



HSNC Board's  
**Smt. Chandibai Himathmal Mansukhani College**  
(Autonomous)



(Affiliated to the University of Mumbai)

University College Code : 217-JD Office : T14

Principal : Dr. Manju Lalwani Pathak

Ref No: CHM (A) AC/C/01/2025

Date: 18<sup>th</sup> June 2025

## CIRCULAR

The immediate attention of all concerned is invited to this office Circular No. CHM (A) AC 05/2025 dated 19<sup>th</sup> May, 2025 regarding the Choice Based and Credit Based Syllabus (CBCS) for all subjects of F.Y.B.Sc. & T.Y.B.Sc. in Biotechnology SEM - I & SEM – V respectively.

It is hereby communicated that the recommendations of the syllabus made by the Ad-hoc Board of Studies in Biotechnology coordinated by the Dean, Faculty of Applied Sciences in the meeting of Academic Council held on 23<sup>rd</sup> May, 2025 vide item No. 2.3, have been accepted and subsequently passed.

In accordance, therewith, the syllabus as per the CBCS has been brought into force with effect from the academic year 2025 – 2026 and accordingly the same is attached for reference and is available on the College's website [www.chmcollege.in](http://www.chmcollege.in)

Ulhasnagar - 421 003

18<sup>th</sup> June, 2025

**Dr. Manju Lalwani Pathak**

Principal & Chairperson, Academic Council

Copy forwarded for information to:-

- 1) The Dean, Faculty of Humanities.
- 2) The Chairperson, Ad-hoc Board of Studies.
- 3) The Controller of Examination.
- 4) The Registrar



**HSNC Board's**  
**Smt. Chandibai Himathmal Mansukhani College, Ulhasnagar**  
**(Autonomous)**  
**Affiliated to the University of Mumbai**

**Bachelor of Science**  
**(Biotechnology)**  
**(Self-Financing Course)**

**Semester – V**

**Choice Based and Credit Based syllabus**  
**with effect from the**  
**Academic Year 2025-2026**

### **PREAMBLE**

Biotechnology has emerged as a multi-disciplinary subject that comprises many specialized areas including Microbiology, Biochemistry, Physics, Engineering & Technology. The degree course of Bachelor of Science with Choice Based Credit System (CBCS) in Biotechnology has been designed with a multi-faceted approach so as to meet the ever growing challenges in the fields of Biochemistry, Molecular Biology, Genetics, Immunology, Animal Tissue Culture, Bioengineering and Bioprocess Technology, Food and Pharmaceutical, Agriculture, Plant Biotechnology, Computational Statistics & IPR.

The study program in Biotechnology, as one of the core subjects, is designed to cultivate a scientific attitude and an interest towards the modern area of Biotechnology. The beneficiaries of this course will get enriched with a wide range of theoretical and practical knowledge in the above fields.

The B. Sc. course shall build graduates that shall apply the knowledge gained for collection and interpretation of data in research. They shall also be acquainted with skills for presentation of data in a standard scientific style.

There are 05 core courses which encompass all important aspects of the discipline of Biotechnology and are all compulsory courses. The present syllabus is restructured anticipating the future needs of Biotechnology with more emphasis on imparting hands-on skills. The main thrust is laid on making syllabus compatible with developments in Education, Research and Industrial sectors.

Graduate candidates will develop a sense of societal, ethical and legal responsibility pertaining to Biotechnology. The knowledge shall promote our graduates to stand independently amidst the growing technological innovations in the subject.

### **PROGRAMME SPECIFIC OUTCOMES (PSOs)**

**PSO1:** Graduates will gain knowledge and develop specialized skills in the different areas of Biotechnology, thus making them competent and eligible for higher education/Postgraduate studies.

**PSO2:** Graduates will develop practical skills which will include various laboratory techniques, data analysis as well as research skills.

**PSO3:** Graduate candidates will develop a sense of societal, ethical and legal responsibility pertaining to different areas of Biotechnology.

**PSO4:** Graduates will have evolved as confident personalities with transferable skills to help them to groom as responsible citizens, contributing to the growth of Biotechnology nationally and globally.

**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**Third Year B.Sc.  
(Biotechnology)**

**Semester- V**

**Title: Cell Biology**

**with effect from  
Academic Year 2025-2026**

**Title: Cell biology**

**Course Code: CHM(A)USBT501**

| <b>Sr. No.</b> | <b>Heading</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>Particulars</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>1</b>       | <b>Description the Course:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | This course provides an integrated overview of cell cycle regulation, cell signalling pathways, developmental biology, and cancer mechanisms. It covers molecular controls of cell division and apoptosis, principles of signal transduction. The course then transitions into developmental biology, examining the stages of embryonic development, mechanisms of differentiation, gene expression regulation, and pattern formation. Emphasis is placed on understanding how disruptions in these processes contribute to disease. |
| <b>2</b>       | <b>Vertical</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | -                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>3</b>       | <b>Type</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Theory + Practicum                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|                | <b>Teaching Methods</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Lecture/ Discussion/ Presentation/ Case Study/ Flipped classroom/ Industrial visit etc.                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>4</b>       | <b>Credit</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 2.5 Credits                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>5</b>       | <b>Hours allotted</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 50 Hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>6</b>       | <b>Marks allotted</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 100 Marks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>7</b>       | <b>Course Objectives:</b> <ol style="list-style-type: none"><li>1. To explore the molecular mechanisms that control cell cycle progression, including the roles of cyclins, cyclin- dependent kinases (CDKs), and checkpoints.</li><li>2. To introduce fundamental concepts of cell signaling including target cell adaptation and neural networks.</li><li>3. To explore concepts of developmental biology.</li><li>4. To introduce the fundamental concepts of cancer biology, including the hallmarks of cancer, tumor progression, and metastasis</li></ol> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>8</b>       | <b>Learning Outcomes:</b> Student will be able to <ol style="list-style-type: none"><li><b>LO1:</b> Acquire understanding about the roles of cyclins, cyclin dependent kinases (CDKs), and checkpoints in maintaining cell cycle fidelity.</li><li><b>LO2:</b> Explain the concepts of cell signaling.</li><li><b>LO3:</b> Explain the basic concepts of developmental biology and its implications.</li><li><b>LO4:</b> Evaluate the consequences of cell cycle, and cell signalling dysregulation in diseases, particularly cancer.</li></ol>                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

