

**ERA UNIVERSITY, LUCKNOW**  
**STUDY & EVALUATION SCHEME (Effective from Session 2025-26)**  
**B.Sc. BIOTECHNOLOGY**  
**YEAR II, SEMESTER – IV**

| S.No.             | Course category   | Course code | Course title   | Hours/Week |   |   | EVALUATION SCHEME |    |       |              | Course Total | C         | Attributes    |                  |                   |        |                            |              |                     |
|-------------------|-------------------|-------------|--|------------|---|---|-------------------|----|-------|--------------|--------------|-----------|---------------|------------------|-------------------|--------|----------------------------|--------------|---------------------|
|                   |                   |             |  | L          | T | P | Mid Sem Exam      | TA | Total | End Sem Exam |              |           | Employability | Entrepreneurship | Skill Development | Gender | Environment Sustainability | Human values | Professional Ethics |
|                   |                   |             |  |            |   |   |                   |    |       |              |              |           |               |                  |                   |        |                            |              |                     |
| <b>THEORY</b>     |                   |             |  |            |   |   |                   |    |       |              |              |           |               |                  |                   |        |                            |              |                     |
| 1.                | Major Own Faculty | B020401T    | Microbiology & Immunology                                  | 3          | 1 | 0 | 10                | 15 | 25    | 75           | 100          | 4         | √             | √                | √                 | √      |                            |              |                     |
| 2.                | Major Own Faculty | B020402T    | Enzymology & Enzyme Kinetics                               | 3          | 1 | 0 | 10                | 15 | 25    | 75           | 100          | 4         | √             | √                | √                 |        |                            |              |                     |
| 3.                | Vocational        | I020403T    | Animation IV (Motion Graphics Composting & Visual Effects) | 2          | 0 | 2 | 10                | 15 | 25    | 75           | 100          | 3         | √             |                  | √                 | √      |                            |              |                     |
| 4.                | Co-Curricular     | H020404T    | Physical Education & Yoga                                  | 1          | 0 | 2 | 10                | 15 | 25    | 75           | 100          | 2         | √             | √                | √                 | √      |                            |              |                     |
| <b>PRACTICALS</b> |                   |             |  |            |   |   |                   |    |       |              |              |           |               |                  |                   |        |                            |              |                     |
| 5.                | Major Own Faculty | B020405P    | Microbiology & Immunology Lab                              | 0          | 0 | 8 | 10                | 15 | 25    | 75           | 100          | 4         | √             | √                | √                 | √      |                            |              |                     |
| 6.                | Major Own Faculty | B020406P    | Enzymology & Enzyme Kinetics Lab                           | 0          | 0 | 4 | 10                | 15 | 25    | 75           | 100          | 2         | √             | √                | √                 | √      |                            |              |                     |
| <b>Total</b>      |                   |             |  |            |   |   |                   |    |       |              | <b>600</b>   | <b>19</b> |               |                  |                   |        |                            |              |                     |

L- Lecture      T- Tutorial      P- Practical      C- Credit      TA- Teacher Assessment

*Student may exit the program after @ 2<sup>nd</sup> year with Diploma after completing additional 4 credit training/ Research course.*

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**ERA UNIVERSITY**  
**Department of Biotechnology**  
**Course Outline**  
**Academic Year: 2025-26**

