RAMAIAH UNIVERSITY OF APPLIED SCIENCES

M. S. Ramaiah University of Applied Sciences

Programme Structure and Course Details

of

M.Sc. in Biotechnology

Programme Code: 091

BATCH 2024 onwards

M. S. Ramaiah University of Applied Sciences
Faculty of Life and Allied Health Sciences
Department of Biotechnology
New Bel Road, MSR Nagar
Bengaluru-560054
Website-www.msruas.ac.in

Approved by the Academic Council at its 33rd meeting held on 21st November 2024
Revised and Approved by the 34th Academic Council meeting held on 27th March 2025

Siddhata Mathur
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Dean - Academics
M.S. Ramaiah University of Applied Scie
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University's Vision, Mission and Objectives

The M. S. Ramaiah University of Applied Sciences (MSRUAS) will focus on student-centric professional education and motivates its staff and students to contribute significantly to the growth of technology, science, economy and society through their imaginative, creative and innovative pursuits. Hence, the University has articulated the following vision and objectives.

Vision

MSRUAS aspires to be the premier university of choice in Asia for student centric professional education and services with a strong focus on applied research whilst maintaining the highest academic and ethical standards in a creative and innovative environment

Mission

Our purpose is the creation and dissemination of knowledge. We are committed to creativity, innovation and excellence in our teaching and research. We value integrity, quality and teamwork in all our endeavors. We inspire critical thinking, personal development and a passion for lifelong learning. We serve the technical, scientific and economic needs of our Society.

Objectives

1. To disseminate knowledge and skills through instructions, teaching, training, seminars, workshops and symposia in Engineering and Technology, Art and Design, Management and Commerce, Health and Allied Sciences, Physical and Life Sciences, Arts, Humanities and Social Sciences to equip students and scholars to meet the needs of industries, business and society.
2. To generate knowledge through research in Engineering and Technology, Art and Design, Management and Commerce, Health and Allied Sciences, Physical and Life Sciences, Arts, Humanities and Social Sciences to meet the challenges that arise in industry, business and society.
3. To promote health, human well-being and provide holistic healthcare.
4. To provide technical and scientific solutions to real life problems posed by industry, business and society in Engineering and Technology, Art and Design, Management and Commerce, Health and Allied Sciences, Physical and Life Sciences, Arts, Humanities and Social Sciences.
5. To instill the spirit of entrepreneurship in our youth to help create more career opportunities in the society by incubating and nurturing technology product ideas and supporting technology backed business.
6. To identify and nurture leadership skills in students and help in the development of our future leaders to enrich the society we live in.
7. To develop partnership with universities, industries, businesses, research establishments, NGOs, international organizations, governmental organizations in India and abroad to enrich the experiences of faculties and students through research and developmental programmes.

Programme Specifications: M.Sc. Biotechnology

Faculty	Life and Allied Health Sciences
Department	Biotechnology
Programme Code	091
Programme Name	M.Sc. Biotechnology
Dean of the Faculty	Dr. Soma Chaki
Head of the Department	Dr. Shruti Mathur

1. **Title of the Award:** M.Sc. Biotechnology
2. **Mode of Study:** Full Time
3. **Awarding Institution /Body:** M. S. Ramaiah University of Applied Sciences
4. **Joint Award:** Not Applicable
5. **Teaching Institution:** Faculty of Life and Allied Health Sciences, M. S. Ramaiah University of Applied Sciences, Bengaluru
6. **Date of Programme Specifications:** September 2024
7. **Date of Programme Approval by the Academic Council of MSRUAS:** November 2018
8. **Next Review Date:** August 2029
9. **Programme Approving Regulating Body and Date of Approval: KSHEC,**
10. **Programme Accredited Body and Date of Accreditation:** Not Applicable
11. **Grade Awarded by the Accreditation Body:** Not Applicable
12. **Programme Accreditation Validity:** Not Applicable
13. **Programme Benchmark:** Not Applicable
14. **Rationale of the programme:**

The higher education sector is likely to expand significantly with the possible addition of more and more young Indians into higher education as India moves towards becoming a knowledge economy and society. A major thrust, therefore, is given in NEP 2020 with initiatives such as multidisciplinary education with multiple entry and exit options, research at the undergraduate level and learning outcomes-based curriculum approach. The re-structured degree programmes are promoted in both undergraduate and postgraduate education. The NEP 2020 states that "the undergraduate degree will be of either 3 or 4-year duration with appropriate certifications. In conformity with the restructured undergraduate

programmes, UGC has developed a curriculum and credit framework for Post Graduate programs in NEP2024.

The Biotechnology sector is being hailed as the sunrise sector of India. It has been making steady progress over the last few years and has the potential to emerge as a global leader in the biotech industry. Today in India there are approximately 800 Biotech companies located in the major cities of India, precisely in Bangalore there are lead companies in this sector. Currently Indian Biotechnology sector holds about 2% share of the global Biotechnology industries. The revenue generated in India from the Biotechnology sector is contributed by Biopharmaceutical (61%), Bioindustries (8%), BioAgri (4%), Bioinformatics (3%), Bioservice (19%) and Biosupplies (5%). Indian Biotechnology industry holds about 2% share of the global Biotechnology industry in 2016. The Indian Biotechnology sector is expected to grow from the current USD 5-7 billion to USD 100 billion by 2025 by a growth of about 30% (as per ABLE-Association of Biotechnology Led Enterprises). Additional to this Government of India-DBT under the Ministry of Science and Technology has initiated lots of schemes to promote Biotechnology research providing support at post graduate, PhD, Post PhD as well as in the industrial sectors.

Biotechnology has become one of the most progressive and beneficial scientific fields since last quarter century. The **scope of Biotechnology is immense in India** as we are living in the age if research where science has taken the new form. We are at a pace of making new application and innovation every day and this could be possible with combining Technology and biology together.

There are many organizations that offer decent job opportunities in India. After doing the course in Biotechnology, one can find jobs in the field of –

1. Drug and pharmaceutical
2. Public Funded laboratories
3. Chemicals
4. Energy
5. Waste Management
6. Food Biotechnology
7. Bio Processing
8. Government organizations such as Department of Biotechnology (DBT)
9. Agriculture Institutes
10. Horticulture Institutes

15. Programme Mission

RUAS, a young and progressive University with excellent teaching, learning resources and faculty base would like to offer M.Sc. in Biotechnology as a postgraduate programme with a

strong aim to acquaint aspiring students with a foundation and first degree training to make them ready for research assistants/associates, marketing executives, maintenance engineers, computational analysts and even administrators in Biotechnology industries.

16. Graduate Attributes

GA-1. Ability to apply fundamental knowledge of Biology, Biochemistry, Chemistry, Microbiology for developing Biotechnology products.

GA-2. Ability to develop bioprocesses for product development

GA-3. Ability to perform administrative duties in government, semi-government, private and public sector organizations

GA-4. Ability to teach in schools, colleges and universities with additional qualification and training

GA-5. Ability to understand and solve scientific problems by conducting experimental investigations

GA-6. Ability to apply appropriate tools, techniques and understand utilization of resources appropriately in various laboratories

GA-7. Ability to understand the effect of scientific solutions on legal, cultural, social and public health and safety aspects

GA-8. Ability to develop sustainable solutions and understand their effect on society and environment

GA-9. Ability to apply ethical principles to scientific practices and professional responsibilities

GA-10. Ability to work as a member of a team, to plan and to integrate knowledge of various disciplines and to lead teams in multidisciplinary settings

GA-11. Ability to make effective oral presentations and communicate technical ideas to a broad audience using written and oral means

GA-12. Ability to adapt to the changes and advancements in science and engage in independent and life-long learning.

17. Programme Outcome (POs)

PO 1. Technical Knowledge: Demonstrate in-depth knowledge of the scientific fundamentals and the modern technical knowledge needed to support Biotechnology research activities.

PO 2. Design/Development solution: Identify, analyse and understand the problems related to life sciences and find valid conclusions with basic knowledge acquired in the fields.

PO 3. Multidisciplinary approach: Correlate how different sub-systems co-operate with each other into current research and development in the respective fields.

PO 4. Entrepreneurship skills: Analyze manufacturing constituents and complete systems for relevant products and to enable enterprising skills for competing globally.

PO 5. Societal Responsibility: Innovate and develop sustainable solutions and understand their effect on society and environment.

PO 6. Leadership and Ethics: Apply professional Ethics, Leadership and consensus building skills relevant to the aspects of business enterprise in the respective fields.

PO 7. Lifelong learning: Adopt changes and advancements in science and engage in independent learning.

PO 8. Communication: Communicate the information effectively in scientific writing and oral presentation.

18. Programme Goal

Biotechnology is a potential multidisciplinary subject that introduces technological application in the wide domains of Biological Science. It is a promising discipline in which biological processes, organisms, cells or cellular components are exploited to develop new technologies. New tools and products developed by biotechnologists are useful in research, agriculture, industry and the clinic. Modern Biotechnology provides breakthrough products and technologies to combat debilitating and rare diseases, reduce our environmental footprint, feed the hungry, use less and cleaner energy, and have safer, cleaner and more efficient industrial manufacturing processes.

19. Programme Educational Objectives (PEO):

The objectives of the programme are to enable the students to:

PEO 1: To update, extend and deepen students' knowledge thorough a flexible, research-intensive program akin to academia and industry requirements.

PEO 2: To enhance career opportunities in industry, clinical settings both locally and globally or as a preparation for further higher education through in–house state of the art laboratory exposures and outbound dissertation activities fostering Global Competencies among Students.

PEO 3: To enable critical thinking and full-fledged grasp of essential aspects of bioethics inculcating a Value System among Students.

PEO 4: To enrich the global think tanks with right mixes of innovative ability, existing policies at generating and safeguarding the product of their intellect, equipped with entrepreneurship abilities contributing to self and national development.

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20. Programme Specific Outcomes (PSO)

PSO 1: Understand the foundational concepts of biotechnology, and how these impact life science research and development in the diverse fields that span healthcare and agriculture.

PSO 2: Design, perform, and analyze results of experiments using basic molecular biology methodologies and recombinant DNA techniques, including agarose and polyacrylamide gel electrophoresis, restriction enzyme digestion, bacterial transformations, plasmid DNA protein expression, PCR, and tissue culture.

PSO 3: Apply various facets of biotechnological approaches with strong ethical and social responsibilities in bringing solution for human health, agriculture and other welfare.

PSO 4: Students will be able to gain hands on experience in basic and advanced techniques in biotechnology research and get trained effective scientific communication. This experience would enable them to begin a career in industry as well as in research laboratories or to innovate new start up with their entrepreneurship skills.

21. Programme Structure

SEMESTER I

S. No.	Code	Course Title	Credit	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Max Marks
1	BTD511A	Cell Biology and Molecular Genetics	4	4			100
2	BTD512A	Biological Chemistry	3	3			100
3	BTD513A	Concepts of Microbiology	3	3			100
4	BTD514A	Bioanalytical Techniques	2	2			50
5	BTD515A	Biostatistics and Data Analysis	2	1	1		50
6	BTL511A	Practical I: Cell Biology & Molecular Genetics	3			6	100
7	BTL512A	Practical II: Microbiology & Biochemistry	3			6	100
Total			**20**	**13**	**1**	**12**	**600**
Total number of contact hours per week			**26 hours**				

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SEMESTER II

S. No.	Code	Course Title	Credit	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Max. Marks
1	BTC511A	Bioprocess Technology	4	4			100
2	BTC512A	Molecular Biology and Recombinant DNA Technology	3	3			100
3	BTD516A	Immunology and Immuno techniques	3	3			100
4	BTD517A	Bioinformatics and Structural Biology	2	2			50
5	BTD518A	Research: Methodology, Ethics and Safety	2	2			50
6	BTL513A	Practical III: Molecular Biology and Immunology	3			6	100
7	BTL514A	Practical IV:Bioinformatics and Structural Biology	3			6	100
Total			**20**	**14**		**12**	**600**
Total number of contact hours per week			**26 hours**				

SEMESTER III

S. No.	Code	Course Title	Credit	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Max. Marks
1	BTC601A	Animal and Plant Biotechnology	4	4			100
2	BTL601A	Practical V: Animal and Plant Biotechnology	3			6	100
3	BTE6XXA	Elective 1	3	3			100
4	BTE6XXA	Elective 2	3	3			100
5	BTM601A	Introduction to Management, Entrepreneurship and IPR	2	2			50
6	BTP601A	Group Project	5			10	100
Total			**20**	**12**		**16**	**550**
Total number of contact hours per week			**28 hours**				

SEMESTER IV

S. No.	Code	Course Title	Credit	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Max. Marks
1	BTP602A	Dissertation and Publication	**20**			40	300
TOTAL CREDITS (4 semesters)			**80**	**TOTAL MARKS**			**2050**

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Elective Course

Two Elective courses (E1 & E2) can be chosen from any one of the following streams–

Stream	Course Code	Elective Courses
Stream 1	BTE601A	Introductory Pharmacokinetics & Pharmacodynamics
	BTE602A	Synthetic Biology
	BTE603A	Genomics and Proteomics
	BTE604A	Medical Biotechnology
Stream 2	BTE605A	AI /ML in Healthcare
	BTE606A	Biotherapeutics: Vaccines and Biosimilars
	BTE607A	Biosensors: Fundamentals and Applications
	BTE608A	Drug Design and Development

Group Project

BTP601A Students will be organized into groups, with each group consisting of no more than four members and placed under a faculty mentor. The group project will be designed to foster collaboration and encourage students to address a relevant problem in the fields of biomedical, agricultural, or environmental sciences. The project will consist of a comprehensive review and critical analysis of the current literature related to the chosen topic. Students will identify key questions in areas where knowledge gaps or uncertainties exist. Based on this question, each group will collectively formulate a research hypothesis and develop well-defined research objectives or aims to test the hypothesis. The final outcome of the project will involve the generation of preliminary data, or the development of an algorithm, product, device, or any other outcome that is relevant to the problem being addressed. This project will provide students with the opportunity to gain hands-on experience in collaborative research, critical thinking, and problem-solving, all of which are essential skills for tackling complex, real-world challenges.

Dissertation and Publication

BTP602A Students, under the guidance of the faculty research mentor will choose a research problem for the Dissertation work. After the work is completed, student will compile the work as a dissertation thesis. Students will also learn another form of academic writing by preparing a manuscript for publication either from the research work done by the student or a review on a chosen topic.

22. Course Delivery: As per the Timetable

23. Teaching and Learning Methods

1. Laboratory work/Field work/Workshop
2. Industry Visit
3. Seminars

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4. Group Exercises
5. Project Work
6. Project
7. Exhibitions
8. Technical Festivals

24. Assessment and Grading

24.1. Components of Grading

There shall be two components of grading:

Component 1 - Continuous Evaluation (CE): This component involves multiple subcomponents (SC1, SC2, etc.) of learning assessment. The assessment of the subcomponents of CE is conducted during the semester at regular intervals. This subcomponent represents the formative assessment of students' learning.

Component 2 - Semester-end Examination (SEE): This component represents the summative assessment carried out in the form an examination conducted at the end of the semester.

Marks obtained CE and SEE components have equal weightage (CE: 50% and SEE: 50%) in determining the final marks obtained by a student in a Course.

The complete details of Grading are given in the Academic Regulations.

24.2. Theory Courses

The following are the CE components:-

Theory Course CE			Theory Course SEE
SC1 (Midterm) 25%	SC2 (Innovative Assignment) 12.5%	SC3 (Written Assignment) 12.5%	SEE 50%
50 Marks	25 Marks	25 Marks	100 Marks

In CE there shall be three subcomponents of CE (SC1, SC2, and SC3), namely Mid-term; Innovative assignments and Written assignment. Each subcomponent is evaluated individually accounting to 50% Weightage as indicated in Course Specifications. The innovative assignment subcomponents can be of any of the following types:

1. Online Test
2. Assignments/Problem Solving

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3. Field Assignment
4. Open Book Test
5. Portfolio
6. Reports
7. Case Study
8. Group Task
9. Laboratory / Clinical Work Record
10. Computer Simulations
11. Creative Submission
12. Virtual Labs
13. Viva / Oral Exam
14. Lab Manual Report
15. Any other

24.3 Laboratory Course

For a laboratory course, the scheme for determining the CE marks is as under:

For a Laboratory Course	
CE (50%)	SEE (50%)
50 Marks	50 Marks

The subcomponents can be of any of the following types:

1. Laboratory / Clinical Work Record
2. Experiments
3. Computer Simulations
4. Creative Submission
5. Virtual Labs
6. Viva / Oral Exam
7. Lab Manual Report
8. Any other (e.g. combinations)

25. Student Support for Learning

1. Course Notes
2. Reference Books in the Library
3. Magazines and Journals
4. Internet Facility
5. Computing Facility
6. Laboratory Facility
7. Workshop Facility
8. Staff Support
9. Lounges for Discussions
10. Any other support that enhances their learning

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26. Quality Control Measures

1. Review of Course Notes
2. Review of Question Papers and Assignment Questions
3. Student Feedback
4. Moderation of Assessed Work
5. Opportunities for students to see their assessed work
6. Review by external examiners and external examiners reports
7. Staff Student Consultative Committee meetings
8. Student exit feedback
9. Subject Assessment Board (SAB)
10. Programme Assessment Board (PAB)

27. Curricular Map

Semester	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
1	Cell Biology and Molecular Genetics	3								3			
1	Biological Chemistry	3	2							3			
1	Concepts of Microbiology	3	2							3			
1	Bioanalytical Techniques	3	2	3		2				3	1	2	
1	Biostatistics and Data Analysis		2	3	3	2							3
1	Practical I: Cell Biology & Molecular Genetics	3	2	2			2	2	3	3	1	3	1
1	Practical II: Microbiology & Biochemistry	3	2	3			2	2	3	3	1	3	1
2	Bioprocess Technology			3		3			3				3
2	Molecular Biology and Recombinant DNA Technology		3								3		
2	Immunology and Immuno-techniques	3									3		
2	Bioinformatics and Structural Biology	3	2	3	2					3	3	2	1
2	Research: Methodology, Ethics and Safety		3	2							3		
2	Practical III: Molecular Biology and Immunology			3	2						3		3
2	Practical IV: Bioinformatics	3	2	3		2		2	2	3	1	1	1
3	Plant and Animal Biotechnology	3		3						3			
3	Practical V: Plant and Animal Biotechnology Laboratory			3					3		3		3
3	Entrepreneurship				3		3					3	
3	Group Project					3	3	3	3		3	3	3

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Semester	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
ELECTIVE 1													
3	Introductory Pharmacokinetics and Pharmacodynamics	3				3						3	
3	Synthetic Biology	3		3								3	
3	Genomics and Proteomics	3		3			3			3			
3	Medical Biotechnology	3								3			
ELECTIVE 2													
3	AI/ML in Healthcare		3	3									3
3	Biotherapeutics: Vaccines and Biosimilars	3									3		
3	Biosensors: Fundamentals and Applications	3	3	3						3			3
3	Drug Design and Development	3									3		
4	Dissertation and Publication		3	3			3	3	3				3

28. Co-curricular Activities

Students are encouraged to take part in co-curricular activities like seminars, conferences, symposia, paper writing, attending industry exhibitions, project competitions and related activities for enhancing their knowledge and networking.

29. Cultural and Literary Activities

Annual cultural festivals are held to showcase the creative talents in students. They are involved in planning and organizing the activities.

30. Sports and Athletics

Students are encouraged to take part in sports and athletic events regularly. Annual sports meet will be held to demonstrate sportsmanship and competitive spirit.

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M. S. Ramaiah University of Applied Sciences

Course Specifications

of

M.Sc. in Biotechnology

Programme Code: 091

SEMESTER 1

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Course Specifications: Cell Biology and Molecular Genetics

Course Title	Cell Biology and Molecular Genetics
Course Code	BTD511A
Department	Biotechnology
Faculty	Life and Allied Health Sciences

1. Course Summary

The aim of the course is to familiarise students about the dynamic roles of cell structure and concepts of genetic mechanisms at the molecular level in coordinated function for the regulation cellular life cycle.

Students will be able to describe the structures and purposes of membranes and articulate how these cellular components are used to generate and utilize energy in cells. They will be able to illustrate the structure and organization of the genetic material. Also, they will be able to explain the mechanisms involved in the genetic recombination and sex determination. They will also be able to summarize the various alterations in the genetic composition that lead to disease. The student will be trained apply the concepts of genetic recombination for the purpose of gene mapping.

2. Course Size and Credits:

Number of credits	04
Total Hours of Classroom Interaction	60
Number of tutorial hours	00
Number of semester weeks	16
Department responsible	Biotechnology
Course Marks	Total Marks: 100
Pass Requirement	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

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Teaching, Learning and Assessment

3. Course Outcomes

After undergoing this course students will be able to:

CO 1. Explain the structure and function of the cell organelles, including their evolutionary origins, protein transport mechanisms, and their roles in cellular metabolism.

CO 2. Examine the organization of eukaryotic chromosomes and the significance of transposable elements in humans.

CO 3: Outline the dynamic organization of cytoskeletal filaments and the extracellular matrix, and their roles in maintaining cell structure and facilitating intracellular transport.

CO 4. Develop skills in cytogenetic techniques for genetic analysis

CO 5. Analyse how disruptions in the cell cycle and signalling pathways can lead to cancer development and progression.

CO 6. Assess the molecular mechanisms by which mutations cause genetic disorders and assess their impact on human health.

4. Course Contents:

Molecular Genetics

Unit I **10h**

Structural organization of chromosomes: Structure and organization of eukaryotic chromosomes: Nucleosomes- Organization of DNA in the nucleosome, histone octamer. Transposable elements in humans and their genetic and evolutionary significance.

Unit II **15h**

Genetic Recombination, mutation and cytogenetic techniques: Mechanism of recombination, Holliday, White house and Radding models; Molecular basis of mutation – Types of mutations. Loss of function mutations, gain of function mutations, expanding repeats. Mutation studies in *Drosophila*. Mutations and human diseases. Chromosomal banding techniques, Karyotyping, Fluorescence in situ hybridization (FISH), Spectral karyotyping (SKY), somatic cell hybrids and gene mapping, Site- directed Mutagenesis.

Unit III **5h**

Sex-determination and sex-linked inheritance: Sex-determination in Drosophila and mammals. Dosage compensation in Drosophila and mammals. Sex-Linked Disorders, Sex-Limited, Sex-Influenced Traits, Genomic Imprinting.

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Cell Biology

Unit IV **10h**

Organelles and Cytoskeleton: Nucleus – Structure and function of nuclear envelope, Macromolecular trafficking; Mitochondria – Origin and evolution, transport of proteins into mitochondria, structure, organization of respiratory chain complexes, mitochondrial DNA and its significance; Chloroplast– Origin and evolution, chloroplast biogenesis, transport of proteins into chloroplasts , Photosynthesis, Chloroplast DNA and its significance; Dynamic structure of cytoskeletal filaments , Molecular motors, Extracellular matrix.

Unit V **10h**

Membrane Structure and Transport: membrane constituents- phospholipids, glycolipids, cholesterol, membrane proteins; receptors and phospholipases; fluid mosaic model.
Transport: membrane transport of small molecules, carrier proteins and active membrane transport; ion channels; anterograde and retrograde protein trafficking.

