Deccan Education Society's

Fergusson College (Autonomous)
Pune

Learning Outcomes-Based Curriculum

for 3/4 years B. Sc. / B. Sc. (Honours) Programme

as per guidelines of

NEP-2020

for

F. Y. B. Sc. (Biotechnology)

With effect from Academic Year

2023-2024

Program Outcomes (POs) for B.Sc.	
PO1	**Disciplinary Knowledge:** Demonstrate comprehensive knowledge of the disciplines that form a part of a graduate programme. Execute strong theoretical and practical understanding generated from the specific graduate programme in the area of work.
PO2	**Critical Thinking and Problem solving:** Exhibit the skills of analysis, inference, interpretation and problem-solving by observing the situation closely and design the solutions.
PO3	**Social competence:** Display the understanding, behavioural skills needed for successful social adaptation, work in groups, exhibits thoughts and ideas effectively in writing and orally.
PO4	**Research related skills and Scientific temper:** Develop the working knowledge and applications of instrumentation and laboratory techniques. Able to apply skills to design and conduct independent experiments, interpret, establish hypothesis and inquisitiveness towards research.
PO5	**Trans-disciplinary knowledge:** Integrate different disciplines to uplift the domains of cognitive abilities and transcend beyond discipline-specific approaches to address a common problem.
PO6	**Personal and professional competence:** Performing dependently and also collaboratively as a part of team to meet defined objectives and carry out work across interdisciplinary fields. Execute interpersonal relationships, self-motivation and adaptability skills and commit to professional ethics.
PO7	**Effective Citizenship and Ethics:** Demonstrate empathetic social concern and equity centred national development, and ability to act with an informed awareness of moral and ethical issues and commit to professional ethics and responsibility.
PO8	**Environment and Sustainability:** Understand the impact of the scientific solutions in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.
PO9	**Self-directed and Life-long learning:** Acquire the ability to engage in independent and life-long learning in the broadest context of socio-technological changes.

PSO No.	Program Specific Outcomes (PSOs) Upon completion of this programme the student will be able to
PSO1	**Academic competence:** (i) Demonstrate comprehensive knowledge, imparted by highly qualified and competent faculty, and develop interdisciplinary skills in the fields of Biotechnology. (ii) Acquire good experimental and laboratory skills applied in biotechnology and allied subjects in well-equipped and state of the art laboratories. (iii) Understand the scope and applications of biotechnology and acquire competence in the domain of Biotechnology to enable bright future prospects
PSO2	**Personal and Professional Competence:** (i) Demonstrate conceptual learning through systematic thinking and self - study and life- long learning that helps to solve scientific problems in the field of Biotechnology. (ii) Apply appropriate tools and techniques in biotechnology, to design and perform experiments proficiently and become competent to pursue higher studies or join the industry sector. (iii) Acquire good oral and written communication skills. (iv) Discuss the upcoming fields of Biotechnology. (v) Experience opportunity to participate in/manage/curate many co and extracurricular activities for overall development.
PSO3	**Research Competence:** (i) Acquire an ability to identify, formulate, analyze and solve scientific problems in various areas of Biotechnology and allied fields. (ii) Demonstrate appropriate skills in design of experiments with proper scientific approach. (iii) Develop ability to apply scientific research methodology and achieve ethical research aptitude.
PSO4	**Entrepreneurial and Social competence:** (i) Employ skills and knowledge acquired in skill imparting and entrepreneurial courses in upcoming fields of Biotechnology (ii) Develop a sense of environmental, social, ethical and professional responsibility.

Fergusson College (Autonomous), Pune
Proposed First Year Curriculum as per NEP 2020

Department of Biotechnology

Structure for Major / Minor

Semester	Paper Code	Paper Title	Type	Credits
I	**BTH-100 (Major)**	Practicals in Cell Biology and Biomolecules	Practical	**2**
	BTH-101 (Major)	Introduction to Cell Biology and Biomolecules	Theory	**4**
	BTH-120 (GE/OE)	Everyday Biotechnology	Theory	**2**
	BTH-121 (GE/OE)	Biotechnology in Dairy industry	Theory	**2**
	BTH-130 (VSC)	Basics of Biostatistics and Computers	Voc. Skills	**2**
	BTH-140 (SEC)	Survey Methodology	Skill	**2**
	IKS - 101 (IKS)	Indian Knowledge System	IKS	**2**
II	**BTH-150 (Major)**	Practicals in Fundamentals of Life Sciences	Practical	**2**
	BTH-151 (Major)	Fundamentals of Life Sciences	Theory	**4**
	BTH-161 (Minor for other students)	Concepts in Biotechnology	Theory	**2**
	MIC 165 (Minor for Biotech students)	Fundamentals of Microbial Sciences	Theory	**2**
	BTH-170 (GE/OE)	Biotechnology in Health and Diagnosis	Theory	**2**
	BTH-171 (GE/OE)	Entrepreneurship in Biotechnology: Mushroom cultivation	Theory	**2**
	BTH-180 (VSC)	Techniques in Biotechnology	Voc. Skills	**2**
	BTH-190 (SEC)	Basic Bioinstrumentation	Skill	**2**

Teaching and Evaluation (Only for FORMAL education courses)

Course Credits	No. of Hours per Semester Theory/Practical	No. of Hours per Week Theory / Practical	Maximum Marks	CE 40 %	ESE 60%
1	**15 / 30**	**1 / 2**	**25**	**10**	**15**
2	**30 / 60**	**2 / 4**	**50**	**20**	**30**
3	**45 / 90**	**3 / 6**	**75**	**30**	**45**
4	**60 / 120**	**4 / 8**	**100**	**40**	**60**

