (T)Level of course: 200

Course objectives: To increase one's ability to draw conclusions and develop inferences aboutattitudes and behaviour, when confronted with different situations that are common in modern organizations.

Course outcomes: On completion of the course the students will be able to:
CO1: Understand the importance of individual differences
CO2: Develop a better understanding of self in relation to society and nation
CO3: Facilitation for a meaningful existence and adjustment in society

Module	CourseContents	Periods
I	**ManagingPersonalEffectiveness** Settinggoalsto maintain focus, Dimensionsof personal effectiveness(self-disclosure,opennesstofeedbackandperceptiveness),Integrationofpersonal and organizationalvisionforeffectiveness,A healthybalanceofwork andplay, Defining Criticism: Types of Criticism, Destructive vs	**4**
II	**Positive PersonalGrowth** Understanding&developingpositiveemotions, Positive approach towards future,Impactof positivethinking,Importanceof disciplineand hardwork, Integrity andaccountability,Importanceof ethicsinachievingpersonalgrowth.	**4**
III	**HandlingDiversity** Defining Diversity,Affirmation Action and Managing Diversity, IncreasingDiversityinWorkForce,BarriersandChallengesinManaging Diversity.	**4**
IV	**DevelopingNegotiation Skills** MeaningandNegotiationapproaches(TraditionalandContemporary) Process andstrategiesofnegotiations. Negotiationandinterpersonal communication. RapportBuilding–NLP.	**4**
Total		**16**

Text Books

1. J William Pfeiffer (ed.) Theories and Models in Applied Behavioural Science, Vol 3, Management; Pfeiffer &Company
2. Blair J. Kolasa, Introduction to Behavioural Science for Business, John Wiley & Sons Inc.

SYLLABUS (5th SEMESTER)

Course Title: Genomics and ProteomicsCourse Component: Major	
Course code: BTC152M501	**Credit: 4**
Level of course: 300	**L-T-P-C: 4-0-0-4**
Scheme of Evaluation: Theory (T)	

Course Objective: The course is designed to apprise the students to the vital concepts of technologies pertinent to Genomics and Proteomics, their applications and demonstrate skills to apply the knowledge in scientific queries.

Course Outcome:

On successful completion of the course the students will be able to:		
Course Outcome		**BT Level**
CO 1	**Remember** the various techniques involved in the study of genomics and proteomics.	BT 1
CO 2	**Understand** the basic principle of all the techniques associated with genomics and proteomics study.	BT 2
CO 3	**Apply** the knowledge in the study of genomics and proteomics of a cell under specific conditions.	BT 3
CO 4	**Analyze**the effect of various intrinsic and extrinsic factors on the genome and proteome of a cell under certain conditions	BT 4

Detailed Syllabus:

Modules	**Topics & Course Contents**	**Periods**
I.	Importance of genome projects, human genome project, Sequence component of eukaryotic genome, satellite, microsatellite and minisatellite DNA; physical mapping by building clone contigs, genomic libraries, YAC, BAC libraries. General organization of human genome.Introduction to functional genomics	**16**
II.	Genomics and Transcriptomics: Microarray, RNA sequencing, methods to study differential gene expression: differential display PCR Tools for genome analysis- PCR and automated DNA sequencing, RFLP, DNA foot printing, DNA finger printing, RAPD, AFLP, SNP detection techniques, Applications of DNA markers	**16**

III.	Introduction to Proteome Concept and nature of proteome, overview of the tools to study proteome, and categories of current proteomic studies, Application of Proteomic studies in (Gene Expression, Protein, Biomarker discovery in disease diagnosis and drug designing); Proteomic interactions (Y2H approaches, Co-IP); Sequencing of proteins, Concepts of protein engineering, protein microarray.	**16**
IV	Proteomic tools: SDS-PAGE, Native PAGE, western blotting and immune-detection, 2D-gel electrophoresis., in gel digestion, Purification of proteins using various chromatographic techniques. Mass spectrometry: Principle and practices.	**16**
	TOTAL	**64**
Pedagogy: Lectures, Assignments, Seminars		

Credit distribution:

4 credits: 4 × 30= 120 Notional Credit Hours (80 class hours + 40 Experiential learning)

Experiential learning activities may include:

- undergraduate research
- participation in a student design team
- completion of an internship
- student teaching
- classroom presentation *etc.*

Text Books

1. Discovering Genomics, Proteomics and Bioinformatics, 2nd Edition. Campbell AM &Heyer LJ, Benjamin Cummings 2007; CSH Press, NY. ISBN-10: 8131715590
2. Principles of Proteomics. R.M Twyman (2004) (BIOS Scientific publishers). ISBN-10: 1859962734
3. Genome III – T.A. Brown Garland Science Publ. June 08, 2006. ISBN-10: 0815341385

Reference Books

1. Principles of Gene Manipulation and Genomics- Primrose S &Twyman R, 7th Edition, Blackwell, 2006. ISBN-10: 1405135441
2. Principles of Genome Analysis and Genomics. Primrose SB &Twyman RM. 2007. Blackwell. ISBN-10: 1405101202

Course Title: Plant and Animal Biotechnology	**Course Component: Major**
Course Code: BTC152M502	**Credit: 4**
Level of Course: 300	**L-T-P-C:4-0-0-4**
Scheme of Evaluation: Theory (T)	

Course Objective: The course is designed to understand the various processes involved in plants tissue culture and how the techniques learnt can help in the creation of tissue cultured plants.

Course Outcome:

On successful completion of the course the students will be able to:		
Course Outcome		**BT Level**
CO 1	**Remember** about the process of tissue culture, callus culture, suspension cell culture of plant tissues and the basic theories of animal cell culture.	**BT 1**
CO 2	**Understand** the processes and techniques of creation of tissue cultured plants and animal cells and new hybrids	**BT 2**
CO 3	**Apply** the knowledge of in conservation of plants and animals and production of high yield animals.	**BT 3**
CO 4	**Analyse** the theoretical knowledge in the generation of new plants and animal cell lines for experimental purpose	**BT 4**

Detailed Syllabus:

Modules	**Topics & Course Contents**	**Periods**
I.	**Plant tissue cultures**: callus, meristem culture etc., secondary metabolites in plant tissue cultures; protoplast culture and somatic hybridization; haploid plants and soma-clonal variation. Methods for Plant Conservation: Germplasm conservation- in situ, ex situ conservations and in vitro conservation; cryopreservation, Transgenic crop plants - Review of transgenic plants (Bt-cotton and other Bt- plants, Golden rice etc.), development of pathogen resistant cultivars using resistant lines.	**16**
II.	**Genetic engineering of crop plants**: Agrobacterium-mediated gene transfer, direct gene transfer; Biolistic gene transfer, alternative approaches of gene transfer – microinjectionand electroporation. Bioreactors- Stirred tank, Bubble column, Air lift, Rotating drum and immobilized plant cell reactor.	**16**
III.	**Animal Cell Culture**: History of animal cell culture; Basic requirement for animal cell culture; Cell culture media and reagents; Animal cell; Tissue and organ cultures; Primary culture and establishedcelllines;Basic technique of mammalian cell culture, cell synchronization, Scaling of animal cell culture, Transfection and transformation of cells, Application of animal cell culture for in vitro testing of	**16**

	drugs; Testing of toxicity for environmental pollutants in cell culture; Stem cells and their application, in-vitro fertilization; culture of embryos; cryopreservation of embryos; embryo transfer; embryo splitting	
IV	**Animal health Biotechnology:**History of development of vaccines; Introduction to the concept of vaccines; Conventional methods and Recombinant approaches to vaccine production; Hybridoma technology; Application of cell culture technology in vaccine production and pharmaceutical proteins. Introduction of DNA fingerprinting. Scope and application of DNA forensics: animal species identification; detection of adulteration of meat by DNA based techniques.	**16**
	TOTAL	**64**
Pedagogy: Lectures, Assignments, Seminars		