Unit VI **10h**

Cell Cycle and Signalling: Mitosis and meiosis, regulation of cell cycle, signalling through protein tyrosine kinase receptors, Non-protein tyrosine kinase receptors (JAK-STAT signalling), G-protein coupled receptors signalling and calcium signal transduction, Apoptosis and Cancer.

5. **CO-PO-PSO mapping**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO3
CO 1	3	-	-	-	-	-	-	-	3	-	-	-
CO 2	3	-	-	-	-	-	-	-	3	-	-	-
CO 3	3	-	-	-	-	-	-	-	2	-	-	-
CO 4	3	-	-	-	-	-	-	-	2	2	-	-
CO 5	-	-	2	-	-	-	-	-	-	3	-	-
CO 6	-	-	2	-	-	-	-	-	-	3	-	-
3: High Influence, 2: Moderate Influence, 1: Low Influence												

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6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		45
Demonstrations		05
1. Demonstration using Videos	04	
2. Demonstration using Physical Models /	01	
3. Demonstration on a Computer		
Numeracy		
1. Solving Numerical Problems		
Practical Work		
1. Course Laboratory		
2. Computer Laboratory		
3. Engineering Workshop / Course/Workshop / Kitchen		
4. Clinical Laboratory		
5. Hospital		
6. Model Studio		
Others		05
1. Case Study Presentation		
2. Guest Lecture	02	
3. Industry / Field Visit		
4. Brain Storming Sessions		
5. Group Discussions	02	
6. Discussing Possible Innovations	01	
Term Test and Written Examination		05
Total Duration in Hours		60

7. Course Assessment and Reassessment

The components and subcomponents of course assessment are presented in the Academic Regulations document pertaining to the Programme. The procedure to determine the final course marks is also presented in the Academic Regulations document as well.

The assessment questions are set to test the course learning outcomes. In each component or subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

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Focus of Course Learning Outcomes in each component assessed				
	CE (50% Weightage)			SEE (50% Weightage)
	SC1	SC2	SC3	
	50 Marks	25 Marks	25 Marks	100 Marks
CO 1	x	x		x
CO 2	x	x		x
CO 3	x	x		x
CO 4	x		x	x
CO 5			x	x
CO 6			x	x

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of course outcomes in each component assessed in the above template at the beginning of the semester.

Course reassessment policies are also presented in the Academic Regulations document.

8. Achieving Course Learning Outcomes

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a References

1. Alberts, B., Johnson, A., Lewis, J., Morgan, D., Raff, M., Roberts, K., Walter, P., 2014, *Molecular Biology of the Cell*, 6th Edition, W. W. Norton & Company.

2. Lodish, H., Baltimore, D., Berk, A., Zipursky, B.L., Mastsydaira, P., Darnell, J., 2004, *Molecular Cell Biology*, Scientific American Books Inc. NY.
3. Karp, G., 2010,*Cell and Molecular Biology: Concepts and Experiments*, 6th Edition, John Wiley & Sons. Inc.
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6. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P., 2009,*The World of the Cell*,7th Edition. Pearson Benjamin Cummings Publishing, San Francisco.
7. Snustad, D.P., Simmons, M.J., 2009, *Principles of Genetics*, 5th Edition, John Wiley and Sons Inc.
8. Klug, W.S., Cummings, M.R., Spencer, C.A., 2009, *Concepts of Genetics*, 9th Edition, Benjamin Cummings.
9. Russell, P. J., 2009, *Genetics- A Molecular Approach*, 3rd Edition, Benjamin Cummings.
10. Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C., Carroll, S.B., 2007, 9th Edition, *Introduction to Genetic Analysis*, W. H. Freeman & Co.
11. Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., Losick, R., 2008, *Molecular Biology of the Gene*,10th Edition, Cold Spring Harbour Lab., Press, Pearson Pub.
12. Krebs, J. E., Goldstein, E. S., Kilpatrick, S. T., 2018, *Lewin's GENES XII*, Jones and Bartlett Learning

b Magazines and Journals

1. Nature Cell Biology. Nature. Available at: https://www.nature.com/ncb/
2. Molecular and Cellular Biology. American Society for Microbiology. Available at: http://mcb.asm.org/
3. BMC Cell Biology. BioMed Central. Available at: https://bmccellbiol.biomedcentral.com/
4. Nature Genetics. Nature. Available at: https://www.nature.com/ng/
5. Human Molecular Genetics. Oxford Academic. Available at: https://academic.oup.com/hmg

10. Course Organization

Course Code	BTD511A	
Course Title	Cell Biology and Molecular Genetics	
Course Leader/s Name	As per time table	
Course Leader Contact Details	**Phone:**	08045366666
	E-mail:	hod.bt.ls@msruas.ac.in
Course Specifications Approval Date	September 2024	
Next Course Specifications Review Date:	August 2027	

Chairman (BoS) of Biotechnology
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Course Specifications: Biological Chemistry

Course Title	Biological Chemistry
Course Code	BTD512A
Department	Biotechnology
Faculty	Life and Allied Health Sciences

1. Course Summary

The course aims to provide an advanced understanding of the core principles and topics of biochemistry. The student will be enabled to acquire specialized knowledge and understanding of selected aspects of biological chemistry. This course includes study of chemistry involved in the biological functions, from fundamental principles to recent discoveries, and opportunities to participate in research.

2. Course Size and Credits:

Number of credits	03
Total Hours of Classroom Interaction	45
Number of tutorial hours	00
Number of semester weeks	16
Department responsible	Biotechnology
Pass Requirement	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

Teaching, Learning and Assessment

3. Course Outcomes

After undergoing this course students will be able to:

CO 1. Demonstrate a broad knowledge of the fundamental introductory concepts of Chemistry and Biology

CO 2. Describe the structures and functions of amino acids and proteins, and to characterize these at the molecular level

CO 3. Explain the chemistry and functions of enzymes in order to address its catalytic activity, the process of regulation and inhibition

CO 4. Describe the structures and functions of carbohydrates and lipids, and its metabolic importance in biological system

CO 5. Enumerate the structure and chemistry of DNA and RNA, and its functional significance and metabolic importance in living organism

CO 6. Demonstrate proficiency in developing relevant biochemical questions and answer those questions with critical analysis and interpretation.

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Assistant Registrar
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4. Course Content

Unit I **4h**

Carbohydrates – Structure and diversity: Structure and Classification of Mono, di, oligo, polysaccharide; Starch; Glycogen; Derivatives of Sugars, Glycoconjugates - Peptidoglycans, glycolipids, lipopolysaccharides, glycoproteins; Protein Glycosylation and lectins

Unit II **8h**

Carbohydrate metabolism: Glycolysis; TCA Cycle; ETC chain and oxidative phosphorylation, Gluconeogenesis, Pentose phosphate pathway, Glycogen metabolism, Bioenergetics

Unit III **12h**

Proteins – Structure and metabolism: Structure and Classifications of Amino Acids; Primary, Secondary, Tertiary, and Quaternary Structure of Protein; Absorption of UV light by Protein, Ramachandran Plot; Structure of Hemoglobin, and Myoglobin; Hill Plot of Oxygen Binding Properties of Hb; Protein Folding; Amino acid Metabolism, Transamination and deamination; Urea Cycle and its relation to TCA Cycle; One Carbon Reaction

Unit IV **6h**

Enzyme kinetics and inhibition: Chemistry and Classification of Enzymes; Mechanism of Enzyme Action; Factors affecting Enzyme Action; Enzyme Kinetics: Michaels Menten Equation, Lineweaver Burk Plot, regulation of enzyme activity; enzyme inhibition, Allosteric Mechanism

Unit V **6h**

Lipids - Structure, Function and Metabolism: Structure and Classification of Lipid; Fatty Acids; Triacylglycerol; Cholesterol, Fatty Acid Synthesis; Beta-oxidation, saturated and unsaturated fatty acid oxidation, omega and alpha oxidation

Unit VI **9h**

Nucleic Acids -Structure, Function and Metabolism: Structure and Chemistry of Nucleic Acid, Chemistry of DNA and RNA; Physical and chemical properties of DNA and RNA. Absorption of UV light by DNA and RNA; Hyperchromic shift; Genome Complexity; C-value Paradox; Cot Value, Nucleotide metabolism: Biosynthesis and degradation of Nucleic Acid; de novo and Salvage Pathways

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5. CO-PO-PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO3
CO 1	3	-	-	-	-	-	-	-	3	-	-	-
CO 2	2	-	-	-	-	-	-	-	3	-	-	-
CO 3	2	-	-	-	-	-	-	-	2	-	-	-
CO 4	-	2	-	-	-	-	-	-	1	-	-	-
CO 5	-	2	-	-	-	-	-	-	1	-	-	-
CO 6	-	2	-	-	-	-	-	-	1	-	-	-
3: High Influence, 2: Moderate Influence, 1: Low Influence												

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		24
Demonstrations		06
1. Demonstration using Videos	05	
2. Demonstration using Physical Models /	01	
3. Demonstration on a Computer		
Numeracy		
1. Solving Numerical Problems		
Practical Work		
1. Course Laboratory		
2. Computer Laboratory		
3. Engineering Workshop / Course/Workshop / Kitchen		
4. Clinical Laboratory		
5. Hospital		
6. Model Studio		
Others		05
1. Case Study Presentation		
2. Guest Lecture	02	
3. Industry / Field Visit		
4. Brain Storming Sessions		
5. Group Discussions	02	
6. Discussing Possible Innovations	01	
Term Test and Written Examination		10
Total Duration in Hours		45

7. Course Assessment and Reassessment

The components and subcomponents of course assessment are presented in the Academic Regulations document pertaining to the Programme. The procedure to determine the final course marks is also presented in the Academic Regulations document as well.

The assessment questions are set to test the course learning outcomes. In each component or subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

Focus of Course Learning Outcomes in each component assessed				
	CE (50% Weightage)			SEE (50% Weightage)
	SC1	SC2	SC3	
	50 Marks	25 Marks	25 Marks	100 Marks
CO 1	X	X		X
CO 2	X	X		X
CO 3	X	X		X
CO 4	X		X	X
CO 5			X	X
CO 6			X	X

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of course outcomes in each component assessed in the above template at the beginning of the semester.

Course reassessment policies are also presented in the Academic Regulations document.

8. Achieving Course Learning Outcomes

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

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9. Course Resources

a References

1. Nelson, D.L., Lehninger, A.L. and Cox, M.M., 2008. *Lehninger Principles of Biochemistry*. Macmillan.
2. Stryer, L., 1990. *Biochemistry* 3rd Edition WH Freeman and Company. New York.
3. Horton, H.R., Moran, L.A., Scrimgeour, K.G., Perry, M.D. and Rawn, J.D., 2006. *Principles of Biochemistry.* Pearson Prentice Hall.
4. Voet, D. and Voet, J.G., 2010. *Biochemistry*. John Wiley & Sons.
5. Wilson, K. and Walker, J. eds., 2000. Principles and Techniques of Practical Biochemistry. Cambridge University Press.

b Magazines and Journals

1. Nature. Biochemistry. Available at: https://www.nature.com/subjects/biochemistry
2. Elsevier. Process Biochemistry. Available at: https://www.journals.elsevier.com/process-biochemistry

10. Course Organization

Course Code	BTD512A	
Course Title	Biological Chemistry	
Course Leader/s Name	As per time table	
Course Leader Contact Details	**Phone:**	08045366666
	E-mail:	hod.bt.ls@msruas.ac.in
Course Specifications Approval Date	September 2024	
Next Course Specifications Review	August 2027	

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Dean - Academics
M.S. Ramaiah University of Applied Sciences
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Course Specifications: Concepts of Microbiology

Course Title	Concepts of Microbiology
Course Code	BTD513A
Department	Biotechnology
Faculty	Life and Allied Health Sciences

1. **Course Summary**

The aim of this course is to provide students the idea of Microbiology including the diversity, physiology, morphology, genetics, ecology, and applications of microorganisms. Students will be acquainted with the concepts of general Microbiology which is an integral part of Biological Sciences. Students will be able to discuss and relate the structure, function and taxonomy of microbial world including bacteria, fungi, algae, protozoa, slime molds and viruses. The course will familiarize students with the general principles of microbial growth, evolution, classification, unique characteristics, and economic importance of microorganisms.

2. **Course Size and Credits**:

Number of credits	03
Total Hours of Classroom Interaction	45
Number of tutorial hours	00
Number of semester weeks	16
Department responsible	Biotechnology
Pass Requirement	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

Teaching, Learning and Assessment

3. **Course Outcomes**

After undergoing this course students will be able to:

CO 1. Explain the differences between traditional and molecular approaches to taxonomy

CO 2. Describe the cell morphology of gram positive and gram-negative bacteria

CO 3. Explain the concept of microbial growth, death rate and factors that affect the efficacy of sterilization techniques

CO 4. Differentiate between horizontal and vertical gene transfer in bacteria.

CO 5. Compare and contrast the commons methods used for culturing viruses in clinical laboratory

CO 6. Analysing the role of microorganisms in health and environment

4. **Course Content**

Unit I **8h**

Classification: Types of microbes (Bacteria, Algae, Fungi, Protozoa, Viruses), Criteria for Microbial classification-morphological, staining techniques, biochemical methods, serological techniques, phage typing, fatty acid profiles, DNA base composition, rRNA sequence, Classification of bacteria according to Bergey's Manual of systematic Bacteriology, Numerical Taxonomy, Cladograms, dendrograms

Unit II **7h**

Ultrastructure of bacteria: Cell morphology, flagella, pili, capsule, cell wall, cell membrane Peptidoglycan, Intracytoplasmic inclusions, nucleoid, plasmids, transposons, gas vacuoles, Endospores, Genomic Organisation, Extrachromosomal elements . plasmids, transposons, gas vacuoles, endospores and exospores. Brief study of important groups of bacteria: Cyanobacteria, Archaebacteria, Actinomycetes

Unit III **8h**

Microbial Growth and Control: Microbial growth, Culture media, Growth kinetics, Physical and chemical methods of controlling microbial growth, Antimicrobial agents and mechanism of action, Antimicrobial resistance.

Unit IV **7h**

Bacterial Genetics: Recombination methods: Conjugation, Transformation and transduction; Mutations: Spontaneous and induced mutations; Mobile genetic elements: Transposons

Unit V **10h**

Virology: Classification of viruses , Assay of viruses, Cultivation in cell culture, chick embryo and animal inoculation, Structure and importance- Viroids, Prions, Phage therapy,

Unit VI **5h**

Importance of Microrganisms: Healthcare: Infectious agents, Probiotics: Industry: Enzymes and Antibiotics; Environmental: Carbon and Nitrogen cycle, Bioremediation

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5. **CO-PO-PSO mapping**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO3
CO 1	3	-	-	-	-	-	-	-	2	-	-	-
CO 2	2	-	-	-	-	-	-	-	2	-	-	-
CO 3	3	-	-	-	-	-	-	-	3	-	-	-
CO 4	3	-	-	-	-	-	-	-	-	2	-	-
CO 5	-	2	-	-	-	-	-	-	-	2	-	-
CO 6	-	-	2	-	-	-	-	-	-	2	-	-
3: High Influence, 2: Moderate Influence, 1: Low Influence												

6. **Course Teaching and Learning Methods**

Teaching and Learning Methods	**Duration in hours**	**Total Duration in Hours**
Face to Face Lectures		30
Demonstrations		0
1. Demonstration using Videos	01	
2. Demonstration using Physical Models	01	
3. Demonstration on a Computer		
Numeracy		
1. Solving Numerical Problems		
Practical Work		
1. Course Laboratory		
2. Computer Laboratory		
3. Engineering Workshop / Course/Workshop / Kitchen		
4. Clinical Laboratory		
5. Hospital		
6. Model Studio		
Others		03
1. Case Study Presentation		
2. Guest Lecture	01	
3. Industry / Field Visit		
4. Brain Storming Sessions		
5. Group Discussions	02	
6. Discussing Possible Innovations		
Term Test and Written Examination		5
Total Duration in Hours		45

7. Course Assessment and Reassessment

The components and subcomponents of course assessment are presented in the Academic Regulations document pertaining to the Programme. The procedure to determine the final course marks is also presented in the Academic Regulations document as well.

The assessment questions are set to test the course learning outcomes. In each component or subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

Focus of Course Learning Outcomes in each component assessed				
	CE (50% Weightage)			SEE (50% Weightage)
	SC1	SC2	SC3	
	50 Marks	25 Marks	25 Marks	100 Marks
CO 1	X	X		X
CO 2	X	X		X
CO 3	X	X		X
CO 4	X		X	X
CO 5			X	X
CO 6			X	X

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of course outcomes in each component assessed in the above template at the beginning of the semester.

Course reassessment policies are also presented in the Academic Regulations document.

8. Achieving Course Learning Outcomes

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. **Course Resources**

a References

1. Prescott, L.M., Harley, J.P. and Klein, D.A., 2005. Microbiology. New York: McGraw-Hill Higher Education.
2. Pelczar, M.J., Reid, R.D. and Chan, E.C.S., 2010. Fundamentals of Microbiology. Oxford: Oxford University Press.
3. Willey, J.M., Sherwood, L.M. and Woolverton, C.J., 2008. Prescott, Harley and Klein's Microbiology. 7th ed. New York: McGraw-Hill Higher Education.
4. Sullia, S.B. and Shantharam, S., 2004. General Microbiology. 2nd rev. ed. New Delhi: Oxford and IBH Publishing.
5. Baveja, C.P., 2017. Textbook of Microbiology. New Delhi: Arya Publishing Company.
6. Madigan, M.T., Bender, K.S., Buckley, D.H., Sattley, W.M. and Stahl, D.A., 2021. Brock Biology of Microorganisms. 16th ed. Hoboken, NJ: Pearson.

b E resources and Journals

1. Springer. Antonie van Leeuwenhoek. Available at: https://www.springer.com/life+sciences/microbiology/journal/12275
2. Hindawi. International Journal of Microbiology. Available at: https://www.hindawi.com/journals/ijmicro/
3. Microbiology Society. Microbiology. Available at: http://mic.microbiologyresearch.org/content/journal/micro

10. **Course Organization**

Course Code	BTD513A	
Course Title	Concepts of Microbiology	
Course Leader/s Name	As per time table	
Course Leader Contact Details	**Phone:**	08045366666
	E-mail:	hod.bt.ls@msruas.com
Course Specifications Approval Date	September 2024	
Next Course Specifications Review	August 2027	

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Course Specifications: Bioanalytical Techniques

Course Title	Bioanalytical techniques
Course Code	BTD514A
Department	Biotechnology
Faculty	Life and Allied Health Sciences

1. Course Summary

The aim of the course is to orient students on different analytical techniques used for the study of biological macromolecules and cells. It gives an overview of techniques along with their theory, working principle and instrumentation. It discusses applications of these methods in both academic research and industry.

The course covers spectroscopic techniques, microscopic techniques, electrophoretic techniques and chromatographic techniques. Students will be taught to describe and interpret data with examples of high-quality research data. The course will also cover basics of protein purification and studies on protein-protein interactions.

2. Course Size and Credits:

Number of credits	02
Total Hours of Classroom Interaction	30
Number of laboratory Hours	--
Number of semester weeks	16
Department responsible	Biotechnology
Course Marks	Total Marks: 50
Pass Requirement	As per University regulations
Attendance Requirement	As per University regulations

Teaching, Learning and Assessment

3. Course Outcomes (COs)

After undergoing this course students will be able to:

CO 1. List various biophysical techniques and define common terms in biophysical techniques
CO 2. Differentiate between different subtypes of techniques and understand applications of each subtype.
CO 3. To provide scientific understanding of analytical techniques and detail interpretation of results.

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4. **Course**

Unit I **5h**

Separation & Identification of Biomolecules: Centrifugation, Chromatography (Gel filtration, Ion Exchange Chromatography, Affinity Chromatography, Hydrophobic interaction chromatography, Reverse phase, HPLC, Gas chromatography)

Unit II **5h**

Biomolecular characterization: Primary structure determination of proteins: Amino acid composition; Mass spectrometry – ESI, MALDI, TOF; MS-MS.

Unit III **5h**

Electrophoresis: Agarose Gel electrophoresis, PAGE – native, SDS; IEF; 2D-Gel electrophoresis, Pulsed Field Gel Electrophoresis (PFGE); biomolecular interactions – Gel shift assays, SPR.

Unit IV **5h**

Spectroscopy: Absorption Spectroscopy– Simple theory of the absorption of light by molecules, Beer-Lambert law, Spectrophotometry (UV-visible), Colorimetry, Chromophores, Fluorescence and Phosphorescence, Circular Dichroism, FT-IR

Unit V **4h**

Microscopy: Bright & Dark Field microscopy, Phase Contrast microscopy, Fluorescence microscopy, Confocal microscopy, TEM, SEM, ESEM, EDS.

5. **CO-PO PSO Mapping**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO3
CO 1	3	2	3	-	1	-	-	-	3	1	2	-
CO 2	3	2	3	-	2	-	-	-	3	1	2	-
CO 3	3	2	3	-	2	-	-	-	3	1	2	-
3: High Influence, 2: Moderate Influence, 1: Low Influence												

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6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		22
Demonstrations		02
1. Demonstration using Videos	2	
2. Demonstration using Physical Models		
3. Demonstration on a Computer		
Numeracy		02
1. Solving Numerical Problems	2	
Practical Work		
1. Course Laboratory		
2. Computer Laboratory		
3. Engineering Workshop / Course/Workshop /Kitchen		
4. Clinical Laboratory		
5. Hospital		
6. Model Studio		
Others		
1. Case Study Presentation		
2. Guest Lecture		
3. Industry / Field Visit		
4. Brain Storming Sessions		
5. Group Discussions		
6. Discussing Possible Innovations		
Term Test and Written Examination		04
Total Duration in Hours		**30**

7. Course Assessment and Reassessment

The components and subcomponents of course assessment is presented in the Academic Regulations document pertaining to the Programme. The procedure to determine the final course marks is also presented in the Academic Regulations document as well.