Eligibility: As per the rules and regulations of Savitribai Phule Pune University (SPPU)

F.Y.B.Sc. Semester I		
BTH-100	**Practicals in Cell Biology and Biomolecules (Major-Practical)**	**Credits:** 2 **Hours:** 60
Course Outcomes (COs) On completion of the course, the students will be able to:		
CO1	Demonstrate and analyze different stages of mitosis and meiosis	
CO2	Illustrate the enumeration and measurement of sizes of various types of cells	
CO3	Perform organelle separation by differential centrifugation.	
CO4	Calculate and prepare standard solutions, buffers	
CO5	Test the presence of biomolecules in a sample	
CO6	Perform titration of amino acids	

Unit	Content	Number of practicals (15P)
	Cell Biology	
1	Study of mitosis (onion root tip) – preparation of slides and identification of different stages	1.5
2	Study of meiosis (grasshopper testis/*Tradescantia* anther)– preparation of slides and identification of different stages	1.5
3	Enumeration of yeast cells using a counting chamber	1
4	Micrometry – measurement of cell size and nucleus from various cell types	2
5	Organelle separation by differential centrifugation	2
	Biomolecules	
5	Mathematical Calculations, problems based on normality, molarity, stock and working standard preparation, buffer preparation	3
6	Detection tests for Carbohydrates, Proteins, Lipids and Nucleic acids.	3
7	Titration of amino acid.	1

F.Y.B.Sc. Semester I		
BTH-101	**Introduction to Cell Biology and Biomolecules (Major- Theory)**	**Credits:** 4 **Hours:** 60
Course Outcomes (COs) On completion of the course, the students will be able to:		
CO1	Describe the structure and functions of cellular organelles	
CO2	Explain plasma membrane, cytoskeleton and extra cellular matrix	
CO3	Outline and contrast the archaebacterial, prokaryotic and eukaryotic cells	
CO4	Explain the chemical foundation of Biochemistry	
CO5	Determine the structure of biomolecules	
CO6	Formulate and solve numerical problems related to buffer preparations	

Unit	Content	Number of hours
	Cell Biology	
1	Introduction to Cell and its functions. Comparative account of archaebacteria, prokaryotic and eukaryotic cells. Introduction to virus.	5
2	Structure and function of cell organelles: Endoplasmic reticulum, Mitochondria, Chloroplast, Ribosomes, Golgi body, Nucleus, Lysosomes, Vacuoles, Peroxisomes and Glyoxysomes	10
3	Plasma membrane, cytoskeleton and extra cellar matrix: Organization and properties of plasma membrane. Cytoskeleton- Structure- assembly and disassembly of cytoskeleton elements Extracellular matrix and cell junctions- relevance to tissuestructure, Plasmodesmata- structure and function Plant cell wall - primary and secondary cell wall	8
4	Cell division, Cell Cycle and its regulation: Mitosis, meiosis in plants and animals, Phases of cell cycle. Checkpoints and regulation of cell cycle	7
	Biomolecules	
5	Chemical foundation of Biochemistry: Common functional groups of biomolecules, molecular components of a cell, Stereoisomers, Geometric isomers, Enantiomers, Chiral and achiral molecules, Physical and chemical properties of water, pH scale, Buffer preparation, Henderson-Hasselbalch equation	5
6	Carbohydrates: structure, classification, reactions, sugar derivatives	7
7	Proteins: classification of amino acids, structural levels of proteins, physical and chemical properties	8
8	Lipids: structure, function, classification, lipoproteins	5
9	Nucleic acids: structure and functions of DNA and RNA, types	5

	of RNA,	

References:

1. Molecular Cell Biology. Lodish H., Berk A, Kaiser C., K Reiger M., Bretscher A., Ploegh H., Angelika Amon A., Matthew P. Scott M.P., 7th Edition, (2012) W.H. Freeman and Co., USA
2. Molecular Biology of the Cell, Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter, 5th Edition (2007) Garland Science, USA
3. Cell Biology, Gerald Karp. 6th edition, (2010) John Wiley & Sons., USA
4. The Cell: A Molecular Approach, Geoffrey M. Cooper, Robert E. 6th edition (2013), Hausman, Sinauer Associates, Inc. USA
5. Becker's World of then Cell, Jeff Hardin, Gregory Bertoni, Lewis J.Kleinsmith, 8th Edition (2016), Pearson Education Limited, USA
6. Biochemistry: 4th Edition, (2011), Voet and Voet, John Wiley and Sons, Inc.
7. Principles of Biochemistry,7th edition (2017), Lehninger, Freeman W.H. and Company
8. Biochemistry, Berg J., Tymoczko J., Stryer L., 8th edition (2015), Freeman W. H. and Company

F.Y.B.Sc. Semester I		
BTH-120	**Everyday Biotechnology** **(GE/OE-Theory)**	**Credits:** 2 **Hours:** 30
Course Outcomes (COs) **On completion of the course, the students will be able to:**		
CO1	Outline the history and importance of biotechnological approaches in daily life	
CO2	Discuss the fundamental molecular basis of living organisms and distinguish between different forms of life	
CO3	Illustrate important basic techniques that are relevant in today's time and correlate their use with their molecular understanding	
CO4	Explain the principles of genetic manipulation and apply biotechnological concepts to improve quantity and/or quality in various fields	