## Syllabus

### UNIT I: Cell cycles

- Introduction: Prokaryotic and Eukaryotic cell cycle
- The Early Embryonic Cell Cycle and the Role of MPF
- Cell cycle in Yeasts and the Molecular Genetics of Cell-Cycle Control
- Apoptosis, Cell-Division Controls in Multicellular Animals

### UNIT II: Cell Signaling

- Introduction General Principles of Cell Signaling
- Signaling via G-Protein-linked Cell-Surface receptors
- Signaling via Enzyme-linked Cell-Surface Receptors
- Target-Cell Adaptation, The Logic of Intracellular signaling
- Lessons from Computer-based "Neural Networks"

### UNIT III: Developmental Biology

- Overview of how the modern era of developmental biology emerged through multidisciplinary approaches
- Stages of development- zygote, blastula, gastrula, neurula cell fate & commitment – potency- concept of embryonic stem cells, differential gene expression, terminal differentiation, lineages of three germ layers, fate map
- Mechanisms of differentiation- cytoplasmic determinants, embryonic induction, concept of morphogen, mosaic and regulative development Pattern formation- axis specification, positional identification (regional specification), Morphogenetic movements, Model organisms in Developmental biology

### UNIT IV: Cancer Biology

- Cancer: Introduction, Cancer as a Micro evolutionary Process
- The Molecular Genetics of Cancer
- Cancer and Viral Cancer diagnosis and chemotherapy

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#### Scheme of Examination and Assessment Pattern

Paper – 100 Marks

**External Examination: Semester End External – 75 marks Time: 2.5 hours**

Format of Question Paper

| Question No | Nature of Questions                                                    | Marks           |
|-------------|------------------------------------------------------------------------|-----------------|
| Q1          | Objective Questions based on unit I, II, III and IV (Internal Options) | 15              |
| Q2          | Unit I (a and b OR c and d)                                            | 15              |
| Q3          | Unit II (a and b OR c and d)                                           | 15              |
| Q4          | Unit III (a and b OR c and d)                                          | 15              |
| Q5          | Unit IV (a and b OR c and d)                                           | 15              |
|             |                                                                        | <b>Total 75</b> |

**Note:**

1. All questions are compulsory with internal options within the questions.

2. Each question carries 15 marks.

**Internal Examination: Continuous Evaluation – 25 marks**

|    | Assessment / evaluation                | Marks           |
|----|----------------------------------------|-----------------|
| 1. | Class test / Presentation              | 20              |
| 2. | Department Activities, Attendance etc. | 05              |
|    |                                        | <b>Total 25</b> |

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**REFERENCES:**

1. Molecular Cell Biology. 7th Edition, (2012) Lodish H., Berk A, Kaiser C., K Reiger M., Bretscher A., Ploegh H., Angelika Amon A., Matthew P. Scott M.P., W.H. Freeman and Co., USA
2. Molecular Biology of the Cell, 5th Edition (2007) Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter. Garland Science, USA
3. Cell Biology, 6th edition, (2010) Gerald Karp. John Wiley & Sons., USA
4. The Cell: A Molecular Approach, 6th edition (2013), Geoffrey M. Cooper, Robert E. Hausman, Sinauer Associates, Inc. USA
5. Developmental Biology; Scott Gilbert; 9th Edition
6. Developmental biology :Veerbala Rastogi
7. Concept of Developmental biology: Dr.Amrita Singh,Mangalam Publication
8. [NPTEL :: Biotechnology - NOC:Cell Biology: Cellular organization, division and processes](#)
9. [NPTEL :: Biotechnology - NOC:Introduction to Developmental Biology](#)

**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**Third Year B.Sc.  
(Biotechnology)**

**Semester- V**

**Title: Biochemistry**

**with effect from  
Academic Year 2025-2026**

**Title: Biochemistry**  
**Course Code: CHM(A)USBT502**

| Sr. No. | Heading                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Particulars                                                                                                                                                                                                                                                                                                                                                                                                            |
|---------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | <b>Description the Course:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | This course provides comprehensive knowledge of protein structures, functions, and mechanism of interactions; principles and mechanisms of protein folding, factors affecting protein stability and methods of purification as well as biosynthesis and its regulation of crucial carbohydrates present in bacteria, plants and animals. It also comprises some part of Endocrinology and basic knowledge of Nutrition |
| 2       | <b>Vertical</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | -                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 3       | <b>Type</b><br><b>Teaching Methods</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Theory + Practicum<br><br>Lecture/ Discussion/ Presentation/ Case Study/Flipped classroom/ Industrial visit etc.                                                                                                                                                                                                                                                                                                       |
| 4       | <b>Credit</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 2.5 Credits                                                                                                                                                                                                                                                                                                                                                                                                            |
| 5       | <b>Hours allotted</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 50 Hours                                                                                                                                                                                                                                                                                                                                                                                                               |
| 6       | <b>Marks allotted</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 100 Marks                                                                                                                                                                                                                                                                                                                                                                                                              |
| 7       | <b>Course Objectives:</b> <ol style="list-style-type: none"> <li>1. To understand the structure, function and interactions, principles and mechanisms of protein folding, factors affecting protein stability and methods of purification of proteins.</li> <li>2. To study biosynthesis and its regulation of crucial carbohydrates present in bacteria, plants and animals.</li> <li>3. To understand the structure, storage, release, transport, biochemical functions and disorders associated with various hormones.</li> <li>4. To understand basic knowledge of nutrition involving macronutrients, vitamins, minerals and understand the impact of malnutrition and over nutrition on health.</li> </ol> |                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 8       | <b>Learning Outcomes:</b> Student will be able to<br><b>LO1:</b> Explain protein structures, functions, mechanisms of interactions, principles and mechanisms of protein folding, factors affecting protein stability and methods of purification.<br><b>LO2:</b> Understand biosynthesis and its regulation of crucial carbohydrates present in bacteria, plants and animals.<br><b>LO3:</b> Understand the structure, storage, release, transport, biochemical functions and disorders associated with various hormones.<br><b>LO4:</b> Acquire basic knowledge of nutrition involving macronutrients, vitamins and minerals and understand the impact of malnutrition and over nutrition on health.           |                                                                                                                                                                                                                                                                                                                                                                                                                        |

## Syllabus

### UNIT I: Protein Chemistry

- Protein structure: Tertiary and Quaternary structures
- Protein Denaturation and Folding
- Protein Function: Reversible binding of a protein to a ligand, Oxygen binding proteins
- Complementary Interactions between proteins and ligands, Immunoglobulins
- Protein interactions modulated by Chemical Energy: Actin, Myosin and Molecular Motors
- Protein sequencing by Edman degradation and Mass spectrometry
- Protein purification

