B.Sc. BIOTECHNOLOGY

Course Structure and Syllabus

(For the candidates admitted from the academic year 2025-2026 onwards)

Choice Based Credit System (CBCS)

&

Learning Outcomes-Based Curriculum Framework (LOCF)

THANTHAI HANS ROEVER COLLEGE (AUTONOMOUS)
(Approved by NAAC, Affiliated to Bharathidasan University)
ELAMBALUR, PERAMBALUR – 621 220

BIOTECHNOLOGY

VISION

- To be a Centre of Excellence in field of Biotechnology education, research, training and entrepreneurship guided by sound scientific principles, quality teaching and thrust for improvement.

MISSION

- To develop a strong Biotechnology program based on quality education, research, and training.
- To impart quality education to the students and enhance their skills which will make them globally competitive.
- To develop trained biotechnology professionals who can contribute to the continuous improvement of biotechnological services and products.
- To develop scientific and/or technical resources as per biotechnology industry demands.

Programme Outcomes (POs)

Upon completion of the programme, the undergraduate will be able to

PO1: Gain a thorough grounding in the fundamentals of new technologies in biotechnology.

PO2: Understand the key principles of biochemical functioning at an advanced level. Better awareness of the major issues at the forefront of the discipline, will possess an in-depth understanding of the area of biochemistry chosen for research emphasis.

PO3: Conduct experiments, as well as to analyze data, understood the basic concepts, fundamental principles, and the scientific theories related to various scientific phenomena and their relevancies in the day-to-day life.

PO4: Progress to valuing and organization levels.

PO5: Handle scientific instruments, plan and perform laboratory experiments to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability in biotechnology.

PO6: Distinguish ability to engage in lifelong learning independently with a high level of enthusiasm and commitment to improve knowledge and competence continuously.

PO7: Apply ethical principles and commit to professional ethics, responsibilities and norms of the research practice.

PO8: Recognize the importance of Bioethics, IPR, and entrepreneurship so as to assure the next generation of Indian Industrialists.

Programme Specific Outcomes (PSOs)

PSO1: Students will be able to design the studies, conduct experiments, analyze and interpret data for investigating problems in Biotechnology and allied fields.

PSO2: Demonstrate proficiency in life science and foundation biotechnology course.

PSO3: Demonstrate a working knowledge of advanced biological sciences.

PSO4: Demonstrate competence in application of engineering principles to biological systems.

PSO5: Understand the applications of biotechnology in all spheres of botechnological and develop the ideas with improved productivity thereby increasing benefit, better human health and decreased environmental pollution.

B.Sc. Biotechnology

Choice Based Credit System–Learning Outcomes Based Curriculum Frame Work (CBCS- LOCF)

(For the candidates admitted from the academic year 2025 - 2026 onwards)

Semester	Part	Course Code	Title of the Course	Int. Hrs /Week	Credits	End Sem. Exam Hrs	Max. Marks		
							CIA	ESE	Total
I	I	25UT1/H1	Language	6	3	3	25	75	100
	II	25UE1	English-I	6	3	3	25	75	100
	III	25UBT1CC1	Cell Biology	5	5	3	25	75	100
	III	25UBT1CP1	Cell Biology - Practical	4	4	3	40	60	100
		25UBT1AC1	Biological Chemistry	4	3	3	25	75	100
		25UBT2AP1	Biological Chemistry & Fundamentals of Microbiology – Allied Practical	3*	---	---	---	---	---
	IV	25UVE	Value Education	2	2	3	25	75	100
			Value Added Course*	--	2*	3	50	50	100*****
Total				**30**	**20**	**-**	**-**	**-**	**600**
II	I	25UT2/H2	Language	6	3	3	25	75	100
	II	25UE2	English-II	6	3	3	25	75	100
	III	25UBT2CC2	Molecular Biology	5	5	3	25	75	100
		25UBT2CP2	Molecular Biology – Practical	3	3	3	40	60	100
		25UBT2AC2	Fundamentals of Microbiology	4	3	3	25	75	100
		25UBT2AP1	Biological Chemistry & Fundamentals of Microbiology – Allied Practical	2	2	3	40	60	100
	IV	25UBT2NME1	Organic Farming and Health Managements	2	2	3	25	75	100
		25UES	Environmental Studies	2	2	3	25	75	100
			Value Added Course*	--	2*	3	50	50	100*****
Total				**30**	**23**	**-**	**-**	**-**	**800**
III	I	25UT3/H3	Language	6	3	3	25	75	100
	II	25UE3	English-III	6	3	3	25	75	100
	III	25UBT3CC3	Genetics	4	4	3	25	75	100
		25UBT3CP3	Genetics – Practical	3	3	3	40	60	100
		25UBT3AC3	Immunology and Immunotechnology	4	3	3	25	75	100
		25UBT4AP2	Immunology and Immunotechnology & Bioinformatics and Biostatistics – Allied Practical	3	--	--	--	--	--
	IV	25UBT3NME2	Bioinstrumentation	2	2	3	25	75	100
		25UBT3SE1	Enzymology	2	2	3	25	75	100
			Value Added Course*	--	2*	3	50	50	100*****
				30	**20**	**-**	**-**	**-**	**700**

Semester	Part	Course Code	Title of the Course	Int. Hrs /Week	Credits	End Sem. Exam Hrs	Max. Marks		
							CIA	ESE	Total
IV	I	25UT4/H4	Language	6	3	3	25	75	100
	II	25UE4	English-IV	6	3	3	25	75	100
	III	25UBT4CC4	Genetic Engineering and rDNA Technology	5	4	3	25	75	100
		25UBT4CP4	Genetic Engineering and rDNA Technology - Practical	3	3	3	40	60	100
		25UBT4AC4	Bioinformatics and Biostatistics	4	3	3	25	75	100
		25UBT4AP2	Bioinstrumentation & Bioinformatics and Biostatistics – Allied Practical	3	2	3	40	60	100
	IV	25UBT4SE2	Medical Coding	2	2	3	25	75	100
		25UHW	Health and Wellness	1	1	--	--	--	100
			Value Added Course*	--	2*	3	50	50	100*
			Total	**30**	**21**	**-**	**-**	**-**	**800**
V	III	25UBT5CC5	Plant Biotechnology	6	5	3	25	75	100
		25UBT5CC6	Animal Biotechnology	6	5	3	25	75	100
		25UBT5CC7	Plant tissue culture	5	5	3	25	75	100
		25UBT5CP5	Plant Biotechnology and Animal Biotechnology – Practical	3	3	3	40	60	100
		25UBT5DE11 25UBT5DE12	Nano Biotechnology Good Laboratory Practices	4	4	3	25	75	100
		25UBT5DE21 25UBT5DE22	IPR, Bioethics and Biosafety Biotechnology For Human Welfare	4	4	3	25	75	100
	IV	25USS	Soft Skills	2	2	3	25	75	100
		25UBT5SI	Summer Internship ans IA	--	2*	3	--	--	100
			Value Added Course*	--	2*	3	50	50	100*
			Total	**30**	**28**	**-**	**-**	**-**	**800**
VI	III	25UBT6CC8	Core 8-Environmental Biotechnology	6	5	3	25	75	100
		25UBT6CC9	Core 9-Pharmaceutical Biotechnology	6	5	3	25	75	100
		25UBT6CC10	Core 10 (T)- Industrial Biotechnology	6	5	3	25	75	100
		25UBT6DE31 25UBT6DE32	DE3-Medical Biotechnology/ Marine Biotechnology	4	4	3	25	75	100
		25UBT6DE41 25UBT6DE42	DE4-Cancer Biology/ Stem Cell Biology	4	4	3	25	75	100
		25UBT6PW	Project Work	3	3	3	20	80	100
	V	25UGS	Gender Studies	1	1	3	25	75	100
	V		Extension Activity	--	1	--	--	--	--
			Value Added Course*	--	2*	3	50	50	100*
			Total	**30**	**28**	**-**	**-**	**-**	**700**
			Total	**180**	**140**				**4400**

* **Extra Credit Courses, which will not be included in the total CGPA**

- Summer Internship after 4th semester during summer vacation -30 Hours and 2 credits will be included in the 5th semester.