Credit distribution:

4 credits: 4 × 30= 120 Notional Credit Hours (80 class hours + 40 Experiential learning)

Experiential learning activities may include:

- undergraduate research
- participation in a student design team
- completion of an internship
- student teaching
- classroom presentation *etc.*

Text books

1. Satyanarayana,U.Biotechnology (Books and Allied (P) Ltd.2005).
2. Slater, A., Scott, N. W., Fowler, M. R Plant Biotechnology: The Genetic Manipulation of Plants (Oxford University Press, USA; 2NDedition, 2008).
3. Animal cell biotechnology Portner, 2nd edition, Humana Press,2007.
4. Pinkert, Transgenic animal technology, Academic Press,2006.

Reference Books

1. Adrian, S. Plant Biotechnology: The Genetic Manipulation Of Plants (Oxford University Press,2008)
2. Bohnert, H. J. et al Bioengineering and Molecular Biology of Plant Pathways, Volume 1 (Elsevier, USA,2008)
3. Davey,M.R. Plant Cell Culture: Essential Methods (Wiley-Blackwell Publishing, 2010)
4. Gordon, Reproductive technologies in farm animals, CAB Intl,2005.
5. Ed. John R.W. Masters, Animal cell culture- Practical approach, 3rd edition, Oxford University Press, 2000.

Course Title: Practical – V Course Component: Major	
Course Code: BTC152M513	**Credit: 4**
Level of Course: 300	**L-T-P-C:0-0-8-4**
Scheme of Evaluation: Practical (P)	

Course Objective: The course is designed to learn about the various experiments used in plant and animal tissue culture and their role in the generation of new plants, animals and their products.

Course Outcome:

On successful completion of the course the students will be able to:		
Course Outcome		**BT Level**
CO 1	**Remember** about the procedures of tissue culture and maintenance of plant culture laboratory. The students will also be aware of the process of fermentation and preparation of various fermented food products.	**BT 1**
CO 2	**Understand** the role of various instruments and setups in the tissue culture laboratory and in bioprocess industry.	**BT 2**
CO 3	**Apply** the knowledge of plant tissue culture in conservation and fermentation in food preservation and processing.	**BT 3**
CO 4	**Analyze** the theoretical knowledge in the generation of new plants and innovative food products	**BT 4**

Detailed Syllabus:

Module	**Topics & Course Contents**	**Periods**
I.	1. Overview of setup in a plant tissue culture laboratory 2. Preparation of media for plant tissue culture. 3. Micropropagation using apical/nodal explants. 4. Isolation of protoplasts.	**24**
II.	1. Study of equipment's and materials for animal cell culture. 2. Demonstration of the process and techniques of animal cell culture. 3. Isolation of human lymphocytes from the blood. 4. Culture of human blood lymphocytes	**24**
III.	1. G-banding of human chromosomes and physical mapping of human genome. 2. Design of PCR primers from Genomic DNA. 3. DNA isolation and single nucleotide genotyping.	**24**
IV	1. Extraction and quantification of proteins 2. Digests proteins into peptides, which are then separated and analysed by mass spectrometry 3. Native and SDS-PAGE. 4. Compare protein expression in biological samples.	**24**
	TOTAL	**96**

Credit distribution:

4 credits: 4 × 30= 120 Notional Credit Hours (96lab hours + 24 Experiential learning)

Experiential learning activities may include:

- undergraduate research
- participation in a student design team
- completion of an internship
- student teaching
- classroom presentation *etc.*

Text books

1. Ed. John R.W. Masters, Animal cell culture- Practical approach, 3rd edition, Oxford University Press, 2000.

Reference books: As suggested under the theory courses.

Course Title: Basics of Molecular Biology	**Course Component:** Minor
Course Code: BTC152N501	**Credit: 4**
Level of Course: 300	**L-T-P-C:4-0-0-4**
Scheme of Evaluation: Theory (T)	

Course Objective: The main objective of the course is to provide basic foundation on biomolecules and molecular events of life with reference to their properties, and biological functions.

Course outcome:

On successful completion of the course the students will be able to:		
Course Outcome		**BT Level**
CO 1	**Remember** the basic concepts of cellular organelles biomolecules and molecular biology.	**BT 1**
CO 2	**Demonstrate** the concepts in understanding the formation of various molecular events in life forms.	**BT 2**
CO 3	**Develop** the knowledge gained in solving practical experiments.	**BT 3**
CO 4	**Analyze** and **categorize** the various molecular reactions involved in various molecular events	**BT 4**

Detailed Syllabus:

Modules	Topics & Course Contents	Periods
I.	**Basics of cell structure:**Introduction and classification of organisms by cell structure, Structure and function of prokaryotic cell and its components. Cell wall of bacteria, outermembrane of Gram-negative bacteria, Compartmentalization of eukaryotic cells, cytosol, Cell Membrane, Chemical components of biological membranes, organization and Fluid Mosaic Model, **Cell organelles**: Structure and functions of various cell organelles like Endoplasmic reticulum: Golgi complex, Mitochondria, Chloroplasts, Overview of the cell-cycle and cell division.	**14**
II.	**Biological macromolecules:** **Amino acids and Proteins:** structure, classification of amino acids, concept of zwitterionic structure, physical and chemical properties. classification of proteins on the basis of composition, conformation and function, different level of structural organization of proteins (primary, secondary, tertiary &quaternary) **Nucleic acids:** Ribonucleic and deoxyribonucleic acids, purines and pyrimidines, nucleosides and nucleotides. **Carbohydrate:** Structure, function and properties of Carbohydrates. **Lipids:** Definition and classification of lipids, structure and function of fatty acids, storage lipids, structural lipids.	**12**
III.	**DNA Replication:**Models of DNA replication, Mechanism of DNA replication in prokaryotes and eukaryotes (initiation, elongation, replication fork, replication machinery, termination), Enzymes and proteins involved in DNA replication (nucleases, DNA polymerases, DNA helicases, gyrases, SSCP, topoisomerase, primase).	**12**
IV	**Protein synthesis**: Central dogma of life, transcription in prokaryotes and eukaryotes, Enzymes and proteins involved in transcription, post transcriptional modification, Genetic code - characteristics and properties, Wobble hypothesis, Translation initiation and elongation.	**10**
	TOTAL	**48**

Credit distribution:

3 credits: 4 × 30= 120 Notional Credit Hours (60 class hours + 60 Experiential learning)

Experiential learning activities may include:

- Undergraduate research
- Participation in a student design team
- Completion of an internship
- Student teaching
- Classroom presentation *etc*.