Unit	Contents	No. of hours
1	**Introduction to biotechnology:** The Biotech timeline: from historical perspectives to current trends Flavours of biotechnology- medical, agriculture, industrial, environmental biotechnology.	**3**
2	**Molecules of life:** Introduction to biomolecules, their types and functions in the cell: carbohydrates, proteins, lipids, nucleic acids, vitamins and minerals Introduction to central dogma	**5**
3	**Cells and organisms:** Introduction to types of living forms: bacteria, protists, fungi, plants, animals; basic structural features and examples of each	**5**
4	**Principles of genetic manipulation:** Overview of recombinant DNA technology: objective, tools, methodology Important techniques used in daily life -PCR, DNA sequencing, use of bioinformatics and *omic* approaches etc.	**8**
5	**Cell culture and applications:** Introduction to microbial cell culture and applications from daily life Introduction to plant tissue culture and relevant applications like GM plants etc. Introduction to animal cell/tissue culture, emerging trends and applications Demonstration of few basic techniques and applications	**9**

References:

1. Milestones in Biotechnology: Classic papers in Genetic Engineering: J. A. Davis, W. S. Resnikoff
2. Biotechnology, B.D. Singh
3. Biotechnology: A Problem Approach by Pranav Kumar and Usha Mina
4. Principles of Gene Manipulation & Genomics – Primrose and Twyman (2006, 7thEdition)
5. Plant biotechnology - J Hammond & P. McGravey, V.Yushibov, Springer-Verlag
6. Amann, R.I. Stromley, J. Stahl: Applied & Environmental Microbiology

BTH-121	**Biotechnology in Dairy industry (GE/OE)**	**Credits:** 2 **Hours:** 30
Course Outcomes (COs) On completion of the course, the students will be able to:		
CO1	Outline Scope and opportunities of Dairy Industry in India	
CO2	Assess common micro-organisms found in milk and spoilage /contamination of milk	
CO3	Articulate different methods of Pasteurization	
CO4	Develop and devise microbial quality of milk by performing various test and Design Fermented Dairy Products	

Unit No.	Title of Unit and Contents	No of hrs
1	**Dairy Industry in India:** Scope and opportunities for dairy Industry, Composition, nutritive value and Physico-Chemical properties of dairy products.	2
2	**Spoilage of milk:** • Common micro-organisms found in milk • Sources of contamination of milk • Fermentation and spoilage of milk • Flavour and Colour defects, Sweet curdling, and Stormy fermentation, Ropiness • Milk borne diseases	6
3	**Preservation of Milk by Pasteurization & its storage:** • Methods of Pasteurization – LTH, HTST, UHT • Storage specifications after pasteurization • Membrane Technology for Milk and Milk Products	5
4	**Analysis of milk:** • Total bacterial count. (direct and indirect methods) • Brucella ring test and tests for mastitis. • Demonstration of some common tests like MBRT / Phosphatase etc.	4
5	**Fermented Dairy Products:** • Types (Yogurt, Kefir, different types of Cheeses) • Role Starter cultures and other organisms • Probiotic dairy products and their health benefits • New concepts in Dairy Products.	10
6	**Milk and Milk Product Standards and Legislations in India.**	1
7	**Visit to Dairy Industry**	2

References:

1. Advances in Biotechnology, S. N. Jogdand, Himalaya Publishing House
2. Milk & Milk Products, C. Eckles, 4th edition, Tata McGraw Hill Publications
3. Prescott, S.C. and Dunn, C. G., (1983) Industrial Microbiology, Reed G. AVI techbooks.
4. https://www.india.gov.in/topics/agriculture/dairy
5. https://icar.org.in/content/milk-production-management-dairy-development
6. https://www.nddb.coop/resources/dkportal

F.Y.B.Sc. Semester I		
BTH-130	**Basics of Biostatistics and Computers (VSC)**	**Credits:** 2 **Hours:** 30
Course Outcomes (COs) **On completion of the course, the students will be able to:**		
CO1	Describe various generations of computers and how computers have evolved.	
CO2	Outline how word, excel and PowerPoint will help biotechnologists to organize, analyse and interpret the data in a scientific manner.	
CO3	Calculate the measures of central tendency and dispersion and describe the data, create frequency tables, summarize data, represent data visually.	
CO4	Classify the variables into categories such as discrete and continuous, qualitative and quantitative and so on.	
CO5	Compare mean, variance and other parameters and statistics, between groups, samples, populations. Test the goodness of fit and independence of attributes. Judge the observed patterns in the data collected, based on the outcomes of hypothesis testing.	
CO6	Design and develop the database.	
Unit	**Content**	**No. of hrs**
1	**Introductory Statistics:** The need of statistics in biology Variables and constants **Types of variables** – discrete, continuous **Types of data** – raw, grouped **Graphical representation of data** – bar graphs, scatter plots, frequency diagrams, pie chart, histogram, polygon, curve	5