-Value added course (Outside Instruction hours: 30 hours)

1. **Part-wise Credits**

Part	Course details	No. of Courses	Total Credits
I	Tamil	04	12
II	English	04	12
III	Core Course Theory	10	48
	Core Practical	05	16
	Project with Viva-Voce	01	03
	Allied Course Theory	04	12
	Allied Practical	02	04
	Discipline-Specific Electives	04	16
IV	Skill Enhancement Courses	03	06
	Non-Major Elective	02	04
	Value Education	01	02
	Environmental Studies	01	02
	Summer Internship	01	02*
V	Gender Studies	01	01
	Health and Wellness	01	01
	Extension Activity		01
		Total	**140**

2. **List of Value-Added Courses**

Course Code	Course Title
25UBTVAC1	Mushroom Technology
25UBTVAC2	Herbal Technology
25UBTVAC3	Hands on training in Sophisticated Instruments

3. **Attendance**

75% of attendance in each semester shall appear for the examination.

Attendance between 65% and 74% shall apply for **condonation** in the prescribed form with the prescribed fee.

Attendance between 50% and 64% shall apply for **condonation** in prescribed form **with** the prescribed fee along with the **Medical Certificate**.

Attendance below 50% are **not eligible to appear for the examination**. They shall re-do the semester(s) after completion of the Programme.

4. **Question Paper Pattern of CIA I and CIA II Examinations**

UG Programme		
Maximum Marks : 50		**Duration: 1 ½ Hours**
Section - A	**i) a-** (3 Questions for Multiple Choice) One question from each unit	3 x 1 = 03 Marks
	b- (5 Questions for Fill in the Blanks) One question from each unit	3 x 1 = 03 Marks
	ii) (5 short answer questions) One question from each unit	2 x 2 = 04 Marks
Section - B	**4 Questions** One set of questions from each unit	4 x 5 = 20 Marks
Section - C	**3 Questions** One question from each unit	2 x10 = 20 Marks

Question Paper Pattern of Pre-Semester and End Semester Examinations

UG Programme		
Maximum Marks : 75		**Duration: 3 Hours**
Section - A	**i) a-** (5 Questions for Multiple Choice) One question from each unit	5 x 1 = 05 Marks
	b- (5 Questions for Fill in the Blanks) One question from each unit	5 x 1 = 05 Marks
	ii) (5 short answer questions) One question from each unit	5 x 2 = 10 Marks
Section - B	**5 Questions** (Internal Choice: Either or) One set of questions from each unit	5 x 5 = 25 Marks
Section - C	**3 Questions** (Answer any 3 out of 5 Questions) One question from each unit	3 x10 = 30 Marks

5. The ratio of marks allotted to the continuous internal assessment and to the end semester examination

	Internal Marks	**External Marks**
Theory	25 Marks	75 Marks
Practical	40 Marks	60 Marks
Project	20 Marks	80 Marks

6. The Internal components of Theory course

	Maximum Marks
Maximum mark of CIA I & CIA II	Converted to 30 Marks
5 Assignments (5x5)	25 Marks
Seminar	10 Marks
Pre-Semester	Converted to 25 Marks
Library Assignment & Attendance	10 Marks
Total	100 Marks

100 marks converted to 25 marks.

7. The Internal components of Practical course

	Maximum Marks
Two Model Practical Exams	60 Marks
Record	10 Marks
Viva-Voce	10 Marks
Attendance	10 Marks
Overall Performance	10 Marks
Total	100 Marks

100 marks converted to 40 marks.

8. Passing Minimum for Theory

	Continuous Internal Assessment (CIA)	End Semester Examination (ESE)	CIA + ESE
Theory	40% out of 25 Marks [i.e. 10 Marks]	40% out of 75 Marks [i.e.30 Marks]	40 Marks
Practical	40% out of 40 Marks [i.e. 16 Marks]	40% out of 60 Marks [i.e.24 Marks]	40 Marks
Project	Viva-Voce 20 Marks 40% out of 20 Marks [i.e. 8 Marks]	Project Report 80 Marks 40% out of 80 marks [i.e. 32 marks]	40 Marks

9. UG Project Evaluation

Project Title Registration

Students must fill out the Final Year Project Title Registration Form. The Project Proposal Form should be submitted by the student to his/her supervisor before the commencement of the project. The form must include three project titles, the abstracts of the projects, objectives /aim (or goal), scope of the project, and proposed methodology. The first proposal **(Review 1)** is presented (seminar) before the project review committee for panel assessment.

Students should record project-related activity in a log. The log is a weekly record of the student's progress in meeting their objectives. Students should also record the meeting details with their supervisor in the log. Students should meet with their supervisor regularly, taking their log along to review progress. The complete log should be submitted as an appendix in the final report.

Review 1 – Project Proposal (20 Marks)

Present the abstracts of the projects, objectives /aim (or goal), scope of the project, and proposed methodology to the project review committee members.

The project review committee will assign the students a project, and the head of the department will assign them a supervisor.

a. Abstract of the proposed work.
b. Study of the Existing Systems. & drawbacks in the existing systems.
c. Objectives and scope of the proposed work.
d. Relation with current issues.
e. Methodology.
f. Presentation of proposed work.

Review 2 – Midterm Presentation (20 Marks)

a. Implemented modifications suggested in Review 1.
b. Timeframe work being followed.
c. Defined Objectives are achieved.
d. Individual or Team Contribution.
e. 75% of the Project Work is completed.

Review 3 - Final Presentation (30 Marks)

At the end of the final year project, students will be required to make a brief presentation on their project (UG: 6 minutes for each student). The presentation should cover the following:

a. Overview of the project (project objectives and scopes).
b. Methodology.
c. Result and discussion.
d. Conclusion and recommendation.
e. References.
f. Project demonstration (Optional) .

Project Report Evaluation (10 Marks)

a. The project report is in the specified format.
b. Results are presented in a very appropriate manner.
c. Project work is well summarized and concluded.
d. Future extensions in the project are well specified.
e. References and citations are appropriate and well-mentioned.

