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

2024-2025

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

NEP 2.0 Subject Credit distribution Structure 2024-25

Department 0f Biotechnology (Science)

FYBSc Sem-I	**Theory/ Practical**	**Paper Code**	**Paper Title**	**Credits**	**Exam type**
Discipline Specific Core, DSC-1	Theory	BTH-1001	Fundamentals of Biotechnology - I	2	CE +ESE
Discipline Specific Core, DSC-2	Practical	BTH-1011	Biotechnology Practical 1	2	CE +ESE
Open Elective-1 (For other faculty)	Theory	BTH-1021	Everyday Biotechnology	2	Only CE

FYBSc Sem - II	**Theory/ Practical**	**Paper Code**	**Paper Title**	**Credits**	**Exam type**
Discipline Specific Core, DSC-3	Theory	BTH-1002	Fundamentals of Biotechnology - II	2	CE +ESE
Discipline Specific Core, DSC-4	Practical	BTH-1012	Biotechnology Practical 2	2	CE +ESE
Open Elective-2 (For other faculty)	Theory	BTH-1022	Biotechnology in health and diagnosis	2	Only CE
Skill Enhancement Course, SEC-1	Theory/ Practical	BTH-1032	Biostatistics and Computers	2	Only CE

Head

Department of Biotechnology

F.Y.B.Sc. Semester I		
BTH-1001	**Fundamentals of Biotechnology-I** **Theory** **(Discipline Specific Core, DSC 1)**	**Credits:** 2 **Hours:** 30
Course Outcomes (COs) **On completion of the course, the students will be able to:**		**Bloom's Cognitive Level**
CO1	Recall the concept of origin of life and evolution of cells.	1
CO2	Explain characteristics of animal and plant life forms and describe their tissue organisation.	2
CO3	Apply the knowledge of different life forms to study their associations.	3

Sr. No	Topic	Number of lectures (30)
1	**Introduction and scope of Biotechnology**.	2
2	**Introduction to cell and its function:** ● Origin of life: Unicellularity to multicellularity ● Evolution of cells: events and factors responsible (endosymbiosis, vertical and horizontal gene transfer etc.) ● Comparative account of archaebacteria, prokaryotic and eukaryotic cell. ● General Characteristics of different Animal and Plant Life Forms.	10
3	**Animal Tissue organisation and functions:** ● Introduction to animal tissue systems – epithelial tissue, muscular tissue, connective tissue, nervous tissue. ● Introduction to Cell junctions- relevance to tissue structure.	6
4	**Plant Tissue organisation and function:** ● Epidermal, Ground, Vascular, Mechanical tissue systems; ● Morphology- Vegetative and reproductive plant parts; ● Anatomy- Vegetative and reproductive plant parts ● Plant cell wall - primary and secondary.	6
5	**Multi life form associations and their significance**: ● Competition, commensalism, mutualism and parasitism with suitable examples.	6

References:

1. Principles of Anatomy and Physiology by Gerard Tortora and Bryan Derrickson 16th Edition. 2020
2. Animal Physiology by Christopher Moyes and Patricia Schulte, Third edition (Pearson), 2021.
3. Animal Physiology by Hill, Wyse and Anderson, fourth edition, 2016.
4. Botany for Degree students- Angiosperms by B. R. Vashishta
5. Class book of Botany- by A.C. Dutta
6. College Botany Vol.I, II, III by Ganguli, Das Dutta.
7. Taxonomy of Vascular Plants by G H. Lawrence
8. Plant Physiology- by Taiz,L. and Zeiger E.
9. Molecular Cell Biology. Lodish H., Berk A, Kaiser C., K Reiger M., Bretscher A., Ploegh H., Angelika Amon A., Matthew P. Scott M.P., 8th Edition, (2016) W.H. Freeman and Co., USA
10. Molecular Biology of the Cell, Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter, 6th Edition (2014) Garland Science, USA
11. Cell Biology, Gerald Karp. 9th edition, (2020) John Wiley & Sons., USA
12. The Cell: A Molecular Approach, Geoffrey M. Cooper, Robert E. 7th edition (2015), Hausman, Sinauer Associates, Inc. USA
13. Becker's World of then Cell, Jeff Hardin, Gregory Bertoni, Lewis J.Kleinsmith, 8th Edition (2016), Pearson Education Limited, USA