|   |  |                        |                         |
|---|--|------------------------|-------------------------|
| <b>Course Name: Microbiology &amp; Immunology</b>   | <b>Course Code: B020401T</b>   | <b>Year: II</b>        | <b>Semester: IV</b>     |
| <b>Co-curricular/Vocational/Core/Elective: Core</b> |  |                        |                         |
| <b>Credits: 4</b>                                   | <b>Total No. of Lectures: 60 Lecture-Tutorial-Practical (in hours/week) L-T-P: 3-1-0</b>   |                        |                         |
| <b>Evaluation Spread</b>                            | <b>Internal Continuous</b>   | 25                     | <b>End Term Exam</b> 75 |
| <b>Course Objective</b>                             | The course aims to provide students with an understanding of general microbiology, contribution of microbiology to human life for various daily needs. The knowledge is used in health care for prevention of diseases, diagnosis, sterilization methods and drug production. Further, the knowledge is also extended into food production, production of alcohol, in agriculture, leather industry, etc   |                        |                         |
| <b>Course Outcome</b>                               | <p><i>After the successful course completion, learners will develop following attributes:</i></p> <p>CO1: Understand the classification, morphology, and physiology of diverse microorganisms.</p> <p>CO2: Learn sterile techniques, microbial cultivation, and basic microbial identification.</p> <p>CO3: Learn about microbial nutrition, growth, and control methods. Understand the structure, physiology, genetics, and diversity of microorganisms, Explore the role of microbes in health, environment, and agricultural biotechnology.</p> <p>CO4: Understand the types of Immunity and the cell and organs of immune responses and their functions.</p> <p>CO5: Acquire basic knowledge of Antigens and Antibodies and Antigen Antibody reactions.</p> <p>CO3: Comprehend Histocompatibility, structure of MHC class I, II &amp; III antigens and their mode of antigen presentation; understand different types of Complement systems, Hypersensitivities and Autoimmunity.</p> <p>CO4: Understand Passive and Active immunization and different types of Vaccines.</p> |                        |                         |
| <b>Pedagogy</b>                                     | Interactive, discussion-based, student-centered, Presentation  |                        |                         |
| <b>Internal Evaluation Mode</b>                     | Sessional Test; Quiz; Assignments; Attendance; Presentations   |                        |                         |
| <b>UNIT</b>   | <b>Topic</b>   | <b>No. of Lectures</b> |                         |
| <b>I</b>  | Foundations of Microbiology: Historical discoveries in microbiology: From spontaneous generation to germ theory, Role of microbiology in shaping modern science, General characteristics of bacteria, fungi, protozoa, algae, archaea, and viruses, Beneficial vs harmful microorganisms: An introduction, Introduction to the five-kingdom and three-domain classification systems  | 8 hours                |                         |
| <b>II</b>   | Microscopy and Microbial Structure: Light microscopy and electron microscopy: Working principles, types, applications, Sample preparation: Fixation, staining techniques (simple, differential, special), Prokaryotic cell structure: Cell wall, membrane, capsule,  | 7 hours                |                         |

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|      | flagella, fimbriae, Eukaryotic microbial structures: Fungal and protozoan morphology, Structural features of viruses and bacteriophages  |         |
| III  | Microbial Growth and Nutrition: Microbial nutritional types: Phototrophs, chemotrophs, autotrophs, heterotrophs, Growth curve: Lag, log, stationary, and decline phases, Physical and chemical factors influencing microbial growth (pH, temperature, osmotic pressure, oxygen), Types of culture media: Synthetic, complex, selective, differential, Sterilization and disinfection: Heat, filtration, radiation, and chemical methods. | 7 hours |
| IV   | <b>Recombination in Prokaryotes:</b> Conjugation, Transformation and Transduction, Bacteriophage: Lytic and lysogenic cycle.<br><b>Microbial agents of disease:</b> General characteristics of common pathogenic microorganisms: Bacterial (tuberculosis, gall, etc.), viral (SARS, TMV, etc.) fungal (red rot of sugar cane, dermatitis, etc.) and protozoan (malaria, etc.).   | 8 hours |
| V    | <b>Basics of Immunology:</b> Types of immunity: Innate and Adaptive; An overview of primary and secondary immune responses; Haematopoiesis; Structure and functions of Cell of immune system; Overview of organs of immune system- primary and secondary lymphoid organs.  | 8 hours |
| VI   | <b>Immune Responses:</b> Factors influencing immunogenicity; haptens, adjuvants, Antibodies: Structure, types, and functions. Clonal selection theory. Antigen-Antibody Reactions- Precipitation, Agglutination and ELISA.   | 8 hours |
| VII  | <b>Histocompatibility:</b> Structure of MHC class I, II & III and their mode of antigen presentation; MHC restriction<br><b>Complement system:</b> Classical, alternate and lectin pathways of complement activation.  | 7 hours |
| VIII | <b>Hypersensitivity:</b> General features of hypersensitivity, Basics of various types of hypersensitivity: Type I, Type II, Type III and Type IV.<br><b>Autoimmunity:</b> General concept of autoimmunity and tolerance; Passive & active immunization. Overview of types of vaccines.  | 7 hours |