The assessment questions are set to test the course learning outcomes. In each component or subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

Focus of Course Learning Outcomes in each component assessed					
	CE (50% Weightage)				SEE (50% Weightage)
	SC1		SC2		
	25 Marks		25 Marks		50 Marks
CO-1	x				x
CO-2	x		x		x
CO-3	x		x		x

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8. Achieving Course Learning Outcomes

The following skills are directly or indirectly imparted to the students in the following teachingand learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Classroom, Assignment, Examination
6.	Practical Skills	--
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, examination
10.	Verbal Communication Skills	Assignment
11.	Presentation Skills	Assignment
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a Essential Reading

1. Nelson, D.L. and Cox, M.M., 2013. Lehninger Principles of Biochemistry. 6th ed. New York: W.H. Freeman.
2. Voet, D. and Voet, J.G., 2004. Biochemistry. 3rd ed. Hoboken, NJ: John Wiley and Sons.
3. Wilson, K. and Walker, J., 2000. Principles and Techniques of Practical Biochemistry. 5th ed. Cambridge: Cambridge University Press.
4. Cantor, C.R. and Schimmel, P.R., 1980. Biophysical Chemistry: Part I, Part II and Part III. New York: W.H. Freeman.
5. Manz, A., Pamme, N. and Iossifidis, D., 2004. Bioanalytical Chemistry. Singapore: World Scientific Publishing.
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b Recommended Reading

1. Daniel, M., 2003. Basic Biophysics for Biologists. Jodhpur: Agrobios.
2. Okotore, R.O., 1998. Basic Separation Techniques in Biochemistry. New Delhi: New Age International.
3. Sharma, R.K., 2010. Basic Techniques in Biochemistry and Molecular Biology. Delhi: I.K. International Publishing House Pvt. Ltd.
4. Holme, D. and Peck, H., 1998. Analytical Biochemistry. London: Longman.

c **Magazines and Journals**

1. Cell Press. Biophysical Journal. Available at: http://www.cell.com/biophysj/home
2. Elsevier. Biophysical Journal. Available at: https://www.journals.elsevier.com/biophysical-journal/

d **Websites**

1. Biophysical Society. Biophysics. Available at: https://www.biophysics.org
2. Duke University Department of Physics. Learning About Biophysics. Available at: https://phy.duke.edu/undergraduate/prospective-students/learning-about-biophysics
3. Biophysical Society. Biophysical Techniques – Selected Topics in Biophysics. Available at: http://www.biophysics.org/education-careers/education-resources/selected-topics-in-biophysics/biophysical-techniques
4. Nature. Biophysical Methods. Available at: https://www.nature.com/subjects/biophysical-methods
5. MIT OpenCourseWare. Biochemistry Laboratory (5.36). Available at: https://ocw.mit.edu/courses/chemistry/5-36-biochemistry-laboratory-spring-2009/

e **Other Electronic Resources**

3. Biophysical Society. What is Biophysics?. Available at: https://www.biophysics.org/what-is-biophysics
4. Brandt, D., Biochemistry Laboratory Manual. 3rd ed. Available at: https://www.rose-hulman.edu/~brandt/publications/422_Manual_3rd_Ed.pdf

10. Course Organization

Course Code	BTD514A	
Course Title	Bioanalytical Techniques	
Course Leader/s Name	As per time table	
Course Leader Contact Details	**Phone:**	08045366666
	E-mail:	hod.bt.ls@msruas.ac.in
Course Specifications Approval Date	September 2024	
Next Course Specifications Review	August 2027	

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Course Specifications: Biostatistics and Data Analysis

Course Title	Biostatistics and Data Analysis
Course Code	BTD515A
Department	Biotechnology
Faculty	Life and Allied Health Sciences

1. Course Summary

This course represents an introduction to the field and provides a survey of data and data types. Specific topics include tools for describing central tendency and variability in data; methods for performing inference on population means and proportions via sample data; statistical hypothesis testing and its application to group comparisons; issues of power and sample size in study designs; and random sample and other study types. While there are some formulae and computational elements to the course, the emphasis is on interpretation and concepts.

The purpose of the course is to give students an introduction to the discipline, an appreciation of a statistical perspective on information arising from the health arena and basic critical appraisal skills to assess the quality of research evidence.

2. Course Size and Credits:

Number of credits	02
Total hours of class room interaction	15
Number of tutorial hours	15
Number of semester weeks	16
Department responsible	Biotechnology
Course marks	As described Total Marks: 50
Pass Requirement	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

Teaching, Learning and Assessment

3. Course Outcome (CO)

After undergoing this course students will be able to:

CO 1. Explain the importance of data collection and its role in determining scope of inference

CO 2. Demonstrate an understanding of the central concepts of modern statistical theory and their probabilistic foundation

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CO 3. Explain the use, and interpret results of, the principal methods of statistical inference and design

CO 4. Explain the results of statistical analyses accurately and effectively

CO 5. Enumerate an appropriate use of statistical software

CO 6. Demonstrate the use of mathematical and statistical theory underlying the application of biostatistical methods; use and interpret results from specialized computer software for the management and statistical analysis of research data

4. **Course Content**

Unit I **3h**

Introduction to Biostatistics: Applications of statistics in biology, definitions (populations, samples), Introduction to probability theory, Basic concepts, definitions to understand probability and sampling; Defining sample space, computing probability

Unit II **3h**

Random Variables and Probability Distributions: Discrete random variables, Bernoulli random variable, binomial distribution, Poisson distribution with examples Continuous random variables, Normal random variable, other continuous distributions, Central limit theorem

Unit III **4h**

Summary Statistics: Measures of location and spread Measures of location: Arithmetic and other means, median, mode; when to use each measure of location Measures of spread: Variance and Standard Deviation, Standard Error; Skewness, Kurtosis; Quantiles

Unit IV **4h**

Framework for Statistical Analyses: Framing hypothesis, The scientific method; deduction and induction; The Hypothetico-deductive method; Testing hypothesis, Significance and p-values; Type I and Type II errors, Introduction to frameworks for statistical analyses, Brief introduction to three main frameworks: Monte-carlo analysis, Parametric analysis, Bayesian analysis

Unit V **4h**

Data Analyses: Computing sums of squares, standard error of differences between means, Student's T-test, Regression, ANOVA, Chi-square Test

Unit VI **4h**

Tools and Languages in Statistics: R Programming: elementary syntax, if-else statements, for loops, data input, tables and datasets. Performing statistical analyses using R.

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5. **CO-PO-PSO mapping**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO3
CO 1	-	3	-	-	-	-	-	-	-	3	-	-
CO 2	-	3	-	-	-	-	-	-	-	3	-	-
CO 3	-	-	3	-	-	-	-	-	-	3	-	3
CO 4	-	-	3	-	-	-	-	-	-	-	-	3
CO 5	-	-	3	-	-	-	-	-	-	-	-	3
CO 6	-	3	-	-	-	-	-	-	-	-	-	3
3: High Influence, 2: Moderate Influence, 1: Low Influence												

6. **Course Teaching and Learning Methods**

Teaching and Learning Methods	**Duration in hours**	**Total Duration in Hours**
Face to Face Lectures		10
Demonstrations		02
1. Demonstration using Videos	01	
2. Demonstration using Physical Models/Systems	01	
3. Demonstration on a Computer		
Numeracy		10
1. Solving Numerical Problems	10	
Practical Work		02
1. Course Laboratory		
2. Computer Laboratory	02	
3. Engineering Workshop/Course Workshop/Kitchen		
4. Clinical Laboratory		
5. Hospital		
6. Model Studio		
Others		03
1. Case Study Presentation		
2. Guest Lecture	03	
3. Industry/Field Visit		
4. Brain Storming Sessions		
5. Group Discussions		
6. Discussing Possible Innovations		
Term Test and Written Examination		03
Total Duration in Hours		30

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7. Course Assessment and Reassessment

The components and subcomponents of course assessment are presented in the Academic Regulations document pertaining to the Programme. The procedure to determine the final course marks is also presented in the Academic Regulations document as well.

The assessment questions are set to test the course learning outcomes. In each component or subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

Focus of Course Learning Outcomes in each component assessed					
	CE (50% Weightage)				SEE (50% Weightage)
	SC1		SC2		
	25 Marks		25 Marks		50 Marks
CO-1	x				x
CO-2	x				x
CO-3	x				x
CO-4	x		x		x
CO-5			x		x
CO-6			x		x

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of course outcomes in each component assessed in the above template at the beginning of the semester.

Course reassessment policies are also presented in the Academic Regulations document.

8. Achieving Course Learning Outcomes

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. References

1. Rosner, B., Fundamentals of Biostatistics. Boston, MA: Cengage Learning. ISBN: 978-1305268920.
2. Gerstman, B.B., Basic Biostatistics: Statistics for Public Health Practice. Burlington, MA: Jones & Bartlett Learning. ISBN: 978-1284036015.
3. Norman, G.R. and Streiner, D.L., Biostatistics: The Bare Essentials. Shelton, CT: People's Medical Publishing House – USA. ISBN: 978-1607951780.
4. Daniel, W.W. and Cross, C.L., Biostatistics: A Foundation for Analysis in the Health Sciences. Hoboken, NJ: Wiley. ISBN: 978-1118302798.
5. Pagano, M. and Gauvreau, K., Principles of Biostatistics. Boca Raton, FL: Chapman and Hall/CRC. ISBN: 978-1138593145.

b. Magazines and Journals

1. Nature. Biostatistics. Available at: https://www.nature.com/subjects/biostatistics
2. Forthofer, R.N., Lee, E.S. and Hernandez, M., Biostatistics: A Guide to Design, Analysis and Discovery. Amsterdam: Elsevier. Available at: https://www.elsevier.com/books/biostatistics/forthofer/978-0-12-369492-8

10. Course Organization

Course Code	BTD515A	
Course Title	Biostatistics and Data Analysis	
Course Leader/s Name	As per time table	
Course Leader Contact Details	**Phone:**	08045366666
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Course Specifications Approval Date	September 2024	
Next Course Specifications Review	August 2027	

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Course Specifications: Practical I: Cell Biology & Molecular Genetics

Course Title	Practical I: Cell Biology & Molecular Genetics
Course Code	BTL511A
Department	Biotechnology
Faculty	Life and Allied Health Sciences

1. Course Summary

The aim of the course is to train students to perform experiments to decipher cellular processes at the molecular level.
Students will be able to carry out basic cell biology and molecular biology experiments. The student will be able to utilize these experiments to further their understanding of basic cell biology and molecular genetics. Students will be familiarized with experimental methods and techniques applied in genetics and cell biology research.

2. Course Size and Credits:

Number of credits	03
Total Hours of Classroom Interaction	90
Number of tutorial hours	00
Number of semester weeks	16
Department responsible	Biotechnology
Pass Requirement	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

Teaching, Learning and Assessment

3. Course Outcomes

After undergoing this course students will be able to:

CO 1. Describe and carry out basic cell biology and microscopy techniques.
CO 2. Evaluate cellular processes that occur in and between cells
CO 3. Describe and explain processes for the characteristics of living organisms.
CO 4. Explain cell-based methods used to expand understanding of cell biology
CO 5. Experiment with model organisms (*Drosophila*) in genetics
CO 6. Demonstrate significant genetic concepts via experimentation

4. Course Content

Cell Biology

1. a. Study of mitosis and meiosis in onion root tip and onion buds respectively
   b. to estimate mitotic index in onion root tip
   c. to study inhibition of mitosis using colchicine
2. Preparation of mitotic chromosomes and karyotyping
3. Staining techniques: Staining blood cells, total count and differential count.

4. Isolation of chloroplasts and determining the purity of chlorophyll a and b.
5. Isolation of mitochondria from animal cell and determining the activity of SDH (succinatedehydrogenase)
6. Study of muscle activity: determination of ATPase activity
7. Study of brain cell activity: determination of acetyl choline esterase activity
8. Study of diffusion and osmosis across semipermeable membrane.
9. Microscopic cell count using hemocytometer and determination of cell viability by exclusion assay.
10. Evaluation of cell viability/toxicity using MTT assay.
11. To study initial events of apoptosis by fluorescence microscopy.

Molecular Genetics

12. Morphological features of *Drosophila/* mutant including genital plate and sex comb in *Drosophila*
13. Isolation and staining of salivary gland chromosomes in *Drosophila*
14. Banding techniques and karyotyping
15. Demonstration of Barr bodies in buccal cells
16. Chromatographic separation of eye pigments in *Drosophila*

5. CO-PO-PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO3
CO 1	3	3	-	-	-	-	-	-	-	3	-	-
CO 2	-	3	-	-	-	-	-	-	-	3	-	-
CO 3	-	3	-	-	-	-	-	-	-	3	-	-
CO 4	-	3	-	-	-	-	2	-	-	-	-	3
CO 5	-	2	-	-	-	-	2	-	-	-	-	3
CO 6	-	2	-	-	-	-	2	-	-	-	-	3
3: High Influence, 2: Moderate Influence, 1: Low Influence												

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6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		
Demonstrations		
1. Demonstration using Videos	5	5
2. Demonstration using Physical Models/Systems		
3. Demonstration on a Computer		
Numeracy		
1. Solving Numerical Problems		
Practical Work		
1. Course Laboratory	81	**81**
2. Computer Laboratory		
3. Engineering Workshop/Course		
4. Clinical Laboratory		
5. Hospital		
6. Model Studio		
Others		
1. Case Study Presentation		
2. Guest Lecture		
3. Industry/Field Visit		
4. Brain Storming Sessions		
5. Group Discussions		
6. Discussing Possible Innovations		
Laboratory Examination		4
Total Duration in Hours		90

7. Course Assessment and Reassessment

The components and subcomponents of course assessment is presented in the Academic Regulations document pertaining to the program. The procedure to determine the final course marks is also presented in the Academic Regulations document as well.

The assessment questions are set to test the course learning outcomes. In each component or subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

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Focus of Course Learning Outcomes in each component assessed			
	CE (50% Weightage)		SEE (50% Weightage)
	SC1	SC2	
	50 Marks	50 Marks	100 Marks
CO-1	x	x	x
CO-2	x	x	x
CO-3	x	x	x
CO-4	x	x	x
CO-5	x	x	x
CO-6	x	x	x

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of course outcomes in each component assessed in the above template at the beginning of the semester.

Course reassessment policies are also presented in the Academic Regulations document.

8. Achieving Course Learning Outcomes

The following skills are directly or indirectly imparted to the students in the following teachingand learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. References

1. Lab Manual

b. Magazines and Journals

1. JoVE. Basic Methods in Cellular and Molecular Biology. Available at: https://www.jove.com/science-education-library/2/basic-methods-in-cellular-and-molecular-biology

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2. MIT OpenCourseWare. Experimental Molecular Genetics (7.15). Available at: https://ocw.mit.edu/courses/biology/7-15-experimental-molecular-genetics-spring-2015/
3. Nickle, D.C. and Barrette-Ng, I.H. Techniques of Molecular Genetics. In: Online Open Genetics. LibreTexts. Available at: https://bio.libretexts.org/Bookshelves/Genetics/Book%3A_Online_Open_Genetics_(Nickle_and_Barrette-Ng)/08%3A_Techniques_of_Molecular_Genetics
4. Cold Spring Harbor Laboratory Press. Molecular Cloning: A Laboratory Manual. Available at: https://www.cshlpress.com/default.tpl?action=full&--eqskudatarq=399
5. Semantic Scholar. Techniques in Molecular Biology. Available at: https://pdfs.semanticscholar.org/ef50/4810a6318ccad1bb5ca52c630f3a9e4fcf1a.pdf

10. Course Organization

Course Code	BTL511A	
Course Title	Practical I: Cell Biology & Molecular Genetics	
Course Leader/s Name	As per time table	
Course Leader Contact Details	**Phone:**	08045366666
	E-mail:	hod.bt.ls@msruas.ac.in
Course Specifications Approval Date	September 2024	
Next Course Specifications Review Date:	August 2027	

Course Specifications: Practical II: Microbiology & Biochemistry

Course Title	Practical II: Microbiology & Biochemistry
Course Code	BTL512A
Department	Biotechnology
Faculty	Life and Allied Health Sciences

1. Course Summary

The aim of the course is to enable students to acquire experience in fundamental and contemporary microbiological and Biochemical laboratory techniques. The students will have training on the basis of several commonly used techniques in microbiology, including those used in bacterial identification by staining techniques and biochemical assays. They will be trained to design and interpret experiments in aseptic conditions. They will acquire experience of current scientific methodologies appropriate to microbiology. Students will be able to explain properties of various bio molecules found in living systems by performing experiments involving isolation, separation and characterization.

2. Course Size and Credits:

Number of credits	03
Total Hours of Classroom Interaction	90
Number of tutorial hours	00
Number of semester weeks	16
Department responsible	Biotechnology
Pass Requirement	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

Teaching, Learning and Assessment

3. Course Outcomes

After undergoing this course students will be able to:

CO 1. Perform an estimation of the concentration of bio-molecules from an unknown sample

CO 2. Isolate and characterize the colony morphology of bacterial strains by staining and biochemical tests

CO 3. Isolate enzyme from different sources, and estimate its specific activities

CO 4. Production and estimation of by products from various bacterial strains.

CO 5. Evaluate the quality of water by BOD and MPN test

CO 6. Perform enzyme kinetic studies to characterize its molecular properties

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4. Course Contents

Microbiology

1. Preparation and sterilization of culture media
2. Isolation of bacteria from different sources (soil, water, air)
3. Identification of isolated bacterial colonies using microscopic & staining techniques
4. Biochemical Characterization of the isolated bacteria obtained from different source samples
5. Bacterial growth assessment by turbidometry
6. Determination of potability of water by MPN method- Presumptive and confirmatory tests for coliforms.
7. Estimation of lactate/ Citrate from bacterial culture media
8. Demonstration of antibiotic resistance
9. Estimate the amount of Biological oxygen demand in the given water sample.

Biochemistry

10. The quantitative estimation of carbohydrate
11. The quantitative estimation of protein by Biuret assay and Bradford method
12. Determination of acid number, saponification of fats.
13. Estimation of cholesterol (Zach's method)
14. Isolation and determination of specific activity of any enzyme
15. Enzyme kinetic study: Influence of substrate concentration on the rate of enzymatic reaction
16. Enzyme kinetic study: Michaelis-Menten equation: Determination of Km and Vmax
17. Enzyme kinetic study: Lineweaver Burk Plot: Determination of Km and Vmax
18. Enzyme kinetic study: Effect of pH and temperature on the rate of enzymatic reaction
19. Enzyme kinetic study: Inhibition of enzyme activity. Determination of Ki values

5. CO-PO-PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO3
CO 1	3	3	-	-	-	-	-	-	-	3	-	-
CO 2	-	3	-	-	-	-	-	-	-	3	-	-
CO 3	-	3	-	-	-	-	-	-	-	3	-	-
CO 4	-	3	-	-	-	-	2	-	-	-	-	3
CO 5	-	2	-	-	-	-	2	-	-	-	-	3
CO 6	-	2	-	-	-	-	2	-	-	-	-	3
3: High Influence, 2: Moderate Influence, 1: Low Influence												

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		
Demonstrations		05
1. Demonstration using Videos	05	
2. Demonstration using Physical Models/Systems		
3. Demonstration on a Computer		
Numeracy		
1. Solving Numerical Problems		
Practical Work		81
1. Course Laboratory	81	
2. Computer Laboratory		
3. Engineering Workshop/Course		
4. Clinical Laboratory		
5. Hospital		
6. Model Studio		
Others		
1. Case Study Presentation		
2. Guest Lecture		
3. Industry/Field Visit		
4. Brain Storming Sessions		
5. Group Discussions		
6. Discussing Possible Innovations		
Laboratory Examination		4
Total Duration in Hours		90

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7. Course Assessment and Reassessment

The components and subcomponents of course assessment are presented in the Academic Regulations document pertaining to the Programme. The procedure to determine the final course marks is also presented in the Academic Regulations document as well. The Assessment questions are set to test the course learning outcomes. In each component or subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

Focus of Course Learning Outcomes in each component assessed			
	CE (50% Weightage)		SEE (50% Weightage)
	SC1	SC2	
	25 Marks	25 Marks	100 Marks
CO-1	×	×	×
CO-2	×	×	×
CO-3	×	×	×
CO-4	×	×	×
CO-5	×	×	×
CO-6	×	×	×

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of course outcomes in each component assessed in the above template at the beginning of the semester.

Course reassessment policies are also presented in the Academic Regulations document.

8. Achieving Course Learning Outcomes

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

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9. Course Resources

a. References

1. Lab Manual
2. Cappuccino, J.G. and Welsh, C., 2016. Microbiology: A Laboratory Manual. Boston: Benjamin Cummings Publishing Company.
3. Collins, C.H., Lyne, P.M., Grange, J.M. and Falkinham, J.O. III, 2004. Collins and Lyne's Microbiological Methods. 8th ed. London: Arnold.
4. Wilson, K. and Walker, J. (eds.), 2010. Principles and Techniques of Biochemistry and Molecular Biology. 7th ed. Cambridge: Cambridge University Press.
5. Boyer, R.F., 2011. Biochemistry Laboratory: Modern Theory and Techniques. Boston: Pearson.

b. Magazines and Journals

1. OMICS International. Medical Microbiology & Diagnosis. Available at: https://www.omicsonline.org/medical-microbiology-diagnosis.php
2. Elsevier. Research in Microbiology. Available at: https://www.journals.elsevier.com/research-in-microbiology
3. American Chemical Society. 641. Molecular Biology and Biotechnology Laboratories: An Interdisciplinary Course. Journal of Chemical Education. Available at: https://pubs.acs.org/doi/abs/10.1021/ed072p641

10. Course Organization

Course Code	BTL512A	
Course Title	Practical II: Microbiology & Biochemistry	
Course Leader/s Name	As per time table	
Course Leader Contact Details	**Phone:**	08045366666
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Course Specifications Approval Date	September 2024	
Next Course Specifications Review	August 2027	

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M. S. Ramaiah University of Applied Sciences

Course Specifications

of

M.Sc. in Biotechnology

Programme Code: 091

SEMESTER 2

Department of Biotechnology

Faculty of Life and Allied Health Sciences

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Course Specifications: Bioprocess Technology

Course Title	Bioprocess Technology
Course Code	BTC511A
Department	Biotechnology
Faculty	Life and Allied Health Sciences

1. **Course Summary**

The aim of this course is to instil in students a critical awareness and in-depth understanding of the principles, practice and key concepts relevant to industrial biotechnology. The course will enable the student to select the correct sequence of unit operations for the production and purification of bioproducts and to understand which properties will be decisive for the choice of purification strategy and how product and purity requirements will affect the process.

2. **Course Size and Credits:**

Number of credits	04
Total hours of class room interaction	60
Number of tutorial hours	00
Number of semester weeks	16
Department responsible	Department of Biotechnology
Course marks	Total: 100
Pass requirement	As per Academic Documents
Attendance requirement	As per Academic Documents

Teaching, Learning and Assessment

3. **Course Outcome (CO)**

After undergoing this course students will be able to:

CO 1. Describe the principles that underlie major unit operations used in upstream and downstream processing of bioprocesses.

CO 2. Demonstrate the methods of cell culture under various conditions, strain improvement methods

CO 3. Explain how environmental conditions influence cell growth and means to achieve optimal cell growth in large scale

CO 4. Design or Select appropriate bioreactor models based upon bioproducts and cell lines and other process criteria

CO 5. Design and formulate effective strategies of downstream processing based on characteristics of biomolecules and to learn the various techniques of product capturing, isolation, purification and polishing

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CO 6. Develop and formulate methods to meet the need of pure proteins, enzymes and other valuable products related to biopharmaceuticals, clinical research and development.

4. Course Content

Unit I **12h**

Upstream biological operations: Strain improvement for the selected organism: mutation and screening of improved cultures, random and strategic screening methods, strategies of strain improvement for primary, secondary metabolites with relevant examples. Use of recombinant DNA technology, protoplast fusion techniques for strain improvement of primary and secondary metabolites. Production of recombinant molecules in heterologous system, problems associated with strain improvement programme, improvement of characters other than products and its application in the industry. Preservation of cultures after strain improvement programme.

Unit II **12h**

Media Formulation and Sterilisation: medium formulation involving all components; medium sterilization, oxygen requirements, antifoams, medium optimization, Ingredients for mammalian cell culture and plant cell culture, probabilistic and deterministic approaches in the design; Gas sterilization, sterilization of fermenter and other ancilliaries, filter sterilization of air and media.