10. End Semester Exam Project Work Evaluation

S.No.	Register No	Name of the student	Title of the Project	PPT presentation / Demonstration (2)	Usage of the latest tools and/or methodology (3)	Result and Discussion (2)	Individual contribution (3)	Viva-Voce (10)	Total (20)

11. Guidelines for the Preparation of a Project Report

Arrangements of Contents:

The Project Report has to be organised in the following order**.**

1. Cover Page (Refer to Appendix 1)
2. Inside Title Page (Refer to Appendix 1)
3. Declaration Certificate (Refer to Appendix 2)
4. Bonafide Certificate (Refer to Appendix 3)
5. Acknowledgements
6. Abstract
7. Table of Contents
8. List of Figures
9. List of Tables
10. Abbreviations/ Notations/ Nomenclature (if any)
11. Report text content (Minimum 5 Chapters – Minimum 80 Pages)

Chapter 1

Chapter 2

…....

Chapter 5

12. References
13. Appendices (if any)

APPENDIX 1

A typical Specimen of the Cover Page and Title Page
<Font Style Times Roman>

TITLE <Font Size 18>

A Project Report submitted <Font Size 14> <Italic>

in partial fulfillment for the award of the degree <Font Size 14> <Italic>

NAME OF THE DEGREE <Font Size 16>

Submitted By <Font Size 14> <Italic>

	Name	Register Number
1.		
2.		
3.		
4.		
5.		

under the guidance of <Font Size 14> <Italic>

NAME OF THE GUIDE<Font Size 16>

NAME OF THE DEPARTMENT <Font Size 16>

THANTHAI HANS ROEVER COLLEGE (Autonomous) <Font Size 16>

Elambalur, Perambalur – 621 220 <Font Size 14>

APRIL – 2026 <Font Size 16>

APPENDIX 2

Thanthai Hans Roever College (Autonomous)
(Accredited with 'A' Grade by NAAC (3rd cycle) with GPA 3.23 out of 4)
(Affiliated to Bharathidasan University, Tiruchirapalli)
Elambalur, Perambalur – 621 220

CERTIFICATE <Font size – 16>

<Below paragraph Font size – 14>

This is to certify that this Project entitled "**Title of the project**" is a bonafide record work done by the following members

<Following lines Font size – 12>

Name	**Register Number**
6.	
7.	
8.	
9.	
10.	

<Below paragraph Font size – 14>

in partial fulfillment of the requirement for the award of degree of Bachelor of Science in Computer Science during the year 2024-2025

Guide <Font size – 12> **Head of the Department**

Date of Viva –Voce: <Font size – 12>

Examiner <Font size – 12>

1.

2.

APPENDIX 3

Thanthai Hans Roever College (Autonomous)
(Accredited with 'A' Grade by NAAC (3rd cycle) with GPA 3.23 out of 4)
(Affiliated to Bharathidasan University, Tiruchirapalli)
Elambalur, Perambalur – 621 220

BONAFIDE CERTIFICATE <Font size – 16>

<Below paragraph Font size – 14>

This is to certify that the project entitled "…….**TITLE OF THE PROJECT**……..." is the bonafide work carried out by the following students under my supervision does not form part of any other project or report based on which a degree or award was conferred on an earlier occasion on his or any other candidate.

Name	**Register Number**
1.	
2.	
3.	
4.	
5.	

Guide <<Signature of Guide >>

<<Signature of guide>> <<Font size – 16>>

<<Academic Designation>>

<<Department>>

Report Size
The report may contain a minimum of about **80 pages**, excluding references and appendices.

Paper Size
A4-size paper.

Paper Quality
White bond paper weighing 80 g/m2 or more should be used. The same quality of paper should be used throughout. Photographs or images with dense colors may be printed on a single side on glossy paper.

Margins
A margin of 2.54 cm is to be provided on the left and right sides, whereas the top and bottom margins should be 3 cm. No printed matter should appear in the margin except the page numbers. All page numbers should be centered inside the bottom margin, 2 cm from the bottom edge of the paper.

Font
Times New Roman **(TNR)** 12-point font has to be used throughout the running text. The captions for tables and figures should have a font size of 11, and footnotes should be set at font size 10. **Line**

Spacing
The line spacing in the main text should be 1.5. Single line spacing should be given for quotations, abstracts, figure captions, table captions, figure legends, footnotes, and references. The equations, tables, figures, and quotations should be set off from the main text both before and after with a spacing of 1.5. Two consecutive paragraphs should be separated by triple line spacing

Headings
The following format has to be followed in the headings of chapters and sections.

CHAPTER 3

TITLE PAGE-CENTERED TNR 17-POINT BOLD ALL CAPS

3.1. Section Heading

Left aligned with number, TNR 16 points, bold and leading caps

3.1.1. Second level section heading

The left is aligned with the number, TNR 14 points, and bold, sentence case.

3.1.1.1. Third level section heading

The left is aligned with the number, TNR 12 points, and bold, sentence case.

Fourth-level section heading. Numbered subsections beyond the third level are not recommended. However, fourth-level subsection headings may be included without numbering. TNR 12-point font, left aligned, and italicized.

Running text should be set in 12-point TNR and fully justified. The first line of the paragraph should have an indentation of 1.5 Cm.

Page Numbering

All page numbers (**Roman or Arabic**) should be typed without punctuation at the central bottom of each page. The preliminary pages of the reports (such as Title page, Acknowledgement, Table of Contents, etc.) should be numbered in lower-case Roman numerals. The title page will be numbered as (i), but this should not be typed. The page immediately following the title page shall be numbered as (ii). Pages of the main text, starting with Chapter 1, should be consecutively numbered using Arabic numerals.

Table / Figure/equation Format

Tables, figures, and equations shall be numbered chapter-wise. For example, the second figure in Chapter 3 will be numbered Figure 3.2. The figure can be cited in the text as Fig. 3.2. The figure caption shall be located below the figure.

Tables shall be numbered similarly (Table 2 in Chapter 3 will be numbered Table 3.2) and shall be cited in the text as Table 3.2. The table number and caption shall be located above the table.

Equations aligned to the page's center with equation numbers in the text have to be given at the end of the line within brackets.

Listing of the References

References are to be listed after the last chapter. They are to be listed in alphabetical order and numbered. Within a reference, the line spacing should be single. Each reference should be separated by one blank line. The reference number should be left-aligned. The text of the reference should have an indentation of 10 mm. The reference format to be followed for journal articles, textbooks, conference proceedings, etc., is given below

References

Journals

1. Deodhar. S.V. and Patel. A .N. (1996) “Behavior of brick masonry in compression” Journal of Structural Engineering 22, 221-227.

2. Liu. H., Williams Burkett. and Kirk Haynes.(2005) “Improving freezing and thawing properties of fly ash bricks”, World of coal ash conference 11-15.

3. Prakas, K. (2011). Feedback and optimal sensitivity: Model reference transformations, multiplicative seminorms, and approximate inverses. IEEE Transactions on Automatic Control, 26(2): 301–320.

4. Ram, R., Krishna, S. and Peter, K. (2005a). Risk sensitive estimation and a differential game. IEEE Transactions on Automatic Control, 39(9): 1914– 1918.

5. Sarangapani. G., Venkatarama Reddy. B. V. and Jagadish. K. S. (2009) “Structural characteristics of bricks, mortars and masonry” Journal of Structural Engineering 29(2), 101-110.