#### Suggested Readings

1. Introduction to Microbiology, Ingraham, 2ed.
2. General Microbiology, R.Y. Stanier, J.L. Ingraham, M. L. Wheelis and P.R. Painter, Macmillian
3. Prescott's Microbiology, Joanne M. Willey, Linda M. Sherwood, Christopher J. Woolverton.
4. Microbiology VI Edition, M.J. Pelczar, E.C.S. Chan and N.R. Kreig, Tata McGraw Hill Biotechnology (B.Sc. Edition), B.D Singh.
5. William, E. Paul (1989) Fundamental Immunology, 2nd Edition Raven Press, New York.
6. William, R. Clark (1991) the Experimental Foundations of Modern Immunology (4th Edition) John Wiley and Sons, New York.
7. Basic Immunology, A.K. Abbas and A.H. Lichtman, Saunders W.B. Company
8. Fundamentals of Immunology, W. Paul, Lippincott Williams and Wilkins

Course created by

DR. SACHIN KISHOR  
SACHIN KISHOR

Approved by:

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MAPPED CO's WITH PO's & PSO's

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| I    | CO1       |
| II   | CO2       |
| III  | CO3       |
| IV   | CO4       |

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PSO7 | PSO8 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|------|------|
| CO1 |     | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   |     | ✓    | ✓    | ✓    |      | ✓    | ✓    | ✓    |      |
| CO2 |     | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   |     | ✓    | ✓    | ✓    |      | ✓    | ✓    | ✓    |      |
| CO3 |     | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   |     | ✓    | ✓    | ✓    |      | ✓    | ✓    | ✓    |      |
| CO4 |     | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   |     | ✓    | ✓    | ✓    |      | ✓    | ✓    | ✓    |      |

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**ERA UNIVERSITY**  
**Department of Biotechnology**  
**Course Outline**  
**Academic Year: 2025-26**

|   |   |                              |                      |                 |                        |
|---|---|------------------------------|----------------------|-----------------|------------------------|
| <b>Course Name:</b> Enzymology and Enzyme kinetics  |   | <b>Course Code:</b> B020402T |                      | <b>Year:</b> II | <b>Semester:</b> IV    |
| <b>Co-curricular/Vocational/Core/Elective:</b> Core |   |                              |                      |                 |                        |
| <b>Credits:</b> 4                                   | <b>Total No. of Lectures:</b> 60 <b>Lecture-Tutorial-Practical (in hours/week)</b> L-T-P: 3-1-0   |                              |                      |                 |                        |
| <b>Evaluation Spread</b>                            | <b>Internal Continuous</b>  | 25                           | <b>End Term Exam</b> | 75              |                        |
| <b>Subject prerequisites</b>                        | To study this subject, a student must have had biology in class 12 <sup>th</sup>  |                              |                      |                 |                        |
| <b>Course Objective</b>                             | To understand the kinetics and mechanisms of action of enzymes, to become familiar with the basic methods of studying enzymes, and to appreciate how individual reactions are controlled and integrated into the metabolic pathways of the cell. Acquired theoretical and experimental knowledge will enable students to find appropriate employment in different development, scientific-research laboratories, or to continue their further studies in biochemistry or related disciplines.   |                              |                      |                 |                        |
| <b>Course Outcome</b>                               | <i>After the successful course completion, learners will develop following attributes:</i><br>CO1: Understand the structure and function of enzymes, methods of isolation, purification and characterization of enzymes.<br>CO2: Learn how enzymes are able to increase speed of a biochemical reaction, mechanism of enzyme catalysis and enzyme inhibition.<br>CO3: Understand techniques of enzyme immobilization and applications of immobilized enzyme systems.<br>CO4: Have knowledge of enzyme regulation and applications of enzymes in industries. |                              |                      |                 |                        |
| <b>Pedagogy</b>                                     | Interactive, discussion-based, student-centered, Presentation   |                              |                      |                 |                        |
| <b>Internal Evaluation Mode</b>                     | Sessional Test; Quiz; Assignments; Attendance; Presentations  |                              |                      |                 |                        |
| <b>UNIT</b>   | <b>Topic</b>  |                              |                      |                 | <b>No. of Lectures</b> |
| <b>I</b>  | <b>Enzymes as Catalysts:</b> Overview-Proteins as catalysts, Enzyme characteristics and properties; Enzyme nomenclature & classifications. Coenzymes and Cofactors- Prosthetic group, coenzymes involved in different metabolic pathways; factors (pH, temperature etc.) affecting the rate of enzyme catalysis.  |                              |                      |                 | 7 Hrs                  |
| <b>II</b>   | Isoenzymes, Abzymes, Synzymes, Metallo-enzymes and metal activated enzymes, Enzyme Isolation, Purification and Characterization.  |                              |                      |                 | 7Hrs                   |
| <b>III</b>  | <b>Mechanism of enzyme catalysis:</b> Acid-base catalysis, covalent catalysis, proximity. <b>Mechanism of Enzyme Kinetics:</b> Lock and key, Induced fit model and Transition state Hypothesis. Derivation of Michaelis Menten equation for Uni-substrate reactions; Briggs-Haldane steady-state approach, Vmax, Km and Kcat and their significance, methods for the determination of Km, Vmax; Lineweaver-Burk equation and plot.  |                              |                      |                 | 8 Hrs                  |