Text Books

1. Nelson, D.L., Cox, M.M., *Lehninger Principles of Biochemistry* 4th Edition, 2004, WH Freeman and Company, New York, USA
2. Watson, J.D., Molecular Biology of the Gene, Pearsons, 8th edition

Reference Books:

1. Berg, J. M., Tymoczko, J. L. and Stryer., *Biochemistry*, 6th Edition,2006, W.H Freeman and Co.
2. Buchanan, B., Gruissem, W. and Jones, R., *Biochemistry and Molecular Biology of Plants*, 2nd Edition, 2015, American Society of Plant Biologists, USA.
3. Lodish. H, Berk. A, Lawrence, A, Matsudaira. A, Baltimore. D and Dernell. J. Molecular Cell Biology (Fourth Edition). Media Connected – W.H.Freeman and Company. 2009
4. Cell and Molecular Biology by De Robertis E.D.P and De Robertis E.M.F, 1987. Laea Febiger International Edition, USA. 8th ed 2010.

Course Title: Internship	**Course Component:** Major
Code: BTC152M524	**Credit: 4**
Scheme of Evaluation: Project and Viva-voce	**Level of Course: 300**

Course Objective: In this course the students shall carry out a period of training in the form of an internship at a well-established laboratory/ industry/ factory or University. The student will train himself/ herself in the core areas of biotechnology and shall present a report.

Course Outcome:

On successful completion of the course the students will be able to:		
Course Outcome		**BT Level**
CO 1	**Remember**the basic concepts taught to be incorporated in the training	**BT 1**
CO 2	**Understand** the role of various instruments required in biology and their use in training process.	**BT 2**
CO 3	**Apply** the knowledge of working with the instruments/ equipment during the internship period.	**BT 3**
CO 4	**Analyze** the results obtained based upon the concept and training received	**BT 4**

SYLLABUS (6th SEMESTER)

Course Title: Genetic Engineering	**Course Component: Major**
Course code: BTC152M601	**Credit: 4**
Level of course: 300	**L-T-P-C: 4-0-0-4**
Scheme of Evaluation: Theory (T)	

Course Objectives: The main objective of the course is to provide basic foundation on Genetic Engineering with reference to their practical applications in biological systems.

Course Outcome:

On successful completion of the course the students will be able to:		
	Course outcome	**BT Level**
CO1	**Recall** the structure of various vectors used in Genetic Engineering	**BT1**
CO2	**Understand** the concepts of gene manipulation and the techniques involved.	**BT2**
CO3	**Develop** the knowledge gained in solving practical experiments.	**BT3**
CO4	**Analyze** the practical outcome of the gene manipulation techniques.	**BT4**

Detailed Syllabus:

Modules	**Topics & Course Contents**	**Period**
I	Basics Concepts: DNA modifying enzymes, classification and nomenclature; Cohesive and blunt end ligation; Linkers; Adaptors; Radioactive and non-radioactive probes; Selectable and Scorable marker genes. Cloning Vectors: Plasmids; Phagemids, M13 vectors; pUC19, Insertion and Replacement vectors; Cosmids; Artificial chromosome vectors (YACs; BACs); Plant based vectors: Ti and Ri as vectors;Expression vectors.	**12**
II	Cloning Methodologies: Insertion of Foreign DNA into Host Cells; Transformation; Construction of libraries; Isolation of mRNA and total RNA; cDNA and genomic libraries; cDNA and genomic cloning; Hybridization techniques: Southwestern,Northern and Western hybridization; DNA-Protein InteractionsElectromobility shift assay; DNase Ifoot printing.	**17**
III	PCR and Its Applications: Primer design; Fidelity of thermostable enzymes; DNA polymerases; Types of PCR – multiplex, nested, reverse transcriptase, real time PCR, touchdown PCR, hot start PCR, colony PCR, cloning of PCR products;PCR in molecular diagnostics; Viral and bacterial detection; PCR based mutagenesis;	**17**
IV	Sequencing methods; Enzymatic DNA sequencing; Chemical sequencing of DNA; Automated DNA sequencing;Transfection techniques; Introduction to	**18**

	siRNA technology and MicroRNA; Principle and application of gene silencing; Gene knockouts and Gene Therapy; Creation of knockout mice; DNA microarray techniques.	
	TOTAL	**64**
Pedagogy: Lectures, Assignments, Seminars		

Credit distribution:

4 credits: 4 × 30= 120 Notional Credit Hours (80 class hours + 40 Experiential learning)

Experiential learning activities may include:

- Undergraduate research
- Participation in a student design team
- Completion of an internship
- Student teaching
- Classroom presentation *etc*.

Text Books:

1. Brown, T. A., Gene Cloning and DNA Analysis: An Introduction, 8th Edition, John Wiley & Sons Ltd., 2021
2. Nicholl D. S. T., An Introduction to Genetic Engineering, 4th Edition, Cambridge University Press, 2023

Reference Books:

1. Sambrook, J., and Russel, D.W., Molecular Cloning: A Laboratory Manual, Vols 1-3, CSHL, 2001.
2. Primrose, S. B., Twyman, R.M., and Old, R.W. Principles of Gene Manipulation. 6th Edition, S. B. University Press, 2001.
3. Selected papers from scientific journals.

Course Title: Bioinformatics and Biostatistics	**Course Component: Major**
Course code: BTC152M602	**Credit: 4**
Level of course: 300	**L-T-P-C: 4-0-0-4**
Scheme of Evaluation: Theory (T)	

Course Objective: The course aims to give a holistic theoretical and practical knowledge in field of bioinformatics and biostatistics to relate the role of computational biology and statistics in biotechnology.

Course Outcome:

On successful completion of the course the students will be able to:		
Course Outcome		**BT Level**
CO 1	**Remember** the various software and biological databases and their application in the analysis of various biological experiments.	**BT 1**
CO 2	**Understand** the various software and their use in the analysis of various biological results.	**BT 2**
CO 3	**Apply** the knowledge to analyse the results of biological experiments statistically using various computational tools.	**BT 3**
CO 4	**Analyse** the various biological events and their probable outcome using computational tools.	**BT 4**

Detailed Syllabus:

Modules	**Topics & Course Contents**	**Periods**
I.	**Basics of bioinformatics**: Definition, Scope and Goal, Application in Computational Biology, Limitations; **Biological Database**: Types of databases, biological database: GenBank, EMBL, DDBJ, Uniprot-KB: SWISS-PROT, PDB, AceDBs, literature databases, PubMed; Webtools: ExPASy server **Sequence Analysis and Sequence Alignment:** Basic concepts of sequence similarity, identity and homology, definitions of homologues, orthologues and paralogues, Basic concepts of sequence alignment, Uses of Sequence Alignment, Pairwise, multiple, Database Similarity search, **Scoring matrices:**Basic concept of a scoring matrix, Matrices for nucleic acid and proteins sequences, PAM and BLOSUM series, matrix derivation methods and principles **Sequence similarity search:** BLAST and FASTA **Structural bioinformatics**: proteins and its structure, Determination of protein 3-Dimensional structure, Protein structure visualization, comparison, Secondary and tertiary structure prediction	**16**

II.	Molecular Phylogenetics:Basic concepts, Methods in evaluation of phylogeny and steps in constructing alignments and phylogenetic Trees, Types of phylogenetic tree. Protein Structure Prediction and Molecular Interaction studies: Methods of protein structure prediction, validation by Ramachandran Plot, Docking and Molecular Dynamic Simulation (MDS). Chemoinformatic and Computer Aided Drug Designing (CADD):Introduction to cheminformatics, Use of cheminformatics, Prospectus of cheminformatics,	**16**
III.	**Statistical tools:** Measures of central tendencies and dispersion, concept of probability and theoretical distributions (Binomial, Poisson and normal distribution), Correlation and Regression; Random numbers, sampling methods, random plot design. Basics of testing of hypothesis. Analysis of variance (one way and two way), Students t test, Chi-square test, F-test and Z-test.	**16**
IV	**Statistical Science and biological assays:** Importance, nature and planning of bioassays;Direct and indirect bioassays; Design of experiments by Analysis of variance and Dose-response analysis. **Analysis of biochemical data:** Application of multiple regressions in epidemiologic and clinical data; Study of association between disease and risk factors. Application of odds ratio, Logistic regression with dichotomous response variable.	**16**
	TOTAL	**64**
Pedagogy: Lectures, Assignments, Seminars		

Credit distribution:

4 credits: 4 × 30 = 120 Notional Credit Hours (80 class hours + 40 Experiential learning)

Experiential learning activities may include:

- Undergraduate research
- Participation in a student design team
- Completion of an internship
- Student teaching
- Classroom presentation *etc*.