2	**Descriptive Statistics:** Definition and simple problems related to Measures of Central Tendency – Mean, median and mode, Quartiles, quartile plots, box plots **Measures of dispersion** – Standard deviation, variance, coefficient of variance , Skewness and kurtosis	5
3	**Probability:** Classical definitions and its limitations Independence and conditional probability, Probability sampling Population, sample, sampling methods – Simple random, stratified	5
4	**History of Computers**: Evolution, generations of computers – I to V, Classification of computers – mainframe, mini, micro, workstations, parallel processing and super Comparison with respect to memory, power, cost and size, Client server architecture.	3
5	**Spreadsheet Applications (Microsoft Excel):** Worksheet Basics: Entering information in a Worksheet, Saving & Opening a Worksheet, Editing, Copying & Moving data, Inserting, Deleting & Moving Columns & Rows, Clearing, Statistical analysis of the data using Excel.	3
6	**Word Processing (Microsoft Word):** Creating, Saving & Operating a document, Editing, Inserting, Deleting, Formatting, Moving & Copying Text, Find & Replace, Spell Checker & Grammar Checker, Document Enhancement (Borders, Shading, Header, Footer), Printing document (Page layout, Margins), Introduction to the use of Wizards & Templates, Working with Graphics (Word Art), Working with Tables & Charts, Inserting, Files (Pictures, Databases, Spreadsheets)	3
7	**Usage of multimedia – (Microsoft Power Point):** Creation of Computer, Presentations with graphics ,Creation of slides, Rapid Presentation design using wizards	3
8	**Databases : Basic concepts in:** Data abstraction, Data models , Instances and schemes, E-R model (Entity and entity sets, relations and relationship sets, E-R diagrams, reducing E-R diagrams to tables),Network data model, Basic concepts, multimedia databases, Text databases ,Introduction and overview of biological database, Concepts in text-based searching , MEDLINE, PubMed, bibliographic databases, Demonstration of Searching and Information Retrieval of Biological Databases: Through Entrez and SRS Search Engines **Database Applications (Microsoft Access):** Fields, Records, Files, Organization of Files, Access Modes; Updating Records, Querying, Reports, Forms & subforms,	3

References:

1. R.G. Bartle and D.R. Sherbert 2nd edition, (1992), Introduction to real analysis, John Wiley,USA

2. Introductory biostatistics. 1st edition. (2003), Chap T. Le. John Wiley, USA

3. High Yield T M Biostatistics. (2001) Antony N Glaser. Lippincott Williams and Wilkins, USA

4. Sinha P & Sinha P. 2011. Computer Fundamentals. BPB Publications, Connaught Place, Delhi,478 pp.

F.Y.B.Sc. Semester I		
BTH-140	**Survey Methodology (SEC)**	**Credits:** 2 **Hours:** 30
Course Outcomes (COs) **On completion of the course, the students will be able to:**		
CO1	Describe basic types of survey methods	
CO2	Discuss aspects of survey design and modes of data collection	
CO3	Examine various errors in surveys	
CO4	Analyse data and present results	
CO5	Review ongoing surveys and the ethical and legal issues of data collection	
CO6	Interpret survey data and review outcome	

Unit.	Content	No. of Hrs
1	**Introduction to Survey Methodology:** Purpose of surveys Types of surveys (with examples of ongoing surveys) Overview of survey methodology Ethical and legal issues	2
2	**Survey Design:** Lifecycle of a survey Questionnaire design Study variables Sampling and population coverage Modes of data collection	6
3	**Errors in surveys and Non-response:** Measurement and processing errors Coverage error Sampling errors Interviewer-bias Non-response errors	4
4	**Survey Data Analysis and Presentation:** Interpreting survey findings Methods of data analysis Presentation of results and outcome	9
5	**Designing, conducting, analysing and presenting a survey**	9

References:

1. Groves, Robert M., editor. Survey Methodology. 2nd ed, Wiley, 2009.
2. Belson, William A. Validity in Survey Research: With Special Reference to the Techniques of Intensive Interviewing and Progressive Modification for Testing and Constructing Difficult or Sensitive Measures for Use in Survey Research: A Report. Gower, 1986.
3. Fowler, Floyd J. Improving Survey Questions: Design and Evaluation. Sage Publications, 1995.
4. Levy, Paul S., and Stanley Lemeshow. Sampling of Populations: Methods and Applications. 4th ed, Wiley, 2008.
5. Metwally, Elham. "Survey Research Methods20121Earl R. Babbie.Survey Research Methods. Belmont, CA: Wadsworth, Inc 1990." Journal of Organizational Change Management, vol. 25, no. 1, Feb. 2012, pp. 186–88.
6. Salant, Priscilla, and Don A. Dillman. How to Conduct Your Own Survey.Wiley, 1994.
7. "The Survey Research Handbook." Technometrics, vol. 41, no. 1, Feb. 1999, pp. 83–84.

E Resources: λ https://www.mitre.org/sites/default/files/pdf/05_0638.pd

F.Y.B.Sc. Semester I		
IKS - 101	**Indian Knowledge System (IKS)**	**Credits:** 2 **Hours:** 30

Course Outcomes (COs) On completion of the course, the students will be able to:	
CO1	Recall the basic concepts of Indian Knowledge System (IKS)
CO2	Articulate the foundation of IKS and explain historical and cultural context of Indian knowledge systems
CO3	Use the knowledge of IKS to understand discipline specific case studies.
CO4	Develop critical thinking and problem-solving skills in the context of Indian knowledge systems.