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| IV   | Kinetics of bi-substrate enzyme-catalysed reactions: Cleland representation and nomenclature for multi-substrate reactions, kinetic mechanisms and initial rate equations of random, ordered and ping pong bi-substrate reactions, distinction between different bisubstrate mechanisms using primary and secondary plots.  | 8 Hrs |
| V    | <b>Enzyme Inhibition:</b> Reversible enzyme inhibition (competitive, non-competitive, uncompetitive and mixed); irreversible enzyme inhibition; enzyme kinetics in the presence of inhibitors: Determination of $K_i$ ; Suicide inhibitor   | 7 Hrs |
| VI   | <b>Enzyme Immobilization:</b> Overview, Types of enzyme immobilization viz. entrapment method, carrier binding method, cross-linking method, nano-crystallization method; examples of immobilized enzymes; Advantages and disadvantages of different Immobilization techniques; Overview of applications of immobilized enzyme systems  | 7 Hrs |
| VII  | <b>Enzyme Regulation:</b> General mechanisms of enzyme regulation, reversible and irreversible covalent modifications of enzymes, feedback inhibition product inhibition; allosteric regulation of enzyme activity: qualitative description of "concerted" & "sequential" models for allosteric enzymes, positive cooperativity, negative cooperativity and half-site reactivity, Hill and Scatchard plots. | 8 Hrs |
| VIII | <b>Physicochemical properties and mechanism of action of two substrate catalysed enzymes:</b> chymotrypsin, lysozyme, hexokinase and alcohol dehydrogenase. <b>Applications of Enzymes:</b> Food industry, agriculture industry and Clinical Approaches on comprehensive account  | 8 Hrs |

#### Suggested Readings

1. Trevor Palmer & Philip Bonner. Enzymes: Biochemistry, Biotechnology, Clinical chemistry. 2<sup>nd</sup> Ed., Affiliated East-West Press
2. T. Devasena. Enzymology, 2010, Oxford University Press
3. M.Y. Khan. Principles of enzyme technology, 1<sup>st</sup> Ed, S. Chand Company
4. Dr. S.M. Bhatt. Enzymology & Enzyme technology, 1<sup>st</sup> Ed., PHI Learning Press
5. Price Nicholas & Lewis Stevens. Fundamentals of Enzymology: cell & molecular biology of catalytic proteins. 3<sup>rd</sup> Ed., Oxford University Press
6. Enzymes by Dixon M, Webb EC, 2 ND Ed., Academic Press
7. Biochemistry 5th Revised edition by Lubert Stryer, Jeremy M. Berg, John L. Tymoczko, Macmillan Publishers, USA

Course created by:

Dr. AMIT MANI  
Tiwari

Approved by:



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| I    | CO1       |
| II   | CO2       |
| III  | CO3       |
| IV   | CO4       |

**MAPPED CO's WITH PO's & PSO's**

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PSO7 | PSO8 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|------|------|
| CO1 | √   | √   | √   | √   | √   | √   | √   |     | √    |      | √    |      | √    | √    | √    |      |
| CO2 | √   | √   | √   | √   | √   | √   | √   |     | √    |      | √    |      | √    | √    | √    |      |
| CO3 | √   | √   | √   | √   | √   | √   | √   |     | √    |      | √    |      | √    | √    | √    |      |
| CO4 | √   | √   | √   | √   | √   | √   | √   |     | √    |      | √    |      | √    | √    | √    |      |