Text Books:

1. Lesk, A. (2019). Introduction to bioinformatics. Oxford university press.
2. Xiong, J. (2006). Essential bioinformatics. Cambridge University Press.

Reference Books:

1. David W. Mount. Bioinformatics: Sequence and Genome Analysis, Published CSHL Press.
2. Des Higgins, Willie R. Taylor. Bioinformatics: Sequence, Structure and Databanks: A Practical, Approach, Oxford University Press.

Course Title: Bioprocess Engineering	**Course Component: Major**
Course code:BTC152M603Credit: 4	
Level of course: 300	**L-T-P-C: 4-0-0-4**
Scheme of Evaluation: Theory (T)	

Course Objectives: The main objective of the course is to provide comprehensive understanding on the principles underlying various techniques used in bioprocess engineering and technology for the development of fermented product. The content of the course is aligned with SDG2: Zero hunger.

Course Outcome:

On successful completion of the course the students will be able to:		
Course outcome		**BT Level**
CO1	Recall the structure of various types of fermenters and bioreactors	**BT1**
CO2	Understand the concepts of fermented product development	**BT2**
CO3	Develop the knowledge to implement modern biotechnology in the food and pharmaceuticalindustries	**BT3**
CO4	Analyze the practical outcome of bioprocess engineering	**BT4**

Detailed Syllabus:

Modules	**Topics & Course Contents**	**Period**
I	Basic principle of Biochemical engineering: Isolation screening and maintenance of industrially important microbes, microbial growth and death kinetics (particularly with reference to industrially useful microorganisms), strain improvement for increased yield and other desirable characteristics.	**16**
II	Detailed study of the design and operation of different types of fermenters, Mode of fermentation processes: Bioreactor designs, types of fermentations and fermenters: Upstream processing: scale up and scale down process. thermal death of micro-organisms, enzyme inhibition, Downstream processing: Bioseparation: drying, crystallization, storage and packaging, treatment of effluent and its disposal.	**16**
III	Applications of enzymes in industry and food processing: enzymatic bioconversions e.g. starch and sugar conversion processes, High-Fructose Corn Syrup, and their downstream processing, backing by amylases, deoxygenation and desugaring by glucoses oxidase, beer mashing and chill proofing, cheese making by proteases; application of enzymes in detergents. Fermentated foods: microbes and their use in pickling, productingcolours and flavours, and process of wastes-whey,	**16**

	molasses, starch substrates and other food wastes for bioconversion to useful products; Bacteriocins: production and applications.	
IV	Biodegradation of xenobiotic compounds and toxic wastes, removal of spilled oil & grease deposits, Biosurfactants, Bioremediation of soil & water, solid waste & waste water treatment, use of microorganism for the production of energy: Biogas (production of methane and hydrogen), fuel alcohol production & hydrocarbon production.	**16**
	TOTAL	**64**
Pedagogy: Lectures, Assignments, Seminars		

Credit distribution:

4 credits: 4 × 30 = 120 Notional Credit Hours (80 class hours + 40 Experiential learning)

Experiential learning activities may include:

- Undergraduate research
- Participation in a student design team
- Completion of an internship
- Student teaching
- Classroom presentation *etc*.

Text Books:

1. Fermentation and Biochemical Engineering Handbook, Principles, Process Design, and Equipment; Edited by Henry C. Vogel; Noyes Publications, New Jersey, U.S.A. ISBN: 0-8 155- 1407-7. 2.
2. Biotechnology- Volume 3- Bioprocessing; VCH VerlagsgesellschaftmbH. Weinheim, ISBN 3-527- 28313-7 (Weinheim); ISBN 1-56081-153-6 (New York).

Reference Books:

1. Principles of Fermentation Technology, P. E. Stanbury, A. Whitaker and S.J. Hall, Butterworth Heinemann, ISBN: 07506 45016.
2. Practical Fermentation Technology, B. Mcneil and L. M. Harvey, John Wiley & Sons Ltd, The Atrium, Southern Gate, Chichester, ISBN 978-0470-0143492.
3. Buchanan, B., Gruissem, W. and Jones, R., Biochemistry and Molecular Biology of Plants, 2nd Edition, 2015, American Society of Plant Biologists, USA.

Course Title:Practical – VI Course Component: Major	
Course code:BTC152M614Credit: 4	
Level of course: 300	**L-T-P-C: 0-0-8-4**
Scheme of Evaluation: Practical (P)	

Course Objectives: The main objective of the course is toperform the experiments associated with the subjects taught and understand the underlying principles.

Course Outcome:

On successful completion of the course the students will be able to:		
	Course outcome	**BT Level**
CO1	**Learn** and **remember** about the process of preparation of consumables for various experiments	**BT1**
CO2	**Understand** about the principles involved in Genetic Engineering, Bioprocess Technology and Bioinformatics	**BT2**
CO3	**Apply** the knowledge of bioprocess technology in developing various products	**BT3**
CO4	**Categorize** the equipment's used and the underlying safety measures in a laboratory	**BT4**

Detailed Syllabus:

Modules	**Topics & Course Contents**	**Period**
I	• Isolation of genomic DNA from bacteria, plants and blood. • Isolation of plasmid DNA from bacteria • Quantification of DNA through Spectrophotometric analysis	**20**
II	• Agarose gel electrophoresis • PCR (Polymerase Chain Reaction), Setting up a PCR reaction, Optimization of PCR conditions, gel documentation	**24**
III	• Designing of stirred tank bioreactor • Production of wine from fruit juice • Isolation of protoplast from plant • Fusion of protoplast • Preparation of synthetic seeds	**24**
IV	• Introduction to bioinformatics software • Database search and sequence download • Sequence retrieval and analysis • BLAST, FASTA: Search and analysis of data • Sequence alignment: algorithms for global and local alignments, pairwise alignment and multiple sequence alignment • Phylogenetic analysis and tree building • Protein structure download and structural analysis • ADMET – drug properties analysis and toxicology study	**28**

TOTAL	**96**

Credit distribution:

4 credits: 4 × 30= 120 Notional Credit Hours (96 lab hours + 24 Experiential learning)

Experiential learning activities may include:

- undergraduate research
- participation in a student design team
- completion of an internship
- student teaching
- classroom presentation etc.

Text Books:

As suggested under the theory papers.

Course Title: Entrepreneurship Development **Course Component:** Minor
Course code: BTC152N601 Credit: 4
Level of course: 300 **L-T-P-C: 4-0-0-4**
Scheme of Evaluation: Theory (T)

Course Objective: The main objective of the course is to provide the basic understanding in entrepreneurship and its importance in daily life. The content of the course is aligned with SDG9: Industry, innovation, and infrastructure.