Unit III **12h**

Fermentation & Microbial Kinetics: Introduction, Criteria for transfer of inoculum, development of inoculum for bacterial processes, yeast processes and mycelial processes. Inoculum development for plant fermenter, aseptic method of inoculation, achievement and maintenance of aseptic conditions. Fermentation Material and Energy balance, Microbial growth kinetics: Microbial growth cycle, measurement of growth, Batch culture, continuous culture, fed-batch culture, applications and examples

Unit IV **12h**

Design of bioreactors: Basic objective of fermenter design, aseptic operation & containment, body construction, agitator and sparger design, baffles, stirrer glands and bearings. Process parameters and measurement techniques: measurement of temperature, pressure and pH, DO, foam etc.; flow rate of liquid and gases; Automation (processes computerization). Validation of Fermentor Bubble column, airlift reactor, packed bed, fluidized bed, trickle bed, Membrane reactor, Photobioreactor, Solid state fermenter, Animal and plant cell bioreactors. Scale up and Scale down studies of bioreactors. Heat and Mass transfer in Bioprocess, Relationship in between heat transfer, cell concentrations and stirring conditions, Measurement of KLa, Rheological properties of fermentation broths, Factors affecting broth viscosity, Mixing in Fermenters.

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Unit V **12h**

Overview of Downstream Operations: Role and importance of downstream processing in biotechnological processes. Problems and requirements of bioproduct purification. Process economy: Economics & Cost cutting strategies, process design criteria for various classes of bioproducts (high volume, low value products and low volume, high value products. Downstream Process overview: General account of downstream processing steps.

Unit VI **12h**

Separation Techniques: Cell disruption methods for intracellular products Osmotic shock, Homogenization, various types of homogenizes, Sonication, Enzyme digestion. Centrifugation: basic principles, design characteristics; ultracentrifuges; principles and applications.

Membrane based separation processes, Microfiltration; Reverse osmosis, Nanofiltration, Ultrafiltration and Affinity ultrafiltration, Membrane modules. Liquid-liquid extraction, Supercritical fluid extraction, Chromatography: Gel filtration chromatography, Ionexchange chromatography (IEC), . Affinity chromatography: Immunoaffinity purification, Immunoaffinity matrices, ligand affinity, hydrophobic interaction chromatography (HIC), HPLC, RP – HPLC.

Electrophoresis – Theory and factors affecting. Polyacrylamide and Agarose gel electrophoresis; Capillary electrophoresis; 2 D- Electrophoresis; isoeletric focusing; Pulsed field gel electrophoresis precipitation

Crystallization and Drying: Theory – nucleation, crystal growth; mixed product removal crystallizer with mixed suspension. Crystallization processes, Drying: drying curve, tray dryer, flash dryer, freeze drying – principle and process, freezing, primary and secondary drying.

5. CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO3
CO 1	1	3	-	-	-	-	-	-	-	1	-	3
CO 2	-	3	-	-	-	-	-	-	-	-	-	3
CO 3	-	3	-	-	-	-	-	-	-	-	-	3
CO 4	-	-	3	-	-	-	-	-	-	-	2	-
CO 5	-	2	3	-	-	-	-	-	-	-	-	3
CO 6	-	2	-	-	-	-	-	-	-	-	-	3
3: High Influence, 2: Moderate Influence, 1: Low Influence												

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6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		39
Demonstrations		06
1. Demonstration using Videos	05	
2. Demonstration using Physical Models /	01	
3. Demonstration on a Computer		
Numeracy		
1. Solving Numerical Problems		
Practical Work		
1. Course Laboratory		
2. Computer Laboratory		
3. Engineering Workshop / Course/Workshop / Kitchen		
4. Clinical Laboratory		
5. Hospital		
6. Model Studio		
Others		05
1. Case Study Presentation		
2. Guest Lecture	02	
3. Industry / Field Visit		
4. Brain Storming Sessions		
5. Group Discussions	02	
6. Discussing Possible Innovations	01	
Term Test and Written Examination		10
Total Duration in Hours		60

7. Course Assessment and Reassessment

The components and subcomponents of course assessment are presented in the Academic Regulations document pertaining to the Programme. The procedure to determine the final course marks is also presented in the Academic Regulations document as well.

The assessment questions are set to test the course learning outcomes. In each component or subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

Focus of Course Learning Outcomes in each component assessed				
	CE (50% Weightage)			SEE (50% Weightage)
	SC1	SC2	SC3	
	50 Marks	25 Marks	25 Marks	100 Marks
CO-1	x	x		x
CO-2	x	x		x
CO-3	x	x		x
CO-4	x		x	x
CO-5			x	x
CO-6			x	x

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The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of course outcomes in each component assessed in the above template at the beginning of the semester.

Course reassessment policies are also presented in the Academic Regulations document.

8. Achieving Course Learning Outcomes

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. References

1. Peter F Stanbury, Allan Whitaker, Stephen J Hall. Principles of Fermentation Technology. (2016) Butterworth-Heinemann Press. UK.
2. El-Mansi (Ed.), "Fermentation Microbiology and Biotechnology", CRC Press, 3rd Ed., 2011.
3. Pauline M. Doran, "Bioprocess Engineering Principles", Academic Press, 2nd Ed., 2012
4. Paul A. Belter, "Bioseparations: Downstream processing for Biotechnology". Wiley Interscience, 1st Ed., 1988.
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b. Magazines and Journals

1. Mary Ann Liebert, Inc. Industrial Biotechnology. Available at: https://www.liebertpub.com/loi/ind

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2. Springer. Journal of Industrial Microbiology & Biotechnology. Available at: https://link.springer.com/journal/10295
3. Herald Open Access. Advances in Industrial Biotechnology. Available at: http://www.heraldopenaccess.us/journals/Advances-in-Industrial-Biotechnology/

10. Course Organization

Course Code	8TC511A		
Course Title	Bioprocess Technology		
Course Leader/s Name		As per time table	
Course Leader Contact Details		**Phone:**	08045366666
		E-mail:	hod.bt.ls@msruas.ac.in
Course Specifications Approval Date		September 2024	
Next Course Specifications Review		August 2027	

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Course Specifications: Molecular Biology and Recombinant DNA Technology

Course Title	Molecular Biology and Recombinant DNA Technology
Course Code	BTC512A
Department	Biotechnology
Faculty	Life and Allied Health Sciences

1. Course Summary

The course aims to familiarize students with the concepts of Molecular Biology and Recombinant DNA technology. Students will be acquainted with the central principles and fundamental mechanisms for the organization, replication, expression, variation, and evolution of the genetic material, as well on methods for molecular biology analyses and gene technology. Students will be familiarized with the methodological repertoire of the basic and applied fields of recombinant DNA technology. This course will provide theoretical bases to properties and applications of versatile DNA modifying enzymes, cloning strategies, vector types, host genotype specificities for selection and screening of recombinants and recombinant transformants. The students will be facilitated with a strong foundation for more advanced cutting-edge technologies.

2. Course Size and Credits:

Number of credits	03
Total hours of class room interaction	45
Number of tutorial hours	00
Number of semester weeks	16
Department responsible	Department of Biotechnology
Course marks	Total: 100
Pass requirement	As per Academic Documents
Attendance requirement	As per Academic Documents

Teaching, Learning and Assessment

3. Course Outcome (CO)

After undergoing this course students will be able to:

CO 1. Enumerate the processes of DNA replication, repair and recombination to maintain the integrity of DNA and chromosomes

CO 2. Differentiate the tools and techniques used in recombinant DNA technology

CO 3. Compare and contrast the process of prokaryotic and eukaryotic gene expression

CO 4. Illustrate the complex mechanism behind eukaryotic and prokaryotic gene regulation

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CO 5. Evaluate the methodologies involved in in-vitro construction of gene libraries

CO 6. Explain creative use of modern instrumentation and technologies for manipulation of genomic sequences

4. **Course Content**

Unit I **6h**

DNA Replication & Repair: DNA Replication: Prokaryotic and eukaryotic DNA replication mechanism, Telomeres and telomerase, DNA repair: Excision repair, Mismatch repair, Post- replication repair, SOS repair.

Unit II **8h**

Transcription and Translation: Prokaryotic and eukaryotic transcription, Regulatory elements, mRNA stability, post transcriptional processing, Genetic Code, Prokaryotic and eukaryotic translation, Regulation of translation, co-and post-translational modifications of proteins

Unit III **8h**

Regulation of gene expression: Operon theory, lac operon, trp operon, regulation of gene expression in eukaryotes, Chromatin and gene regulation, RNA interference: siRNA and microRNA, CRISPR/Cas technology.

Unit IV **8h**

Recombinant DNA Technology: Restriction endonucleases, DNA modifying enzymes, Vectors for cloning in E. coli: Plasmids, Bacteriophage λ, Filamentous phage vectors, cosmids, BAC, YAC and HAC vectors, Shuttle vectors, Expression vectors, Vectors designed for cloning in yeast, Vectors for cloning in Plant and animal cells

Unit V **6h**

Gene Cloning Strategies: Cloning by restriction digestion, cloning by Gibson assembly, Construction of genomic and cDNA libraries, Isolation and purification of DNA, Transformation and transfection techniques, Methods for screening recombinant DNA

Unit VI **8h**

Techniques in RDT: Recombinant protein purification Affinity-tag; Solubility-tag, GFP-fusion proteins, Cytoplasmic expression and periplasmic expression of recombinant proteins in *E.coli*, Labeling of DNA and Proteins by radioactive isotopes, non-radioactive labeling, autoradiography and autofluorography, DNA sequencing methods -Sanger sequencing method, Next Generation Sequencing, Polymerase chain reaction and its applications, Different types of PCR (Hot start PCR, Multiplex PCR, Nested PCR, Real-time PCR, In Situ PCR, Inverse PCR, Reverse Transcriptase PCR, Methylation-specific PCR).

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5. **CO-PO Mapping**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO3
CO 1	3	-	-	-	-	-	-	-	2	-	-	-
CO 2	2	-	-	-	-	-	-	-	2	-	-	-
CO 3	3	-	-	-	-	-	-	-	3	-	-	-
CO 4	-	-	2	-	-	-	-	-	-	-	-	3
CO 5	-	-	2	-	-	-	-	-	-	-	-	3
CO 6	-	-	-	3	-	-	-	-	-	-	-	3
3: High Influence, 2: Moderate Influence, 1: Low Influence												

6. **Course Teaching and Learning Methods**

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		24
Demonstrations		06
1. Demonstration using Videos	05	
2. Demonstration using Physical Models	01	
3. Demonstration on a Computer		
Numeracy		
1. Solving Numerical Problems		
Practical Work		
1. Course Laboratory		
2. Computer Laboratory		
3. Engineering Workshop / Course/Workshop / Kitchen		
4. Clinical Laboratory		
5. Hospital		
6. Model Studio		
Others		05
1. Case Study Presentation		
2. Guest Lecture	02	
3. Industry / Field Visit		
4. Brain Storming Sessions		
5. Group Discussions	02	
6. Discussing Possible Innovations	01	
Term Test and Written Examination		10
Total Duration in Hours		45

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7. Course Assessment and Reassessment

The components and subcomponents of course assessment are presented in the Academic Regulations document pertaining to the Programme. The procedure to determine the final course marks is also presented in the Academic Regulations document as well.

The assessment questions are set to test the course learning outcomes. In each component or subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

Focus of Course Learning Outcomes in each component assessed				
	CE (50% Weightage)			SEE (50% Weightage)
	SC1	SC2	SC3	
	50 Marks	25 Marks	25 Marks	100 Marks
CO-1	x	x		x
CO-2	x	x		x
CO-3	x	x		x
CO-4	x		x	x
CO-5			x	x
CO-6			x	x

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of course outcomes in each component assessed in the above template at the beginning of the semester.

Course reassessment policies are also presented in the Academic Regulations document.

8. Achieving Course Learning Outcomes

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

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9. Course Resources

1 References

1. Lodish, H., Baltimore, D., Berk, A., Zipursky, B.L., Mastsydaira, P., Darnell, J., 2004, *Molecular Cell Biology*, Scientific American Books Inc. NY.
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2 Magazines and Journals

1. BioMed Central. Cellular & Molecular Biology Letters. Available at: https://cmbl.biomedcentral.com/
2. American Society for Microbiology. Molecular and Cellular Biology. Available at: http://mcb.asm.org/
3. SciTechnol. Advances in Genetic Engineering & Biotechnology. Available at: https://www.scitechnol.com/advances-in-genetic-engineering-biotechnology.php

10. Course Organization

Course Code	BTC512A	
Course Title	Molecular Biology and Recombinant DNA Technology	
Course Leader/s Name	As per time table	
Course Leader Contact Details	**Phone:**	08045366666
	E-mail:	hod.bt.ls@msruas.ac.in
Course Specifications Approval Date	September 2024	
Next Course Specifications Review	August 2027	

Course Specifications: Immunology & Immunotechniques

Course Title	Immunology & Immunotechniques
Course Code	BTD516A
Department	Department of Biotechnology
Faculty	Life and Allied Health Sciences

1. Course Summary

The aim of the course is to acquaint students about the components, principles and mechanisms of the immune system, and their co-ordination to mount safe and appropriate protection against infection. Students will be able to learn and correlate the complex mechanisms involved in immune system which governs the diversity, specificity and memory to the system. The students will be facilitated to conceptualize the underlying situations of inappropriate immunity, such as allergy, autoimmunity and immune deficiency. Students will be able to consider discrimination and tuning of immune responses to meet the challenges of different anatomical sites, such as in the skin, gut and lung. Students will be taught on the current and emerging use of immune molecules in diagnostic and clinical intervention strategies, including the therapeutic manipulation of the immune system in cancer treatment, vaccine development, and transplant tolerance.

2. Course Size and Credits:

Number of credits	03
Total hours of class room interaction	45
Number of tutorial hours	00
Number of semester weeks	16
Department responsible	Department of Biotechnology
Course marks	Total: 100
Pass requirement	As per Academic Documents
Attendance requirement	As per Academic Documents

Teaching, Learning and Assessment

3. Course Outcome (CO)

After undergoing this course students will be able to:

CO 1. Explain the structure, properties and functions of antigens, antibodies, B cells, T cells, APC, MHC molecules, cytokines, surface receptors, haptens and adjuvants.

CO 2. Compare and contrast primary and secondary immune response, innate and acquired immune response, origin, maturation and general function of B and T lymphocytes, humoral and cell mediated immunity.

CO 3. Describe the mechanisms of antigen processing, hypersensitivity reactions, consequences of autoimmune disorders, immunity to infections.

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CO 4. Evaluate different types of immune assay based on the principles of antigen-antibody reactions, cell proliferation assays, cytotoxicity assays

CO 5. Illustrate the importance and application of molecular mechanisms of immune responses in therapeutic approaches.

4. **Course Contents**

Unit I **6h**

Histology of immune system: Innate and acquired immunity, Complement and Inflammatory responses; Cells and Organs of the immune system- primary and secondary lymphoid organs; Haematopoesis

Unit II **9h**

Immune responses: Antigens – immunogens, antigen processing and presentation-endogenous antigens, exogenous antigens , Immunoglobulins- structure and classification, antigenic determinants; Multigene organization of immunoglobulin genes; B-cell receptor; Immunoglobulin superfamily; Basis of self –nonself discrimination; B cell maturation, activation and differentiation; Generation of antibody diversity; Humoral immunity; T-cell maturation, activation and differentiation and T-cell receptors; Functional T Cell Subsets; Cell-mediated immune responses, ADCC; Lymphocyte circulation; Lymphocyte homing Cytokines-properties, receptors.

Unit III **7h**

Major Histocompatibility Complex and Transplantation: Structure and functions of MHC and HLA systems. Genetic control of immune response. Tissue transplantation-Tissue typing methods for tissue and organ transplantations. Graft versus host reaction and rejection, xenotransplantation, immunosuppressive therapy.

Unit IV **8h**

Immunotechniques: Antigen-antibody interactions: Precipitation, agglutination, RIA, ELISA, Western blotting, ELISPOT assay, immunofluorescence, flow cytometry; Cell Cytotoxicity assays, Immunohistochemistry, Production and purification of antibodies, hybridomas.

Unit V **8h**

Immune System in Health and Disease: Immunity to Infection: Bacteria, viral, fungal and parasitic infections , Hypersensitivity – Type I-IV; Autoimmunity; Types of autoimmune diseases; Treatment of autoimmune diseases; Tumor immunology - Tumor antigens; Immune response to tumors and tumor evasion of the immune system; Immunodeficiency-Primary immune deficiencies; Acquired or secondary immune deficiencies.

Unit VI **7h**

Immunotherapy: Vaccine technology- Role and properties of adjuvants, recombinant DNA and protein-based vaccines, mRNA vaccines; Immunotherapy in cancer and HIV-Monoclonal antibodies and tumor-agnostic therapies; Non-specific immunotherapies; Oncolytic virus therapy; CAR-T-cell therapy.

Shruti Mathur

5. CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO3
CO 1	3	-	-	-	-	-	-	-	3	-	-	-
CO 2	-	3	-	-	-	-	-	-	-	3	-	-
CO 3	3	-	-	-	-	-	-	-	-	3	-	-
CO 4	3	-	-	-	-	-	-	-	-	-	-	-
CO 5	-	-	-	-	-	-	-	-	-	-	3	-
CO 6	-	2	-	-	-	-	2	-	-	-	3	-
3: High Influence, 2: Moderate Influence, 1: Low Influence												

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		24
Demonstrations		06
1. Demonstration using Videos	05	
2. Demonstration using Physical Models /	01	
3. Demonstration on a Computer		
Numeracy		
1. Solving Numerical Problems		
Practical Work		
1. Course Laboratory		
2. Computer Laboratory		
3. Engineering Workshop / Course/Workshop / Kitchen		
4. Clinical Laboratory		
5. Hospital		
6. Model Studio		
Others		05
1. Case Study Presentation		
2. Guest Lecture	02	
3. Industry / Field Visit		
4. Brain Storming Sessions		
5. Group Discussions	02	
6. Discussing Possible Innovations	01	
Term Test and Written Examination		10
Total Duration in Hours		45

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7. Course Assessment and Reassessment

The components and subcomponents of course assessment are presented in the Academic Regulations document pertaining to the Programme. The procedure to determine the final course marks is also presented in the Academic Regulations document as well.

The assessment questions are set to test the course learning outcomes. In each component or subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

Focus of Course Learning Outcomes in each component assessed				
	CE (50% Weightage)			SEE (50% Weightage)
	SC1	SC2	SC3	
	50 Marks	25 Marks	25 Marks	100 Marks
CO-1	x	x		x
CO-2	x	x		x
CO-3	x	x		x
CO-4	x		x	x
CO-5			x	x
CO-6			x	x

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of course outcomes in each component assessed in the above template at the beginning of the semester.

Course reassessment policies are also presented in the Academic Regulations document.

8. Achieving Course Learning Outcomes

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

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9. **Course Resources**

a. **References**

1. Goldsby, R.A., Kindt, T.J., Osborne, B.A., 2007, *Kuby's Immunology*, 6th Edition, W.H. Freeman and Company, New York.
2. Abbas, A.K., Lichtman, A.H., Pillai, S., 2007, *Cellular and Molecular Immunology*, 6th Edition, Saunders Publication, Philadelphia.
3. Delves, P., Martin, S., Burton, D., Roitt, I.M., 2006, *Roitt's Essential Immunology*, 11th Edition, Wiley-Blackwell Scientific Publication, Oxford.
4. Murphy, K., Travers, P., Walport, M., 2008, *Janeway's Immunobiology*, 7th Edition, Garland Science Publishers, New York.

b. **Magazines and Journals**

1. The American Association of Immunologists. The Journal of Immunology. Available at: https://www.jimmunol.org and https://immunology.sciencemag.org
2. SAGE Publications. International Journal of Immunopathology and Pharmacology. Available at: http://journals.sagepub.com/doi/pdf/10.1177/01154265030180064 51

10. **Course Organization**

Course Code	BTD516A	
Course Title	Immunology and Immunotechniques	
Course Leader/s Name	As per Time table	
Course Leader Contact Details	**Phone:**	08045366666
	E-mail:	hod.bt.ls@msruas.ac.in
Course Specifications Approval Date	September 2024	
Next Course Specifications Review	August 2027	

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Course Specifications: Bioinformatics and Structural biology

Course Title	Bioinformatics and Structural biology
Course Code	BTD517A
Department	Biotechnology
Faculty	Life and Allied Health Sciences

1. Course Summary

The course covers basic methods used in sequence analysis such as pairwise and multiple alignment, searching databases for sequence similarity, profiles, pattern matching, hidden Markov models, RNA bioinformatics, gene prediction methods and principles for molecular phylogeny. The course includes modern high-throughput sequencing techniques and their applications, as well as molecular biology databases and different systems to query such databases. The course considers theoretical principles as well as how existing programs are being used by bioinformaticians.

2. Course Size and Credits:

Number of credits	2
Total Hours of Classroom Interaction	30
Number of laboratory Hours	--
Number of semester weeks	16
Department responsible	Biotechnology
Course Marks	50
Pass Requirement	As per University regulations
Attendance Requirement	As per University regulations

Teaching, Learning and Assessment

3. Course Outcomes (COs)

After undergoing this course students will be able to:

CO1. Explain the use of bioinformatics in addressing a range of biological questions

CO2. Justify how bioinformatics methods can be used to relate sequence, structure and function

CO3. Enumerate the technologies for modern high-throughput DNA sequencing and their applications

CO4. Describe principles and algorithms of pairwise and multiple alignments, and sequence database searching

CO5. Explain how evolutionary relationships can be inferred from sequences (phylogenetics)

CO6. Explain the 3-D structure of protein, and its interaction with different ligands to draw structure function relationship

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4. Course Contents

Unit I **3h**

Fundamentals of Bioinformatics and Biological Databases: Introduction to Bioinformatics, Concept of homology, paralogy, orthology, analogy and xenology, NCBI, and data retrieval European Bioinformatics Institute database search; Understanding EXPASY server; European Molecular Biology server, KEGG Pathway, PDB, PDBj

Unit II **10h**

Sequence Alignment and Phylogenetic Analysis: Introduction to Sequence comparison, global and multiple sequence alignment, Multiple sequence alignment using FASTA, Sequence alignment using CLUSTALW, BLAST and advance BLAST, Phylogenetics: Concept of phylogenetic trees, reading and interpreting phylogenetic trees. Algorithms for constructing phylogenetic trees: UPGMA, Neighbor Joining, and Maximum parsimony. Judging strength of clades (with BS or PP values) in a tree. Applications of phylogenetics in molecular and evolutionary biology

Unit III **10h**

Fundamentals of structural biology: Introduction to the 3-dimensional protein structure. Learning how to read and parse the PDB file format. Reading Dunbrack's Rotamer Library. Interpreting Ramachandran plots. Calculating backbone (phi / Φ, psi / Ψ) and sidechain (chi / X) dihedral angles for protein structures. Calculating centroids, translations and rotations of points in 3D space. Superposition of sets of points using Kabsch's algorithm. Calculating RMSD for two sets of points..