Conference proceedings

1. Payne, D.B. and Gunhold, H.G. (1986). Digital sundials and broadband technology, In Proc. IOOC-ECOC, 1986, pp. 557-998.

2. Singh, K. and Robin, R. (2008). A linear-quadratic game approach to estimation and smoothing. In the American Control Conference, New York. June 20 – 25, 2008, pp. 2818–2822.

Online journals with a DOI (Digital Object Identifier)

1. Amra Bratovcic, (2025). Exploring Food Waste Potential for Bioethanol Production in Sustainable Energy and Emission Reduction, Journal of Sustainable Bioenergy Systems 15(2): 272- 275. doi: 10.4236/jsbs.2025.152004

2. Krebs, D.L. and Denton, K. (2006). Explanatory limitations of cognitive developmental approaches to morality. Psychological Review, 113(3): 672- 675. doi: 10.1037/0033-295X.113.3.672

Online journals without a DOI

1. Vicki, G.T., Thomas, M., Cullen, A. and Fernandez, H. (2007). Modeling the hydrological impact on Tropical Forests. Forest Ecology, 13(10): 122-132. http://www.uiowa.edu/~grpproc/crisp/crisp.html

Online abstracts

1. Perilloux, C. and Buss, D.M. (2008). Human relationships: Costs experienced and coping strategies deployed. Evolutionary Psychology, 6(1): 164-181. Abstract retrieved from http://www.epjournal.net

Online books

1. Perfect, T.J. and Schwartz, B. L. (Eds.) (2002). Applied metacognition. Retrieved from http://www.questia.com/read/107598848 (--If DOI is available, use the DOI instead of a URL)

SEMESTER – I

Sem.	Course Code	Credits	Title of the Course	AC / CC / DE / ES / GS / NME / PF / PW / VAC/ VE / SE / WK	Category			Sem. Exam	Max. Marks		
					Theo Hrs.	Lecture Hrs.	Lab. Hrs.		CIA	ESE	Total.
1	25UBTICC1	5	**CELL BIOLOGY**	CC	5	-	-	**3 Hrs.**	**25**	**75**	**100**

Pre-Requisite:

Course Objectives: The purpose of learning this course is:

1. Cell biology is the study of the structure and function of prokaryotic and eukaryotic cells
2. In this course the students will learn different areas of cellular biology including the structure and functions of cell,
3. Cellular organelles, synthesis and function of macromolecules such as carbohydrate, protein, lipid, DNA & RNA;

Course Outcomes:

CO1: Understand the discovery and basic properties of cells, and differentiate between prokaryotic and eukaryotic cells.

CO2: Explain the mechanisms of cell division, including mitosis, meiosis, and binary fission

CO3: Describe membrane potentials and the role of extracellular matrix and cytoskeleton in cell structure and communication

CO4: Evaluate the roles of mitochondria and chloroplasts in cellular respiration and photosynthesis.

CO5: Utilize various microscopy and staining techniques, and understand the use of radioisotopes in cell biology investigations.

Unit-I	**Fundamentals of cell**	12 Hrs.

Cell: Introduction about discovery and cell theory, Basics of cell structure, types and functions. Characteristics of Prokaryotic and Eukaryotic cell (Plant and Animal cell)

Unit-II	**Cell Membrane and Permeability:**	12 Hrs.

Chemical components of biological membranes, organization and Fluid Mosaic Model, Basics on membrane as a dynamic entity, cell recognition and membrane transport. (Active, Passive and Osmosis), Endocytosis: Definition and steps involved in Endocytosis

Unit-III	**Cellular Organelles**	12 Hrs.

Structure and functions of Organelles: Nucleus, Mitochondria, Chloroplast, Endoplasmic Reticulum, Golgi apparatus, Ribosomes, Lysosomes, Vacuoles, Peroxisomes and Glyoxisomes.

Unit-IV	**Cellular Interaction**	12 Hrs.

Cell-cell Interaction: Definition, Types and functions. extracellular matrices – structural components and functions; Major components of cytoskeleton and its Function. Cell Signalling-Introduction.

Unit-V	**Cell Cycle**	12 Hrs.

Cell cycle: Definition, Phases of cell cycle: Mitosis and Meiosis, Key Regulatory Proteins involved in cell cycle

Text Books:

1. Alberts, B., Johnson, A., Lewis, J., Morgan, D., Raff, M., Roberts, K., Walter, P., "Molecular Biology of the Cell", (7th edition), Garland Science, 2022, ISBN: 978-0-8153-4591-3
2. Lodish, H., Berk, A., Kaiser, C.A., Krieger, M., Bretscher, A., Ploegh, H., Matsudaira, P., "Molecular Cell Biology",(9th edition), W. H. Freeman, 2021, ISBN: 978-1-319-11467-1
3. Pollard, T.D., Earnshaw, W.C., Lippincott-Schwartz, J., Johnson, G.T., "Cell Biology", (4th edition), Elsevier, 2022, ISBN: 978-0-323-59532-0

4. Karp, G., "Cell and Molecular Biology: Concepts and Experiments",(9th edition), Wiley, 2021, ISBN: 978-1-119-54716-2
5. Becker, W.M., Kleinsmith, L.J., Hardin, J., Bertoni, G.P., "Becker's World of the Cell", (9th edition), Pearson, 2017, ISBN: 978-0-13-414662-6

Reference Books:

1. Stenesh, J., "Cell Biology and Genetics", (1st edition), CRC Press, 2022, ISBN: 978-1-003-12143-2
2. Wolpert, L., Tickle, C., Martinez Arias, A., "Principles of Development", 6th edition, Oxford University Press, 2019, ISBN: 978-0-19-880056-9
3. Russell, P.J., "Genetics: A Molecular Approach", (4th edition), Pearson, 2020, ISBN: 978-0-13-481872-6
4. Malyavantham, K.S., "Cell and Molecular Biology: An Integrated Approach", (1st edition), Elsevier, 2022, ISBN: 978-0-323-85246-1
5. Schaechter, M., "Desk Encyclopedia of Cell Biology", 2nd edition, Academic Press, 2021, ISBN: 978-0-12-818610-4

Web Resources:

1. https://www.ncbi.nlm.nih.gov/books
2. https://www.khanacademy.org/science/biology/cell-biology
3. https://www.nature.com/ncb
4. https://www.cell.com/
5. https://www.nature.com/scitable

Prepared by Checked by HoD

Sem.	Course Code	Credits	Title of the Course	AC / CC / DE / ES / GS / NME / PF / PW / VAC/VE / SE / WK	Category			Sem. Exam	Max. Marks		
					Theo. Hrs.	Lecture Hrs.	Lab. Hrs.		CIA	ESE	Total.
I	25UBT1CP2	4	**CELL BIOLOGY - PRACTICAL**	CC - P			4	**3 Hrs.**	**25**	**75**	**100**

Pre-Requisite:

Course Objectives:

1. The students will learn, understand & develop skill and hands on training in basics of cell biology
2. Study the cells and their enumeration by appropriate techniques
3. Study the different types of cell division.
4. Acquire knowledge in subcellular fractionation

Course Outcomes:

CO1: Describe the principle and applications of Microscope.