### UNIT II: Metabolism

- Carbohydrate biosynthesis and its regulation: Peptidoglycan in Bacteria
- Starch and sucrose in Plants
- Glycogen in Animals
- Biosynthesis and regulation of Cholesterol, Atherosclerosis, FASC

### UNIT III: Endocrinology

- Basic of Group I and II hormones
- Structure, storage, release, transport, biochemical functions and disorders associated with hormones secreted by: Hypothalamus
- Anterior Pituitary gland - GH, stimulating hormones
- Posterior Pituitary gland: oxytocin and vasopressin
- Thyroid gland: Thyroxine, calcitonin; Parathyroid gland: PTH;
- Adrenal medulla: epinephrine and norepinephrine;
- Adrenal cortex: Glucocorticoids ;
- Pancreas – insulin and glucagon ;
- Female Gonads: estrogen and progesterone ;
- Male gonads: testosterone
- Placenta: hCG

### UNIT IV: Nutrition

- Introduction and Functions of Nutrients
- Concept of RDA, BMR
- Meal planning for various age groups: Adolescents; Athletes; Pregnant women; Geriatrics
- Minerals and Vitamins Dietary sources, bioactive form, functions and disorders associated with fat soluble vitamins (A D E, K) and water soluble vitamins (B groups I, II & III, Vitamin C)
- Minerals: classification, physiological and biochemical functions of principal and trace elements.
- Malnutrition – Over nutrition (obesity) and PEM (Kwashiorkor and Marasmus),
- Treatment and management of nutritional disorders through diet and medication: Vitamin, mineral and protein deficiency
- Introduction to Nutraceuticals

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**Scheme of Examination and Assessment Pattern**

Paper – 100 Marks

**External Examination: Semester End External – 75 marks Time: 2.5 hours**

Format of Question Paper

| Question No | Nature of Questions                                                    | Marks           |
|-------------|------------------------------------------------------------------------|-----------------|
| Q1          | Objective Questions based on unit I, II, III and IV (Internal Options) | 15              |
| Q2          | Unit I (a and b OR c and d)                                            | 15              |
| Q3          | Unit II (a and b OR c and d)                                           | 15              |
| Q4          | Unit III (a and b OR c and d)                                          | 15              |
| Q5          | Unit IV (a and b OR c and d)                                           | 15              |
|             |                                                                        | <b>Total 75</b> |

**Note:**

1. All questions are compulsory with internal options within the questions.
2. Each question carries 15 marks.

**Internal Examination: Continuous Evaluation – 25 marks**

|    | Assessment / evaluation                | Marks           |
|----|----------------------------------------|-----------------|
| 1. | Class test / Presentation              | 20              |
| 2. | Department Activities, Attendance etc. | 05              |
|    |                                        | <b>Total 25</b> |

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**REFERENCES:**

1. Lehninger, principles of biochemistry, 4th edition (2005), David Nelson and Michael Cox W.H. Freeman and Company, New York.
2. Biochemistry , 4th edition (2010), Voet and Voet, John Wiley and sons, USA
3. Harper's Illustrated Biochemistry, 27th edition, RK Murray, DK Granner, PA Mayes and VW Rodwell, McGraw Hills publication.
4. Biochemistry, 4nd edition (2017), Satyanarayana and Chakrapani, Books & Allied (P)Ltd
5. Nutrition and Dietetics (with Indian Case Studies), 3rd Edition, Shubhangini A.Joshi, Tata McGraw Hill Education Private Limited
6. A Handbook of Food and Nutrition, 5th Edition, Swaminathan N, Bangalore printing and publishing Co.Ltd.
7. Vitamins & Minerals Demystified, Steve Blake, McGraw Hill
8. [https://onlinecourses.nptel.ac.in/noc20\\_cy10/preview](https://onlinecourses.nptel.ac.in/noc20_cy10/preview)
9. [https://onlinecourses.nptel.ac.in/noc24\\_cy57/preview](https://onlinecourses.nptel.ac.in/noc24_cy57/preview)

**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**Third Year B.Sc.  
(Biotechnology)**

**Semester- V**

**Title: Practical of Cell biology + Biochemistry**

**with effect from  
Academic Year 2025-2026**

**Title: Practical of Cell biology + Biochemistry**  
**Course Code: CHM(A)USBTP501-502**

| Sr. No. | Heading                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Particulars                                                                                                                                                                                                                                                                                                                                       |
|---------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | <b>Description the Course:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | This course includes skills to identify, estimate & analyse biomolecules using spectrophotometry and electrophoresis. The course will also expose students to skills which will enable them to isolate and study model organisms from nature. The course will introduce techniques for study of development of chick embryos by candling of eggs. |
| 2       | <b>Vertical</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | -                                                                                                                                                                                                                                                                                                                                                 |
| 3       | <b>Type</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Practical                                                                                                                                                                                                                                                                                                                                         |
| 4       | <b>Credit</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 3 Credits                                                                                                                                                                                                                                                                                                                                         |
| 5       | <b>Hours allotted</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 120 Hours                                                                                                                                                                                                                                                                                                                                         |
| 6       | <b>Marks allotted</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 100 Marks                                                                                                                                                                                                                                                                                                                                         |
| 7       | <b>Course Objectives:</b> <ol style="list-style-type: none"> <li>1. To develop skills to identify, estimate &amp; analyse biomolecules like Carbohydrates, proteins &amp; vitamins.</li> <li>2. To understand essential analytical techniques such as PAGE.</li> <li>3. To develop skills to isolate and study model organisms such as <i>Drosophila</i>, <i>C. elegans</i>, <i>Daphnia</i> from nature.</li> <li>4. To study the development of chick embryos by candling of eggs.</li> </ol>                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                   |
| 8       | <b>Learning Outcomes:</b> Student will be able to<br><br><b>LO1:</b> Identify, estimate & analyse biomolecules like Carbohydrates, proteins & vitamins.<br><b>LO2:</b> Understand essential analytical techniques such as PAGE.<br><b>LO3:</b> Isolate and study model organisms such as <i>Drosophila</i> , <i>C. elegans</i> , <i>Daphnia</i> from nature.<br><b>LO4:</b> Understand & explain the development of chick embryos by candling of eggs.                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                   |
| 9       | <b>Practical Syllabus</b> <ul style="list-style-type: none"> <li>• Estimation of Starch by Anthrone method.</li> <li>• Isolation of <i>Drosophila</i>, <i>C. elegans</i>, <i>Daphnia</i> from nature.</li> <li>• Study of development of chick embryo by candling of eggs</li> <li>• Determination of Protein stability and viscosity.</li> <li>• Estimation of vitamin C by DCPIP method.</li> <li>• Analysis of protein purity using PAGE.</li> <li>• Determination of Calcium in milk by Complexometric titration (EDTA titration)</li> <li>• Total Cholesterol estimation.</li> <li>• Vitamin B12 bioassay</li> </ul> |                                                                                                                                                                                                                                                                                                                                                   |