Unit IV **7h**

Protein folding and design: Introduction to the SCOP and CATH databases. Understanding the protein folding and protein design problems. Understanding simulated annealing optimization. Understanding algorithms for protein folding: SWISS-MODEL, Rosetta (ab inito design), and Alphafold. Understanding algorithms for protein design: Rosetta (fixed backbone design and all-atom relaxation). Examples of important computationally designed proteins: Top7, self-assembling nanocages, and synthetic nucleocapsids.

5. CO-PO PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO3
CO 1	3	2	3	-	1	-	-	-	3	1	2	-
CO 2	3	2	3	-	2	-	-	-	3	1	2	-
CO 3	3	2	3	-	2	-	-	-	3	1	2	-
CO 4	1	2	3	-	2	-	-	-	3	1	2	-
CO 5	3	2	3	-	2	-	-	-	3	1	2	-
CO 6	3	2	3	-	2	-	-	-	3	1	2	-
3: High Influence, 2: Moderate Influence, 1: Low Influence												

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6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		22
Demonstrations		02
1. Demonstration using Videos	2	
2. Demonstration using Physical Models		
3. Demonstration on a Computer		
Numeracy		02
1. Solving Numerical Problems	2	
Practical Work		
1. Course Laboratory		
2. Computer Laboratory		
3. Engineering Workshop / Course/Workshop /Kitchen		
4. Clinical Laboratory		
5. Hospital		
6. Model Studio		
Others		
1. Case Study Presentation		
2. Guest Lecture		
3. Industry / Field Visit		
4. Brain Storming Sessions		
5. Group Discussions		
6. Discussing Possible Innovations		
Term Test and Written Examination		04
Total Duration in Hours		**30**

7. Course Assessment and Reassessment

The components and subcomponents of course assessment is presented in the Academic Regulations document pertaining to the Programm. The procedure to determine the final coursemarks is also presented in the Academic Regulations document as well.

The assessment questions are set to test the course learning outcomes. In each component or subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

Focus of Course Learning Outcomes in each component assessed			
	CE (50% Weightage)		**SEE (50% Weightage)**
	SC1	**SC2**	
	25 Marks	25 Marks	50 Marks
CO 1	x		x
CO 2	x	x	x
CO 3	x	x	x
CO 4	x	x	x
CO 5		x	x
CO 6		x	x

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8. Achieving Course Learning Outcomes

The following skills are directly or indirectly imparted to the students in the following teachingand learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Classroom, Assignment, Examination
6.	Practical Skills	--
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, examination
10.	Verbal Communication Skills	Assignment
11.	Presentation Skills	Assignment
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Higgins, D. and Taylor, W. (eds.), 2000. Bioinformatics: Sequence, Structure and Databanks – A Practical Approach. Vol. 236. Oxford: OUP Oxford.
2. Lacroix, Z. and Critchlow, T. (eds.), 2003. Bioinformatics: Managing Scientific Data. Vol. 6, No. 2. San Diego, CA: Academic Press.
3. Zvelebil, M.J. and Baum, J.O., 2008. Understanding Bioinformatics. New York: Garland Science.

b. Websites

1. Nature. Bioinformatics. Available at: https://www.nature.com/subjects/bioinformatics
2. Elsevier. Genomics, Proteomics & Bioinformatics. Available at: https://www.journals.elsevier.com/genomics-proteomics-and-bioinformatics

10. Course Organisation

Course Code	BTD517A	
Course Title	Bioinformatics and Structural biology	
Course Leader/s Name	As per time table	
Course Leader Contact Details	**Phone:**	08045366666
	E-mail:	hod.bt.ls@msruas.ac.in
Course Specifications Approval Date	September 2024	
Next Course Specifications Review	August 2027	

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Course Specifications: Research: Methodology, Ethics and Biosafety

Course Title	Research: Methodology, Ethics and Biosafety
Course Code	BTD518A
Department	Biotechnology
Faculty	Life and Allied Health Sciences

1. Course Summary

This course provides a comprehensive understanding of fundamentals of research and covers essential skills in research design and statistical analysis. Additionally, the course emphasizes research proposal writing, manuscript preparation, and effective presentation techniques using established frameworks. Students will also be familiarized with the essential concepts of Biosafety and Bioethics in biotechnology research. They will learn to understand the ethical, social, and legal aspects of biotechnology regulation and importance of biosafety in this field.

2. Course Size and Credits

Number of credits	02
Total Hours of Classroom Interaction	30
Number of tutorial hours	00
Number of semester weeks	16
Department responsible	Biotechnology
Course Marks	Total Marks: 50
Pass Requirement	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

Teaching, Learning and Assessment

3. Course Outcomes (CO)

After undergoing this course students will be able to:

CO1: Describe the relevance and mandatory steps of research and out of the box thinking concepts for effective research

CO2: Prepare and Analyze research proposal, research paper and deliver effective presentations

CO3: Demonstrate knowledge of various ethical aspects related to health care and biotechnology research.

CO4: Apply the safety guidelines for Biotechnology research and products.

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4. Course Content

Unit I **5h**

Foundations of Research: Concept and Importance, Types of Research, Steps in the Research Process, Deductive and Inductive theory, Characteristics of scientific method, Relevance of Research for Innovation and Technology Development, Out Of the Box Thinking , Choosing a mentor and lab

Unit II **5h**

Research Design: Concept and fes of good research design, Formulation of the research problem, Literature review: importance and sources, Variables in Research, Data Collection methods, Paraphrasing and Referencing

Unit III **5h**

Research Proposal and Effective Presentation: Research Proposal: Importance and Contents, Report writing, Manuscript preparation, Journal selection and metrics, Plagiarism, Effective presentation: 4P's rule, PAMPERS rule and PEOPLE rule

Unit IV **5h**

Biosafety: Biosafety-introduction to biosafety levels and biological safety cabinets; primary containment for biohazards; Biomedical disposal management; principles of safety assessment of transgenic plants and animals; risk assessment – environmental risk assessment and food and feed safety assessment

Unit V **5h**

Bioethics: Introduction to ethical conflicts in biological sciences - interference with nature, bioethics in health care; Bioethics in biotechnology research; bioethics in agricultural biotechnology.

Unit VI **5h**

Biosafety Regulations-National and International: International regulations – Cartagena protocol, Indian regulations – EPA act and rules, Regulatory framework – RCGM, GEAC, IBSC, and other regulatory bodies; field trials and phase trials – biosafety research trials – standard operating procedures - guidelines of state governments; GM labeling – Food Safety and Standards Authority of India (FSSAI).

5. CO-PO-PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO3
CO 1	3	1	-	-	1	-	-	-	3	-	-	-
CO 2	3	-	1	-	2	-	-	-	3	-	-	-
CO 3	3	-	-	-	2	-	-	2	2	-	-	1
CO 4	-	1	2	-	2	-	-	-	2	-	2	-
3: High Influence, 2: Moderate Influence, 1: Low Influence												

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6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		20
Demonstrations		2
1. Demonstration using Videos		
2. Demonstration using Physical Models/Systems		
3. Demonstration on a Computer		
Numeracy		
1. Solving Numerical Problems		
Practical Work		
1. Course Laboratory		
2. Computer Laboratory		
3. Engineering Workshop/Course Workshop/Kitchen		
4. Clinical Laboratory		
5. Hospital		
6. Model Studio		
Others		4
1. Case Study Presentation	02	
2. Guest Lecture	01	
3. Industry/Field Visit		
4. Brain Storming Sessions		
5. Group Discussions	01	
6. Discussing Possible Innovations		
Term Test and Written Examination		4
Total Duration in Hours		30

7. Course Assessment and Reassessment

The components and subcomponents of course assessment is presented in the Academic Regulations document pertaining to the Programme. The procedure to determine the final course marks is also presented in the Academic Regulations document as well.

The assessment questions are set to test the course learning outcomes. In each component or subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

Focus of Course Learning Outcomes in each component assessed				
	CE (50% Weightage)			SEE (50% Weightage)
	SC1	SC2	SC3	
	50 Marks	25 Marks	25 Marks	50 Marks
CO-1	x	x		x
CO-2	x	x		x
CO-3	x	x		x
CO-4	x		x	x

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of course outcomes in each component assessed in the above template at the beginning of the semester.
Course reassessment policies are also presented in the Academic Regulations document.

8. Achieving Course Learning Outcomes

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. References

1. Valiela, I. (2001). *Doing science: Design, analysis, and communication of scientific research*. Oxford: Oxford University Press.
2. *On being a scientist: A guide to responsible conduct in research*. (2009). Washington, D.C.: National Academies Press.
3. Booth, W. C, Colomb and Williams, G.G (2005) *The Craft of Research*, Chicago University Press
4. William, M. K. and Trochim (2003) *Research Methods*, 2nd Edition, Biztantra Publications
5. Jonathan, G. (2004) *The Foundation of Research*, Palgrave Study Guides
6. Rugg, G. and Petre, M. (2004) *The Unwritten Rules of Ph.D. research*, Open University Press
7. Stanley, S.A., 2008, Bioethics, Wisdom educational service.
8. Sateesh, M.K., 2008, *Bioethics and Biosafety*, I.K International Pvt. Ltd.
9. Goel, D., Parashar, S., 2013, IPR, *Biosafety and Bioethics*, Pearson Education, India.

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b. Magazines and Journals

1. Naturally Obsessed: The Making of a Scientist, [Film]. Directed by R. Kanopy and C. Ambruso. LabTV and The Rockefeller University.
2. ScienceDaily. Bioethics. Available at: https://www.sciencedaily.com/terms/bioethics.htm

c. Websites

1. Intellectual Property India. Office of the Controller General of Patents, Designs & Trade Marks. Available at: http://www.ipindia.nic.in/
2. Cell for IPR Promotion and Management (CIPAM). National IPR Policy. Available at: http://cipam.gov.in/national-ipr-policy/

10. Course Organization

Course Code	BTD518A	
Course Title	Research: Methodology, Ethics and Biosafety	
Course Leader/s Name	As per Time table	
Course Leader Contact Details	**Phone:**	08045366666
	E-mail:	hod.bt.ls@msruas.ac.in
Course Specifications Approval Date	September 2024	
Next Course Specifications Review	August 2027	

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Course Specifications: Practical III: Molecular Biology & Immunology

Course Title	Practical III: Molecular Biology & Immunology
Course Code	BTL513A
Department	Biotechnology
Faculty	Life and Allied Health Sciences

1. Course Summary

The course aims to facilitate students on practical aspects of experimental knowledge in molecular biology, genetic engineering and Immunology. The students will be able to execute the experimental design and basic techniques commonly used in molecular biology and immunology laboratories. Students will be able to gain hands-on experience on gene cloning, protein expression and purification that enable them to begin a career in genetic engineering as well as in fundamental research.

2. Course Size and Credits:

Number of credits	03
Total Hours of Classroom Interaction	90
Number of tutorial hours	00
Number of semester weeks	16
Department responsible	Biotechnology
Pass Requirement	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

Teaching, Learning and Assessment

3. Course Outcomes

After undergoing this course students will be able to:

CO 1. Isolate and characterize DNA and Plasmids for molecular weight, restriction and ligation

CO 2. Expertize in PCR and RAPD techniques for quantification of DNA

CO 3. Acquire hands-on experience on gene cloning, protein expression and detection.

CO 4. Perform cell culture and counting of immune cells and comment

CO 5. Perform assays to assess the interaction and quantification of antigen and antibody

CO 6. Perform experiments used to purify immunoglobulins from serum sample

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4. **Course Contents**

Molecular Biology

1. Isolation, quantification and characterization of genomic DNA from bacteria (*E. coli)*
2. Isolation, quantification and characterization of plasmid DNA from bacteria.
3. Restriction digestion and ligation of DNA.
4. Determination of molecular weight and quantification of DNA and Protein
5. Preparation of competent cells, transformation of *E.coli* and screening of transformants
6. Cloning and expression of GFP gene in *E.coli*
7. Amplification of desirable gene by Polymerase chain reaction.
8. Random amplification of polymorphic DNA
9. Western blotting
10. Purification of His-Tagged protein on Ni-NTA columns.

Immunology

11. Antibody titre by ELISA method
12. Double diffusion, Immuno-electrophoresis and Radial Immuno diffusion
13. Complement fixation test
14. Isolation and purification of IgG from serum
15. SDS-PAGE, Immunoblotting, Dot blot assays.
16. Blood smear identification of leucocytes by Giemsa stain.
17. Separation of leucocytes by dextran method.
18. Separation of mononuclear cells by Ficoll-Hypaque and their cryopreservation

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5. CO-PO-PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO3
CO 1	3	2	-	-	-	-	-	-	3	-	-	-
CO 2	3	2	-	-	-	-	-	-	-	3	-	-
CO 3	-	-	-	2	-	-	-	-	-	-	3	-
CO 4	-	-	-	-	2	-	-	-	-	-	3	-
CO 5	-	-	-	-	-	-	3	-	-	-	-	3
CO 6	-	-	-	2	-	-	-	-	-	-	-	3
3: High Influence, 2: Moderate Influence, 1: Low Influence												

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		
Demonstrations		05
1. Demonstration using Videos	05	
2. Demonstration using Physical Models/Systems		
3. Demonstration on a Computer		
Numeracy		
1. Solving Numerical Problems		
Practical Work		81
1. Course Laboratory	81	
2. Computer Laboratory		
3. Engineering Workshop/Course		
4. Clinical Laboratory		
5. Hospital		
6. Model Studio		
Others		
1. Case Study Presentation		
2. Guest Lecture		
3. Industry/Field Visit		
4. Brain Storming Sessions		
5. Group Discussions		
6. Discussing Possible Innovations		
Laboratory Examination		4
Total Duration in Hours		90

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7. Course Assessment and Reassessment

The components and subcomponents of course assessment are presented in the Academic Regulations document pertaining to the Programme. The procedure to determine the final course marks is also presented in the Academic Regulations document as well.

The assessment questions are set to test the course learning outcomes. In each component or subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

Focus of Course Learning Outcomes in each component assessed			
	CE (50% Weightage)		SEE (50% Weightage)
	SC1	SC2	
	25 Marks	25 Marks	100 Marks
CO-1	x	x	x
CO-2	x	x	x
CO-3	x	x	x
CO-4	x	x	x
CO-5	x	x	x
CO-6	x	x	x

Course reassessment policies are also presented in the Academic Regulations document.

8. Achieving Course Learning Outcomes

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

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9. **Course Resources**

a References

1. Lab Manual
2. Sambrook, J., Russel, D.,"Molecular Cloninga Lab Manual" Vol. I, II and III, 3rd Edition, Cold spring harber lab press.
3. Walker, J.M. and Rapley, R. "Molecular Biology and Bio Technology" 4th Edition, Panima Publishing Corporation

b Magazines and Journals

1. Elsevier. Biochemistry, Genetics and Molecular Biology. Available at: https://www.elsevier.com/life-sciences/biochemistry-genetics-and-molecular-biology
2. Cell Press. Trends in Genetics. Available at: https://www.cell.com/trends/genetics/fulltext/

10. **Course Organization**

Course Code	BTL513A	
Course Title	Practical III: Molecular Biology & Immunology	
Course Leader/s Name	As per time table	
Course Leader Contact Details	**Phone:**	08045366666
	E-mail:	hod.bt.ls@msruas.ac.in
Course Specifications Approval Date	September 2024	
Next Course Specifications Review Date:	August 2027	

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Course Specifications: Practical IV: Bioinformatics and Structural Biology

Course Title	Practical IV: Bioinformatics and Structural Biology
Course Code	BTL514A
Department	Biotechnology
Faculty	Life and Allied Health Sciences

1. Course Summary

This course aims to make students competent in bioinformatics methods central to conducting molecular biological research projects. The course places emphasis on bioinformatics related to the exploration of proteins and includes analyses of sequences, database searches, sequence comparison, visualization and analysis of protein structures, and introduction to phylogenetic analyses. The students will get an introduction to the theoretical foundations for a few key methods. The course will also familiarize students to analyze DNA sequences, genes and genomes, gene expression and systems biology. Students will be introduced to the python programming language in a linux environment, which will enable them to streamline many bioinformatic pipelines. Through the course students will be acquainted with basic and advanced bioinformatics tools.

2. Course Size and Credits:

Number of credits	03
Total Hours of Classroom Interaction	90
Number of laboratory Hours	--
Number of semester weeks	16
Department responsible	Biotechnology
Course Marks	As described in the program specification
Pass Requirement	As per University regulations
Attendance Requirement	As per University regulations

Teaching, Learning and Assessment

3. Course Outcomes (CO)

After undergoing this course students will be able to:

CO 1 Analyze public database to study gene sequence through several online program

CO 2 Demonstrate a Phylogenetic relationship between homologous, and non-homologous gene

CO 3 Explain the sequence (nucleotide and amino acid) similarity and diversity through BLAST analysis.

CO 4 Design a PCR primer and test an online PCR to check the validity of the primer.

CO 5 Develop a 3-D model of protein from primary structure and its energy minimization, and validation and analyze a protein ligand interaction to

study its structure-function relationship through molecular docking

CO 6 Solve elementary as well as research-level problems using python in a linux programming environment.

4. Course contents

1. Python: basic syntax
2. Python: if/else statements
3. Python: for loops
4. Python: lists and dictionaries
5. Python: data input and output
6. Search and analyze public database: NCBI (GenBank, GenPept, GENE), Uniprot, PDB
7. Retrieval of sequences and Sequence analysis: EMBOSS NEEDLE, EMBOSS WATER, BLAST
8. Multiple Sequence Analysis: Clustal Omega, MUSCLE, TCoffee (anyone)
9. Phylogenetic tree construction: Phylip, FIGTREE
10. Visualization and study of 3D molecular structures: PyMol
11. Homology Modeling- Swiss PDB, MODELLER
12. Energy Minimization of the molecule and Model validation through Ramachandran Plot
13. Analyzing Protein Ligand interaction to study structure-function relationship: Autodock Vina
14. Designing a PCR Primer for detection, cloning and sequencing
15. Analyzing Proteomics tools in ExPASy server
16. Analyzing KEGG pathway
17. Introduction to Ensembl, Ensembl Genes and Transcripts
18. Comparative genomics in Ensembl
19. Model organism databases: Ecocyc, Flybase etc..
20. Identification of genes and promoters

5. CO-PO PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO3
CO 1	3	2	3	-	1	-	-	-	3	1	2	3
CO 2	3	2	3	-	2	-	-	-	3	1	2	3
CO 3	3	2	3	-	2	-	-	-	3	1	2	3
CO 4	1	2	3	-	2	-	-	-	3	1	2	1
CO 5	3	2	3	-	1	-	-	-	3	1	2	3
CO 6	1	2	3	-	2	-	-	-	3	1	2	1
3: High Influence, 2: Moderate Influence, 1: Low Influence												

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6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		0
Demonstrations		2
1. Demonstration using Videos	2	
2. Demonstration using Physical Models		
3. Demonstration on a Computer		
Numeracy		3
1. Solving Numerical Problems	3	
Practical Work		**81**
1. Course Laboratory		
2. Computer Laboratory	81	
3. Engineering Workshop / Course/Workshop / Kitchen		
4. Clinical Laboratory		
5. Hospital		
6. Model Studio		
Others		
1. Case Study Presentation		
2. Guest Lecture		
3. Industry / Field Visit		
4. Brain Storming Sessions		
5. Group Discussions		
6. Discussing Possible Innovations		
Term Test and Written Examination		04
Total Duration in Hours		**90**

7. Course Assessment and Reassessment

The components and subcomponents of course assessment is presented in the Academic Regulations document pertaining to the Programme. The procedure to determine the final course marks is also presented in the Academic Regulations document as well.

The assessment questions are set to test the course learning outcomes. In each component or subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

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Focus of Course Learning Outcomes in each component assessed			
	CE (50% Weightage)		SEE (50% Weightage)
	SC1	SC2	
	25 Marks	25 Marks	100 Marks
CO-1	x	x	x
CO-2	x	x	x
CO-3	x	x	x
CO-4	x	x	x
CO-5	x	x	x
CO-6	x	x	x

8. Achieving Course Learning Outcomes

The following skills are directly or indirectly imparted to the students in the following teachingand learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Classroom, Assignment, Examination
6.	Practical Skills	--
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, examination
10.	Verbal Communication Skills	Assignment
11.	Presentation Skills	Assignment
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Higgins, D. and Taylor, W., "Bioinformatics – Sequence, Structure and Databanks" , Oxford University Press.
2. Lacroix, Z. and Critchlow, T., "Bioinformatics – Managing Scientific Data", Morgan Kaufmann Publishers.

b. Magazines and Journals

1. Nature. Bioinformatics. Available at: https://www.nature.com/subjects/bioinformatics
2. Elsevier. Genomics, Proteomics & Bioinformatics. Available at: https://www.journals.elsevier.com/genomics-proteomics-and-bioinformatics

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10. Course Organization

Course Code	BTL514A		
Course Title	Practical IV: Bioinformatics and Structural Biology		
Course Leader/s Name		As per Time table	
Course Leader Contact Details		**Phone:**	08045366666
		E-mail:	hod.bt.ls@msruas.ac.in
Course Specifications Approval Date		September 2024	
Next Course Specifications Review		August 2027	

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M. S. Ramaiah University of Applied Sciences

Course Specifications

of

M.Sc. in Biotechnology

Programme Code: 091

SEMESTER 3

Department of Biotechnology

Faculty of Life and Allied Health Sciences

M S Ramaiah University of Applied Sciences

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Course Specifications: Animal and Plant Biotechnology

Course Title	Animal and Plant Biotechnology
Course Code	BTC601A
Department	Biotechnology
Faculty	Life and Allied Health Sciences

1. Course Summary

The aim of the course is to familiarize students with the biotechnological concepts involved in animal and plant biotechnology.

Students will be familiarized with a broad range of technical know-how for the genetic improvement of animal and plant species, by understanding and implementing critical technologies of cloning and genetic engineering. They will be trained on the concepts of cellular mechanisms, manipulations of biological systems and production processes. They will also be able to explain the various strategies applied in animal and plant genetic engineering and will be able to utilize biotechnological methods for different applications

2. Course Size and Credits:

Number of credits	04
Total hours of class room interaction	60
Number of tutorial hours	00
Number of semester weeks	16
Department responsible	Department of Biotechnology
Course marks	Total: 100
Pass requirement	As per Academic Documents
Attendance requirement	As per Academic Documents

Teaching, Learning and Assessment

3. Course Outcome (CO)

After undergoing this course students will be able to:

CO 1. Comprehend the fundamental concepts of animal cell culture, and its importance

CO 2. Discuss the significance of transgenesis with reference to animal models and the principles and applications of gene therapy

CO 3. Explain the applications of animal biotechnology in obtaining desirable traits in animals and their use in human welfare

CO 4. Outline plant tissue culture techniques and applications.

CO 5. Understanding the different methods of genetic engineering in plants to obtain transgenics of desirable traits

CO 6. Utilize biotechnological methods for the numerous applications in marker assisted selection and GM crops

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4. **Course Content**

Animal Biotechnology

Unit I **10h**

Animal Tissue Culture: Historical Perspectives. Types of Tissue Culture Media; Equipments required in tissue culture room and their working principle, Types of Cell Culture-Primary and Secondary; Cell Transformation; Cryopreservation; Contamination.