CO2: Demonstrate the observation of different types of cells and their enumeration

CO3: Illustrate the different types of cell division

CO4: Outline a clear and concise idea about specialized chromosomes

CO5: Identify the motility of an organism

Experiments

1. Microscope – Bright field and Dark field
2. Structure observation - Prokaryotic & Eukaryotic cell
3. Observation – Different types of cells – parenchyma, collenchymas, clerenchyma, epithelium
4. Size and shape of an organism (prokaryote) – simple staining,
5. 11. Cell division - Mitotic stages - Preparation of Onion Root Tip
6. 12. Cell division - Meiotic stages - Preparation of Tradescantia Flower bud
7. Cell count - Hemocytometer (Blood sample)
8. Study of Plasma Membrane Permeability using beetroot or onion cells
9. Osmosis and Plasmolysis in plant cells (Potato)
10. Motility of an organism – Hanging drop
11. Sub cellular fractionation using Density Gradient method

Demonstration

12. . Micrometry
13. Cell division – Binary fission of yeast
14. Polytene and diplotene chromosome – Chirinamous larva
15. 15. Microtome – Temporary & permanent slide preparation.

Text Books:

1. Bruce Alberts, Alexander D. Johnson, David Morgan, Martin Raff, Keith Roberts, Peter Walter, "Molecular Biology of the Cell", 7th edition, Garland Science, 2022, ISBN: 9780393884821
2. Thomas D. Pollard, William C. Earnshaw, Jennifer Lippincott-Schwartz, Graham Johnson, "Cell Biology", 4th edition, Elsevier, 2022, ISBN: 9780323757485
3. Gerald Karp, Janet Iwasa, Wallace Marshall, "Karp's Cell and Molecular Biology: Concepts and

Experiments", 9th edition, Wiley, 2021, ISBN: 9781119671944
4. Geoffrey M. Cooper, Robert E. Hausman, "The Cell: A Molecular Approach", 8th edition, Oxford University Press, 2022, ISBN: 9780197540771

Reference Books:

1. Stephen R. Bolsover, Elizabeth A. Shephard, Hugh A. White, Jeremy S. Hyams, "Cell Biology: A Short Course", 3rd edition, Wiley-Blackwell, 2023, ISBN: 9781119979514
2. Ralph Buchsbaum, Mildred Buchsbaum, "Animals Without Backbones: An Introduction to the Invertebrates", 3rd edition, University of Chicago Press, 2021, ISBN: 9780226078748
3. John Wilson, Tim Hunt, "Molecular Biology of the Cell: The Problems Book", 6th edition, Garland Science, 2015, ISBN: 9780815344537
4. David E. Sadava, "Cell Biology: Organelle Structure and Function", 2nd edition, Jones & Bartlett Learning, 2020, ISBN: 9781284199120

Web Resources:

1. https://youtu.be/Izk1QMg8190
2. https://youtu.be/IR5jps-xmzA
3. https://www.ncbi.nlm.nih.gov/
4. https://www.biointeractive.org/
5. https://www.coursera.org/

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Sem.	Course Code	Credits	Title of the Course	AC / CC / DE / ES / GS / NME / PF / PW / VAC/VE / SE / WK	Category			Sem. Exam	Max. Marks		
					Theo. Hrs.	Lecture Hrs.	Lab. Hrs.		CIA	ESE	Total.
I	25UBT1AC1	3	**BIOLOGICAL CHEMISTRY**	AC	4			3 Hrs.	25	75	100

Pre-Requisite:

Course Objectives: The purpose of learning this course is:

1. To make the students understand the basics of biomolecules.
2. To study structural and functional properties of carbohydrates, proteins, lipids and nucleic acids.
3. To make the students learn the disorders of metabolic pathways.
4. This course would make the students to understand the significance of biochemistry.
5. Understand the nutritional significance of carbohydrates, lipids and proteins.

Course Outcomes:

CO1: Developed a very good understanding of various bio molecules

CO2: Understand the types of chemical reactions

CO3: Recall the Structure, Classification, Chemistry and Properties of Carbohydrates and Explain Various Biochemical Cycles involved in Carbohydrate Metabolism.

CO4: Recall the Structure, Classification, Chemistry and Properties of Lipids, Nucleic acid and Explain Various Biochemical Cycles involved in Fatty acid and Nucleic acid Metabolism.

CO5: Understand the Structure, Classification, Chemistry and Properties of proteins amino acids and Identify and explain nutrients in foods and the specific functions in maintaining health.

Unit-I **Basic chemistry of Life** 08 Hrs.

Biochemistry-the chemical foundation of life. Water: its unique properties, ionization of water, buffering action in biological system, properties and characteristics of water. and differences, Acids & Bases : Concepts and properties, pH scale, measurement of pH. Buffer solutions, properties of buffers,

Unit-II **Carbohydrates** 10 Hrs.

Carbohydrates: Definition, Structure, Classifications, Properties and Biological importance.

Unit-III **Lipids & Fatty acids** 09 Hrs.

Lipids: Definition, Structure, Classifications, Properties and Biological importance. Fatty acids: Definition, Structure, Classifications and Properties

Unit-IV **Proteins & Amino acids** 10 Hrs.

Proteins: Definition, Structure **(**Egg Albumin, Keratin, Collagen) Biological functions of Proteins. Amino acids Definition, structure, Classification, Properties and biological importance

Unit-V **Nucleic acids, Vitamins & Minerals** 08 Hrs.

Nucleic acids: Definition, Types and Functions. Vitamins: Definition, Fat soluble vitamins A, D, E and K & Water-Soluble vitamin B1, B2, B3, B6, B12 and C, Functions. Minerals: Definition, Types and Functions.

Text Books:

1. Prasad R Manjeshwar, "A Text-book of Biochemistry", (5th Edition), Prasad book house publications, 2019, ISBN: 9788189560221.
2. Jain J L, Sunjay Jain, Nitin Jain, "Fundamentals of Biochemistry", (7th edition), S. Chand publication, 2016, ISBN: 978-8121924535.
3. Sathyanarayana U, Chakrapani U. "Biochemistry", (4th edition), Elsevier Publishers, 2013, ISBN: 978-81-312-3601-7.
4. David L. Nelson, Michael Cox, "Lehninger:Principles of Biochemistry", (7th edition), Kalyani Publishers, 2017, ISBN: 978-1319108243.
5. Srivastava H S, "Elements of Biochemistry", Rastogi Publications, 2006, ISBN: 978-0-891-18562-8.

Reference Books:

1. Michael Cox, Albert L. Lehniger, Lehninger, "Principles of Biochemistrty", (4th edition), WH Freeman and Company, 2013, ISBN: 9783662082904.

2. Murray, “Harper’s biochemistry”, (26th edition), Appleton and Lange Publishers, 2013, ISBN: 978-0838535622.
3. Geoffrey L, Zubay, William W, Parson, Dennis E. Vance, “Principles of Biochemistry”, (3rd edition), W.C. Brown Publishers, 1995, ISBN:
4. Lubert Stryer, “Biochemistry”, (5th Edition), W H Freemann and company, 2007, ISBN: 978-0716746843.
5. Bahl Arun, Bahl B S, “A Textbook of Organic Chemistry”, (22nd Edition), S. Chand & Sons publications, 2016, ISBN: 978-9352531967.