- Cancer Biology: (Field visit / ACTREC web page visit and assignment writing in the journal) ACTREC home page:  
[https://docs.google.com/document/d/13Pzz928dI5Dn7NkgdrWks58ZoJXA-zDwAwVAT2HX\\_LE/edit?usp=share](https://docs.google.com/document/d/13Pzz928dI5Dn7NkgdrWks58ZoJXA-zDwAwVAT2HX_LE/edit?usp=share)

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Scheme of Examination and Assessment Pattern

Paper – 100 Marks

| Question No | Nature of Questions                              | Marks            |
|-------------|--------------------------------------------------|------------------|
| Q1          | Practical                                        | 25               |
| Q2          | Practical                                        | 25               |
| Q3          | Practical                                        | 15               |
| Q4          | Practical                                        | 15               |
| Q5          | Assignment/ Field report on cancer Biology/ Viva | 10               |
| Q6          | Journal                                          | 10               |
|             |                                                  | <b>Total 100</b> |

**Note:**

- Certified Journal is compulsory** for appearing at the time of practical exam, failing which they will not be allowed to appear for examination.
- Students are required to perform at least 75% of practicals, for the journal to be certified. The journal serves as record of the student’s practical work is an essential component of evaluation process.

**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**Third Year B.Sc.  
(Biotechnology)**

**Semester- V**

**Title: Immunology & Stem Cell Biology**

**with effect from  
Academic Year 2025-2026**

**Title: Immunology & Stem Cell Biology****Course Code: CHM(A)USBT503**

| <b>Sr. No.</b> | <b>Heading</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>Particulars</b>                                                                                                                                                                                                                                                                                                                                                  |
|----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>1</b>       | <b>Description the Course:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | This course provides a detailed understanding of innate immune response & its interaction with adaptive immune response. The course gives detailed insights of hypersensitivity reactions, autoimmune diseases & tolerance. Other topics include the concept of immunisation & vaccines. Cytokines & adaptive immunity are also discussed in detail in this course. |
| <b>2</b>       | <b>Vertical</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | -                                                                                                                                                                                                                                                                                                                                                                   |
| <b>3</b>       | <b>Type</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Theory + Practicum                                                                                                                                                                                                                                                                                                                                                  |
|                | <b>Teaching Methods</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Lecture/ Discussion/ Presentation/ Case Study/ Flipped classroom/ Industrial visit etc.                                                                                                                                                                                                                                                                             |
| <b>4</b>       | <b>Credit</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 2.5 Credits                                                                                                                                                                                                                                                                                                                                                         |
| <b>5</b>       | <b>Hours allotted</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 50 Hours                                                                                                                                                                                                                                                                                                                                                            |
| <b>6</b>       | <b>Marks allotted</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 100 Marks                                                                                                                                                                                                                                                                                                                                                           |
| <b>7</b>       | <b>Course Objectives:</b> <ol style="list-style-type: none"><li>1. To understand the innate immune response &amp; its interaction with adaptive immune response.</li><li>2. To provide a comprehensive understanding of the vaccines &amp; biological functions and regulatory mechanisms of cytokines.</li><li>3. To categorize and understand the different Type and Methods of hypersensitivity reactions (Type I-IV), and their implications in allergic diseases.</li><li>4. To understand the concept of immunological tolerance, mechanisms, detection &amp; treatment of autoimmune diseases.</li></ol> |                                                                                                                                                                                                                                                                                                                                                                     |
| <b>8</b>       | <b>Learning Outcomes:</b> Student will be able to <ol style="list-style-type: none"><li><b>LO1:</b> Appreciate basic immunological principles of innate immunity, adaptive immunity &amp; cytokines in development of therapeutic strategies.</li><li><b>LO2:</b> Understand the concept of strategies for novel vaccine designs.</li><li><b>LO3:</b> Categorize various hypersensitivity reactions and gain knowledge about diagnosis, treatment and management.</li><li><b>LO4:</b> Understand mechanisms of immunological tolerance, detection and treatment of various autoimmune diseases</li></ol>        |                                                                                                                                                                                                                                                                                                                                                                     |

**Syllabus****UNIT I: Innate immune reactions & Vaccines**

- Innate immune response: Overview, Inflammation, Phagocytosis , Natural Killer cells
- Induced cellular Innate responses, Antiviral defense
- Microbial Evasion of Innate Immunity, Regulation of Innate Immune Responses.
- Interactions between Innate & Adaptive immunity
- Role of innate immunity in stimulating adaptive immune responses
- Ubiquity of Innate immune reactions
- Vaccines - active , passive immunization, types of vaccines , recent advances

**UNIT II: Hypersensitivity**

- Introduction to hypersensitivity
- Types and treatment/ therapy
- Type I Hypersensitivity Reactions (Allergy)
- Antibody-Mediated (Type II) Hypersensitivity reactions
- Immune Complex-Mediated (Type III) Hypersensitivity
- Delayed-Type (Type IV) Hypersensitivity (DTH)
- Detection of various hypersensitivity reactions, Treatment & Management

**UNIT III: Cytokines & Adaptive immunity**

- Cytokines - history, properties, functional categories of cytokines (overview), cytokine receptors, role of cytokines and cytokine receptors in disease
- T-Cell Differentiation
- B-Cell Differentiation
- Antibody related immune responses: Properties of antibodies that determine effector function
- Functions of antibodies at special anatomic sites

**UNIT IV: Tolerance & autoimmunity**

- Tolerance
- Possible Mechanisms for the Induction of Autoimmunity & factors responsible for autoimmunity
- Autoimmune Diseases which target Specific Organs: Hashimoto's Thyroiditis, Type 1 Diabetes Mellitus, Myasthenia Gravis
- Systemic Autoimmune Diseases: Systemic Lupus Erythematosus (SLE), Multiple Sclerosis, Rheumatoid Arthritis
- Stem cells & their application in therapy

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**Scheme of Examination and Assessment Pattern**