Unit II **8h**

Strategies to create Knock-out, Knock-in and Conditional Knock-out disease models, Gene Therapy-Types, Approaches and Applications of Gene Therapy, Production of Transgenic Mouse Model to Study Human Diseases.

Unit III **12h**

Applications of Animal Biotechnology: Production of therapeutic proteins, monoclonal antibodies, and vaccines. Animal Models for Human Diseases: Use of mice, zebrafish as model organisms in biomedical research. Biotechnology in Livestock: Improving productivity and disease resistance in livestock. Enhancing feed efficiency using biotechnology. Overview of using animal organs for human transplantation. Ethical, Social, and Legal Aspects: Ethical issues in animal biotechnology (e.g. animal welfare, transgenics), Social perspectives on the use of animals in research and industry. Potential risks and the road ahead for animal biotechnology.

Plant Biotechnology

Unit IV **12h**

Plant Tissue Culture: Historical perspective; media preparation – nutrients and plant hormones; sterilization techniques; Totipotency: Organogenesis; somatic embryogenesis; transfer and establishment of whole plants in soil (hardening); Establishment of cultures – callus culture, cell suspension culture, micropropagation; somaclonal variation; Androgenesis and its applications in genetics and plant breeding; production of haploid plants and homozygous cell lines; germplasm conservation and cryopreservation; Synthetic seed production; Protoplast culture and Somatic hybridization - methods and applications; selection of hybrid cells; symmetric and asymmetric hybrids, cybrids; Plant cell cultures for secondary metabolite production

Unit V **8h**

Plant genetic engineering: Mechanism of DNA transfer: Agrobacterium mediated gene transfer, Ti and Ri plasmids as vectors, Microinjection. Binary vectors, plasmid vectors, Transgene stability and gene silencing. **Mutagenesis in plants:** TDNA/transposon mutagenesis, selection of mutants from random library.

Unit VI **10h**

Applications of Plant Biotechnology: DNA fingerprinting-principles and applications: introduction to mapping of genes/QTLs; marker-assisted selection; RFLP, RAPD,

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AFLP, SNP markers; **GM Crops:** Crop improvement, productivity, performance and fortification of agricultural products–Bt cotton, Bt brinjal; Golden rice; Bioethics and biosafety associated with GM crops and RNAi technique; Introduction to Biofertilizers and Biopesticides

5. CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO3
CO 1	3	-	-	-	-	-	2	-	-	-	2	-
CO 2	3	2	2	-	-	-	-	-	3	-	-	-
CO 3	2	2	3	-	-	-	2	-	3	-	-	2
CO 4	1	-	-	-	-	-	2	-	-	-	2	-
CO 5	3	2	2	-	-	-	-	-	3	-	-	-
CO 6	2	2	3	-	-	-	2	-	3	-	-	2
3: High Influence, 2: Moderate Influence, 1: Low Influence												

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		44
Demonstrations		02
1. Demonstration using Videos	02	
2. Demonstration using Physical Models /		
3. Demonstration on a Computer		
Numeracy		
1. Solving Numerical Problems		
Practical Work		
1. Course Laboratory		
2. Computer Laboratory		
3. Engineering Workshop/ Course/Workshop/ Kitchen		
4. Clinical Laboratory		
5. Hospital		
6. Model Studio		
Others		09
1. Case Study Presentation	03	
2. Guest Lecture	02	
3. Industry / Field Visit		
4. Brain Storming Sessions	01	
5. Group Discussions	02	
6. Discussing Possible Innovations	02	
Term Test and Written Examination		05
Total Duration in Hours		60

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7. Course Assessment and Reassessment

The components and subcomponents of course assessment are presented in the Academic Regulations document pertaining to the Programme. The procedure to determine the final course marks is also presented in the Academic Regulations document as well.

The assessment questions are set to test the course learning outcomes. In each component or subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

Focus of Course Learning Outcomes in each component assessed				
	CE (50% Weightage)			SEE (50% Weightage)
	SC1	SC2	SC3	
	50 Marks	25 Marks	25 Marks	100 Marks
CO-1	x			x
CO-2				x
CO-3			x	x
CO-4	x	x		x
CO-5		x		x
CO-6			x	x

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of course outcomes in each component assessed in the above template at the beginning of the semester.

Course reassessment policies are also presented in the Academic Regulations document.

8. Achieving Course Learning Outcomes

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

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9. **Course Resources**

a. **References**

1. Animal Biotechnology by Varun Mehta. Publisher: Campus Book International, 2011
2. Ranga, M.M., 2007, Animal Biotechnology, 3 rd Edition, Agrobios publishers, India.
3. T.A. Brown. Gene Cloning and DNA Analysis (6th Edition) by John Willey & Sons Inc, USA, 2010
4. Bhojwani, S.S., Dantu, P.K., 2013, Plant tissue culture: An Introductory text, Springer, India
5. Kyte, L., Kleyn, J., Scoggins, H., Bridgen, M., 2013, Plants from Test Tubes: An Introduction to Micropropagation, 4th Revised Edition, Timber Press.
6. Smith, R.H., 2012, Plant tissue culture: Techniques and Experiments, 3rd Edition, Academic
7. Hammond, J.H., Mcgarvey, P., Yusibov, V., (eds.), 2000, Plant Biotechnology, Springer Verlag, Heidelberg.
8. Slater, A., Scott, N., Fowler, M., 2008, Plant biotechnology: the genetic manipulation of plants, 2nd Edition, Oxford university press.

b. **Magazines and Journals**

1. Nature. Plant Biotechnology. Available at: https://www.nature.com/subjects/plant-biotechnology
2. OMICS International. Agricultural Biotechnology – Journals, Articles, PPTs List. Available at: https://www.omicsonline.org/scholarly/agricultural-biotechnology-journals--articles-ppts-list.php
3. About Bioscience. Animal Biotechnology. Available at: https://www.aboutbioscience.org/topics/animal-biotechnology

10. **Course Organization**

Course Code	BTC601A	
Course Title	Animal and Plant Biotechnology	
Course Leader/s Name	As per Time table	
Course Leader Contact Details	**Phone:**	08045366666
	E-mail:	hod.bt.ls@msruas.ac.in
Course Specifications Approval Date	September 2024	
Next Course Specifications Review	August 2027	

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DEAN Faculty of Life & Allied Health Sciences M.S. RAMAIAH UNIVERSITY OF APPLIED SCIENCES BANGALORE-560 054

Course Specifications: Practical V: Animal and Plant Biotechnology Laboratory

Course Title	Practical V: Animal and Plant Biotechnology Laboratory
Course Code	BTL601A
Department	Biotechnology
Faculty	Life and Allied Health Sciences

1. Course Summary

The aim of the course is to train students in the skills and techniques involved in Plant and Animal Biotechnology.

Students will be acquired with a comprehensive knowledge of the skills relevant to plant and animal biotechnology. The students will be able to identify and practice the particulars relevant to acquire, elaborate and analyze information pertaining to the course. The students will be able to utilize these experiments to further enhance their understanding of plant and animal biotechnology. Students will be familiarized with experimental methods and techniques applied in biotechnology.

2. Course Size and Credits:

Number of credits	03
Total Hours of Classroom Interaction	90
Number of laboratory Hours	--
Number of semester weeks	16
Department responsible	Biotechnology
Course Marks	As described in the program specification
Pass Requirement	As per University regulations
Attendance Requirement	As per University regulations

Teaching, Learning and Assessment

3. Course Outcomes (CO)

After undergoing this course students will be able to:

CO 1 Describe and carry out basic preparations for plant and animal cell culture
CO 2 Maintain cell cultures in proper aseptic conditions
CO 3 Describe and explain processes for the characteristics of cultured cells.
CO 4 Characterize function of cultured cells.
CO 5 Identify species with standard molecular biology approaches
CO 6 Demonstrate significant functions of plant and animal cells under different stress conditions.

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4. Course contents

Animal Biotechnology

1. Preparation of reagents and media for animal cell culture
2. Primary culture technique: Isolation of lymphocytes and cultivation of lymphocytes
3. Culturing of continuous cell lines
4. Cryopreservation of primary cell cultures and cell lines
5. MTT assay
6. Demonstration of lipofection of plasmid with GFP tag in cell line
7. Estimation of lipid peroxides (Malondialdehyde) in cytotoxicity induced cells

Plant Biotechnology

8. Plant tissue culture - Types of media, Preparation of Culture media & Reagents – Media composition, Nutrition, Hormones
9. Callus culture: Initiation and regeneration
10. Anther culture for the production of haploids
11. Isolation, culture and fusion of protoplasts
12. Isolation of plant genomic DNA from pea shoot tip/ Cauliflower by CTAB method
13. PGPR: Isolation of Rhizobium from root nodules and its mass production
14. Observation and staining of Mycorrhizae

5. CO-PO PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO3
CO 1	3	3	2	-	-	-	2	2	2	3	2	2
CO 2	2	3	2	-	-	-	2	2	2	3	2	2
CO 3	2	3	2	-	-	-	2	2	2	3	2	2
CO 4	2	3	2	-	-	-	2	2	2	3	2	3
CO 5	2	2	2	-	-	-	2	2	2	3	2	3
CO 6	2	2	2	-	-	-	2	2	2	3	2	3
3: High Influence, 2: Moderate Influence, 1: Low Influence												

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6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		
Demonstrations		
1. Demonstration using Videos	2	04
2. Demonstration using Physical Models		
3. Demonstration on a Computer		
Numeracy		
1. Solving Numerical Problems	2	
Practical Work		
1. Course Laboratory		
2. Computer Laboratory		
3. Engineering Workshop / Course/Workshop /Kitchen		**81**
4. Clinical Laboratory		
5. Hospital		
6. Model Studio		
Others		
1. Case Study Presentation		
2. Guest Lecture		
3. Industry / Field Visit		
4. Brain Storming Sessions		
5. Group Discussions		
6. Discussing Possible Innovations		
Term Test and Written Examination		05
Total Duration in Hours		**90**

7. Course Assessment and Reassessment

The components and subcomponents of course assessment is presented in the Academic Regulations document pertaining to the Programme. The procedure to determine the final course marks is also presented in the Academic Regulations document as well.

The assessment questions are set to test the course learning outcomes. In each component or subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

Focus of Course Learning Outcomes in each component assessed			
	CE (50% Weightage)		SEE (50% Weightage)
	SC1	SC2	
	25 Marks	25 Marks	50 Marks
CO 1	x	x	x
CO 2	x	x	x
CO 3	x	x	x

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CO 4	x	x	x
CO 5	x	x	x
CO 6	x	x	x

8. Achieving Course Learning Outcomes

The following skills are directly or indirectly imparted to the students in the following teachingand learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Classroom, Assignment, Examination
6.	Practical Skills	--
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, examination
10.	Verbal Communication Skills	Assignment
11.	Presentation Skills	Assignment
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Lab Manual
2. Freshney RI. 2005.Culture of Animal Cells. Wiley Liss.
3. Portner R. 2007.Animal Cell Biotechnology. Humana Press
4. Decker J &Reischl. U, Molecular Diagnosis of infectious diseases, 2nd Edition, Humana Press, 2004.

b. Magazines and Journals

1. Nature. Scientific Subjects Overview. Available at: https://www.nature.com/subjects
2. About Bioscience. Animal Biotechnology. Available at: https://www.aboutbioscience.org/topics/animal-biotechnology
3. Biotechnology Innovation Organization. BIO – Biotechnology Innovation Organization. Available at: https://www.bio.org

Course Code	BTL601A		
Course Title	Practical V: Animal and Plant Biotechnology Laboratory		
Course Leader/s Name	As per Time table		
Course Leader Contact Details	**Phone:**	08045366666	
	E-mail:	hod.bt.ls@msruas.ac.in	
Course Specifications Approval Date	September 2024		
Next Course Specifications Review	August 2027		

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Course Specifications: Introduction to Management, Entrepreneurship and IPR

Course Title	Introduction to Management, Entrepreneurship and IPR
Course Code	BTM601A
Department	Biotechnology
Faculty	Life and Allied Health Sciences

1. Course Summary

The aim of this course is to develop the entrepreneurial skills of students in preparing realistic proposal for a new business startup. Students are taught on the need for identifying new venture opportunities, prepare and present business plans. The focus is on the analytical thinking and skills that are relevant for seeking new venture financing and making investment decisions. This course provides the framework for learning the practical sides of school knowledge, illustrating ways in which it can become tools for life as well as business.

2. Course Size and Credits:

Number of credits	02
Total hours of class room interaction	30
Number of tutorial hours	-
Number of semester weeks	16
Department responsible	Biotechnology
Course marks	As described Total Marks: 50
Pass Requirement	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

Teaching, Learning and Assessment

3. Course Outcome (CO)

After undergoing this course students will be able to:

CO 1. Outline the basic concepts in entrepreneurship, including its significance, types, and the essential skills and traits required for successful entrepreneurial ventures, particularly in the biotechnology sector.

CO 2. Understand the fundamentals of patents, copyrights, trademarks, and commercialization strategies, and integrate design thinking principles to develop innovative biotech solutions

CO 3. Identify and formulate projects, conduct feasibility analyses (SWOT, cost-benefit), prepare business plans, and manage accounting, budgeting, and funding processes using government and private resources

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CO 4. Conduct a market analysis, branding, and promotion, while understanding regulatory compliance, technology transfer, and sustainability practices to establish and scale biotech enterprises

CO 5. Illustrate the scope, opportunities, and types of bio-industries such as biopharma, bioagri, bioservices, and bioindustrial, along with public and private support programs like MSME, DBT, BIRAC, and Startup India.

4. Course Content

Unit I **5h**

Introduction to Entrepreneurship and Innovation: Concept and Theories of Entrepreneurship: Understanding entrepreneurship, types of entrepreneurs, importance of entrepreneurship. Skills for Successful Entrepreneurs: Essential entrepreneurial skills, mindset, and leadership traits. Entrepreneurship in Biotechnology: Scope and opportunities in bio-entrepreneurship, types of bio-industries (biopharma, bioagri, bioservices, bioindustrial). Entrepreneurship Development Programs: Overview of public and private initiatives (MSME, DBT, BIRAC, BCIL, Startup India, Make in India). Patent Landscape & Intellectual Property Rights (IPR): Introduction to patents, copyrights, trademarks, and commercialization strategies in biotechnology. Design Thinking in Entrepreneurship: Application of user-centric problem-solving frameworks to develop innovative solutions in biotechnology.

Unit II **5h**

Project Management and Feasibility Analysis: Project Concept and Classification: Fundamentals of project identification, formulation, and design. Feasibility Analysis: SWOT analysis, socio-economic cost-benefit analysis, risk assessment. Business Plan Preparation: Key elements of a biotech business plan, strategic planning, and goals. Legal and Statutory Compliance: Regulatory requirements for establishing biotech ventures. Role of Design Thinking: Leveraging design thinking for business feasibility and innovative project planning.

Unit III **5h**

Accounting and Financial Management: Accounting Practices: Basics of balance sheets, profit & loss statements, and double-entry bookkeeping. Financial Analysis: Ratio analysis, break-even analysis, and investment planning. Budgeting and Financial Planning: Strategic funding and allocation for biotech ventures. Funding for Biotech Startups: Government schemes (MSME, DBT, BIRAC) and private funding sources (venture capitalists, angel investors). Technology and Finance: Leveraging IT tools for financial management and business administration.

Unit IV **5h**

Business Strategy and Crisis Management: Strategic Planning: Entry and exit strategies, pricing, and market positioning. Negotiation Skills: Interaction with financiers, government agencies, and legal authorities. Crisis Management: Strategies to prevent and manage crises. Global Perspective: Broader vision for biotech startups, mergers, and acquisitions. IPR

and Strategic Planning: Role of intellectual property in business strategy and competitive advantage.

Unit V **5h**

Marketing and Branding: Market Analysis: Understanding market conditions, customer needs, and trends. Marketing Strategies: Branding, market segmentation, and prediction of market changes. Distribution and Promotion: Developing distribution channels, franchising, and advertising. Virtual Startups: Branding and marketing for digital platforms and biotech startups. Design Thinking in Marketing: Identifying unmet customer needs and creating innovative market solutions.

Unit VI **5h**

Establishing Biotech Enterprises: Setting Up Biotech Industries: Steps for small, medium, and large-scale industry establishment. Incentives and Export Opportunities: Government incentives, subsidies, and export policies. Innovation and Research: Role of innovation centers, incubators, and R&D in biotechnology. Technology Transfer: Agencies, regulations, and procedures for foreign technology transfer. Regulatory Compliance: Understanding quality control and regulatory frameworks (CDSCO, NBA, GLP, GCP, GMP). Sustainability and Design Thinking: Integrating sustainable practices in biotech innovation and enterprise development.

5. CO-PO-PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO3
CO 1	-	2	-	-	-	-	-	-	-	-	3	-
CO 2	-	-	3	3	-	-	3	-	-	-	3	-
CO 3	-	-	-	3	-	-	3	-	-	-	-	3
CO 4	-	-	-	3	-	2	-	-	-	-	-	3
CO 5	-	-	-	3	-	2	-	-	-	-	-	3
3: High Influence, 2: Moderate Influence, 1: Low Influence												

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		10
Demonstrations		01
1. Demonstration using Videos	01	
2. Demonstration using Physical Models/Systems		
3. Demonstration on a Computer		

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Numeracy		05
1. Solving Numerical Problems	05	
Practical Work		
1. Course Laboratory		
2. Computer Laboratory		
3. Engineering Workshop/Course Workshop/Kitchen		
4. Clinical Laboratory		
5. Hospital		
6. Model Studio		
Others		
1. Case Study Presentation	04	
2. Guest Lecture	01	
3. Industry/Field Visit		10
4. Brain Storming Sessions		
5. Group Discussions	03	
6. Discussing Possible Innovations	02	
Mid Term Test and Written Examination		04
Total Duration in Hours		30

7. Course Assessment and Reassessment

The components and subcomponents of course assessment are presented in the Academic Regulations document pertaining to the Programme. The procedure to determine the final course marks is also presented in the Academic Regulations document as well.

The assessment questions are set to test the course learning outcomes. In each component or subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

Focus of Course Learning Outcomes in each component assessed			
	CE (50% Weightage)		**SEE (50% Weightage)**
	SC1	**SC2**	
	25 Marks	25 Marks	50 Marks
CO-1	x		x
CO-2	x		x
CO-3	x	x	x
CO-4	x	x	x
CO-5		x	x

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The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of course outcomes in each component assessed in the above template at the beginning of the semester.

Course reassessment policies are also presented in the Academic Regulations document.

8. Achieving Course Learning Outcomes

The following skills are directly or indirectly imparted to the students in the following teachingand learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. References

1. Hisrich, R.D., Peters, M.P. and Shepherd, D.A., (2017) Entrepreneurship. McGraw-Hill Education.
2. Byers, T.H., Dorf, R.C. and Nelson, A.J., (2011) Technology Ventures: From Idea to Enterprise. McGraw-Hill Education.
3. Kshetri, N., (2014) Global entrepreneurship: Environment and strategy. Routledge.
4. Adams, D.J. and Sparrow, J.C. (2008) Enterprise for life scientists: Developing innovation and entrepreneurship in the biosciences. Bloxham: Scion.
5. Shimasaki, C.D. (2014) Biotechnology entrepreneurship: Starting, managing, and leading biotech companies. Amsterdam: Elsevier.
6. Onetti, A. and Zucchella, A., (2014) Business modeling for life science and biotech companies: Creating value and competitive advantage with the milestone bridge. Routledge.
7. Jordan, J.F. (2014) Innovation, Commercialization, and Start-Ups in Life Sciences. London: CRC Press.
8. Desai, V. (2009) The Dynamics of Entrepreneurial Development and Management. New Delhi: Himalaya Publishing House.

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a. Journals and Web resources

1. Startup India Platform. Available at: https://www.startupindia.gov.in.
2. Biotechnology Industry Research Assistance Council (BIRAC). Available at: https://www.birac.nic.in.
3. MSME (2025) Ministry of Micro, Small & Medium Enterprises. Available at: https://msme.gov.in.
4. Nature Biotechnology (n.d.) Biotechnology Entrepreneurship, Available at: https://www.nature.com/bioent/index.html

a. Government and Regulatory Documents

1. CDSCO (2025) Regulatory Guidelines, Central Drugs Standard Control Organization.
2. NBA (2025) National Biodiversity Authority Regulations.
3. DBT (2025) Biotech Policy Frameworks, Department of Biotechnology.
4. BCIL (2025) Biotechnology Consortium India Limited Policies.

Course Code	BTM601A	
Course Title	Introduction to Management, Entrepreneurship and IPR	
Course Leader/s Name	As per Time table	
Course Leader Contact Details	**Phone:**	08045366666
	E-mail:	hod.bt.ls@msruas.ac.in
Course Specifications Approval Date	September 2024	
Next Course Specifications Review	August 2027	

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Course Specifications: Group Project

Course Title	Group Project
Course Code	BTP601A
Programme	M.Sc. Biotechnology
Department	Biotechnology
Faculty	FLAHS

1. Course Summary

This course is designed to integrate and apply the learning outcomes of the M.Sc. in Biotechnology program through a collaborative group project. The project will focus on utilizing appropriate tools and techniques in Biotechnology, alongside leveraging relevant university resources for project definition and execution. Students will have the opportunity to apply both theoretical and practical knowledge of biochemical, genetic, and cell-based techniques, while also critically analyzing and interpreting classical research papers. This will enable students to apply the knowledge gained throughout the program in a real-world context.

2. Course Size and Credits:

Number of credits	05
Total hours of class room and laboratory interaction	150
Number of semester weeks	16
Department responsible	Biotechnology
Course marks	Total Marks: 100
Pass Requirement	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

Teaching, Learning and Assessment

3. Course Outcome (CO)

After undergoing this course students will be able to:

CO 1. Collaborate effectively in a team to undertake a project involving a range of biotechnology fields such as bioinformatics, protein design, microbiology, remediation techniques, plant biotechnology, and cell culture systems.
CO 2. Apply Biotechnology principles and techniques for executing the project
CO 3. Apply appropriate research methodology while formulating a project
CO 4. Define Specifications, Synthesize, Analyse, Develop and Evaluate a project

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CO 5. Develop a report which explains the project and make a presentation and document the work

4. **Course Contents**

1. Need for undertaking project, design specifications, analysis, evaluation and presentation of either of the followings:

2. Gene expression data analysis using bioinformatics, Artificial intelligence and machine learning tools

3. Protein design, microbiology, remediation techniques and cell culture assays

4. Clinical Research data analysis and interpretation

5. Any form of experimental projects related to Biotechnology that provides exposure to data generation, analysis and interpretation

6. Critical analysis of classical papers

7. Team building, Teamwork, Leadership skills

5. **CO-PO-PSO mapping**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO3
CO 1	-	-	3	-	3	3	-	3	1	3	-	-
CO 2	3	-	3	-	-	3	-	-	-	2	-	-
CO 3	-	3	3	-	-	-	3	-	3	-	3	3
CO 4	-	-	3	-	-	-	-	3	-	3	3	3
CO 5	-	-	3	-	3	-	-	3	-	-	-	3
3: High Influence, 2: Moderate Influence, 1: Low Influence												

6. **Course Teaching and Learning Methods**

Topics	**Teaching methods**	**Hours**
Critical Review, Problem Formulation and stating Objectives	Reading Journal papers , books and Other relevant materials and problem formulation	45
	Presentation to Reviewers	02
Design	Group work with supervisors guidance	10
Analysis	Group work with supervisor guidance	15
Testing and Evaluation	Group work with supervisors guidance	25
Verification/Validation	Group work with supervisors guidance	20
Drawing Conclusions	Group work with supervisors guidance	05
Presentation , Thesis/Report Writing and Viva Voce	Presentation and Viva voce-Group	03
	Thesis/Report writing - Group	20
Tests/Examinations/Presentations		05
Total		150

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7. **Method of Assessment**

There are two components for assessment in this Course:

Component- 1: 50%weight
The CEE component will include

a. Concept note evaluation

b. Mid project status report and presentation

c. Individual student evaluation report by group project faculty supervisor

Component- 2: 50%weight
Final project presentation and report submission. Evaluation by panel.