  
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**ERA UNIVERSITY**  
**Department of Biotechnology**  
**Course Outline**  
**Academic Year: 2025-26**

|  |  |                              |                      |                 |                        |
|--|--|------------------------------|----------------------|-----------------|------------------------|
| <b>Course Name:</b> Animation IV<br>(Motion Graphics Compositing & Visual Effects) |  | <b>Course Code:</b> I020403T |                      | <b>Year:</b> II | <b>Semester:</b> IV    |
| <b>Co-curricular/Vocational/Core/Elective:</b> Vocational                          |  |                              |                      |                 |                        |
| <b>Credits:</b> 2+1  | <b>Total No. of Lectures:</b> 30 <b>Lecture-Tutorial-Practical (in hours/week) L-T-P:</b> 2-0-2  |                              |                      |                 |                        |
| <b>Evaluation Spread</b>   | <b>Internal Continuous</b>   | 25                           | <b>End Term Exam</b> |                 | 75                     |
| <b>Course Objective</b>  | The prime objective of this course is to develop students' skills in video editing, compositing, VFX, and motion graphics to communicate concepts creatively and professionally for media, training, marketing, and storytelling applications.   |                              |                      |                 |                        |
| <b>Course Outcome</b>  | <i>After the successful course completion, learners will develop the following attributes:</i><br>CO1: Communicate messages through motion graphics design.<br>CO2: Distinguish and manage a variety of common media file types.<br>CO3: Apply basic techniques of working with audio in a video application.<br>CO4: Perform keyframing of basic transform tools and effects properties.<br>CO5: Perform compositing, masking, and visual effects for professional outputs.<br>CO6: Develop a complete motion graphics project from concept to rendering. |                              |                      |                 |                        |
| <b>Pedagogy</b>  | Interactive, discussion-based, student-centred presentations, demonstrations, and practical lab sessions.  |                              |                      |                 |                        |
| <b>Internal Evaluation Mode</b>  | Practical; Theory; Viva; Attendance; Assignment  |                              |                      |                 |                        |
| <b>UNIT</b>  | <b>Topic</b>   |                              |                      |                 | <b>No. of Lectures</b> |
| <b>I</b>   | <b>Introduction to Motion Graphics &amp; VFX</b><br>Overview of motion graphics, compositing, and VFX in multimedia industries.  |                              |                      |                 | <b>4T + 2P</b>         |
| <b>II</b>  | <b>Adobe After Effects Fundamentals</b><br>Interface, tools, project setup, and basic timeline management.   |                              |                      |                 | <b>4T + 2P</b>         |
| <b>III</b>   | <b>Animating Layers &amp; Keyframes</b><br>Layer animations, transform tools, effects properties, and keyframing basics.   |                              |                      |                 | <b>4T + 2P</b>         |
| <b>IV</b>  | <b>Advanced Compositing Techniques</b><br>Masking, rotoscoping, tracking, and advanced compositing for video.  |                              |                      |                 | <b>4T + 2P</b>         |
| <b>V</b>   | <b>3D Motion Graphics &amp; Visual Effects</b><br>Working in 3D space, cameras, lights, and integrating 3D effects.  |                              |                      |                 | <b>3T + 2P</b>         |
| <b>VI</b>  | <b>Audio Integration &amp; Editing</b><br>Importing, editing, and mixing audio for motion graphics projects.   |                              |                      |                 | <b>3T + 2P</b>         |
| <b>VII</b>   | <b>Project Development &amp; Rendering</b>   |                              |                      |                 | <b>4T + 2P</b>         |

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|             | Compiling projects, final editing, transitions, and rendering outputs.   |                |
| <b>VIII</b> | <b>Industry Applications &amp; Portfolio Preparation</b><br>Real-world project workflows, portfolio building, and professional presentation. | <b>4T + 1P</b> |

### Suggested Readings

1. <https://ptgmedia.pearsoncmg.com/images/9780134665320/samplepages/9780134665320.pdf>.
2. [http://www.delmarlearning.com/companions/content/1435456130/online\\_chapter\\_preview/1-4354-5613-0\\_Ch9.pdf](http://www.delmarlearning.com/companions/content/1435456130/online_chapter_preview/1-4354-5613-0_Ch9.pdf).
3. <https://crossfeyer.com/wp-content/uploads/2018/05/Motion-Graphics-Design-Academy-Free-Edition-Ebook.pdf>.