Paper – 100 Marks

**External Examination: Semester End External – 75 marks Time: 2.5 hours**

Format of Question Paper

| Question No | Nature of Questions                                                    | Marks           |
|-------------|------------------------------------------------------------------------|-----------------|
| Q1          | Objective Questions based on unit I, II, III and IV (Internal Options) | 15              |
| Q2          | Unit I (a and b OR c and d)                                            | 15              |
| Q3          | Unit II (a and b OR c and d)                                           | 15              |
| Q4          | Unit III (a and b OR c and d)                                          | 15              |
| Q5          | Unit IV (a and b OR c and d)                                           | 15              |
|             |                                                                        | <b>Total 75</b> |

**Note:**

1. All questions are compulsory with internal options within the questions.
2. Each question carries 15 marks.

**Internal Examination: Continuous Evaluation – 25 marks**

|    | Assessment / evaluation                | Marks           |
|----|----------------------------------------|-----------------|
| 1. | Class test / Presentation              | 20              |
| 2. | Department Activities, Attendance etc. | 05              |
|    |                                        | <b>Total 25</b> |

11

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- |  |                                                                                                                                                                                                                                                                                                                                  |
|--|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
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|--|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**Third Year B.Sc.  
(Biotechnology)**

**Semester- V**

**Title: Industrial Biotechnology**

**with effect from  
Academic Year 2025-2026**

**Title: Industrial Biotechnology**  
**Course Code: CHM(A)USBT504**

| Sr. No. | Heading                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Particulars                                                                                                                                                                                                                                                        |
|---------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | <b>Description the Course:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | This course offers insight into dairy microbiology, milk preservation, and the technology of fermented products. It includes fermentation processes, downstream processing, and industrial standards like GMP and ISO 9001 2015 for quality control and assurance. |
| 2       | <b>Vertical</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | -                                                                                                                                                                                                                                                                  |
| 3       | <b>Type</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Theory + Practicum                                                                                                                                                                                                                                                 |
|         | <b>Teaching Methods</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Lecture/ Discussion/ Presentation/ Case Study/ Flipped classroom/ Industrial visit etc.                                                                                                                                                                            |
| 4       | <b>Credit</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 2.5 Credits                                                                                                                                                                                                                                                        |
| 5       | <b>Hours allotted</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 50 Hours                                                                                                                                                                                                                                                           |
| 6       | <b>Marks allotted</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 100 Marks                                                                                                                                                                                                                                                          |
| 7       | <b>Course Objectives:</b> <ol style="list-style-type: none"> <li>1. To study dairy technology with reference to microflora, quality factors, and preservation techniques.</li> <li>2. To study about milk products and fermented beverages.</li> <li>3. To understand the downstream processing, recovery and purification in Bioprocess Technology.</li> <li>4. To understand QA/QC principles and ISO 9001:2015 standards</li> </ol>                                                                                 |                                                                                                                                                                                                                                                                    |
| 8       | <b>Learning Outcomes:</b> Student will be able to<br><b>LO1:</b> Explain and evaluate microbiological quality of milk and milk products.<br><b>LO2:</b> Identify, analyze and evaluate the quality of milk products and alcoholic beverages.<br><b>LO3:</b> Evaluate bioreactor design and the principles behind recovery and purification in bioprocesses<br><b>LO4:</b> Explain concepts of quality assurance, quality control, Good Laboratory Practices, and the basics of ISO 9001:2015 Quality Management System |                                                                                                                                                                                                                                                                    |
| 9       | <p style="text-align: center;"><b>Syllabus</b></p> <b>UNIT I: Dairy Technology</b> <ul style="list-style-type: none"> <li>• Normal flora of milk: Types of microorganisms: acid and gas producing, protein and fat splitting, pathogenic and inert organisms</li> <li>• Biochemical changes during storage and abnormal fermentation</li> <li>• Factors affecting bacteriological quality</li> <li>• Microbiological examination of milk, Preservation methods</li> <li>• Starter Cultures</li> </ul>                  |                                                                                                                                                                                                                                                                    |

- Fermented products-Production process and spoilage of Cheese: Swiss and Cheddar -
- Butter
- Yogurt and Buttermilk
- Analogue cottages cheese and it's Identification
- Milk borne diseases & their control bacterial, Viral and other.

## **UNIT II: Fermentation & fermented products**

- The fundamental concept of fermentation & bioprocess technology
- Introduction to Inoculum development -Bacterial and fungal inoculum development with one example each
- Concept of scale up, scale down challenges
- Bioprocess monitoring and control, automated control V/S manual control
- Commercial production of various bioprocess based Products- Bioethanol, Citric acid
- Beverages : Beer, Wine
- Single cell protein
- Microbial polysaccharides and their applications

## **UNIT III: Downstream Processing (DSP)**

- Downstream processing; definition, criteria, and typical steps involved in DSP(with examples)
- Target application of product Vs cost
- Separation of cells and whole broth
- Methods of cell breakage for harvesting intracellular products
- Typical unit operation- Filtration
- Centrifugation- 1 lecture; Solvent recovery
- Membrane processes - 1 lecture; Drying
- Crystallization
- Types and nature of waste generated in bioprocess

## **UNIT IV: QA QC**

- Concept of GMP
- Requirements of GMP implementation
- Documentation of GMP practices
- Regulatory certification of GMP
- Quality Control (QC): Concept of QC and GLP
- Requirements for implementing QC
- QA concepts: Concept of QA
- Requirements for implementing
- ISO 9001 : 2015 Quality Management System- Basics

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**Scheme of Examination and Assessment Pattern**

Paper – 100 Marks

**External Examination: Semester End External – 75 marks Time: 2.5 hours**

Format of Question Paper

| Question No | Nature of Questions                                                    | Marks           |
|-------------|------------------------------------------------------------------------|-----------------|
| Q1          | Objective Questions based on unit I, II, III and IV (Internal Options) | 15              |
| Q2          | Unit I (a and b OR c and d)                                            | 15              |
| Q3          | Unit II (a and b OR c and d)                                           | 15              |
| Q4          | Unit III (a and b OR c and d)                                          | 15              |
| Q5          | Unit IV (a and b OR c and d)                                           | 15              |
|             |                                                                        | <b>Total 75</b> |

**Note:**

1. All questions are compulsory with internal options within the questions.
2. Each question carries 15 marks.

**Internal Examination: Continuous Evaluation – 25 marks**

|    | Assessment / evaluation                | Marks           |
|----|----------------------------------------|-----------------|
| 1. | Class test / Project and presentation  | 20              |
| 2. | Department Activities, Attendance etc. | 05              |
|    |                                        | <b>Total 25</b> |