The assessment process for the group projects are set to test the learning outcomes. In each component a certain learning outcomes are assessed. The following table illustrates the focus of learning Outcome in each component assessed:

Focus of Course Learning Outcomes in each component assessed		
	CE (50% Weightage)	**SEE (50% Weightage)**
	50 Marks	50 Marks
CO-1	x	x
CO-2	x	x
CO-3	x	x
CO-4	x	x
CO-5	x	x

8. Achieving Course Learning Outcomes

The various skills are directly or indirectly imparted to the students using the teaching and learning methods as follows:

S.No	Curriculum and Capabilities Skills	How imparted during the Course
1.	Knowledge	Group Project work
2.	Understanding	Group Project work
3.	Critical Skills	Group Project work
4.	Analytical Skills	Group Project work
5.	Problem Solving Skills	Group Project work
6.	Practical Skills	Group Project work
7.	Group Work	Group Project work
8.	Self Learning	Group Project work
9.	Written Communication Skills	Report writing
10.	Verbal Communication Skills	Presentation
11.	Presentation Skills	Presentation

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12.	Behavioural Skills	Group Project work
13.	Information Management	Group Project work
14.	Leadership Skills	Effective management of learning, time management, achieving the learning outcomes

9. **Course Resources**

a. Essential Reading

1. Assigned reading relevant to the group project.

10. **Course Organization**

Course Code	BTP601A	
Course Title	Group Project	
Course Supervisors Name	Allotted on project basis	
Course Supervisors Contact Details	**Phone:**	080-49066666
	E-mail:	hod.bt.ls@msruas.ac.in
Course Specifications Approval Date	Feb 2025	
Next Course Specifications Review Date:	Jan 2027	

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ELECTIVE I

Course Specifications: Introductory Pharmacokinetics and Pharmacodynamics

Course Title	Introductory Pharmacokinetics and Pharmacodynamics
Course Code	BTE601A
Department	Biotechnology
Faculty	Life and Allied Health Sciences

1. **Course Summary**

This course provides an introduction to the fundamental principles of pharmacokinetics and pharmacodynamics, with a focus on understanding how drugs move through and act within the body. Students will explore how drug concentrations fluctuate in various compartments and the factors influencing these changes, such as absorption, distribution, metabolism, and excretion. The course also covers the mechanisms of drug action, with relevant examples across major drug categories. Through this course, students will gain a foundational understanding of how drugs interact with the body and the factors that determine their therapeutic effectiveness.

2. **Course Size and Credits:**

Number of credits	03
Total Hours of Classroom Interaction	45
Number of tutorial hours	00
Number of semester weeks	16
Department responsible	Biotechnology
Course Marks	Total Marks: 100
Pass Requirement	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

Teaching, Learning and Assessment

3. **Course Outcomes**

After undergoing this course students will be able to:

CO1: Explain the fundamental principles of pharmacology, including drug-receptor interactions, therapeutic drug monitoring, and the role of pharmacology in biomedical sciences and biotechnology applications.

CO2: Evaluate the principles of drug movement (ADME) and metabolism, and assess the factors influencing drug absorption, distribution, and elimination, including genetic variations and enzymatic activities.

CO3: Describe the molecular mechanisms of drug action, including the roles of agonists, antagonists, and the therapeutic index, and analyse the clinical implications of drug toxicity, side effects, and drug interactions.

CO4: Assess and apply knowledge of various drug delivery systems, including controlled release mechanisms, drug pumps, nanotechnology, and targeted delivery, to regulate drug concentrations within the body.

CO5: Analyse and evaluate pharmacological treatments for neurological and oncological conditions, focusing on drug therapies for neurodegenerative diseases, psychiatric disorders, and cancer, with an emphasis on personalized medicine and advanced drug delivery systems.

4. Course Contents

Unit 1: Introduction to Pharmacology **9h**

Overview of pharmacology, drug-receptor interactions, therapeutic drug monitoring, basic pharmacodynamic concepts, pharmacokinetic models, compartmental models, plasma drug concentration versus time curves, bioavailability, protein binding of drugs, half-life of drugs, first-pass effect, cytochrome P450 enzyme system, introduction to drug-metabolizing enzymes, the role of kidneys and liver in drug elimination, therapeutic index and safety margins.

Unit 2: Principles of Drug Movement and Metabolism **9h**

Absorption mechanisms, factors influencing drug absorption (e.g., pH, ionization), drug distribution, volume of distribution and body fluids, clearance, first-order and zero-order elimination, elimination rates, elimination rate constant, half-life, relationship among pharmacokinetic parameters, intravenous bolus dose model, continuous infusions, loading dose, multiple intravenous infusions (intermittent infusions), lipid solubility of the drug, physiologic model, renal elimination, hepatic clearance, drug metabolism, phase I and II metabolism, cytochrome P450 enzymes, drug-metabolizing enzymes, genetic variations in drug metabolism, and drug-drug interactions.

Unit 3: Mechanisms of Drug Action **8h**

Molecular mechanisms of drug action, Drug-receptor interactions, agonists, antagonists, competitive antagonism, non-competitive antagonism, allosteric antagonism, inverse agonists, dose-response relationship, therapeutic index, potency, efficacy, calculation of drug synergy, partial agonists, drug toxicity, side effects, drug interactions, drug-receptor binding, signal transduction mechanisms, G-protein coupled receptors (GPCRs), enzyme-linked receptors, ion channel-linked receptors, second messengers, receptor desensitization.

Unit 4: Drug Delivery Systems and Drug Concentration Regulation **5h**

Nanotechnology-based drug delivery, liposomal drug delivery, controlled-release systems, drug pumps, implantable drug delivery systems, targeted drug delivery, bioavailability, bioequivalence, challenges in drug delivery, advances in drug delivery systems.

Unit 5: Application of Drugs for the Nervous System **7h**

Muscarinic and nicotinic drug systems, adrenergic, serotonergic, and dopaminergic systems, neuropharmacology of neurodegenerative diseases (e.g., Parkinson's, Alzheimer's), pharmacotherapies for neurological disorders (e.g., antiepileptics, antidepressants), mechanisms of drug action in the central nervous system, blood-brain barrier and its impact on drug delivery, drug therapies in pain management, and the role of neurotransmitters in mental health.

Unit 6: Application of Drugs in Cancer Treatment **7h**

Chemotherapy, targeted therapies, immunotherapies, mechanisms of action of anti-cancer drugs (e.g., cytotoxic agents, DNA-damaging agents), drug resistance mechanisms (e.g., multi-drug resistance, efflux pumps), combination therapy in oncology, synergistic effects in multi-drug regimens, personalized medicine in oncology (genetic profiling, individualized treatment plans), biomarkers in cancer treatment (diagnostic, prognostic, and predictive biomarkers).

5. **CO-PO-PSO mapping**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO3
CO 1	3	-	1	-	-	-	-	2	3	-	-	-
CO 2	3	-	2	-	-	-	-	2	3	-	-	-
CO 3	3	2	2	-	-	-	-	2	2	-	-	-
CO 4	3	3	3	-	1	-	-	3	3	-	2	-
CO 5	2	3	3	-	1	-	-	3	3	-	2	-
3: High Influence, 2: Moderate Influence, 1: Low Influence												

6. **Course Teaching and Learning Methods**

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		16
Demonstrations		02
1. Demonstration using Videos	02	
2. Demonstration using Physical Models /		
3. Demonstration on a Computer		
Numeracy		
1. Solving Numerical Problems		
Practical Work		
1. Course Laboratory		
2. Computer Laboratory		

3. Engineering Workshop / Course/Workshop / Kitchen		
4. Clinical Laboratory		
5. Hospital		
6. Model Studio		
Others		22
1. Case Study Presentation	10	
2. Guest Lecture	02	
3. Industry / Field Visit		
4. Brain Storming Sessions	02	
5. Group Discussions	06	
6. Discussing Possible Innovations	02	
Term Test and Written Examination		5
Total Duration in Hours		45

7. Course Assessment and Reassessment

The components and subcomponents of course assessment are presented in the Academic Regulations document pertaining to the Programme. The procedure to determine the final course marks is also presented in the Academic Regulations document as well.

The assessment questions are set to test the course learning outcomes. In each component or subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

Focus of Course Learning Outcomes in each component assessed			
	CE (50% Weightage)		**SEE (50% Weightage)**
	SC1	**SC2**	
	50 Marks	25 Marks	100 Marks
CO-1	X		X
CO-2	X		X
CO-3		X	X
CO-4		X	X
CO-5	X	X	X

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of course outcomes in each component assessed in the above template at the beginning of the semester.

Course reassessment policies are also presented in the Academic Regulations document.

8. Achieving Course Learning Outcomes

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

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S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	Small group discussion
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, examination
10.	Verbal Communication Skills	Class discussions
11.	Presentation Skills	Group presentation
12.	Behavioral Skills	Group presentation
13.	Information Management	Assignment
14.	Personal Management	Small group discussion
15.	Leadership Skills	Small group discussion

9. Course Resources

a References

1. Brunton, L.L., Hilal-Dandan, R. and Knollmann, B.C. (eds.), 2018. Goodman and Gilman's The Pharmacological Basis of Therapeutics. 13th ed. New York: McGraw Hill.
2. Rowland, M. and Tozer, T.N., 2010. Clinical Pharmacokinetics and Pharmacodynamics: Concepts and Applications. 4th ed. Philadelphia: Wolters Kluwer.

b. Magazines and Journals

a. The Dosing Institute. Online Resources from the Dosing Institute. Available at: https://dosinginstitute.com/

b. Ernstmeyer, K. and Christman, E. (eds.), 2023. Nursing Pharmacology. 2nd ed. Eau Claire, WI: Chippewa Valley Technical College. Chapter 1: Pharmacokinetics & Pharmacodynamics. Available at: https://www.ncbi.nlm.nih.gov/books/NBK595006/

10. Course Organization

Course Code	BTE601A	
Course Title	Introductory Pharmacokinetics & Pharmacodynamics	
Course Leader/s Name	As per time table	
Course Leader Contact Details	**Phone:**	08045366666
	E-mail:	hod.bt.ls@msruas.ac.in
Course Specifications Approval Date	Feb 2025	
Next Course Specifications Review	Jan 2027	

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Course Specifications: Synthetic Biology

Course Title	Synthetic Biology
Course Code	BTE602A
Department	Biotechnology
Faculty	Life and Allied Health Sciences

1. **Course Summary**

The objectives of this module will be to teach students the new areas that make up Synthetic Biology which include engineering biology, engineering principles, mathematical modeling, microbiology, molecular biology, biochemical engineering and chemistry.

In addition to academic learning the students will learn how to design specific elements in Synthetic Biology though group and individual work. They will gain experience of verbal, written and visual communication of the designs and topics.

2. **Course Size and Credits:**

Number of credits	03
Total hours of class room interaction	45
Number of tutorial hours	00
Number of semester weeks	16
Department responsible	Department of Biotechnology
Course marks	Total: 100
Pass requirement	As per Academic Documents
Attendance requirement	As per Academic Documents

Teaching, Learning and Assessment

2. **Course Outcome (CO)**

After undergoing this course students will be able to:

CO 1. Understand the importance and basic concepts of synthetic biology
CO 2. Overview of the methods and techniques commonly used in synthetic biology. Develop a scientific approach to the planning, execution, reporting and interpretation of advanced projects with the aim at creating replicating systems with new properties that can be regulated,
CO 3. Gain theory-level information on the current trends in protein designing protocols and methods
CO 4. Analyze and model independently, biological systems. Gain hands-on training to build simple models to better understand genetic regulation and metabolism
CO 5. Develop a scientific approach to entirely synthesize *Escherichia coli* with a recoded genome
CO 6. Gain knowledge on computational modelling techniques

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3. **Course Content**

Unit I **5h**

Introduction: Definition, scope and significance of synthetic biology. Differences between systems biology and synthetic biology. Interdisciplinarity in synthetic biology: integrating biology, computational sciences & Genetic engineering. Basic overview of its applications e.g., Biofuels, Bioremediation and personalized medicines

Unit II **9h**

Advanced Molecular Tools & Methods in synthetic biology: Basics of cloning, mutagenesis, polymerase chain reaction, synthesis of nucleic acids, DNA sequence determination, Recombinant DNA technologies, **DNA synthesis and Assembly:** Golden gate assembly, Gibson assembly and Biobrick standards. **Genome editing technologies:** Transposons, Recombinases, Zinc Fingers, TALEN's, CRISPR/Cas9.

Unit III **8h**

Proteins & Pathway engineering: Rational design, directed evolution, de novo protein design, semi-rational protein design, Computational methods of protein design. Multi-gene editing tools, Applications of pathway engineering to agriculture and personalized medicines

Unit IV **8h**

Computational and mathematical modeling: Gene Regulatory Networks (GRNs): Fundamental Concepts of Ordinary Differential Equations (ODE), Boolean networks. **Databases and softwares**: GRAND, GENECK, NetworkAnalyst. **Metabolic Networks:** Genome scale metabolic models (GEMs), iGEM, Constraints based metabolic modelling-Flux Balance Analyses (FBA), Key applications to metabolic engineering.

Unit V **7h**

Recoding Genomes: Benefits and applications of recoded genomes. Basic concepts on codon reassignment, synonymous mutations, recoded E. coli genome using MAGE, CAGE, Recoded viral, yeast and C. elegans genome.

Unit VI **8h**

Real world applications of synthetic biology: Production of synthetic vaccines, engineered probiotics and gene therapy. Production of stress-resistant crops, synthetic pheromones. Production of Biofuels, Bioplastics and other high value chemicals.

4. CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO3
CO 1	3	-	-	-	-	-	-	-	3	-	-	-
CO 2	-	3	3	-	-	-	-	-	3	-	-	-
CO 3	2	3	3	-	-	-	-	-	3	-	-	-
CO 4	-	-	-	3	2	-	-	-	-	2	-	-
CO 5	-	-	3	-	3	-	-	-	-	2	-	-
CO-6	-	2	-	-	3	-	-	-	-	2	-	-
3: High Influence, 2: Moderate Influence, 1: Low Influence												

5. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		24
Demonstrations		07
1. Demonstration using Videos	05	
2. Demonstration using Physical Models /		
3. Demonstration on a Computer	02	
Numeracy		02
1. Solving Numerical Problems	02	
Practical Work		04
1. Course Laboratory		
2. Computer Laboratory	04	
3. Engineering Workshop / Course/Workshop / Kitchen		
4. Clinical Laboratory		
5. Hospital		
6. Model Studio		
Others		03
1. Case Study Presentation		
2. Guest Lecture	02	
3. Industry / Field Visit		
4. Brain Storming Sessions		
5. Group Discussions	01	
6. Discussing Possible Innovations		
Term Test and Written Examination		05
Total Duration in Hours		45

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6. Course Assessment and Reassessment

The components and subcomponents of course assessment are presented in the Academic Regulations document pertaining to the Programme. The procedure to determine the final course marks is also presented in the Academic Regulations document as well.

The assessment questions are set to test the course learning outcomes. In each component or subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

Focus of Course Learning Outcomes in each component assessed				
	CE (50% Weightage)			SEE (50% Weightage)
	SC1	SC2	SC3	
	50 Marks	25 Marks	25 Marks	100 Marks
CO-1	x	x		x
CO-2	x	x		x
CO-3	x	x		x
CO-4	x		x	x
CO-5			x	x
CO-6			x	x

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of course outcomes in each component assessed in the above template at the beginning of the semester.

Course reassessment policies are also presented in the Academic Regulations document.

7. Achieving Course Learning Outcomes

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

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8. **Course Resources**

a. **References**

1. Huimin Zhao (ed.) (2013) Synthetic Biology. Academic Press. ISBN: 9780123944306.
2. Gibson, D. G., Hutchison III, C. A., Smith, H. O., & Venter, J. C. (eds.) (2014) Synthetic Biology: Tools for Engineering Biological Systems. Cold Spring Harbor Laboratory Press. ISBN: 978-1-621821-18-2.
3. Baldwin, G. & Bayer, T. (2016) Synthetic Biology - A Primer (Revised Edition). Imperial College Press. ISBN: 9781783268795.
4. Weber, W. & Fussenegger, M. (eds.) (2017) Synthetic Gene Networks: Methods and Protocols. Springer Protocol. ISBN: 978-1493962242.

b. **Magazines and Journals**

1. Nature. Synthetic Biology. Available at: https://www.nature.com/subjects/synthetic-biology
2. Elsevier. Current Opinion in Systems Biology. Available at: https://www.journals.elsevier.com/current-opinion-in-systems-biology

10. **Course Organization**

Course Code	BTE602A	
Course Title	Synthetic Biology	
Course Leader/s Name	As per time table	
Course Leader Contact Details	**Phone:**	08045366666
	E-mail:	hod.bt.ls@msruas.ac.in
Course Specifications Approval Date	Feb 2025	
Next Course Specifications Review	Jan 2027	

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Course specifications: Genomics and Proteomics

Course Title	Genomics and Proteomics
Course Code	BTE603A
Department	Biotechnology
Faculty	Life and Allied Health Sciences

1. Course Summary

This course is designed to provide students with a comprehensive understanding of the advanced methodologies in Genomics and Proteomics. Participants will gain proficiency in the fundamental concepts of proteomics, empowering them to identify and compare proteins expressed in a specific genome under distinct conditions. The curriculum emphasizes the study of protein interactions, utilizing acquired knowledge to predict cellular behavior and formulate potential drug targets. Skills will be honed through training in analysis of DNA sequencing and protein mass spectrometry data.

2. Course Size and Credits:

Number of credits	03
Total hours of class room interaction	45
Number of tutorial hours	00
Number of semester weeks	16
Department responsible	Department of Biotechnology
Course marks	Total: 100
Pass requirement	As per Academic Documents
Attendance requirement	As per Academic Documents

Teaching, Learning and Assessment

3. Course Outcome (CO)

After undergoing this course students will be able to:

CO 1. Explain the genome organization in Prokaryotes and Eukaryotes.

CO 2. Detail the principles and methods of DNA sequencing and whole genome sequencing.

CO 3. Compare the different methods of estimating and separating protein

CO 4. Explain the high-throughput analysis of gene function

CO 5. Explain clinical significance of Gene and protein manipulation techniques

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4. Course Contents

Unit I **9h**

Fundamentals of Genomics and Proteomics: Introduction to genomics, transcriptomics, and proteomics, Genome and proteome organization in prokaryotes and eukaryotes, plasmids, DNA cloning basics, DNA sequencing – Sanger sequencing, Pyrosequencing; Tools for genome analysis- restriction mapping, RFLP

Unit II **9h**

Genomics Technologies and Applications: Genome maps – physical and genetic maps. Genome Sequencing: Human Genome Project, Shotgun & Hierarchical (clone contig) methods, genome assembly. NGS techniques – Illumina, PacBio, Oxford Nanopore. Genome assembly, annotation, and functional elements in the genome

Unit III **9h**

Functional Genomics and Transcriptomics: Transcriptomics approaches: RNA-Seq, microarrays, and single-cell transcriptomics. Gene editing technologies: CRISPR-Cas systems and applications. Functional assays and genetic screens

Unit IV **9h**

Proteomics Principles and Techniques: Protein structure, function, and interactions, Proteomics workflows: sample preparation, separation techniques, Mass spectrometry. Quantitative proteomics: label-based (SILAC, iTRAQ) and label-free methods. Post-translational modifications (PTMs) and their functional implications

Unit V **9h**

Applications of genomics and proteomics: Protein-protein interaction (Two hybrid interaction screening), mapping protein modifications, future directions, Multi-omics approaches: combining genomics, proteomics, and metabolomics

5. CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO3
CO 1	-	-	3	-	-	-	-	-	3	-	-	-
CO 2	-	-	3	-	-	-	-	-	-	3	-	-
CO 3	-	-	2	2	-	-	-	-	-	3	-	-
CO 4	-	-	3	3	-	-	-	-	-	3	-	-
CO 5	-	2	-	3	1	-	-	-	-	3	-	-

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CO-6	-	-	3	-	-	2	2	-	-	-	3	-
3: High Influence, 2: Moderate Influence, 1: Low Influence												

6. **Course Teaching and Learning Methods**

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		35
Demonstrations		02
1. Demonstration using Videos	01	
2. Demonstration using Physical Models /		
3. Demonstration on a Computer		
Numeracy		
1. Solving Numerical Problems	01	
Practical Work		
1. Course Laboratory		
2. Computer Laboratory		
3. Engineering Workshop / Course/Workshop / Kitchen		
4. Clinical Laboratory		
5. Hospital		
6. Model Studio		
Others		03
1. Case Study Presentation		
2. Guest Lecture	01	
3. Industry / Field Visit		
4. Brain Storming Sessions		
5. Group Discussions	02	
6. Discussing Possible Innovations		
Term Test and Written Examination		5
Total Duration in Hours		45

7. Course Assessment and Reassessment

The components and subcomponents of course assessment are presented in the Academic Regulations document pertaining to the Programme. The procedure to determine the final course marks is also presented in the Academic Regulations document as well.

The assessment questions are set to test the course learning outcomes. In each component or subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

Focus of Course Learning Outcomes in each component assessed				
	CE (50% Weightage)			SEE (50% Weightage)
	SC1	SC2	SC3	
	50 Marks	25 Marks	25 Marks	100 Marks
CO-1	x	x		x
CO-2	x	x		x

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CO-3	x	x		x
CO-4	x		x	x
CO-5			x	x

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of course outcomes in each component assessed in the above template at the beginning of the semester.

Course reassessment policies are also presented in the Academic Regulations document.

8. Achieving Course Learning Outcomes

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. **Essential Reading**

1. L. Stryer, 2007, *Biochemistry,* W. H. Freeman and Co., New York
2. Brown TA, 2006, *Genomes*, 3rd Edition. Garland Science.
3. Primrose. S , Twyman. R, 2006, *Principles of Gene Manipulation and Genomics*, 7th Edition, Blackwell.
4. Glick .BR , Pasternak. JJ, 2010, *Molecular Biotechnology*, ASM Press,
5. Lovric, J. 2011, *Introducing Proteomics by Josip*, Wiley-Blackwell
6. Liebler, D. C. 2002, *Introduction to Proteomics: Tools for the New Biology.* Totowa, NJ: Humana Press.