Web Resources:

1. https://www.uwyo.edu/molecbio/courses/molb3610/files/3610%20chpts%2012%20notes.pdf/

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Sem.	Course Code	Credits	Title of the Course	AC / CC / DE / ES / GS / NME / PF / PW / VAC/VE / SE / WK	Category			Sem. Exam	Max. Marks		
					Theo. Hrs.	Lecture Hrs.	Lab. Hrs.		INTERNAL	EXTERNALE	Total.
I	25UBT2AP1	2	**BIOLOGICAL CHEMISTRY & FUNDAMENTALS OF MICROBIOLOGY - PRACTICAL**				3	**3 Hrs.**	**40**	**60**	**100**

Pre-Requisite:

Course Objectives: The purpose of learning this course is:

1. To acquire knowledge about aseptic techniques.
2. To comprehend the various methods for identification of unknown microorganisms
3. To impart the students with hands on skills related to biochemical techniques
4. To enable the students to perform qualitative and quantitative analysis of biomolecules

Course Outcomes:

CO1:Describe the general Laboratory safety & Sterilization Techniques

CO2:Develop Skills in Media Preparation, Isolation & Serial Dilution Techniques and Pure Culture Techniques

CO3: Microscopically analyze the morphological features of Bacteria and fungi and define various Staining Techniques

CO4:Perform the Motility of organisms

CO5:Able to characterize and identify bacteria using Biochemical tests.

BIOLOGICAL CHEMISTRY 00 Hrs.

Systematic analysis of Organic compounds

1. Functional group tests (Carboxylic acid (Benzoic acid, phthalic acid),
2. Phenol, Urea, Benzaldehyde, Aniline (Aniline not to be given for exam) Confirmation tests
3. Detection of elements (N, Halogens)
4. Distinguish between aliphatic and aromatic compounds.
5. Distinguish between Saturated and unsaturated compounds

Qualitative Analysis

6. Qualitative analysis of carbohydrates - Glucose, Fructose, Lactose, maltose, sucrose, starch & glycogen.
7. Qualitative analysis of amino acids - Tyrosine, Tryptophan, Arginine, Proline and Cysteine.

Volumetric Analysis:

8. Estimation of Glycine- Formal Titration.
9. Determination of Ascorbic acid – DCPIP method.
10. Estimation of Ferrous sulphate using standard Mohr's salt.

Colorimetric Analysis

11. Estimation of glucose Benedict's / Fehling's Method
12. Estimation of Cholesterol- Zak's method
13.Estimation of proteins – Bradford’s method

FUNDAMENTALS OF MICROBIOLOGY

1. Good Laboratory Practice, Maintenance of hygienic conditions in the laboratory and legal disposal of laboratory wastes.
2. Microscope and its functions, preparation of culture media and sterilization methods.
3. Staining techniques: Simple, Gram’s, Capsule (Negative), Spores,
4. Preparation of temporary mounts- Lacto phenol cotton blue staining Inoculation techniques- Pour plate, spread plate
5. Isolation of bacteria from various sources and dilution techniques Motility of bacteria, Growth studies of bacteria
6. Sterilization techniques – Preparation of Media.
7. Biochemical characterization - catalase, oxidase, IMVIC test and TSI.
8. Antibiotic sensitivity test (demonstration).

Text Books:

1 Jayaraman J, "Laboratory Manual in Biochemistry", (2nd edition), New Age International Private Limited 2011, ISBN: 978-8122430493.
2 Timea Gerczei Fernandez, "Biochemistry Laboratory Manual For Undergraduates: An Inquiry-Based Approach", (2nd edition), 2014, ISBN:3110411326.
3 Irwin H.Segel, "Biochemical calculations", (4th edition), John Wiley & Sons Inc; Genre · Science, 2019, ISBN:9780471774211

Reference Books:

1. Sadasivam S, Manickam A. "Introduction to Practical Biochemicstry.", (2nd edition), New Age International Private Ltd.Publishers, 2009, ISBN: 10: 9393159653.
2. James G Cappucino, N. Sherman, "A lab manual Benjamin Cummins", (2nd edition), Pearson Benjamin Cummings, 2013, ISBN: 0321840224.
3. Talib V H, "Handbook Medical Laboratory Technology", (2nd edition), CBS, 2010, ISBN: 978-8123906775.

Web Resources:

1. http://www.biologydiscussion.com/micro-biology/sterilisation-and-disinfection-methods-and-principles-microbiology/24403.
2. https://www.ebooks.cambridge.org/ebook.jsf?bid=CBO9781139170635
3. https://ttk.elte.hu/dstore/document/871/book.pdf

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SEMESTER – II

Sem.	Course Code	Credits	Title of the Course	AC / CC / DE / ES / GS / NME / PF / PW / VAC/VE / SE / WK	Category			Sem. Exam	Max. Marks		
					Theo. Hrs.	Lecture Hrs.	Lab. Hrs.		CIA	ESE	Total.
II	25UBT2CC2	5	**MOLECULAR BIOLOGY**	CC	5	-	-	**3 Hrs.**	**25**	**75**	**100**

Pre-Requisite:

Course Objectives: The purpose of learning this course is:

1. This course is designed to given an understanding about the basics of molecular biology
2. Classical genetics & molecular aspects.
3. To understand the organization and chemical nature of genetic material
4. To explore the principles of classical genetics and inheritance patterns
5. To gain insight into gene expression and regulatory mechanisms

Course Outcomes:

CO1: Learn about the organization of Chromatin, Chromosomes and Nucleus

CO2: Know about population genetics and laws of inheritance

CO3: Gain knowledge of steps involved in transcription and translation

CO4: Explain how DNA replication has occurred in prokaryotes and eukaryotes

CO5: Understand about the regulation of gene expression

Unit-I	**Genetic Material**	12 Hrs.

Discovery of Genetic Material, Griffith, Hershey and Chase Experiment, Avery and McCarty Experiment, Chargaff's Rule, Watson and Crick Model; Genetic Material: Organisation and types.

Unit-II	**DNA Replication, Recombination and Repair**	12 Hrs.

DNA Replication: Prokaryotes and Eukaryotes, Types and Direction of Replication, Major Enzymes involved in Replication. Recombination: Homologous & Non homologous, DNA Repair Mechanisms (Base Excision, Mismatch, Nucleotide Excision repair, Double strand break repair)

Unit-III	**Transcription**	12 Hrs.

Transcription – Prokaryotic & Eukaryotic. Enzymes involved in Transcription - RNA polymerase. Post transcriptional processing in mRNA (5 cap), 3' – end polyadenylation, splicing

Unit-IV	**Translation**	12 Hrs.

Translation - Prokaryotic & Eukaryotic, Translational inhibitors. Post-translational modifications, Significance and Applications of translation in Biotechnology & Medicine.

Unit-V	**Regulation of gene expression**	12 Hrs.