11

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**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**Third Year B.Sc.  
(Biotechnology)**

**Semester- V**

**Title: Practical of Immunology & Stem Cell  
Biology + Industrial Biotechnology**

**with effect from  
Academic Year 2025-2026**

**Title: Practical of Immunology & Stem Cell Biology + Industrial Biotechnology**

**Course Code: CHM(A)USBTP503-504**

| <b>Sr. No.</b> | <b>Heading</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>Particulars</b>                                                                                                                                                                                                                                                                                                                                  |
|----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>1</b>       | <b>Description the Course:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | This course gives hands-on experience to study antigen-antibody reactions which will help in diagnosis of diseases. This course also trains the students to prepare traditional vaccines & check its sterility. It enables students to analyze the chemical composition of fermented beverages & microbiological quality of milk and milk products. |
| <b>2</b>       | <b>Vertical</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | -                                                                                                                                                                                                                                                                                                                                                   |
| <b>3</b>       | <b>Type</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Practical                                                                                                                                                                                                                                                                                                                                           |
| <b>4</b>       | <b>Credit</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 3 Credits                                                                                                                                                                                                                                                                                                                                           |
| <b>5</b>       | <b>Hours allotted</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 120 Hours                                                                                                                                                                                                                                                                                                                                           |
| <b>6</b>       | <b>Marks allotted</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 100 Marks                                                                                                                                                                                                                                                                                                                                           |
| <b>7</b>       | <b>Course Objectives:</b> <ol style="list-style-type: none"><li>1. To study antigen-antibody reactions and detect presence of antigen/ antibody from patients' samples.</li><li>2. To develop the skill to prepare traditional vaccines &amp; check it's sterility.</li><li>3. To develop skills to analyse microbiological quality of milk and milk products.</li><li>4. To learn to determine the chemical composition of fermented beverages.</li></ol>                                                                                    |                                                                                                                                                                                                                                                                                                                                                     |
| <b>8</b>       | <b>Learning Outcomes:</b> Student will be able to<br><br><b>LO1:</b> Perform antigen-antibody reactions and detect presence of antigen/ antibody from patients' samples.<br><b>LO2:</b> prepare traditional vaccines & check its sterility.<br><b>LO3:</b> Analyse microbiological quality of milk and milk products.<br><b>LO4:</b> Determine the chemical composition of fermented beverages.                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                     |
| <b>9</b>       | <b>Practical Syllabus</b> <ul style="list-style-type: none"><li>• Poster making on any of the following topics:<ul style="list-style-type: none"><li>• Autoimmunity</li><li>• Cytokines</li><li>• Vaccination schedule by WHO</li></ul></li><li>• Antiglobulin testing (Coomb's Test)</li><li>• Analysis of Immunoglobulins by Serum electrophoresis</li><li>• Vaccine preparation &amp; sterility testing- TAB vaccine</li><li>• Determination of moisture content of paneer</li><li>• Microbial analysis of Milk by MBRT and RRT.</li></ul> |                                                                                                                                                                                                                                                                                                                                                     |

|             | <ul style="list-style-type: none"> <li>• Microbiological analysis of milk and checking quality of milk (Standard Plate Count, Coliform count, Thermophiles, Psychrophiles, LPC)</li> <li>• Microbiological analysis of curd. (Isolation of lactic acid bacteria)</li> <li>• Analysis of wine - Acidity, alcohol content and sugar content.</li> <li>• Visit a Dairy plant to observe the preparation of Concentrated &amp; dried milk and other dairy products.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                  |                     |       |    |           |    |    |           |    |    |           |    |    |                                                       |    |    |      |    |    |         |    |  |  |                  |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|---------------------|-------|----|-----------|----|----|-----------|----|----|-----------|----|----|-------------------------------------------------------|----|----|------|----|----|---------|----|--|--|------------------|
| 10          | <p style="text-align: center;"><b>Scheme of Examination and Assessment Pattern</b><br/>Paper – 100 Marks</p> <table border="1"> <thead> <tr> <th>Question No</th><th>Nature of Questions</th><th>Marks</th></tr> </thead> <tbody> <tr> <td>Q1</td><td>Practical</td><td>25</td></tr> <tr> <td>Q2</td><td>Practical</td><td>25</td></tr> <tr> <td>Q3</td><td>Practical</td><td>15</td></tr> <tr> <td>Q4</td><td>Poster/ Assignment/ field visit report on dairy visit</td><td>15</td></tr> <tr> <td>Q5</td><td>Viva</td><td>10</td></tr> <tr> <td>Q6</td><td>Journal</td><td>10</td></tr> <tr> <td colspan="2"></td><td><b>Total 100</b></td></tr> </tbody> </table> <p><b>Note:</b></p> <ol style="list-style-type: none"> <li>1. <b>Certified Journal is compulsory</b> for appearing at the time of practical exam, failing which they will not be allowed to appear for examination.</li> <li>2. Students are required to perform at least 75% of practicals, for the journal to be certified. The journal serves as record of the student's practical work is an essential component of evaluation process.</li> </ol> | Question No      | Nature of Questions | Marks | Q1 | Practical | 25 | Q2 | Practical | 25 | Q3 | Practical | 15 | Q4 | Poster/ Assignment/ field visit report on dairy visit | 15 | Q5 | Viva | 10 | Q6 | Journal | 10 |  |  | <b>Total 100</b> |
| Question No | Nature of Questions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Marks            |                     |       |    |           |    |    |           |    |    |           |    |    |                                                       |    |    |      |    |    |         |    |  |  |                  |
| Q1          | Practical                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 25               |                     |       |    |           |    |    |           |    |    |           |    |    |                                                       |    |    |      |    |    |         |    |  |  |                  |
| Q2          | Practical                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 25               |                     |       |    |           |    |    |           |    |    |           |    |    |                                                       |    |    |      |    |    |         |    |  |  |                  |
| Q3          | Practical                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 15               |                     |       |    |           |    |    |           |    |    |           |    |    |                                                       |    |    |      |    |    |         |    |  |  |                  |
| Q4          | Poster/ Assignment/ field visit report on dairy visit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 15               |                     |       |    |           |    |    |           |    |    |           |    |    |                                                       |    |    |      |    |    |         |    |  |  |                  |
| Q5          | Viva                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 10               |                     |       |    |           |    |    |           |    |    |           |    |    |                                                       |    |    |      |    |    |         |    |  |  |                  |
| Q6          | Journal                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 10               |                     |       |    |           |    |    |           |    |    |           |    |    |                                                       |    |    |      |    |    |         |    |  |  |                  |
|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>Total 100</b> |                     |       |    |           |    |    |           |    |    |           |    |    |                                                       |    |    |      |    |    |         |    |  |  |                  |