Course Outcome:

On successful completion of the course the students will be able to:		
Course Outcome		**BT Level**
CO 1	**Remember** the role of entrepreneurship in daily life.	**BT 1**
CO 2	**Understand** the role of development of entrepreneurship and its activities in sustaining a life.	**BT 2**
CO 3	**Interpret** the knowledge in generating entrepreneurship avenues.	**BT 3**
CO 4	**Outline** the role of entrepreneurship in solving unemployment problem.	**BT 4**

Detailed Syllabus:

Modules	Topics & Course Contents	Periods
I.	Entrepreneurship: Meaning and its needs and importance. Promotion of entrepreneurship, factors influencing entrepreneurship, Features of successful entrepreneurship	**12**
II.	Establishment of enterprise: Forms of business organization, project identification, formulation and feasibility, selection of product. Entrepreneurship and International Business: Meaning of International business, selection of product and market, financing in business and export, institutional support for exports.	**12**
III.	Enterprise financing: Importance of finance/loans and repayments, characteristics of business finance, sources of fixed capital, working capital and its sources, application for loans. Inventories, raw materials and its management.	**12**
IV	Marketing Management: Meaning and importance, marketing mix, product management, marketing research, survey and its importance, physical distribution and stock management.	**12**
	TOTAL	**48**
Pedagogy: Lectures, Assignments, Seminars		

Credit distribution:

4 credits: 4 × 30= 120 Notional Credit Hours (60 class hours + 60 Experiential learning)

Experiential learning activities may include:

- undergraduate research
- participation in a student design team
- completion of an internship
- student teaching
- classroom presentation *etc.*

TextBooks

1. EntrepreneurshipandSmallBusinessManagement:C.B.Gupta,S.S.Khanka,2017, SultanChandand Sons.

ReferenceBooks

1. D.H.Holt,Entrepreneurship:NewVentureCreation. 2016, Pearson Education India.

SYLLABUS (7th SEMESTER)

Course Title: Environmental Biotechnology	**Course Component: Major**
Course code: BTC152M701	**Credit: 4**
Level of course: 400	**L-T-P-C: 3-1-0-4**
Scheme of Evaluation: Theory (T)	

Course Objectives: The main objective of the course is to provide comprehensive understanding on the use of biotechnology to protect and improve the environment. The course covers topics such as the role of microorganisms in environmental processes, and how they can be used to remediate polluted soil and water. The content of the course is aligned with SDG6: Clean water and sanitation.

Course Outcome:

On successful completion of the course the students will be able to:		
Course outcome		**BT Level**
CO1	Recall the environmental problems and their sources	**BT1**
CO2	Understand the concepts of various global and regional environmental concerns due to natural causes and/or human activities, and the impact of these on various forms of life including native biodiversity	**BT2**
CO3	Develop the knowledge on the applications of environmental biotechnology in various fields	**BT3**
CO4	Analyze the examples of different types of environmental pollution and their impacts	**BT4**

Detailed Syllabus:

Modules	Topics & Course Contents	Period
I	Limiting factors, energy transfer and biogeochemical cycling in ecological systems; Response of microbes, plant and animals to environmental stresses; Concept of ecosystems and ecosystem management, Environmental problems- ozone depletion, green house effect, water, air and soil pollution, land degradation.	**16**
II	GEMs in environment; Role of environmental biotechnology in management of environmental problems, Bioremediation, advantages and disadvantages; In situ and ex-situ bioremediation; slurry bioremediation; Bioremediation of contaminated ground water and phytoremediation of soil metals; microbiology of degradation of xenobiotics	**16**
III	Sewage and waste water treatment and solid waste management, chemical measure of water pollution, conventional biological treatment, role of microphyte and macrophytes in water treatment; Recent approaches to	**16**

	biological waste water treatment, composting process and techniques, use of composted materials	
IV	Biofuels, plant derived fuels, biofuel from algae, biogas, landfill gas, bioethanol, biohydrogen; use of biological techniques in controlling air pollution; Removal of chlorinated hydrocarbons from air.	**16**
	Total	**64**
Pedagogy: Lectures, Assignments, Seminars		

Credit distribution:

4 credits: 4 × 30= 120 Notional Credit Hours (80 class hours + 40 Experiential learning)

Experiential learning activities may include:

- Undergraduate research
- Participation in a student design team
- Completion of an internship
- Student teaching
- Classroom presentation *etc*.

Text Books:

1. Wang, L. et al. (2010). Environmental Biotechnology, Humana Press. (available at UTS Library, either in hard copy or electronic version)
2. Wang, L. et al. (2010). Environmental Engineering, Humana Press. (available at UTS Library, either in hard copy or electronic version)

Reference Books:

1. Vallero, D. A. (2010). Environmental Biotechnology: A Biosystems Approach, Elsevier. (available at UTS Library)
2. Evans, G. M. and Furlong, J. C. (2011). Environmental Biotechnology: Theory and Application, Wiley-Blackwell. (available at UTS Library)
3. Jördening, H. J. and Winter, J. (2005). Environmental Biotechnology: Concepts and Applications, Wiley-VCH. (available at UTS Library E-book)

Course Title: Techniques in Molecular Biology	**Course Component: Major**
Course code: BTC152M702	**Credit: 4**
Level of course: 400	**L-T-P-C: 3-1-0-4**
Scheme of Evaluation: Theory (T)	

Course Objective: The course is designed to learn about the various molecular biology techniques and their use in the various molecular biology experiments/tests in different biotech/biomedical laboratories/industries

Course Outcome:

On successful completion of the course the students will be able to:		
Course Outcome		**BT Level**
CO 1	**Remember** the procedures of various molecular techniques to perform molecular biology experiments/tests in different biotech/biomedical	**BT 1**
CO 2	**Understand** the role of various instruments and setups in the Molecular Biology laboratory and in biotech/biomedical industry.	**BT 2**
CO 3	**Apply** the knowledge of molecular biology in biotech/biomedical industry	**BT 3**
CO 4	**Analyze** the theoretical knowledge in the implementation of proper molecular techniques in biotech/biomedical industry	**BT 4**

Detailed Syllabus:

Modules	**Topics & Course Contents**	**Periods**
I.	Extraction methods of nucleic acids, basic extraction steps, and nucleic acid analysis, Polymerase chain reaction (PCR) and Real time PCR, In-situ hybridization. Souther Blot. DNA Sequencing.	**16**
II.	Gel electrophoresis: Agarose and polyacrylamide gel electrophoresis, , Restriction enzymes, Restriction Digestion, RFLP, AFLP, RAPD, DNA fingerprinting.	**16**
III.	Extraction methods of proteins, SDS-PAGE, 2D-gel Gel electrophoresis, Radioimmunoassay, Enzyme Linked Immunosorbent Assay (ELISA) and its types, Western Blot, Co-immunoprecipitation, Chromatin Immunoprecipitation assay.	**16**
IV.	Basic techniques in mammalian cell culture, primary culture and established cell lines, cell synchronization, transfection, and transformation of cells, application of animal cell culture for in vitro testing of drugs; testing of toxicity for environmental pollutants in cell culture. Fluorescence in situ hybridization; techniques for apoptotic cell studies.	**16**
	TOTAL	**64**

Pedagogy: Lectures, Assignments, Seminars

Credit distribution:

4 credits: 4 × 30 = 120 Notional Credit Hours (80 class hours + 40 Experiential learning)

Experiential learning activities may include:

- Undergraduate research
- Participation in a student design team
- Completion of an internship
- Student teaching
- Classroom presentation *etc*.