Unit	Contents	No. of hours
1.	**Overview of IKS** • Survey of IKS Domains: A broad overview of disciplines included in the IKS,and historical developments. • Sources of IKS knowledge, classification of IKS texts, a survey of available primary texts, translated primary texts, and secondary resource materials. Differences between a sutra, bhashya, karika, and vartika texts. Fourteen/eighteen vidyasthanas, tantrayukti • Vocabulary of IKS: Introduction to Panchamahabhutas, concept of a sutra, introduction to the concepts of non-translatables (Ex. dharma, punya, aatma, karma, yagna, shakti, varna, jaati, moksha,loka, daana, itihaasa, puraana etc.) and importance of using the proper terminology. Terms such as praja. janata, loktantra, prajatantra, ganatantra, swariva, surajya, rashtra, desh. • Philosophical foundations of IKS: Introduction to Samkhya, vaisheshika and Nyaya • Methods in IKS: Introduction to the concept of building and testing hypothesis using the methods of tantrayukti. Introduction to pramanas and their validity, upapatti; Standards of argumentation in the vada traditions (introduction to concepts of vaada, samvaada, vivaada, jalpa, vitanda). Concept of poorvapaksha, uttarapaksha.	**15**
2.	**Case Studies (Few of these may be selected as appropriate)** • Mathematics of Madhava, Nilakantha Somayaji • Astronomical models of Aryabhata • Wootz steel, Aranumula Mirrors, and lost wax process for bronze castings • Foundational aspects of Ayurveda • Foundational aspects of Ashtanga yoga	**10**

	• Foundational aspects of Sangeeta and Natva Shastra • Discipline Specific Case Study	
3.	**India and the World:** Influence of IKS on the world, knowledge exchanges with other classical civilizations. and inter-civilizational exchanges	**5**

References:

1. An Introduction to Indian Knowledge Systems: Concepts and Applications, B Mahadevan, V R Bhat, and Nagendra Pavana R N; 2022 (Prentice Hall of India).
2. Indian Knowledge Systems: Vol I and I, Kapil Kapoor and A K Singh; 2005 (D.K. Print World Ltd).
3. The Beautiful Tree: Indigenous India Education in the Eighteenth Century. Dharampal, Biblia Impex, New Delhi, 1983. Reprinted by Keerthi Publishing House Pvt Ltd. Combatore, 1995.
4. Indian Science and Technology ni the Eighteenth Century, Dharampal. Delhi: Impex India, 1971. The British Journal for the History of Science.
5. The Wonder That Was India, Arthur Llewellyn Basham, 1954, Sidgwick& Jackson.
6. The India they saw series (foreigner visitors on India ni history from 5CE to 17th century), Ed. Meenakshi Jain and Sandhya Jain, Prabhat Prakashan

F.Y.B.Sc. Semester II		
BTH-150	**Practicals in Fundamentals of Life Sciences (Major- Practical)**	**Credits:** 2 **Hours:** 60
Course Outcomes (COs) On completion of the course, the students will be able to:		
CO1	Cite the anatomical features of plants and study plasmolysis	
CO2	Determine rate of Transpiration	
CO3	Study tissue types and parasites.	
CO4	Prepare blood smear and compare cell types	
CO5	Cultivate bacteria on media using aseptic techniques	
CO6	Perform staining techniques and demonstrate motility of bacteria	

Sr no	Content	No. of Practical 15 P
1	Observation of microorganisms using staining techniques: Monochrome staining and, Negative /Relief staining, Gram staining of bacteria	2 P
2	Observation of motility in bacteria using: Hanging drop method	1 P
3	Cultivation of microorganisms: Preparation of simple laboratory nutrient media (solid and liquid), Aseptic transfer techniques and Isolation of bacteria by streak plate method	2 P
4	Study of tissue histology	1 P
5	Peripheral blood smear	2 P
6	Study of parasites	2 P
7	Study of anatomical features of root, stem and leaves of Dicotyledons and Monocotyledons. Study of plant tissues by sectioning, staining, maceration	2 P
8	To determine rate of Transpiration under different conditions of shade, wind, and light.	2 P
9	Study of Plasmolysis	1 P

F.Y.B.Sc. Semester II		
BTH-151	**Fundamentals of Life Sciences (Major-Theory)**	**Credits:** 4 **Hours:** 60
Course Outcomes (COs) On completion of the course, the students will be able to:		
CO1	Define and describe Homeostasis	
CO2	Explain tissue and organ systems, parasitology and histology	
CO3	Study and explain the animal model systems	
CO4	Explain general characters and structural aspects of plants.	
CO5	Determine and study plant resources and utilization.	
CO6	Specify physiological aspects and study plant physiology	

Unit	Content **ANIMAL SCIENCE**	No of Hrs. **60**
1	**HOMEOSTASIS :** A. Introduction to homeostasis and feedback mechanism B. Maintenance of blood pH C. Maintenance of body temperature	3
2	**TISSUES AND ORGAN SYSTEMS:** A. Introduction to tissue systems – epithelial tissue, muscular tissue, connective tissue. B. Overview of human nervous, gastro-intestinal, urinary, reproductive, cardiovascular, endocrine and respiratory systems.	15
3	**PARASITOLOGY:** A. Host-parasite interactions and their evolution B. Parasitic adaptations C. Lifecycle and pathogenesis of *Plasmodium* sp	4
4	**MODEL ORGANISMS:** A. Features and relevance of animal models B. Example(s) of invertebrate model systems C. Example(s) of vertebrate model systems	5
5	**METHODS IN ANIMAL HISTOLOGY:** A. Histological processing- sampling, fixing, dehydrating, embedding, sectioning, and staining. B. Principles and examples of cell type specific staining methods	3