**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**Third Year B.Sc.  
(Biotechnology)**

**Semester- V**

**Title: Computational Statistics and IPR**

**with effect from  
Academic Year 2025-2026**

**Title: Computational Statistics and IPR****Course Code: CHM(A)USBTACCSI501**

| Sr. No. | Heading                                                                                                                                                                                                                                                                                                                                                                                                                | Particulars                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|---------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | <b>Description the Course:</b>                                                                                                                                                                                                                                                                                                                                                                                         | This course offers an integrated approach to computational data analysis and intellectual property rights (IPR). Students will gain hands-on experience with statistical tools in MS Excel, including ANOVA, regression, t-tests, matrix operations, and Solver-based optimization. The course also introduces R programming for data handling, matrix operations, and graphical representation. In parallel, students will explore various aspects of IPR, including patents, trademarks, copyrights, and biodiversity-related laws, with a focus on the Indian patent system, patent eligibility, drafting, licensing, and infringement. |
| 2       | <b>Vertical</b>                                                                                                                                                                                                                                                                                                                                                                                                        | -                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 3       | <b>Type</b><br><b>Teaching Methods</b>                                                                                                                                                                                                                                                                                                                                                                                 | Theory + Practicum<br>Lecture/ Discussion/ Presentation/ Flipped classroom / Case Study etc.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 4       | <b>Credit</b>                                                                                                                                                                                                                                                                                                                                                                                                          | 2 Credits                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 5       | <b>Hours allotted</b>                                                                                                                                                                                                                                                                                                                                                                                                  | 50 Hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 6       | <b>Marks allotted</b>                                                                                                                                                                                                                                                                                                                                                                                                  | 100 Marks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 7       | <b>Course Objectives:</b> <ol style="list-style-type: none"><li>1. To get insights of computational statistics using MS excel.</li><li>2. To understand the fundamentals of R programming language for data analysis.</li><li>3. To get introduced to the concepts of intellectual properties and its types.</li><li>4. To understand the basics of patents like patent drafting, licensing and infringement</li></ol> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 8       | <b>Learning Outcomes:</b> Student will be able to<br><b>LO1:</b> Analyze the data using MS Excel.<br><b>LO2:</b> Analyze the data using the R programming language.<br><b>LO3:</b> Evaluate different types of IPR their relevance.<br><b>LO4:</b> Explain the drafting and licensing process in patenting.                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 9       | <b>Syllabus</b><br><br><b>UNIT I: Computational Statistics using Ms Excel</b> <ul style="list-style-type: none"><li>• Loading of Data Analysis Toolpak in Excel</li><li>• Computation of Analysis of Variance, Correlation, Covariance, Descriptive Statistics, Exponential Smoothing</li><li>• Random number generation from different distributions,</li><li>• Regression, Sampling, t-test, Z-test</li></ul>        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |

- Optimization using Solver
- Computation of Determinants of matrix, Inverses of a matrix, Rank of a matrix, Solutions of matrix equations, Characteristic roots and vectors of a matrix

### **UNIT II: Computational Statistics using R**

- Introducing R: Website, Downloading & Installing, Running R program. Types & Structure of data items: creating vector, defining variables, creating sequences, performing vector arithmetic.
- Entering data from keyboard, reading tabular data files, reading from and writing to CSV-files, reading data from HTML tables, initializing a matrix in R, performing Matrix operations.
- Statistical Graphics in R: Basic Graphs- Bar, Pie, line, histograms, Box-plot, Scatterplot, QQ Plot. Descriptive Statistics

### **UNIT III: Introduction to IPR**

- Introduction to patents, trademarks, trade secrets, copyright & related IPR rights, industrial design, traditional knowledge. Geographical indications
- Biodiversity importance and legislation
- International convention and treaties
- Plant variety protection and farmers rights act

### **UNIT IV: Patents**

- Basics of patents: eligibility criteria, classification of Patents, categories
- Patenting biological products. Patentable and non- patentable inventions in India
- Process of Patenting: Patent Search and Inventor's homework, drafting patent applications, Rights of the patent holder, assignment and licensing of patents and patent Infringement
- Patent Agent

**10**

#### **Scheme of Examination and Assessment Pattern**

Paper – 100 Marks

**External Examination: Semester End External – 75 marks Time: 2.5 hours**

Format of Question Paper

| Question No | Nature of Questions                                                       | Marks           |
|-------------|---------------------------------------------------------------------------|-----------------|
| Q1          | Objective Questions based on unit I, II, III and IV<br>(Internal Options) | 15              |
| Q2          | Unit I (a and b OR c and d)                                               | 15              |
| Q3          | Unit II (a and b OR c and d)                                              | 15              |
| Q4          | Unit III (a and b OR c and d)                                             | 15              |
| Q5          | Unit IV (a and b OR c and d)                                              | 15              |
|             |                                                                           | <b>Total 75</b> |

**Note:**

1. All questions are compulsory with internal options within the questions.
2. Each question carries 15 marks.

S

**Internal Examination: Continuous Evaluation – 25 marks**

|    | Assessment / evaluation                | Marks           |
|----|----------------------------------------|-----------------|
| 1. | Class test / Project and presentation  | 20              |
| 2. | Department Activities, Attendance etc. | 05              |
|    |                                        | <b>Total 25</b> |

**11 REFERENCES:**

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**Smt. Chandibai Himathmal Mansukhani College  
(Autonomous)**

**Third Year B.Sc.  
(Biotechnology)**

**Semester- V**

**Title: Practical of Computational Statistics and  
IPR**

**with effect from  
Academic Year 2025-2026**

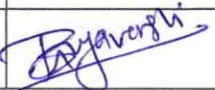
## Title: Practical of Computational Statistics and IPR