Text books

1. Wilson and Walker, Principles and Techniques of Biochemistry and Molecular Biology, 6th Edition, 2008, Cambridge University Press, New York, USA.
2. Owen JA, Punt J and Stranford SA (2013) Kuby Immunology, 7th Edition, WH Freeman and Company, NY.

Reference books

1. Principles of Gene Manipulation and Genomics- Primrose S &Twyman R, 7th Edition, Blackwell, 2006. ISBN-10: 1405135441
2. Male D., Brostoff J., Roitt I and Roth D (2012) Immunology, WB Saunders Co. USA

Course Title: Experiment Design and Data Analysis for Researchers	
Course Component: Major	
Course code: BTC152M703	**Credit: 4**
Level of course: 400	**L-T-P-C: 3-1-0-4**
Scheme of Evaluation: Theory (T)	

Course Objectives: The course aims to build scientific perspective, attitude and skills for systematic enquiry by developing understanding of philosophical foundations of research, various elements of research design and methods and tools for data collection and analysis. The course will enable comprehension of principles and elements of research methodology, to formulate research problem, objectives and questions. It will introduce students to various methods, tools and techniques related to research. The course has a strong practical component. The students will write research proposal and submit a full-length review article based on secondary data.

Course Outcome:

On successful completion of the course the students will be able to:		
Course outcome		**BT Level**
CO1	Recall the scientific principles involved in research methodology	**BT1**
CO2	Understand the strategies and various steps involved in defining research problems	**BT2**
CO3	Develop the knowledge of various tools and techniques involved in for data collection and fieldwork	**BT3**
CO4	Analyze theeffectiveness of literature survey in drafting quality manuscripts	**BT4**

Detailed Syllabus:

Modules	**Topics & Course Contents**	**Period**
I	Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.	**16**
II	Types of Researches Survey, historical, philosophical, experimental, case study, genetic Design of Experiments. Need and purpose, importance, characteristics of good experimental design, basic principles, types of basic experimental design. Questionnaire, schedule, rating scale, tests Collection of Data Need, meaning, nature; constants, variables, variate; characteristics of quantitative data, types of data, data collection, organization of data.	**16**

III	Tools of Research Questionnaire, schedule, rating scale, tests Collection of Data Need, meaning, nature; constants, variables, variate; characteristics of quantitative data, types of data, data collection, organization of data.	**16**
IV	Research Report & Proposal Writing Need of research report, format of research report (preliminary section, main section & reference section), Journal matrices: citation index, h-index, impact factor of journals, mechanics of writing Reports, Research Abstract, and Research Paper, Need of research proposal for dissertation and for obtaining funds from various sources. Effective literature study approaches, analysis Plagiarism, Research ethics.	**16**
	TOTAL	**64**
Pedagogy: Lectures, Assignments, Seminars		

Credit distribution:

4 credits: 4 × 30 = 120 Notional Credit Hours (80 class hours + 40 Experiential learning)

Experiential learning activities may include:

- Undergraduate research
- Participation in a student design team
- Completion of an internship
- Student teaching
- Classroom presentation *etc.*

Text Books:

1. Kothari R.C. (2005): Research Methodology, 2nd Edition, New Age International Publisher Ltd., New Delhi.

Course Title: Practical – VII	**Course Component: Major**
Course code: BTC152M714	**Credit: 4**
Level of course: 400	**L-T-P-C: 0-0-8-4**
Scheme of Evaluation: Practical (P)	

Course Objectives: The main objective of the course is to perform the experiments associated with the subjects taught and understand the underlying principles.

Course Outcome:

On successful completion of the course the students will be able to:		
Course outcome		**BT Level**
CO1	**Learn** and **remember** about the process of preparation of consumables for various experiments	**BT1**
CO2	**Understand** the principles involved in Environmental, Medical Biotechnology and Plant and Animal Physiology	**BT2**
CO3	**Apply** the knowledge in developing solutions to environmental issues	**BT3**
CO4	**Categorize** the equipment's used and the underlying safety measures in a laboratory	**BT4**

Detailed Syllabus:

Modules	**Topics & Course Contents**	**Period**
I	• Isolation and screening of fecal coliforms from contaminated water. • Determination of BOD of contaminated water. • Determination of COD of contaminated water	**20**
II	• To learn human chromosome and karyotyping • Preparation of human chromosome from blood culture • Design PCR primers and PCR amplification from oncogene/tumor suppressor gene	**28**
III	• Extraction of RNA and conversion to cDNA • Gene expression analysis by qRTPCR	**20**
IV	• Histological staining of tissues • Determination of human blood grouping • To learn the principle and procedure of ELISA • VDRL test • WIDAL test • SGPT and SGOT test for liver functioning	**28**
	TOTAL	**96**

Credit distribution:

4 credits: 4 × 30 = 120 Notional Credit Hours (96lab hours + 24 Experiential learning)

Experiential learning activities may include:

- Undergraduate research
- Participation in a student design team
- Completion of an internship
- Student teaching
- Classroom presentation *etc*

Text Books:

As suggested under the theory papers.

Course Title: Research Component-1

Course Component: Major

Course code: BTC152M724

Credit: 4

Level of course: 400

L-T-P-C: 0-0-8-4

Scheme of Evaluation: Practical (P)

***Only for honours with research**

Course Title: Pharmaceutical Biotechnology	**Course Component: Minor**
Course code: BTC152N701	**Credit: 4**
Level of course: 400	**L-T-P-C: 4-0-0-4**
Scheme of Evaluation: Theory (T)	

Course Objectives: The objective of this course is to make Students understand the basic concepts involved in pharmaceutical industry.

Course Outcome:

On successful completion of the course the students will be able to:		
	Course outcome	**BT Level**
CO1	Recall the scientific principles involved in drug development	**BT1**
CO2	Understand the strategies and various steps of new drug discovery process	**BT2**
CO3	Develop the knowledge of pharmaceutical manufacturing in the production of biopharmaceuticals like antibiotics, vaccines, proteins and hormones	**BT3**
CO4	Analyze available drug formulations for suitability of usage	**BT4**

Detailed Syllabus:

Modules	**Topics & Course Contents**	**Period**
I	Definition and scope of Pharmaceutical Biotechnology, sources of drugs, classification of pharmacological agents (based on chemistry, mode of action, dosage forms), route of administration, absorption and bioavailability of drugs, distribution and liver detoxification metabolism and drug excretion.	**16**
II	General classes and properties of phytopharmaceuticals, Extraction of phytochemicals, Phytochemical screening of medicinal plants. Bioassay guided fractionation methods TLC, HPTLC, GC, and HPLC, Role of NMR and Mass spectrometry in drug discovery.	**16**
III	Antimicrobial agents, Antibiotics -source, classification, mode of action, Antimicrobial resistance, and Antimicrobial activity studies (antibacterial, antiviral, antifungal and antiparasitic activity). Pharmacological Assays - In-vitro assays - chemical (anti-oxidant), Biological (anticancerous and assay system based on enzymes and cells), and immunological (RIA and ELISA) - In vivo assays (Anti-inflammatory and Anti-analgesic). Basic concept of computer aided drug designing, ADMET of drugs	**16**
IV	Vaccines: concept, production and types - Inactivated, Attenuated, toxoid, Recombinant vaccines, Peptide and DNA vaccines, Edible vaccines,	**16**

	nanodrugs. Recombinant proteins, approved rDNA drugs in market, Probiotics, Nutraceuticals, Economic and legal considerations in Pharmaceutical Biotechnology	
	TOTAL	**64**
Pedagogy: Lectures, Assignments, Seminars		

Credit distribution:

4 credits: 4 × 30 = 120 Notional Credit Hours (80 class hours + 40 Experiential learning)

Experiential learning activities may include:

- Undergraduate research
- Participation in a student design team
- Completion of an internship
- Student teaching
- Classroom presentation *etc.*

Text Books:

1. Satoskar R.S, Nirmala N. Rege, and Bhandarkar S. D, Pharmacology and Pharmacotherapeutics (Revised 23rd Edition), Popular Prakashan, Mumbai.
2. Tripathy K. D, Essentials of Medical Pharmacology (6th edition), Jaypee publishers
3. Shoba rani R Hiremath, Text book of industrial pharmacy, Orient Longman Pvt ltd 2008.
4. Crommelin Daan J. A., Sindelar D. Robert (3rd edition) Pharmaceutical Biotechnology: Fundamentals and Applications, CRC Press, 2007.