Introduction and Conceptualisation on Gene Regulation In prokaryotes (Lac, Ara, Trp & Gal operon) and Regulation In eukaryotes (RNAi, enhancers, silencers, miRNAs)

Text Books:

1. David P. Clark, Nanette J. Pazdernik, "Molecular Biology", (3rd edition), Elsevier, 2019, ISBN: 9780128132883
2. Bruce Alberts, Alexander D. Johnson, Julian Lewis, David Morgan, Martin Raff, Keith Roberts, Peter Walter, "Molecular Biology of the Cell", (7th edition), Garland Science, 2022, ISBN: 9780393884821
3. James D. Watson, Tania A. Baker, Stephen P. Bell, Michael Levine, Richard Losick, "Molecular Biology of the Gene", (7th edition), Pearson Education, 2013, ISBN: 9780321762436
4. Robert F. Weaver, "Molecular Biology", (6th edition), McGraw-Hill Education, 2018, ISBN: 9781259276340
5. Michael M. Cox, Jennifer A. Doudna, Michael O'Donnell, "Molecular Biology: Principles and Practice", (3rd edition), W.H. Freeman and Company, 2022, ISBN: 9781319384067

Reference Books:

1. Tamar Schlick, "Molecular Modeling and Simulation: An Interdisciplinary Guide", (2nd edition), Springer, 2010, ISBN: 9781441963505
2. Gerry L. Fasman, "Practical Handbook of Biochemistry and Molecular Biology", (1st edition), CRC Press, 2022, ISBN: 9780367772697
3. Michael R. Green, Joseph Sambrook, "Molecular Cloning: A Laboratory Manual", (4th edition), Cold Spring Harbor Laboratory Press, 2012, ISBN: 9781936113422
4. Burton E. Tropp, "Molecular Biology: Genes to Proteins", (5th edition), Jones & Bartlett Learning, 2012, ISBN: 9781449647919
5. Glick, B.R., Pasternak, J.J., Patten, C.L., "Molecular Biotechnology: Principles and Applications of Recombinant DNA", (5th edition), ASM Press, 2017, ISBN: 9781555819333

Web Resources:

1. https://www.web-books.com/MoBio/Free/Chap1.htm
2. https://www.coursera.org/
3. https://www.ebi.ac.uk/
4. https://www.ncbi.nlm.nih.gov/pmc

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Sem.	Course Code	Credits	Title of the Course	AC / CC / DE / ES / GS / NME / PF / PW / VAC/VE / SE / WK	Category			Sem. Exam	Max. Marks		
					Theo. Hrs.	Lecture Hrs.	Lab. Hrs.		CIA	ESE	Total.
II	25UBT2CP2	3	**MOLECULAR BIOLOGY – PRACTICAL**	CC-P			3	**3 Hrs.**	**40**	**60**	**100**

Pre-Requisite:

Course Objectives:

1. In this course the students will get hands on experience in Molecular Biology Techniques
2. Trian the students to get hands-on experience in basic molecular biology techniques.
3. Learn about purification and quantification of macromolecules
4. Acquire knowledge in molecular genetics

Course Outcomes:

CO1: Know about how DNA is isolated from prokaryotes as well eukaryotes

CO2: Develop the basic knowledge on estimation of nucleic acids

CO3: Gain the experience on separation of proteins

CO4: Identify bacterial growth reduction using physical and chemical mutagens

CO5: Learn about how gene transfer methods are used to reproduce bacteria

Experiments

1. Isolation and purification of genomic DNA from prokaryotes.(E.coli)
2. Isolation and purification of genomic DNA from eukaryotes.(blood/liver)
3. Isolation and purification of plasmid DNA.
4. Observation of DNA - Agarose gel electrophoresis.
5. Quantification of nucleic acids – DNA & RNA – UV method.
6. Qualitative analysis of protein by SDS PAGE (coomosie brilliant blue & AgNO3)
8. Bacterial mutagenesis – physical & chemical.(Mention the method)
9. Preparation of *E. coli* competent cells.

Demonstration

1. Bacterial Transformation – CaCl2 method.
2. conjugation.
3. Transduction.

Text Books:

1. Mooyoung M. "Comprehensive Biotechnology". (1st edition), Pergamon press, 1985, ISBN: 978-0080325101
2. George M. Malacinski Freifelder's "Essentials of Molecular Biology", (4th edition), Norosa Publishing House, 2013, ISBN:978-9384323059
3. Stanely R. Maloy, Jhon E Cornan Jr, David Freifelder. "Microbial Genetics", (2nd Edition), Jones and Bartlett publisher , 1994, ISBN:978-0867202489

Reference Books:

1. David P. Clark, Nanette J. Pazdernik, "Molecular Biology", (3rd edition), Elsevier, 2019, ISBN: 9780128132883.
2. Bruce Alberts, Alexander D. Johnson, Julian Lewis, David Morgan, Martin Raff, Keith Roberts, Peter Walter, "Molecular Biology of the Cell", (7th edition), Garland Science, 2022, ISBN: 9780393884821.
3. James D. Watson, Tania A. Baker, Stephen P. Bell, Michael Levine, Richard Losick, "Molecular Biology of the Gene", (7th edition), Pearson Education, 2013, ISBN: 9780321762436
4. Robert F. Weaver, "Molecular Biology", (6th edition), McGraw-Hill Education, 2018, ISBN: 9781259276340.

5. Jeremy M. Berg, John L. Tymoczko, Gregory J. Gatto Jr., Lubert Stryer, "Biochemistry: A Short Course", (4th edition), W.H. Freeman and Company, 2019, ISBN: 9781319114671.

Web Resources:

1. http://www.fastbleep.com/biology-notes/41/122/1216
2. http://cshprotocols.cshlp.org/content/2006/1/pdb.prot4455
3. http://www.med.upenn.edu/lamitinalab/documents/EthanolPrecipitationofDhttp:/
4. http://physiology.med.cornell.edu/faculty/mason/lab/zumbo/files/PHENOLCHLOR

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Sem.	Course Code	Credits	Title of the Course	AC / CC / DE / ES / GS / NME / PF / PW / VAC/VE / SE / WK	Category			Sem. Exam	Max. Marks		
					Theo. Hrs.	Lecture Hrs.	Lab. Hrs.		CIA	ESE	Total.
II	25UBT2AC2	3	**FUNDAMENTALS OF MICROBIOLOGY**	AC	4			**3 Hrs.**	**25**	**75**	**100**

Pre-Requisite:

Course Objectives: The purpose of learning this course is:

1. Students can understand the basics of microbiology, types of microbes
2. To learn the classification and characterization, various applied aspects of microbes in biotechnology field and the role of microbes in pathogenicity.
3. Student learn the classification of sterilization methods.
4. Student can understand bio fertilizer techniques and antibiotics.
5. To learn microbial diseases of various microorganisms.

Course Outcomes:

CO1: Understand the classification of Microorganisms and structure of bacteria

CO2: Understand the various microbiological techniques, different types of media, and techniques involved in culturing microorganisms.

CO3: Categorize the methods of sterilization and identify the significance of culture media in the growth of different microbes

CO4: Exhibit knowledge in analysing the importance of Bioinsecticides, Biofertilizers prebiotics and probiotics.

CO5: Distinguish between normal flora and pathogens and describe the role of microbes in food Intoxications.

Unit-I	**Introduction of Microbiology**	09 Hrs.

History of Microbiology, Scope of microbiology, Discovery of Microorganisms, Koch's Postulates, Microbial classification – Whittaker & Carl woese , Role of microbes in biotechnology

Unit-II	**Morphology of Bacteria**	09 Hrs.