**Course Code: CHM(A)USBTACCSI5P1**

| Sr. No. | Heading                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Particulars                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|---------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | <b>Description the Course:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | This course offers an integrated approach to computational data analysis and intellectual property rights (IPR). Students will gain hands-on experience with statistical tools in MS Excel, including ANOVA, regression, t-tests, matrix operations, and Solver-based optimization. The course also introduces R programming for data handling, matrix operations, and graphical representation. In parallel, students will explore various aspects of IPR, including patents, trademarks, copyrights, and biodiversity-related laws, with a focus on the Indian patent system, patent eligibility, drafting, licensing, and infringement. |
| 2       | <b>Vertical</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | -                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 3       | <b>Type</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Practical                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 4       | <b>Credit</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 2 Credits                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 5       | <b>Hours allotted</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 60 Hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 6       | <b>Marks allotted</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 100 Marks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 7       | <b>Course Objectives:</b> <ol style="list-style-type: none"> <li>1. To study a patent and to develop a patent application for a product or process &amp; to study Case Studies based on Patent.</li> <li>2. To learn to use Excel for biostatistical analysis.</li> <li>3. To develop skills to apply basic commands of R</li> <li>4. To learn to use R for data visualization and manipulation.</li> </ol>                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 8       | <b>Learning Outcomes:</b> Student will be able to<br><b>LO1:</b> Understand a patent and develop a patent application for a product or process & to learn Case Studies based on Patent.<br><b>LO2:</b> Use Excel for biostatistical analysis.<br><b>LO3:</b> Develop skills to apply basic commands of R<br><b>LO4:</b> Learn to use R for data visualization and manipulation.                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 9       | <b>Practical Syllabus</b> <ul style="list-style-type: none"> <li>• To study a patent and to develop a patent application for a product or process.</li> <li>• Case Studies based on Patent.</li> <li>• Assignment on geographical indications</li> <li>• Computation of Analysis of Variance (ANOVA), Correlation and Covariance &amp; Descriptive Statistics in Excel</li> <li>• Random Number Generation from Different Distributions in Excel</li> <li>• Simple Linear Regression in Excel</li> <li>• t-test and Z-test in Excel</li> </ul> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |

|             | <ul style="list-style-type: none"><li>• Applications Basic R Commands, Vector Operations, Data Input and Output</li><li>• Statistical Graphics - Create basic graphs: bar, pie, line, histograms, box plot, scatter plot, QQ plot.</li><li>• Descriptive Statistics - Calculate descriptive statistics for one &amp; two variables.</li><li>• One-Way ANOVA - Perform a one-way &amp; two-way ANOVA test.</li><li>• Correlation Analysis - Calculate correlation coefficients between variables.</li><li>• Regression Analysis - Perform linear regression analysis.</li><li>• Hypothesis Testing - Conduct common tests of significance (t-test, chi-square test).</li><li>• Data Visualization &amp; Data Manipulation using R</li></ul>                                                                                                                                                                                                                                                                                                         |                  |                     |       |    |           |    |    |           |    |    |           |    |    |           |    |    |                                       |    |    |         |    |  |  |                  |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|---------------------|-------|----|-----------|----|----|-----------|----|----|-----------|----|----|-----------|----|----|---------------------------------------|----|----|---------|----|--|--|------------------|
| 10          | <p style="text-align: center;"><b>Scheme of Examination and Assessment Pattern</b><br/><b>Paper – 100 Marks</b></p> <table><tr><th>Question No</th><th>Nature of Questions</th><th>Marks</th></tr><tr><td>Q1</td><td>Practical</td><td>20</td></tr><tr><td>Q2</td><td>Practical</td><td>20</td></tr><tr><td>Q3</td><td>Practical</td><td>10</td></tr><tr><td>Q4</td><td>Practical</td><td>10</td></tr><tr><td>Q5</td><td>Problem based question and Case Study</td><td>30</td></tr><tr><td>Q6</td><td>Journal</td><td>10</td></tr><tr><td></td><td></td><td><b>Total 100</b></td></tr></table> <p><b>Note:</b></p> <ol style="list-style-type: none"><li>1. <b>Certified Journal is compulsory</b> for appearing at the time of practical exam, failing which they will not be allowed to appear for examination.</li><li>2. Students are required to perform at least 75% of practicals, for the journal to be certified. The journal serves as record of the student's practical work is an essential component of evaluation process.</li></ol> | Question No      | Nature of Questions | Marks | Q1 | Practical | 20 | Q2 | Practical | 20 | Q3 | Practical | 10 | Q4 | Practical | 10 | Q5 | Problem based question and Case Study | 30 | Q6 | Journal | 10 |  |  | <b>Total 100</b> |
| Question No | Nature of Questions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Marks            |                     |       |    |           |    |    |           |    |    |           |    |    |           |    |    |                                       |    |    |         |    |  |  |                  |
| Q1          | Practical                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 20               |                     |       |    |           |    |    |           |    |    |           |    |    |           |    |    |                                       |    |    |         |    |  |  |                  |
| Q2          | Practical                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 20               |                     |       |    |           |    |    |           |    |    |           |    |    |           |    |    |                                       |    |    |         |    |  |  |                  |
| Q3          | Practical                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 10               |                     |       |    |           |    |    |           |    |    |           |    |    |           |    |    |                                       |    |    |         |    |  |  |                  |
| Q4          | Practical                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 10               |                     |       |    |           |    |    |           |    |    |           |    |    |           |    |    |                                       |    |    |         |    |  |  |                  |
| Q5          | Problem based question and Case Study                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 30               |                     |       |    |           |    |    |           |    |    |           |    |    |           |    |    |                                       |    |    |         |    |  |  |                  |
| Q6          | Journal                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 10               |                     |       |    |           |    |    |           |    |    |           |    |    |           |    |    |                                       |    |    |         |    |  |  |                  |
|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>Total 100</b> |                     |       |    |           |    |    |           |    |    |           |    |    |           |    |    |                                       |    |    |         |    |  |  |                  |

**Department of B.Sc. (Biotechnology):**

| Sr No | Name of the Faculty       | Designation and College                                              | Signature                                                                           |
|-------|---------------------------|----------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| 1.    | Dr. Bhuvaneshwari Krishna | Assistant Professor &<br>Head of Department,<br>Smt. C.H.M. College. |  |
| 2.    | Dr. Kishori Tarfe         | Assistant Professor,<br>Smt. C.H.M. College.                         |  |
| 3.    | Ms. Vaishnavi Pathare     | Lecturer, Smt. C.H.M. College.                                       |  |
| 4.    | Ms. Pranali Jadhav        | Lecturer, Smt. C.H.M. College.                                       |  |
| 5.    | Ms. Bhairavi Suryavanshi  | Lecturer, Smt. C.H.M. College.                                       |  |

**Name & Signature of the Ad hoc BoS Chairperson: Dr. Bhuvaneshwari Krishna** 

**Name & Signature of the Dean: Ms. Ritika Sachdev** 