Reference Books:

1. Trease, G.E.and Evans, W.C., 2011, Pharmacognosy (12^{th} edition), Bailliere Tindall Eastbourne, U.K
2. Mukherje P.K.,Quality Control Herbal Drugs–An approach to evaluation of botanicals. Business Horizons Pharmaceutical Publishers, 2005
3. Sambamurthy K., Pharmaceutical Biotechnology (1st edition) New Age International

SYLLABUS (8th SEMESTER)

Course Title: Instrumentation and Techniques	**Course Component: Major**
Course code: BTC152M801	**Credit: 4**
Level of course: 400	**L-T-P-C: 3-1-0-4**
Scheme of Evaluation: Theory (T)	

Course Objective: The objective of an Instrumentation and Techniques course is to familiarize students with the analytical equipment, both basic and sophisticated, used in different fields of biotechnology. Students learn about the working principle and operational procedure of the techniques.

Course Outcome

On successful completion of the course, the students will be able to:		
Course outcome		**BT Level**
CO1	**Recall** the basic principles behind routine analytical techniques	BT1
CO2	**Understand** the specific role of an instrument in a biological analysis	BT2
CO3	**Develop** the knowledge to combine multiple instrumental techniques to improve analytical efficiency and accuracy.	BT3
CO4	**Analyze** the mass-spectral and ultramicroscopic data to reveal complex structural information.	BT4

Detailed Syllabus

Modules	**Topics (if applicable) & Course Contents**	**Periods**
I	General introduction to analytical equipment. Maintenance, operation, and safety measures in the laboratory. Spectroscopic techniques: Theory & application of- UV-VIS and IR spectroscopy, Mass spectroscopy (MS), NMR, XRD.	16

II	Electrophoresis: Basic principles and application of SDS-PAGE, agarose, agar cellulose (horizontal and vertical) electrophoresis; submerged electrophoresis, Isoelectricfocusing, Pulse Field Gel Electrophoresis (PFGE); Field inversion electrophoresis, Capillary and Immunoelectrophoresis	16
III	Chromatographic techniques: Partition, ion exchange, gel filtration, and affinity chromatography. Chromatographic methods such as TLC, HPLC, and FPLC. Hyphenated chromatography systems and their applications of LC-MS, GC-MS Centrifugation techniques: principles and applications. Types of centrifuges. Ultracentrifugation and density gradient centrifugation.	16
IV	Microscopy: light, dark field, phase contrast, fluorescent microscopy, SEM, and TEM. Confocal Microscopy, Basic concept of X-ray microprobe analysis, and EM Tomography. Radioactive isotopes: Basic principles and application of tracer techniques, gamma counters, liquid scintillation counter, Measurement of radioactivity. Autoradiography.	16
TOTAL		**64**
Pedagogy: Lectures, Assignments, Seminars		

Credit distribution:

4 credits: 4 × 30 = 120 Notional Credit Hours (80 class hours + 40 Experiential learning)

Experiential learning activities may include:

- Undergraduate research
- Participation in a student design team
- Completion of an internship
- Student teaching
- Classroom presentation, *etc*.

Textbooks

1. Modern Analytical Chemistry, David Harvey, McGraw-Hill, 1st ed, 2000, ISBN: 0–07–237547–7

2. Chemical Analysis: Modern Instrumentation Methods and Techniques, Francis Rouessac, AnnickRouessac, John Wiley & Sons, 2nd ed, 2007. ISBN: 0470859040, 9780470859049

Reference books

1. Principles of Instrumental Analysis", D. A. Skoog, F. J. Holler, S.R. Crouch, Brooks Cole; 6th edition (Dec 6th2006), ISBN: 0495012017, 978-0495012016

2. Physical Biochemistry by David Freifelder.

Course Title: Medical Biotechnology	**Course Component: Major**
Course code: BTC152M802	**Credit: 4**
Level of course: 400	**L-T-P-C: 3-1-0-4**
Scheme of Evaluation: Theory (T)	

Course Objectives: The objective of a Medical Biotechnology course is to teach students how to apply biotechnology to medicine and healthcare. Students learn about molecular biology, genetic engineering, and other areas to address medical challenges. The content of the course is aligned with SDG3: Good health and well – being.

Course Outcome:

On successful completion of the course the students will be able to:		
Course outcome		**BT Level**
CO1	Recall the cellular and molecular the cause and development of diseases or abnormal conditions	**BT1**
CO2	Understand the concepts of human oncogenesis	**BT2**
CO3	Develop the knowledge on the applications of biotechnology in various medical fields	**BT3**
CO4	Analyze the examples of different types of recombinant andimmunotherapeutic techniques	**BT4**

Detailed Syllabus:

Modules	**Topics & Course Contents**	**Period**
I	Introduction: History and scope of medical biotechnology, current status and future prospects. Classification of genetic diseases: Chromosomal disorders – Numerical disorders e.g. trisomies & monosomies, Structural disorders e.g. deletions, duplications, translocations & inversions, Chromosomal instability syndromes. Gene controlled diseases – Autosomal and X-linked disorders, Mitochondrial disorders.	**16**
II	Molecular basis of human diseases: - Pathogenic mutations Gain of function mutations: Oncogenes, Huntington's Disease, Pittsburg variant of alpha 1 antitrypsin. Loss of function - Tumour Suppressor. Genomic. Dynamic Mutations - Fragile- X syndrome, Myotonic dystrophy. Mitochondrial diseases	**16**
III	Gene therapy: Ex-vivo, In vivo, In situ gene therapy, Strategies of gene therapy: gene augmentation Vectors used in gene therapy Biological vectors – retrovirus, adenoviruses, Herpes Synthetic vectors– liposomes, receptor mediated gene transfer. Gene therapy trials – Familial Hypercholesterolemia,	**16**

	ADA, AIDS, Cystic Fibrosis, Solid tumors. epigenetic inheritance, problems & ethics. Gene therapy Models – Liver diseases, Lung diseases, Hematopoietic diseases, & Auto-immune diseases. SARS-CoV-2 (severe acute respiratory syndrome coronavirus 2), and HPV	
IV	Recombinant & Immunotherapy; Clinical applications of recombinant technology; Erythropoietin; Insulin analogs and its role in diabetes; Recombinant human growth hormone; Streptokinase and urokinase in thrombosis; Recombinant coagulation factors, Monoclonal antibodies and their role in cancer; Role of recombinant interferons; Immunostimulants; Immunosupressors in organ transplants; Role of cytokine therapy in cancers	**16**
	TOTAL	**64**
Pedagogy: Lectures, Assignments, Seminars		

Credit distribution:

4 credits: 4 × 30 = 120 Notional Credit Hours (80 class hours + 40 Experiential learning)

Experiential learning activities may include:

- Undergraduate research
- Participation in a student design team
- Completion of an internship
- Student teaching
- Classroom presentation *etc*.