### Short Films

9. <https://www.youtube.com/watch?v=1j5XuOeDnv0>
10. <https://www.actionvfx.com/blog/5-incredible-compositing-tutorials-for-after-effects>
11. <https://www.autodesk.com/solutions/visual-effects>

Course created by: Mr.Faiz Haider

Approved by:

| UNIT | MAPPED CO |
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| I    | CO1       |
| II   | CO2       |
| III  | CO4       |
| IV   | CO5       |
| V    | CO5       |
| VI   | CO3       |
| VII  | CO6       |
| VIII | CO6       |

### MAPPED CO's WITH PO's & PSO's

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PSO7 | PSO8 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|------|------|
| CO1 | √   | √   | √   | √   | √   | √   | √   |     | √    |      | √    | √    | √    | √    | √    | √    |
| CO2 | √   | √   | √   | √   | √   | √   | √   |     | √    |      | √    | √    | √    | √    | √    | √    |
| CO3 | √   | √   | √   | √   | √   | √   | √   |     | √    |      | √    | √    | √    | √    | √    | √    |
| CO4 | √   | √   | √   | √   | √   | √   | √   |     | √    |      | √    | √    | √    | √    | √    | √    |
| CO5 | √   | √   | √   | √   | √   | √   | √   |     | √    |      | √    | √    | √    | √    | √    | √    |
| CO6 | √   | √   | √   | √   | √   | √   | √   |     | √    |      | √    | √    | √    | √    | √    | √    |

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**ERA UNIVERSITY**  
**Department of Biotechnology**  
**Course Outline**  
**Academic Year: 2025-26**

|  |  |                              |                      |                 |                        |
|--|--|------------------------------|----------------------|-----------------|------------------------|
| <b>Course Name:</b> Physical Education and Yoga              |  | <b>Course Code:</b> H020404T |                      | <b>Year:</b> II | <b>Semester:</b> IV    |
| <b>Co-curricular/Vocational/Core/Elective:</b> Co-Curricular |  |                              |                      |                 |                        |
| <b>Credits:</b> 2  | <b>Total No. of Lectures:</b> 15+15P <b>Lecture-Tutorial-Practical (in hours/week) L-T-P:</b> 1-0-2  |                              |                      |                 |                        |
| <b>Evaluation Spread</b>                                     | <b>Internal Continuous</b>   | 25                           | <b>End Term Exam</b> | 75              |                        |
| <b>Subject prerequisites</b>                                 | To study this subject, a student must have had biology in class 12th   |                              |                      |                 |                        |
| <b>Course Objective</b>                                      | The objective of this course is to make students familiar with Physical Education, Concept of Fitness and Wellness, Weight Management, Lifestyle, Yoga and Meditation, Traditional Games of India and Recreation in Physical Education.  |                              |                      |                 |                        |
| <b>Course Outcome</b>  | <i>After the successful course completion, learners will develop following attributes:</i><br>CO1: Gain knowledge about the Physical Education, Importance and Scope of Physical Education in the Modern Society<br>CO2: Concept of fitness and wellness, Weight management and lifestyle of an individual.<br>CO3: The student will also learn about the relation of Yoga with mental health and value Education.<br>CO4: In this course student will also learn about the aspects of the Traditional games of India. |                              |                      |                 |                        |
| <b>Pedagogy</b>  | Interactive, discussion-based, student-centered, Presentation  |                              |                      |                 |                        |
| <b>Internal Evaluation Mode</b>                              | Sessional Test; Assignment; Presentation; Attendance; Quiz   |                              |                      |                 |                        |
| <b>UNIT</b>  | <b>Topic</b>   |                              |                      |                 | <b>No. of Lectures</b> |
| <b>I</b>   | <b>Physical Education:</b> Meaning, Definition, Aim and Objective, Misconception About Physical Education, Need, Importance and Scope of Physical Education in the Modern Society, Physical Education Relationship with General Education, Physical Education in India before Independence AND Physical Education in India after Independence.   |                              |                      |                 | <b>6 Hrs</b>           |
| <b>II</b>  | <b>Concept of Fitness and Wellness:</b> Meaning, Definition and Importance of Fitness and Wellness, Components of Fitness, Factor Affecting Fitness and Wellness.<br><b>Weight Management:</b> Meaning and Definition of Obesity, Causes of Obesity, Management of Obesity, Health problems due to Obesity.<br><b>Lifestyle:</b> Meaning, Definition, Importance of Lifestyle, Factor affecting Lifestyle, Role of Physical activity in the maintenance of Healthy Lifestyle.  |                              |                      |                 | <b>5 T + 6P Hrs</b>    |
| <b>III</b>   | <b>Yoga and Meditation:</b> Historical aspect of yoga, Definition, types scopes & importance of yoga, Yoga relation with mental health and value education, Yoga relation with Physical Education and sports, Definition of Asana, differences between asana and physical exercise, Definition and classification of pranayama, Difference between pranayama and deep  |                              |                      |                 | <b>2T + 12P Hrs</b>    |