Cell size, Shape, Cell wall: Gram Positive and Gram negative, Capsules and Slime layer, S Layer, Fimbriae and Pili, Flagella- Motility, Chemotaxis, Bacterial Endospores - Size and Organization

Unit-III	**Microbial Nutrition**	09 Hrs.

Nutritional type of microorganisms by Light, organic and inorganic chemicals. Growth factors: Vitamin. Iron uptake-Siderophores. Culture media- classification based on physical nature and chemical constituents, Defined (BG11) and Complex Media (Nutrient agar, Tryptic soy Broth, MacConkey Agar), Enriched Media, Selective Media and Differential Media.

Unit-IV	**Microbial Growth**	09 Hrs.

Microbial growth curve, Measurement, Generation time, Influence of environmental factors on growth – Temperature, Oxygen and Radiation. Microbial growth in natural environment – Biofilm production and its advantages.

Unit-V	**Microbial diseases**	09 Hrs.

Microbial Disease- host -pathogen interaction, diagnosis and treatment of airborne disease (Pneumonia, Chicken pox), food borne disease (Typhoid, Aspergillosis), Water borne disease (Cholera, Amoebiasis), Sexually transmitted disease (AIDS, Vector borne disease (Dengue, Malaria).

Text Books:

1. Prasad B N, Text Book of Biotechnology, (1st edition), Budha Academic Enterprises, 2003, ISBN: 978-81-7132-489-7
2. Pelczar M J, Chan E C S, Krein N R, "Microbiology", (2nd edition), Tata McGraw Hill Edition, , 2019, ISBN:978-93-90892-22-8.
3. Ananthanarayan, Paniker's, "Textbook of Microbiology", (10th edition), The Orient Blackswan, 2017, ISBN: 978-9386235251.
4. Michael J.Pelczar, J R, E C S.Chan, Noel R Krieg, "Microbiology", (5th edition), Mc Graw-Hill Publishing company limited, 1993, ISBN:13:978-0-07462-320.
5. Sigee D C, "Freshwater Microbiology", (1st edition), Wiley Publication, 2008, ISBN: 978-0470358061.

Reference Books:

1. Benson H J, "Microbiological Applications: A Laboratory manual in General Microbiology", (7th edition), McGraw Hill, 1999, ISBN: 9780071110952.
2. O'Flaherty, Vincent, Collins, Gavin, Mahony, Thérèse. "Environmental Microbiology", (2nd edition), 2010, ISBN: 1002/9780470495117.
3. Cappuccino Welsh, "Microbiology", (12th edition), Pearson Education Global Rights & Permissions Department, 2020, ISBN: 978-0-13-518899-6.
4. Albert G. Moat, John W. Foster, Michael P. Spector, "Microbial physiology", (4th edition), **A** john wiley & sons, inc., publication, 2002, ISBN: 0-471-39483-1.
5. Freeman, "Text Book of Microbiology", (22nd edition), W B Saunders Co Ltd, 1985, ISBN: 978-0721638683.

Web Resources:

1. https://microbenotes.com/category/cellbiology/
2. https://www.nios.ac.in/media/documents/SrSec314NewE/Lesson04.pdf

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Sem.	Course Code	Credits	Title of the Course	AC / CC / DE / ES / GS / NME / PF / PW / VAC/VE / SE / WK	Category			Sem. Exam	Max. Marks		
					Theo. Hrs.	Lecture Hrs.	Lab. Hrs.		CIA	ESE	Total.
II	25UBT2NME1	2	ORGANIC FARMING AND HEALTH MANAGEMENT	SE	2			3 Hrs.	25	75	100

Pre-Requisite:

Course Objectives: The purpose of learning this course is:

1. The paper imparts a thorough knowledge on the basics of academic research.
2. The student will get to understand the core concepts of methodologies & ethics to pursue research.
3. To comprehend the various methods for Health management.
4. Romoting a healthy and sustainable environment, food production system, and individual well-being.
5. Organic farming and health management are interconnected, working towards a system where agricultural practices enhance the health of the environment, food, and people.

Course Outcomes:

CO1: The students will learn, understand Ecology and Environment

CO2: Utilize skills to enhance understanding of Composting method.

CO3: The students will learn Organic Farming

CO4: Develop responsible conduct of health concept

CO5: Utilize skills to enhance understanding of Exercise and Health related fitness

Unit-I	**Ecology**	06 Hrs.

Ecology and Environment – Principles of ecology – Ecosystem - Biotic and abiotic components and interaction – Energy flow –Nutrient cycle – Biodiversity – Endemic – Exotic - Interrelationships.

Unit-II	**Vermicomposting**	06 Hrs.

Composting – Microbial Compost – Vermicompost – Setup for vermicompost unit - Nutrition garden – Ring garden – Double digging – Cultivating vegetables – Common medicinal herbs – Identification and Cultivation.

Unit-III	**Organic farming**	06 Hrs.

Organic farming – Principles and Policies – Certification agencies – AGMARK, fssai, Halal certification – Participatory grading system (PGS) – Storage – Packing – Transportation – Marketing. Micro-enterprises – Self Help Groups – Economics of cultivations – Sustainability

Unit-IV	**Concept of Health**	06 Hrs.

Health: Concept of Health, changing concepts definitions of health, dimensions of health, concept of well being, spectrum of health, determinants of health, ecology of health, right to health, responsibility for health, indicators of health.

Unit-V	**Exercise and Health**	06 Hrs.

Exercise and Health related fitness: Health related fitness, health promotion, physical activity for health benefits. Sports related fitness: Role of nutrition in sports, nutrition to athletic performance.

Text Books:

1 Himadri Panda, "Manufacture of Biofertilizer and Organic Farming", (1st edition), Asia Pacific Business Press Inc, 2024, ISBN: 978-8195744794.

2 Kaptan Baboo, Vikas Singh Sengar, Sandeep Kumar Diwakar, Deo Kumar, Avinash Kumar Singh, A, "Text book of modern organic farming", (2nd edition), Book Rivers publishers, 2023, ISBN: 978-

9355157881.

3 Sujit Chakrabarty, Sumati Narayan, Farooq Ahmad Khan, "Arts & Science of Organic Farming", (1st edition), Notion Press publishers, 2019, ISBN: 978-1684669790.

Reference Books:

1. Veeresh G K, 2006. "Organic farming", (1st edition), India Foundation Books in association with Centre for Environment Education, 2006, ISBN: 978-8175969629.
2. Mangala rai, "Hand Book of Agriculture", (6th edition), ICAR, 2012, ISBN: 978-81-7164-096-6.
3. Sharma B B, "A Guide to Home Gardening", (2nd edition), MIB India, 2007, ISBN: 978-041542198

Web Resources:

1. https://en.wikipedia.org/wiki/Organic_farming
2. https://www.fao.org/fileadmin/templates/nr/sustainability_pathways/docs/Compilation_techniques_organic_agriculture_rev.pdf
3. https://www.fao.org/fileadmin/templates/nr/sustainability_pathways/docs/Compilation_techniques_organic_agriculture_rev.pdf
4. http://www.agritech.tnau.ac.in/org_farm/orgfarm_introduction.html

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