F.Y.B.Sc. Semester I		
BTH-1011	**Biotechnology Practical 1** **Practical** **(Discipline Specific Core, DSC 2)**	**Credits:** 2 **Hours:** 30
Course Outcomes (COs) **On completion of the course, the students will be able to:**		**Bloom's Cognitive Level**
CO1	Define Good Laboratory Practices for safety in laboratories and study basic instruments of biotechnology.	1
CO2	Compare and study different life forms.	2
CO3	Examine different types of animal and plant cells and determine the cell size.	3

Sr. No	Topic	Number of practicals (15P x 4H)
1	Good Laboratory Practices, Lab safety and introduction to common laboratory glassware and instruments.	2
2	Working, use and care of compound microscopes.	2
3	Study of different life forms from pond water/ any other suitable source.	2
4	Peripheral blood smear and study of different cell types.	2
5	Study of plant tissues by maceration.	2
6	Determination of cell size by micrometry.	3
7	Study of association of life forms	2

F.Y.B.Sc. Semester I		
BTH-1021	**Everyday Biotechnology** **Open Elective-1(For other faculty)**	**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

F.Y.B.Sc. Semester II		
BTH-1002	**Fundamentals of Biotechnology-II** **Theory** **(Discipline Specific Core, DSC -3)**	**Credits:** 2 **Hours:** 30
Course Outcomes (COs) **On completion of the course, the students will be able to:**		**Bloom's Cognitive Level**
CO1	Describe specialized cell types, phases of cell cycle and homeostatic regulation.	1
CO2	Associate the role of model organisms and biotechnology in different fields.	2
CO3	Apply the knowledge of tissue structures for histological processing.	3

Sr. No	Topic	Number of lectures (30)
1	**Specialized cell types** ● photoreceptors, gametes, auditory hair cells, ciliated cells. **Cell division and Cell Cycle** ● Phases of cell cycle. ● Mitosis, meiosis in plants and animals.	5
2	**Homeostasis:** ● Introduction ● Feedback mechanism ● Maintenance of blood pH; Thermoregulation ● Osmosis, Turgor pressure, and transpiration.	7
3	**Methods in histology:** ● Histological processing- sampling, fixing, dehydrating, embedding, sectioning, and staining ● Principles and examples of cell type specific staining methods for plant and animal cells.	3
4	**Model systems used in Biotechnology: Features and relevance** ● Animal models: *C. elegans,* Hydra, Drosophila, Zebra Fish. ● Plant models: *Arabidopsis thaliana*, *Datura stramonium*, Fucus.	7
5	**Applications of Biotechnology:** ● Biotechnology in Health, Industry, Environment, Agriculture. ● Economic importance of microbes, plants (Secondary metabolites) and animals; ● Vermiculture, Sericulture, Pearl culture, Apiculture	8

References:

1. Principles of Anatomy and Physiology by Gerard Tortora and Bryan Derrickson 16th Edition. 2020
2. Animal Physiology by Christopher Moyes and Patricia Schulte, Third edition (Pearson), 2021.
3. Animal Physiology by Hill, Wyse and Anderson, fourth edition, 2016.
4. Botany for Degree students- Angiosperms by B. R. Vashishta
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6. College Botany Vol.I, II, III by Ganguli, Das Dutta.
7. Taxonomy of Vascular Plants by G H. Lawrence
8. Plant Physiology- by Taiz,L. and Zeiger E.
9. Molecular Cell Biology. Lodish H., Berk A, Kaiser C., K Reiger M., Bretscher A., Ploegh H., Angelika Amon A., Matthew P. Scott M.P., 8th Edition, (2016) W.H. Freeman and Co., USA
10. Molecular Biology of the Cell, Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter, 6th Edition (2014) Garland Science, USA
11. Cell Biology, Gerald Karp. 9th edition, (2020) John Wiley & Sons., USA
12. The Cell: A Molecular Approach, Geoffrey M. Cooper, Robert E. 7th edition (2015), Hausman, Sinauer Associates, Inc. USA
13. Becker's World of then Cell, Jeff Hardin, Gregory Bertoni, Lewis J.Kleinsmith, 8th Edition (2016), Pearson Education Limited, USA