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|           | breathing.<br><b>Practical:</b> Asana, Suraya-Namaskar, Bhujang Asana, Naukasana, Halasana, Vajrasana, Padmasana, Shavasana, Makrasana, Dhanurasana, Tad Asana. Pranayam: Anulom, Vilom.   |                             |
| <b>IV</b> | <b>Traditional Games of India:</b> Meaning, Types of Traditional Games- Gilli-Danda, Kanche, Stapu, Gutte, etc., Importance/ Benefits of Traditional Games, How to Design Traditional Games.<br><b>Recreation in Physical Education:</b> Meaning, Definition of Recreation, Scope and Importance of Recreation, General Principles of Recreation, Types of Recreational Activities, Aerobics and Zumba (Fir India Movement). | <b>2T +<br/>12P<br/>Hrs</b> |

#### Suggested Readings

1. Singh, Ajmer, Physical Education and Olympic Abhiyan, "Kalayani Publishers", New Delhi, Revised Addition, 2006
2. Patel, Shrikrishna, Physical Education, "Agrawal Publishers", Agra, 2014-15
3. Panday, Preeti, Sharirik Shiksha Sankalan, "Khel Sanskriti Prakashan, Kanpur
4. Kamlesh M.L., "Physical Education, Facts and foundations", Faridabad P.B. Publications.
5. B.K.S. Yengar, "Light and Yog. Yoga Deepika", George Allen of Unwin Ltd., London, 1981.
6. Braj Bilari Nigam, Yoga Power "TheKpath of Personal achievement" Domen and Publishers, New Delhi, 2001. Indira Devi, "Yoga for You", Gibbs, Smith Publishers, Salt Lake City, 2002 Domen and Publishers, New Delhi - 2001.
7. Jack Peter, "Yoga Master the Yogic Powers", Abhishek Publications, Chandigarh, 2004.
8. Janice Jerusalem, "A Guide To Yoga" Parragon Bath, Baiihe-2004.

Course created by:

Approved by:

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| I    | CO1       |
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| III  | CO3       |
| IV   | CO4       |

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PSO7 | PSO8 |
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| CO3 | √   |     |     |     | √   |     | √   |     |      |      | √    |      | √    |      |      |      |
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**ERA UNIVERSITY**  
**Department of Biotechnology**  
**Course Outline**  
**Academic Year: 2025-26**

|   |  |   |  |                 |  |                      |                        |           |  |
|---|--|---|--|-----------------|--|----------------------|------------------------|-----------|--|
| <b>Course Name:</b> Microbiology & Immunology Lab   |  | <b>Course Code:</b> B020405P  |  | <b>Year:</b> II |  | <b>Semester:</b> IV  |                        |           |  |
| <b>Co-curricular/Vocational/Core/Elective:</b> Core |  |   |  |                 |  |                      |                        |           |  |
| <b>Credits:</b> 4                                   |  | <b>Total No. of Lectures:</b> 120 <b>Lecture-Tutorial-Practical (in hours/week) L-T-P:</b> 0-0-8  |  |                 |  |                      |                        |           |  |
| <b>Evaluation Spread</b>                            |  | <b>Internal Continuous</b>  |  | <b>25</b>       |  | <b>End Term Exam</b> |                        | <b>75</b> |  |
| <b>Course Objective</b>                             |  | <ul style="list-style-type: none"> <li>• To develop hands-on skills in basic microbiological and immunology techniques.</li> <li>• To instill aseptic techniques and safe laboratory practices.</li> <li>• To understand microbial diversity through direct observation and culture.</li> <li>• To be able to perform serological diagnostics in laboratory.</li> <li>• To perform basic diagnostic tests.</li> <li>• To build experimental competencies required for careers in biotechnology and life sciences.</li> </ul>  |  |                 |  |                      |                        |           |  |
| <b>Course Outcome</b>                               |  | <p>After the successful course completion, learners will develop following attributes:</p> <p>CO1: Demonstrate proficiency in standard microbiological laboratory techniques, including aseptic handling, sterilization, media preparation, and culture maintenance, ensuring lab safety and scientific rigor.</p> <p>CO2: Isolate, culture, and enumerate microorganisms from diverse environments using selective and differential media, and interpret microbial diversity in qualitative and quantitative terms.</p> <p>CO3: Assess the impact of physical and chemical factors on microbial growth, including pH, temperature, and antibiotics, using controlled experiments.</p> <p>Analyze Blood grouping.</p> <p>CO4: Perform and analyze differential counting of RBC</p> <p>CO6: Perform and analyze Dot Elisa.</p> <p>CO7: Acquired knowledge of and can perform Ouchter on Double diffusion assay.</p> <p>CO8: Perform and analyze separation of serum and plasma from blood.</p> |  |                 |  |                      |                        |           |  |
| <b> Pedagogy</b>                                    |  | Interactive, discussion-based, Practical's  |  |                 |  |                      |                        |           |  |
| <b>Internal Evaluation Mode</b>                     |  | Sessional Test; Viva; Attendance; Lab Record  |  |                 |  |                      |                        |           |  |
| <b>Lab Course</b>                                   |  | <b>List of Experiments</b>  |  |                 |  |                      | <b>No. of Lectures</b> |           |  |
| <b>Microbiology</b>                                 |  | <ol style="list-style-type: none"> <li>1. Study of instruments: Compound microscope, Autoclave, Hot air oven, pH meter, Laminar airflow and centrifuge.</li> <li>2. Sterilization by heat- Hot air oven and Autoclave.</li> <li>3. Preparation of growth media (nutrients agar, nutrient broth and LB) and sterilization.</li> <li>4. To identify given bacterial culture by Gram's staining method.</li> <li>5. To study the Serial dilution technique.</li> <li>6. Isolation of microbial flora from tap water and drinking water (Hostel) -dilution and pour plate methods.</li> <li>7. Isolation of soil Microorganisms by spread plate and pours plate</li> </ol>  |  |                 |  |                      | <b>60 Hours</b>        |           |  |