	PLANT SCIENCE	
6	**CONQUEST OF LAND**: A. Cryptogams- General characters (Habit, habitat, Reproduction, Alternation of generations) and Economic Importance of Algae, Fungi, Bryophytes and Pteridophytes B. Phanerogams- General characters (Habit, habitat, Reproduction, Alternation of generations) and Economic Importance of Gymnosperms and Angiosperms	6
7	**STRUCTURAL ASPECTS OF PLANTS**: A. Plant Tissue Systems- Epidermal, Ground, Vascular, Mechanical tissue systems B. Morphology- Vegetative and reproductive plant parts C. Anatomy- Vegetative and reproductive plant parts	5
8	**PHYSIOLOGICAL ASPECTS OF PLANTS**: Photosynthesis, Respiration, Mineral Nutrition, Plant water relation	11
10	**PLANT PATHOLOGY** Introduction, Concept, Pathogens, Diseases (2-3 examples)	4
11	**PLANT RESOURCES AND THEIR UTILIZATION** Plants as natural resources Forest as potential resource, Secondary metabolites in plants Plant resources used in Cosmetics and Pharmaceutics	4

References:

1. Principles of Anatomy and Physiology by Gerard Tortora and Bryan Derrickson 14th Edition. 2014
2. Animal Physiology by Christopher Moyes and Patricia Schulte, second edition (Pearson), 2014.
3. Animal Physiology by Hill, Wyse and Anderson, third edition, 2012.
4. Practical Manual of Histology for Medical students by Neelkanth Kote, Jaypee Brothers Medical Publishers; second edition (2014)
5. Hedges, S. B.; The origin and evolution of model organisms. Nat. Rev. Genet.3; 838-849 (2002).
6. National Research Council (US) Committee on Developmental Toxicology. Scientific Frontiers in Developmental Toxicology and Risk Assessment. Washington (DC): National Academies Press (US); 2000. 7, Using Model Animals to Assess and Understand Developmental Toxicity. Available from: https://www.ncbi.nlm.nih.gov/books/NBK225677/
7. Baron S, editor. Medical Microbiology. 4th edition. Galveston (TX): University of Texas Medical Branch at Galveston; 1996. Section 4, Parasitology.
8. Botany for Degree Students-Algae by B. R. Vashishta
9. Botany for Degree students- Fungi by B. R. Vashishta
10. Botany for Degree students- Bryophyta by B. R. Vashishta
11. Botany for Degree students- Pteridophyta by B. R. Vashishta
12. Botany for Degree students- Gymnosperms by B. R. Vashishta
13. Botany for Degree students- Angiosperms by B. R. Vashishta
14. Class book of Botany- by A.C.Dutta
15. College Botany Vol.I, II, III by Ganguli, Das dutta.
16. Taxonomy of Vascular Plants by G H. Lawrence
17. Plant Physiology- by Taiz,L. and Zeiger E.

F.Y.B.Sc. Semester II		
BTH-161	**Concepts in Biotechnology (Minor-Theory)**	**Credits:** 2 **Hours:** 30

Course Outcomes (COs) On completion of the course, the students will be able to:	
CO1	Define Biotechnology and Cite the Milestones in the history of biotechnology.
CO2	Explain the role of Biotechnology in various fields.
CO3	Study the application of Biotechnology by visiting facilities.

Unit	Topic	Number of Hrs (30)
1	**What is Biotechnology** Introduction, Biotechnology in day-to-day life, Milestones in the history of biotechnology.	2
2	**Agriculture biotechnology** Role of biotechnology in crop improvement and development of transgenic plants.	7
3	**Medical biotechnology** Role of biotechnology in pharmaceutical industry, drug discovery and vaccine development	7
4	**Food and dairy biotechnology** Biotechnology in food processing. Role of biotechnology to improve quality and nutritional content of food and dairy products.	7
5	**Environmental biotechnology** Need for biotechnology in environment conservation, Current environmental issues and use of biotechnology in solving these issues	7
	Visit to any biotechnology industry.	

References:

1. Milestones in Biotechnology: Classic papers in Genetic Engineering: J. A. Davis, W. S. Resnikoff
2. Plant biotechnology - J Hammond & P. McGravey, V.Yushibov, Springer-Verlag
3. Principles of Gene Manipulation & Genomics – Primrose and Twyman (2006, 7thEdition)
4. Amann, R.I. Stromley, J. Stahl: Applied & Environmental Microbiology
5. Biotechnology, B.D. Singh

Semester II		
MIC-165	**Fundamentals of Microbial Sciences (Minor-Theory)**	**Credits:** 2 **Hours:** 30
CO1	Cite the landmarks and important developments leading to major discoveries Differentiate between Morphological characters of Microorganisms	
CO2	Discuss the structure and function of a bacterial cell	
CO3	Outline the staining techniques of bacterial cells	
CO4	Explain the cultivation and isolation techniques of bacteria	
CO5	Assess the methods of reproduction in microorganisms	
CO6	Calculate Generation time, Growth rate and specific growth rate	

Unit	Topic	No. of Hrs (Total 30)
	MICROBIAL SCIENCE:	
1	**HISTORY:** Important developments leading to major discoveries: (pre golden, golden and post golden era)	1
2	**TYPES AND CHARACTERISTICS OF MICROORGANISMS**	1
3	**STUDIES ON STRUCTURE, CHEMICAL COMPOSITION AND FUNCTIONS OF THE FOLLOWING COMPONENTS IN BACTERIAL CELL:** A. Size, shape and arrangement of bacterial cells B. **Structures External to Cell Wall**: Cell wall (Gram Positive, Gram Negative, Archaea), Glycocalyx, Capsule, Flagella, Fimbriae and Pili, Axial Filaments C. **Structures Internal to Cell Wall** : Cell membrane (Gram Positive, Gram Negative, Archaea), Cell inclusion bodies Endospores Formation and Germination	8
4	**STAINING TECHNIQUES:** A. Definitions of Stain; Types of stains (Basic and Acidic), Leuco compounds, Properties and role of Fixatives, Mordants, Decolorizers and Accentuators B. Principles of staining techniques for following: Monochrome staining and Negative (Relief) staining, Differential staining -	5