Text Books

1. Diagnostic and Therapeutic Antibodies (Methods in Molecular Medicine by Andrew J.T. George (Editor), Catherine E. Urch (Editor) Publisher: Humana Press; edition (2000)

Reference Books

1. Molecular Diagnosis of Infectious Diseases (Methods in Molecular Medicine) by Jochen Decker, U. Reischl
2. Human Molecular Genetics by T. Strachan, Andrew Read Amazon Sales Rank

Course Title: Research Component-2

Course Component: Major

Course code: BTC152M823

Credit: 4

Level of course: 400

L-T-P-C: 0-0-8-4

Scheme of Evaluation: Practical (P)

***Only for honours with research**

Course Title: Developmental BiologyCourse	**Component: Major**
Course code: BTC152M803	**Credit: 4**
Level of course: 400	**L-T-P-C: 3-1-0-4**
Scheme of Evaluation: Theory (T)	

Course Objectives: The main objective is to teach the processes of development, the genetic and molecular basis of development, and the evolutionary history of life forms.

Course Outcome:

On successful completion of the course the students will be able to:		
Course outcome		**BT Level**
CO1	**Remember** the various principles of developmental biology.	BT1
CO2	**Understand** the functions of cellular organelles and how a cell carries out and regulates cellular functions	BT2
CO3	**Apply** the acquired knowledge to solve real-world medical issues.	BT3
CO4	**Analyze**criticallyto solve theoretical questions in the topic.	BT4

Detailed Syllabus:

Modules	**Topics & Course Contents**	**Period**
I	Historical perspective and basic concepts: Phases of development, Cell-Cell interaction, Pattern formation, Differentiation and growth, Differential gene expression, Cytoplasmic determinants and asymmetric cell division	**16**
II	Gametogenesis, Spermatogenesis, Oogenesis; Types of eggs, Egg membranes; Fertilization (External and Internal): Changes in gametes, Blocks to polyspermy; Planes and patterns of cleavage; Types of Blastulae; Fate maps (including Techniques); Early development of frog and chick up to gastrulation; Embryonic induction and organizer	**16**
III	Fate of Germ Layers; Extra-embryonic membranes in birds; Implantation of embryo in humans, Placenta (Structure, types and functions of placenta)	**16**
IV	Metamorphosis: Changes, hormonal regulations in amphibians and insects; Regeneration: Modes of regeneration, epimorphosis, morphallaxis and compensatory regeneration (with one example each); Ageing: Concepts and Theories; Teratogenesis: Teratogenic agents and their effects on embryonic development; Amniocentesis	**16**
	TOTAL	**64**
Pedagogy: Lectures, Assignments, Seminars		

Credit distribution:

4 credits: 4 × 30 = 120 Notional Credit Hours (80 class hours + 40 Experiential learning)

Experiential learning activities may include:

- Undergraduate research
- Participation in a student design team
- Completion of an internship
- Student teaching
- Classroom presentation *etc*.

Text Books:

1. Gilbert, S. F. (2010). Developmental Biology, IX Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA
2. Balinsky B. I. and Fabian B. C. (1981). An Introduction to Embryology, V Edition, International Thompson Computer Press

Reference Books

1. Carlson, R. F. Patten's Foundations of Embryology
2. Kalthoff (2008). Analysis of Biological Development, II Edition, McGraw-Hill Publishers
3. Lewis Wolpert (2002). Principles of Development. II Edition, Oxford University Press.

Course Title: Ecosystem Degradation and Intervention	**Course Component: Major**

Course code: BTC152M804	**Credit: 4**
Level of course: 400	**L-T-P-C: 3-1-0-4**
Scheme of Evaluation: Theory (T)	

Course Objectives: The main objective of the course is to provide the knowledge of functioning of ecosystem, their degradation and the interventions required. The content of the course is aligned with SDG13: Climate action.

Course Outcome:

On successful completion of the course the students will be able to:		
Course outcome		**BT Level**
CO1	**Remember**the concepts of ecosystem and ecology.	**BT1**
CO2	**Understand** the role of ecosystem and ecology in degradation of environment.	**BT2**
CO3	**Apply** the theoretical knowledge of ecosystem in understanding environmental issues.	**BT3**
CO4	**Analyze**the impact of ecosystem degradation upon environment.	**BT4**

Detailed Syllabus:

Modules	Topics & Course Contents	Period
I	Environment: Definitions, Components and Inter-relationships, Parts of the environment, Ecology and Ecosystems, examples of interconnections in nature. Ecology and ecosystem: Structure and boundaries of ecosystem, evolution of an ecosystem, value of ecosystem and ecosystem services. Biogeochemical cycles: Cycling elements, water cycle, carbon cycle, nitrogen cycle, phosphorus cycle, sulphur cycle. Impact of human activity on the cycling elements.	**16**
II	Environmental degradation: Impact of anthropogenic activities on biotic and abiotic components of ecosystem. Causes of biodiversity loss. Ecological balance and footprint; United Nations Millennium ecosystem assessment. Environmental toxicology: Toxic chemicals in the environment (air and water) – their effects and biochemical interactions; Pesticides, Heavy metals, etc.	**16**
III	Global environmental issues: Ozone layer depletion (Montreal protocol), El Nino, Acid rain - causes and effects, Green House Gases(GHG) and greenhouse effect, global climate change, global warming – effect on oceans, coastline and marine ecosystem, impact of global warming on India. Response to global warming – Kyoto protocol and its outcome. Environmental laws: The Environment Protection Act, 1986; The Water (Prevention and Control of Pollution) Act, 1974; The Air (Prevention and Control of Pollution) Act, 1981; The Forest Conservation Act, 1980, Cartagena protocol, COP27,	**16**

IV	Biotechnological interventions for pollution control: Biofilters, Bioremediation, Biotransformation, Biodegradation, and Phytoremediation: In situ and Ex situ bioremediation; Evaluating Bioremediation; Bioremediation of VOCs. Factors affecting process of biodegradation; Contaminant availability for biodegradation; Use of microbes (bacteria and fungi) and plants in biodegradation and Biotransformation; Phytoremediation: Waste water treatment using aquatic plants, sustainable agriculture, waste to energy and waste management.	**16**
	TOTAL	**64**
Pedagogy: Lectures, Assignments, Seminars		

Credit distribution:

4 credits: 4 × 30 = 120 Notional Credit Hours (80 class hours + 40 Experiential learning)

Experiential learning activities may include:

- Undergraduate research
- Participation in a student design team
- Completion of an internship
- Student teaching
- Classroom presentation *etc*

Text Books:

1. Kumar H. D., Modern Concepts Of Ecology, 2018, 8th edition, Vikas Publishing House
2. Tyler Miller, G. Living in the Environment: Principles, Connections, and Solution, 16th edition, 2009,Cengage Publications

Reference Books

1. Nebel, B.J. & Wright, R. Environmental Science: Toward a Sustainable Future. Pearsons, Latest edition.
2. Cunningham, W.P., Cunningham, M.A. & Saigo, B. Environmental Science, a Global Concern. (16thedition). 2021, McGraw-Hill (Boston)