F.Y.B.Sc. Semester II		
BTH-1012	**Biotechnology Practical 2** **Practical** **(Discipline Specific Core, DSC-4)**	**Credits:** 2 **Hours:** 30
Course Outcomes (COs) **On completion of the course, the students will be able to:**		**Bloom's Cognitive Level**
CO1	Identify different stages of cell division and anatomical features of plant tissues.	1
CO2	Demonstrate the phenomenon of osmosis.	2
CO3	Carry out culturing of model organisms.	3

Sr. No	Topic	Number of practicals (15P x 4H)
1	Study of mitosis (onion root tip) – preparation of slides and identification of different stages.	2
2	Study of meiosis (grasshopper testis/*Tradescantia* anther)– preparation of slides and identification of different stages.	2
3	Permanent slide preparation of simple tissue structures.	2
4	Study of osmosis in plants.	2
5	Study of anatomical features of root, stem and leaves of Dicotyledons and Monocotyledons (sectioning and staining).	2
6	Culturing and study of Drosophila.	4
7	Visit to a Sericulture/ Vermiculture /Apiculture facility.	1

F.Y.B.Sc. Semester II		
BTH-1022	**Biotechnology in Health and Diagnosis** **Open Elective-2(For other faculty)**	**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**

F.Y.B.Sc. Semester II		
BTH-1032	**Biostatistics and Computers (Skill Enhancement Course, SEC-1)**	**Credits:** 2 **Hours:** 30
Course Outcomes (COs) On completion of the course, the students will be able to:		**Bloom's Cognitive Level**
CO1	Describe data collection and organization methods.	1
CO2	Summarize different types of data.	2
CO3	Interpret the experimental data and analyse.	3
Unit	Contents	No. of. Lectures
	Biostatistics	15
I	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	3
II	Descriptive Statistics: Definition and simple problems related to Measures of Central Tendency – Mean, median and mode, Quartiles Measures of dispersion – Standard deviation, variance, coefficient of variance, corelation and regression	4
III	Hypothesis Testing: Hypothesis formulation- Null and alternative hypothesis. Parametric and non-parametric tests: Z-test, t-test, Chi-square test, ANOVA. Std error, Type I and Type II errors, Confidence, Significance.	5
IV	Probability: Classical definitions and its limitations, Independence and conditional probability, Probability sampling Population, sample, sampling methods – Simple random, stratified	3
	Computers	15
I	History of Computers: Evolution, generations of computers – I to V	1
II	Microsoft Excel: The Excel environment, Entering and editing data, Modifying a worksheet, Using functions, Formatting, Printing, Charts : Chart basics, Pie Chart, Bar Chart, Line Diagram, Trend lines, Range names and Filter date : Define and apply cell and range names : Use names in Formulas, Filter data based on complex criteria, Use conditional filters, Copy filtered results to another range, Pivot Tables: Prepare data in a table format and name the table, Create a PivotTable for analysing.	3
III	Microsoft Word: Creating the documents and Tabulating the data using word and its formatting, Find & Replace, Spell Checker & Grammar Checker. Citation and Referencing using Microsoft word and Mendeley Microsoft word plugin. Use of Microsoft word while writing research paper, collaboration and sharing in word, Tracking the changes in the documents,	2

	Creation of Hyperlinks, Bookmarks and Cross Referencing.	
IV	Microsoft Powerpoint: Creation of Presentations with graphics, Creation of slides, Preparation of scientific presentations. Insert and Format Text, Shapes and Text Boxes, Images, Order and Group Objects. Insert and Format Tables,Charts,SmartArt graphics, Insert and Manage Media. Apply Slide Transitions,Animate Slide Content,Set Timing for Transitions and Animations. Infogram: A very easy-to-use tool for creating template, visually appealing data visualisations and infographics. BioRender Scientific Image and Illustration Software: BioRender figures to PowerPoint presentations & keep them updated in a click.	2
V	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. Database Applications (Microsoft Access): Fields, Records, Files, Organization of Files, Access Modes; Updating Records, Querying, Reports, Forms & subforms,	7

References:

1. Robert Bartle., and Donald Sherbert. Introduction to real analysis.4th ed. Illinois, USA: John Wiley& Sons, Inc., USA, 2011.
2. Chap T. Le. Introductory Biostatistics. 1st ed. New Jersey, USA: John Wiley& Sons, Inc., USA, 2003.
3. Antony N Glaser. High-Yield™ Biostatistics. Maryland, USA: Lippincott Williams and Wilkins, USA, 2005.