	Gram staining	
5	**CULTIVATION AND ISOLATION:** A. Nutritional requirements and classification of bacteria Design of media: Common ingredients, Types of media and Composition with examples B. Medium Sterilization: Basic definitions, Physical agents and Chemical agents – Mode of action and applications C. Handling of microorganisms and Biosafety measures. D. Concept of Pure Culture, axenic culture, co-culture and Mixed Culture Isolation of microorganisms and pure culture techniques: Streak, Spread, Serial Dilution, Pour plate. E. Preservation and maintenance of microorganisms F. Culture collection centers and their role.	10
6	**MICROBIAL GROWTH** A. Growth curve , definitions of Generation time, Growth rate and specific growth rate B. Reproduction in microorganisms: Binary Fission, Asexual, Sexual, Lytic, Lysogenic Cycle C. Methods of enumeration: Direct and Indirect methods	5

References:

1. Brock Biology of Microorganisms, Michael.T.Madigan, John.M.Martinko, Paul V. Dunlap,David P. Clark- 12th edition, Pearson International edition 2009, Pearson Benjamin Cummings.
2. Ingraham J. L. and Ingraham C.A. (2004). Introduction to Microbiology. 3rdEdition.Thomson Brooks / Cole.
3. Michael J Pelczar, JR. E.C.S. Chan, Noel R. Krieg. (1993) Microbiology, 5th Edition, Tata MacGraw Hill Press.
4. Prescott, Lancing. M., John, P. Harley and Donald, A. Klein (2006) Microbiology, 6th Edition,McGraw Hill Higher Education
5. Willey J. M., Sherwood L. M. and Woolverton C. J. (2013) Prescott's Microbiology, 8thEdition, McGraw-Hill Higher Education
6. Salle A.J. (1971) Fundamental Principles of Bacteriology. 7th Edition. Tata MacGrawHillPublishing Co.
7. Stanier R.Y., Adelberg E.A. and Ingraham J.L. (1987) General Microbiology, 5th Edition.Macmillan Press Ltd.
8. Tortora G.J., Funke B.R., Case C.L. (2006). Microbiology: An Introduction. 8th Edition. Pearson Education Inc

F.Y.B.Sc. Semester I		
BTH-170	**Biotechnology in Health and Diagnosis** **(GE/OE-Theory)**	**Credits:** 2 **Hours:** 30
Course Outcomes (COs) **On completion of the course, the students will be able to:**		
CO1	Outline the basics of immunity and infections of the human body.	
CO2	Explain the working and importance of vaccines.	
CO3	Illustrate the significance of various equipment in clinical diagnostics laboratory	
CO4	Compare the healthy and diseased state of the body based on pathology reports	

Unit	Contents	No. of hours
1	**Immunity and Infections:** Definition and types of immunity, Cells and organs involved in immunity, Blood cell types and their role **Infection causing agents**: Bacteria, Viruses and Parasites Examples of Infections, routes of infection and effect on the body with one example each	**5**
2	**Role of Haematology in Diagnostics**: ABO blood group system and Rh factor, Pulse rate and Blood pressure, Haemoglobin, Blood sugar level analysis, Study of Hemogram, Lipid profile, Vit B12, Vit D profiles Demonstration of few tests/analyses in the laboratory	**8**
3	**Equipment used in pathology laboratory**: Demonstration of working, use and significance of: pH meter, Centrifuge, Microscope, Incubator, Cell counter, Colorimeter and Spectrophotometer, PCR machine, ELISA plate reader	**5**
4	**Vaccines**: History, working of vaccines and importance, immunization schedule followed in India	**4**
5	**Healing the world with Biotechnology** Role of Biotechnology in health Care, diagnosis, and therapeutics with specific examples **Role of Biotechnology in fight against recent Covid 19 pandemic**	**6**
5	Visit to a diagnostic laboratory/ Blood bank	**2**

References:

1. Immunology by Thomas J. Kindt, Richard A. Goldsby, Barbara A. Osborne, Janis Kuby
2. *Biochemistry* by *Satyanarayana*, 5th Edition, 2019
3. Wilson And Walker's Principles and Techniques of Biochemistry and Molecular Biology, 8th edition, 2018
4. Robbins and Cortan, Pathologic Basis of Disease, VIII Edition, Saunders
5. Park, K. Preventive and social medicine, Bhanot. Publishers.
6. Godkar P.B. and Godkar D.P. Textbook of Medical Laboratory Technology, II Edition, Bhalani Publishing House

F.Y.B.Sc. Semester I		
BTH-171	**Entrepreneurship in Biotechnology: Mushroom cultivation (GE/OE-Theory)**	**Credits:** 2 **Hours:** 30
Course Outcomes (COs) **On completion of the course, the students will be able to:**		
CO1	Outline the scope of mushroom cultivation.	
CO2	Classify different types of mushrooms.	
CO3	Illustrate the nutritive value of mushrooms.	
CO4	Explain methods of mushroom cultivation.	