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|                   | <p>methods.</p> <p>8. To study the Growth curve of bacteria.</p> <p>9. To determining the microbe's ability to detoxify hydrogen peroxide-catalase test.</p> <p>10. Antibiotic susceptibility testing.</p>  |                 |
| <b>Immunology</b> | <p>1. To isolate serum from blood.</p> <p>2. To isolate plasma from blood.</p> <p>3. Identification of blood group by simple agglutination method.</p> <p>4. To enumerate the total number of RBCs in the blood sample.</p> <p>5. Estimation of specific antibodies present in serum by rapid slide test (WIDAL test).</p> <p>6. To learn the techniques of Radial immune-diffusion-precipitation reaction.</p> <p>7. To determine the presence of specific antigen by sandwich ELISA method (Dot ELISA).</p> | <b>60 Hours</b> |

**Suggested Readings**

- Aneja, K. R. (2017). Experiments in microbiology, plant pathology and biotechnology (6th ed.). New Age International Publishers.
- Cappuccino, J. G., & Welsh, C. T. (2020). *Microbiology: A laboratory manual* (12th ed.). Pearson Education.
- Dubey, R. C., & Maheshwari, D. K. (2019). *Practical microbiology* (Revised ed.). S. Chand & Company.
- Sharma, K. (2017). *Manual of microbiology tools and techniques*. Ane Books Pvt. Ltd.
- Alfred Brown & Heidi Smith (2014). *Benson's Microbiological Applications, Laboratory Manual in General Microbiology* (13th edition). McGraw Hill Higher Education

Course created by:

Dr. Moud ABAAS  
Dr. Sachin Ainer

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08/09/25

Approved by:

**MAPPED CO's WITH PO's & PSO's**

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**Suggested Readings**

8. Trevor Palmer & Philip Bonner. Enzymes: Biochemistry, Biotechnology, Clinical chemistry. 2<sup>nd</sup> Ed., Affiliated East-West Press
9. T. Devasena. Enzymology, 2010, Oxford University Press
10. M.Y. Khan. Principles of enzyme technology, 1<sup>st</sup> Ed, S. Chand Company
11. Dr. S.M. Bhatt. Enzymology & Enzyme technology, 1<sup>st</sup> Ed., PHI Learning Press
12. Price Nicholas & Lewis Stevens. Fundamentals of Enzymology: cell & molecular biology of catalytic proteins. 3<sup>rd</sup> Ed., Oxford University Press
13. Enzymes by Dixon M, Webb EC, 2<sup>ND</sup> Ed., Academic Press
14. Biochemistry 5th Revised edition by Lubert Stryer, Jeremy M. Berg, John L. Tymoczko, Macmillan Publishers, USA

Course created by: *Dr. AMIT MAHAR*  
*Tricard*  
*(Signature)*

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**MAPPED CO's WITH PO's & PSO's**

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