Unit	Contents	No. of hours
1	**Introduction to Mushrooms:** Biology of mushrooms, Different types of mushrooms, Edible mushrooms.	**4**
2	**Food Value of Mushroom and Health benefits:** Different nutrients present in mushroom and their medicinal values.	**3**
3	**Method of Cultivation:** Preparation of spawn Selection and preparation of substrate Inoculation, Incubation, Identification of Disease in Mushrooms. Harvesting of fruiting bodies. Post harvest handling, Preservation of Mushroom.	**12**
4	**Hands on training/workshop on mushroom cultivation:** Pleurotus species. Agaricus Species.	**6**
5	**Scope for Mushroom farming business:** Demand for mushrooms, economically important mushrooms, Current and future business in India.	**3**
6	**Visit to Mushroom Cultivation facility**	**2**

References:

1. Joy Sarkar Krishnendu Acharya, Anirban Roy. *Mushroom Cultivation Technology* Paperback - 1 January 2020

2. S. Biswas, M. Datta, S. V. Ngachan. *Mushrooms: A Manual for Cultivation*, PHI Learning

3. S. R. Mishra. *Techniques of Mushroom Cultivation* (English, Hardcover)

4. 2020 NIIR BOARD *Handbook On Mushroom Cultivation and Processing (With dehydration, preservation and canning)* Paperback - 1 January 2020

5. (Board Eiri) *Hand Book of Mushroom Cultivation, Processing and Packaging* Publisher: Engineers India Research Institute.
6. B C, Suman, V P Sharma Mushroom Cultivation in India Hardcover - 1 August 2007 Daya Publishing House

F.Y.B.Sc. Semester II		
BTH-180	**Techniques in Biotechnology (VSC)**	**Credits:** 2 **Hours:** 30
Course Outcomes (COs) On completion of the course, the students will be able to:		
CO1	Cite basic Good Laboratory Practices and concept of SOP's	
CO2	Develop basic aseptic techniques	
CO3	Gain practical experience in handling common equipment	
CO4	Explain working, use and care and safety measures of equipment.	
CO5	Acquire knowledge of basic techniques and troubleshoot to identify and resolve common issues.	
CO6	Write scientific report	

Unit	**Topic**	**Number of Hrs (30)**
1	Good Laboratory Practices (GLP)s , safety and their importance in industry.	2
2	Basic Aseptic Techniques	2
3	Introduction to SOPs of various instruments in the laboratory and their preparation.	2
4	Handling of Micropipette and its calibration.	1
5	Working and handling of compound microscopes.	1
6	Working, cleaning and safety measures of Centrifuge.	1
7	Determination of λmax and molar extinction coefficient of given compounds using UV-Vis Spectrophotometer.	2
8	Estimation of Proteins, Carbohydrates and lipids by colorimetric assay.	6
9	Demonstration of agarose gel electrophoresis.	2
10	Demonstration of SDS -PAGE and elucidation of molecular weight of proteins.	3
11	Demonstration of Dot ELISA	2
12	Amino acid separation by paper chromatography	2
13	Amino acid separation by Thin Layer Chromatography	2
14	Report writing	2

References:

1. Biophysical Chemistry: Principles and Techniques by Upadhyay, Upadhyay, Nath
2. Principles and Techniques of Biochemistry and Molecular Biology. Seventh edition. Edited by Keith Wilson and John Walker.

3. Instrumentation measurements and analysis – 2nd edition (2003). Nakra and Choudhari, Tata McGraw Hill, India

F.Y.B.Sc. Semester II		
BTH-190	**Basic Bioinstrumetation (SEC)**	**Credits:** 2 **Hours:** 30
Course Outcomes (COs) On completion of the course, the students will be able to:		
CO1	Introduce basic laboratory instruments and Describe the principle, construction and working of pH meter and conductivity meter and discuss them applications.	
CO2	Explain the principle behind spectroscopy and compare and contrast the different forms	
CO3	Classify different types of centrifuges and describe them construction, working and applications	
CO4	Classify microscopes and discuss the types, the construction, working and applications	
CO5	Justify the role of instruments	
CO6	Design experiments to test the applications of the instruments	

Unit	Content	Number of Hrs (30)
1	Introduction to Laboratory and common laboratory instruments e.g. Incubator, Hot Air Oven, Autoclave, Colorimeter, pH Meter, Distillation Unit, Chemical Balance, Laminar air flow hood, Clinical centrifuge.	2
2	pH meter: Principle, construction, working, calibration, maintenance and applications.	3
3	Microscopes: Construction and Biophysical working principles of the following Microscopes: - Stereozoom (Dissecting) - Compound - Bright and Dark field - Inverted Introduction to Electron Microscope	5
4	Centrifuge: RCF and sedimentation concepts, principle, construction, working, centrifuge types, rotor types and application of preparative & analytical centrifuges.	5
5	Spectroscopy: Beer Lambert's Law, Principle, construction and working of colorimeter, Spectrophotometer, and their applications	5
6	Electrophoresis: Introduction to: Agarose gel electrophoresis, Poly acrylamide gel electrophoresis, Applications	5
7	Basic principles of Chromatography: Introduction to Paper chromatography and Thin Layer Chromatography	5

References:

1. Instrumentation measurements and analysis – 2nd edition (2003). Nakra and Choudhari, Tata McGraw Hill, India.
2. Nuclear Physics: An Introduction. 2nd edition (2011). S. B. Patel. Ansha Publication, India.
3. Biophysical Chemistry: Principles and Techniques by Upadhyay, Upadhyay, Nath
4. Principles and Techniques of Biochemistry and Molecular Biology. Seventh edition. Edited by Keith Wilson and John Walker