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b. **Magazines and Journals**

1. Nature. Nature Cell Biology. Available at: https://www.nature.com/ncb/
2. American Society for Microbiology. Molecular and Cellular Biology. Available at: http://mcb.asm.org/
3. BioMed Central. BMC Cell Biology. Available at: https://bmccellbiol.biomedcentral.com/
4. Cells Alive. Interactive Cell Biology Resources. Available at: https://www.cellsalive.com/
5. University of Arizona. Cell Biology Education Resources. Available at: http://www.biology.arizona.edu/cell_bio/cell_bio.html
6. National Centre for Biological Sciences (NCBS). Cell Biology Course – Jan Term 2018. Available at: https://www.ncbs.res.in/course/jan-term-2018/cell-biology

10. Course Organization

Course Code	BTE603A	
Course Title	Genomics and Proteomics	
Course Leader/s Name	As per time table	
Course Leader Contact Details	**Phone:**	08045366666
	E-mail:	hod.bt.ls@msruas.com
Course Specifications Approval Date	Feb 2025	
Next Course Specifications Review	Jan 2027	

Course Specifications: Medical Biotechnology

Course Title	Medical Biotechnology
Course Code	BTE604A
Department	Biotechnology
Faculty	Life and Allied Health Sciences

1. Course Summary

This course aims to familiarize students with the biotechnological advancements in medicine, including diagnostics, therapeutics and health care strategies. The students will get acquainted with the emerging trends in the field of medical biotechnology. They will also gain insight on the future trends and prospects in biotechnological research pertaining to the field of medicine.

2. Course Size and Credits:

Number of credits	03
Total hours of class room interaction	45
Number of tutorial hours	00
Number of semester weeks	16
Department responsible	Department of Biotechnology
Course marks	Total: 100
Pass requirement	As per Academic Documents
Attendance requirement	As per Academic Documents

Teaching, Learning and Assessment

3. Course Outcome (CO)

After undergoing this course students will be able to:

CO 1. Outline the biotechnological tools in disease diagnosis

CO 2. Distinguish various molecular therapeutic approaches to diseases

CO 3. Explain the role of microbes in therapeutic applications

CO 4. Summarize the recent trends in medical biotechnology

CO 5. Illustrate strategies and techniques used in drug development

CO 6. Discuss the importance of clinical research in medicine

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4. **Course Content**

Unit I **7h**

Disease diagnosis-probe: PCR, LCR immunological assay. Detection of genetic, Neurogenetic disorders involving Metabolic and Movement disorders. Detection of mutations in neoplastic diseases PCR, SSCP, DGGE, HET, PTT, ASO etc.

Unit II **8h**

Molecular therapeutics: Gene therapy, barriers to gene delivery, overview of inherited and acquired diseases for gene therapy; Retro and adeno virus mediated gene transfer; Liposome mediated gene delivery. Cellular therapy; use of stem cells. Streptokinase and urokinase in thrombosis. Medical products developed by using biotechnology tools - Antibiotics, Recombinant Insulin, Erythropoietin, Vaccines, Monoclonal antibodies, Bioengineered tissues, Adult stem cell therapy.

Unit III **7h**

Application of microbes in Medical biotechnology: Antimicrobial drugs, Antibiotic production, Penicillin production, Streptomycin production, Synthesis of vitamin B12 using microbes, Production of enzymes by using microbes, Microbial biotransformation - Biotransformation of antibiotics, Biotransformation of steroids, Challenges of treating microbial infections - Mechanism of drug resistance, Drug-resistant microorganisms, Solution for drug-resistant microorganisms.

Unit IV **7h**

Trends in Medical biotechnology: Embryonic stem cells, Human genome project and its significance, RNA interference technology, Phage therapy, Recombinant DNA technology, Biochips, Liposome-based drug delivery, Nanobiotechnology - introduction, types and synthesis of nanomaterials, protein-based nano structures, DNA-based nano structures, Applications of nanomaterials, nano biosensors, drug and gene delivery, disease diagnostics and therapy, risk potential of nanomaterials.

Unit V **8h**

Drug development: Introduction, Drugs, drug receptors, Relationship between drug concentration and response, agonists, drug clearance, biological half-life, drugs accumulation, basic concepts of toxic effect: Conventional drug design approaches, irrational Vs rational, Lipinski's rule of five, ADME, Calculation of LD 50 and ED 50. Acute, subacute and chronic toxicity studies. Irwin profile test, Drug development process (Preclinical, clinical and toxicological studies). Novel Drug Development approaches - QSAR (quantitative structure activity relationship), High throughput screening.

Unit VI **8h**

Clinical Research: Importance of clinical research, Mile stones of regulations. FDA, US, Indian clinical research, global scenario of clinical research, Regulatory agency. Designing clinical trials- History, principles, scheme for conducting clinical trials, planning defining, objectives, variables, study populations, testable hypothesis, prediction of errors and bioselection of appropriate study design, Execution steps. Ethical Issues in clinical research-

Introduction, codes, declaration and guidelines, Informed consent, special issues, Roles and responsibilities of IRBS, issues with ethics review. ICH-GCP- History of ICH, Objectives, ICH structure, Guidelines, Future of ICH.

5. CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO3
CO 1	3	-	-	-	-	-	-	-	-	-	-	3
CO 2	3	-	-	-	-	-	-	-	-	-	-	3
CO 3	3	-	-	-	-	-	-	-	-	-	-	3
CO 4	-	-	-	-	3	-	-	-	-	-	1	-
CO 5	1	-	-	-	3	-	-	-	-	-	-	3
CO-6	-	-	3	-	3	-	-	-	-	-	-	3
3: High Influence, 2: Moderate Influence, 1: Low Influence												

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		24
Demonstrations		06
1. Demonstration using Videos	05	
2. Demonstration using Physical Models /	01	
3. Demonstration on a Computer		
Numeracy		
1. Solving Numerical Problems		
Practical Work		
1. Course Laboratory		
2. Computer Laboratory		
3. Engineering Workshop / Course/Workshop / Kitchen		
4. Clinical Laboratory		
5. Hospital		
6. Model Studio		
Others		05
1. Case Study Presentation		
2. Guest Lecture	02	
3. Industry / Field Visit		
4. Brain Storming Sessions		
5. Group Discussions	02	
6. Discussing Possible Innovations	01	
Term Test and Written Examination		10

Total Duration in Hours	45

7. Course Assessment and Reassessment

The components and subcomponents of course assessment are presented in the Academic Regulations document pertaining to the Programme. The procedure to determine the final course marks is also presented in the Academic Regulations document as well.

The assessment questions are set to test the course learning outcomes. In each component or subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

Focus of Course Learning Outcomes in each component assessed				
	CE (50% Weightage)			**SEE (50% Weightage)**
	SC1	**SC2**	**SC3**	
	50 Marks	25 Marks	25 Marks	100 Marks
CO-1	x	x		x
CO-2	x	x		x
CO-3	x	x		x
CO-4	x		x	x
CO-5			x	x
CO-6			x	x

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of course outcomes in each component assessed in the above template at the beginning of the semester.

Course reassessment policies are also presented in the Academic Regulations document.

8. Achieving Course Learning Outcomes

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--

12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. **Course Resources**

a. References

1. Pongracz, J., Keen, M., 2008, *Medical Biotechnology*, 1st Edition, Elsevier publications.
2. Jogdand, S.N., 2008, *Medical Biotechnology*, 2nd Edition, Himalaya publishers.
3. Katzung, B.G., 2004, *Basic and Clinical Pharmacology*, 9th Edition, Mc Graw Hill Publications.

b. Magazines and Journals

1. Nature Biotechnology, Nature. Available at: https://www.nature.com/nbt/
2. Medical Biotechnology, iMedPub. Available at: http://www.imedpub.com/scholarly/medical-biotechnology-journals-articles-ppts-list.php

10. **Course Organization**

Course Code	BTE604A	
Course Title	Medical Biotechnology	
Course Leader/s Name	As per time table	
Course Leader Contact Details	**Phone:**	08045366666
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Course Specifications Approval Date	Feb 2025	
Next Course Specifications Review	Jan 2027	

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Course specifications: AI/ML in Healthcare

Course Title	**AI/ML in Healthcare**
Course Code	BTE605A
Department	Biotechnology
Faculty	Life and Allied Health Sciences

1. Course Summary

The aim of this course is to trail the students on the role of artificial intelligence in various health care systems.

The students will first be familiarized with the concepts of AI, machine learning, and deep learning. Students will be taught simple algorithms in AI to give them an understanding of the strengths and limitations of AI.

The students will be familiarized with the needs applications, innovations and challenges to AI in health care systems. Students will be shows case-studies where AI was used for the early detection and diagnosis of diseases. Finally, students will be cautioned about ethical ramifications related to the use of AI.

2. Course size and credits

Number of credits	03
Total hours of class room interaction	45
Number of tutorial hours	00
Number of semester weeks	16
Department responsible	Department of Biotechnology
Course marks	Total: 100
Pass requirement	As per Academic Documents
Attendance requirement	As per Academic Documents

3. Course Outcomes

After undergoing this course students will be able to:

CO 1. Demonstrate the understanding and knowledge regarding to the needs of AI in healthcare

CO 2. Describe simple algorithms in the domain of artificial intelligence

CO 3. Describe simple algorithms in the domain of machine learning

CO 4. Describe the possibilities of applications of AI to healthcare

CO 5. Describe the ethical issues related to AI in health care sector

CO 6 Explore methods to overcome the challenges of AI in the healthcare domain; and ways in which AI will support and assist towards better healthcare

4. Course Contents

Unit I **5h**

Introduction to AI, Basics of AI- the differences between AI, machine learning, and deep learning. Strengths and limitations of AI.

Unit II **10h**

Simple algorithms in AI. Game theory and Nash equilibrium. Description of the zero sum game. Solving a zero sum game using minimax and decision trees. A brief introduction to pathfinding and graph theory. Representing a graph as machine-readable data. The Bridges of Konigsberg problem. Prim's, Kruskal's and Dijkstra's algorithms. Cyclic coordinate descent and robotics.

Unit III **10h**

Simple algorithms in machine learning: Gradient descent, linear regression, logistic regression, K-means clustering, principal component analysis (PCA), and support vector machines (SVM).

Unit IV **10h**

AI in Health Care and Research; AI in medical diagnosis, AI in major healthcare specialties such as Radiology, Pathology, Surgery, Cardiology, Pharmacy and Orthopaedics, AI in early detection, medical treatment and public health

Unit V **5h**

Application of machine learning and deep learning in healthcare, machine learning in radiology, AI for computational pathology

Unit VI **5h**

Challenges of AI in Health care, Ethical and social issues related to AI and Health care

5. CO-PO PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO3
CO 1	3	-	-	-	-	-	-	-	3	-	-	-
CO 2	3	-	-	-	-	-	-	-	3	-	-	-
CO 3	3	2	2	2	-	-	-	-	3	-	-	-
CO 4	-	2	2	2	-	-	-	-	3	-	-	-

CO 5	-	2	2	2	-	-	-	-	-	1	-	-
CO-6	-	2	2	2	-	-	-	-	-	1	-	-
3: High Influence, 2: Moderate Influence, 1: Low Influence												

6. Course Teaching and Learning Methods

	Duration in hours	Total Duration in Hours
Face to Face Lectures		34
Demonstrations		
1. Demonstration using Videos	1	2
2. Demonstration using Physical Models/Systems	1	
3. Demonstration on a Computer		
Numeracy		
1. Solving Numerical Problems		
Practical Work		
1. Course Laboratory		
2. Computer Laboratory		
3. Engineering Workshop/Course Workshop/Kitchen		
4. Clinical Laboratory		
5. Hospital		
6. Model Studio		
Others		
1. Case Study Presentation		4
2. Guest Lecture	1	
3. Industry/Field Visit		
4. Brain Storming Sessions		
5. Group Discussions	2	
6. Discussing Possible Innovations	1	
Term Test and Written Examination		05
Total Duration in Hours		45

7. Course assessment and reassessment

The components and subcomponents of course assessment is presented in the Academic Regulations document pertaining to the Programme. The procedure to determine the final course marks is also presented in the Academic Regulations document as well.

The assessment questions are set to test the course learning outcomes. In each component or subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

Focus of Course Learning Outcomes in each component assessed				
	CE (50% Weightage)			**SEE (50% Weightage)**
	SC1	**SC2**	**SC3**	
	50 Marks	25 Marks	25 Marks	100 Marks
CO-1	x	x		x
CO-2	x	x		x

CO-3		x	x	x
CO-4		x	x	x
CO-5		x	x	x
CO-6	x	x	x	x

8. Achieving learning outcomes

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

1. Mahajan, M.D. and Parag, S., 2018. Artificial intelligence in healthcare.
2. Panesar, A., 2019. Machine learning and AI for healthcare: Big data for improved health outcomes.
3. Recommended journal papers.

10. Course Organization

Course Code	**AI/ML in Healthcare**	
Course Title	BTE601A	
Course Leader/s Name	As per Time table	
Course Leader Contact Details	**Phone:**	
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Course Specifications Approval Date	Feb 2025	
Next Course Specifications Review	Jan 2027	

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Course Specifications: Biotherapeutics: Vaccines and Biosimilars

Course Title	Biotherapeutics : Vaccines and Biosimilars
Course Code	BTE606A
Department	Biotechnology
Faculty	Life and Allied Health Sciences

1 Course Summary

This course aims to educate students on the uses of molecular advances in the discovery of protein and other biomolecular drug candidates and their development into biotherapeutics.

This course provides an in-depth exploration of biotherapeutics, vaccines, and biosimilars, focusing on their scientific principles, development processes, regulatory frameworks, and clinical applications. Students will engage with case studies and critical analyses to gain a comprehensive understanding of these cutting-edge biomedical innovations.

2 Course Size and Credits:

Number of credits	03
Total hours of class room interaction	45
Number of tutorial hours	00
Number of semester weeks	16
Department responsible	Department of Biotechnology
Course marks	Total: 100
Pass requirement	As per Academic Documents
Attendance requirement	As per Academic Documents

Teaching, Learning and Assessment

3 Course Outcome (CO)

After undergoing this course students will be able to:

CO 1. Understand the foundational principles of biotherapeutics, vaccines, and biosimilars.

CO 2. Analyze the production and development pipelines for these biomedical products.

CO 3. Evaluate regulatory, ethical, and market considerations in the biotherapeutics industry.

CO 4. Develop critical insights into the challenges and innovations in vaccine development.

CO 5. Synthesize interdisciplinary knowledge to address complex challenges in biotherapeutics, vaccines, and biosimilars.

4 Course Contents

Unit 1 **7h**

Introduction to Biotherapeutics: Definition, scope, and types of biotherapeutics, Applications of recombinant proteins, monoclonal antibodies (mAbs), and cell and gene therapies, Molecular biology foundations: protein structure-function relationships, Techniques such as CRISPR, recombinant DNA technology, and monoclonal antibody production

Unit 2 **8h**

Principles and Development of Vaccines: Basics of immunology and vaccinology, Mechanisms of the immune system and vaccine design, Types of vaccines: live-attenuated, inactivated, mRNA, protein subunit, and viral vector vaccines; Vaccine development pipeline: preclinical studies, clinical trials, and manufacturing, Challenges in global vaccine distribution: cold chain logistics and equitable access. Case study: Development of COVID-19 mRNA vaccines

Unit 3 **7h**

Biosimilars: Definitions and differences between biosimilars and generics, Market trends and economic considerations, Development and regulatory pathways for biosimilars, International guidelines (FDA, EMA, WHO) and Indian frameworks (CDSCO), Analytical characterization and comparability studies. Case studies: Filgrastim and Infliximab

Unit 4 **8h**

Emerging Technologies in Biotherapeutics

Cutting-edge technologies: artificial intelligence and machine learning in drug design, Monoclonal antibodies (mAbs): Structure, function, and engineering advancements, Applications of mAbs in oncology, autoimmune disorders, and infectious diseases, Emerging therapeutic modalities: CAR-T cell therapy and gene therapy for rare genetic diseases. Innovative approaches to treating previously untreatable conditions, Future prospects and challenges in the biotherapeutics field

Unit 5 **7h**

Ethical and Social Implications: Ethical considerations in biotherapeutics and vaccine development, Balancing innovation and patient safety, Challenges in clinical trials and ensuring equitable access, Addressing societal implications: global health disparities and accessibility, Integration of scientific goals with ethical and commercial considerations

Unit 6 **8h**

Case Studies

Real-world applications connecting theory with practice, Development and impact of Imatinib (Gleevec) as a targeted therapy. Monoclonal antibodies: Case studies on Trastuzumab and Rituximab. Global implications of COVID-19 mRNA vaccines. Lessons from successes and challenges in biotherapeutics and vaccine development

5 CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO3
CO 1	-	-	3	-	-	-	-	-	-	-	-	3
CO 2	1	-	3	-	-	-	-	-	-	-	-	3
CO 3	1	-		-	-	-	-	-	-	-	-	3
CO 4	-	-	3	-	-	-	-	-	-	-	2	-
CO 5	-	-	3	2					-	-	2	3
3: High Influence, 2: Moderate Influence, 1: Low Influence												

6 Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		30
Demonstrations		
1. Demonstration using Videos	04	05
2. Demonstration using Physical Models /	01	
3. Demonstration on a Computer		
Numeracy		
1. Solving Numerical Problems		
Practical Work		
1. Course Laboratory		
2. Computer Laboratory		
3. Engineering Workshop / Course/Workshop / Kitchen		
4. Clinical Laboratory		
5. Hospital		
6. Model Studio		
Others		
1. Case Study Presentation		
2. Guest Lecture	02	05
3. Industry / Field Visit		
4. Brain Storming Sessions		
5. Group Discussions	02	
6. Discussing Possible Innovations	01	
Term Test and Written Examination		5
Total Duration in Hours		45

7 Course Assessment and Reassessment

The components and subcomponents of course assessment are presented in the Academic Regulations document pertaining to the Programme. The procedure to determine the final course marks is also presented in the Academic Regulations document as well.

The assessment questions are set to test the course learning outcomes. In each component or subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

Focus of Course Learning Outcomes in each component assessed				
	CE (50% Weightage)			**SEE (50% Weightage)**
	SC1	**SC2**	**SC3**	
	50 Marks	25 Marks	25 Marks	100 Marks
CO-1	x	x		x
CO-2	x	x		x
CO-3	x	x		x
CO-4			x	x
CO-5			x	x

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of course outcomes in each component assessed in the above template at the beginning of the semester.

Course reassessment policies are also presented in the Academic Regulations document.

8 Achieving Course Learning Outcomes

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9 Course Resources

a. Books

1. Plotkin, S.A., Vaccines: Principles, Practice, and Strategies.
2. Gutka, H.J., Biosimilars: Regulatory, Clinical, and Biopharmaceutical Development.
3. Walsh, G., Biopharmaceuticals: Biochemistry and Biotechnology.

b. Journals

1. Smith, J. and Doe, A., 2021. Advances in mRNA vaccine development. Nature Biotechnology, 39(4), pp.420–428. https://doi.org/10.1038/s41587-021-00812-2.

c. Online Resources

1. World Health Organization (WHO) and U.S. Food and Drug Administration (FDA), Regulatory guidelines.
2. Central Drugs Standard Control Organization (CDSCO), Guidelines for biosimilars in India.
3. Clinical trial registry. Available at: https://clinicaltrials.gov

d. Magazines and Journals

1. BioTherapeutics Inc., https://www.biotherapeuticsinc.com
2. Sorrento Therapeutics, https://sorrentotherapeutics.com
3. G1 Therapeutics, https://www.g1therapeutics.com

10 Course Organization

Course Code	BTE606A	
Course Title	Biotherapeutics : Vaccines and Biosimilars	
Course Leader/s Name	As per Time table	
Course Leader Contact Details	**Phone:**	08045366666
	E-mail:	hod.bt.ls@msruas.ac.in
Course Specifications Approval Date	Feb 2025	
Next Course Specifications Review	Jan 2027	

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Course Specifications: Biosensors: Fundamentals and Applications

Course Title	Biosensors: Fundamentals and Applications
Course Code	BTE607A
Department	Biotechnology
Faculty	Life and Allied Health Sciences

1 Course Summary

The aim of the course is to familiarize students with the biosensor concepts involved in medical and environmental diagnostics, food and agriculture. Students will first be introduced to conventional analogue and digital electronic sensors. Students will be familiarized with a broad range of technical know-how for biosensor development for detection and point-of-care support. They will be trained on the fundamental concepts, development systems, and production processes. They will also be able to explain the various strategies applied to sensor development for medical, and environmental applications and will be able to utilize biotechnological methods for different applications. The students will also be exposed to recent advances in the application of biosensors in health, environment, agriculture, and the food industry.

2 Course Size and Credits:

Number of credits	03
Total hours of class room interaction	45
Number of tutorial hours	00
Number of semester weeks	16
Department responsible	Department of Biotechnology
Course marks	Total: 100
Pass requirement	As per Academic Documents
Attendance requirement	As per Academic Documents

Teaching, Learning and Assessment

3 Course Outcome (CO)

After undergoing this course students will be able to:

CO1. Explain the various components and operating principles of analogue and digital sensors.

CO2. Explain different types of transducers based on their physicochemical characteristics, detection method and technical process

CO3. Apply biosensing techniques in health and the environment.

CO4. Describe cutting-edge biosensor designs and implications for real-life applications.

CO5. Apply biosensing techniques in the agriculture and food industry.

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CO6. Understand the role of biomaterial and nanomaterials in biosensors for signal amplification, detection, and transducer fabrication.

4 **Course Content**

Unit I **7h**

Introduction to analogue and digital sensors: Introduction to sensors, general components of sensors. Classification of sensors: amperometric, voltammetric, optical, acoustic, piezoelectric, fluorescence, colorimetric, and calorimetric sensors. Scope of various biosensors, their advantages, and limitations.

Unit II **7h**

Basic designs and transducers: Design considerations: calibration, dynamic range, signal-to-noise, sensitivity, selectivity, and interference recognition. Types of Transducers: optical, fibre optic, electrochemiluminescence, surface plasmon resonance, electrochemical, impedance, piezoelectric, cantilever. Electrochemical detection methods, redox processes, and electron transfer. Electrochemical cells for measurements, processes at the electrode surface. voltammetry and amperometry, immobilized enzyme-electrodes

Unit III **10h**

Biosensors in health and environment: Biomolecules in biosensors: enzymes, DNA, antigen-antibody, proteins, peptide, aptamer. Microfabricated biosensors and point-of-care diagnostic systems, Non-invasive biosensors in clinical analysis; Surface plasmon resonance and evanescent wave biosensors, Enzyme-based biosensors (ELISA), Antibody-based biosensors, DNA-based biosensors. Immobilization of biomolecules on transducer surfaces. design of enzyme electrodes and their application as biosensors in healthcare. Case study - Biosensors and diabetes management, Biosensors in daily health monitoring, biosensors in cancer and HIV early diagnosis, Detection of viruses and bacteria.

Unit IV **7h**

Design of materials for biomedical application: Working Principle & Application of Smartphones & wearable sensors, Textile-integrated non-contact sensors - Long-term monitoring of respiration and pulse, Flexible Sensors, Conformal Electronics, MEMS, Lab-on-chip.

Unit V **7h**

Biosensors in food and agriculture: Detection of product content, allergic components, pathogens, and pesticide residues. Monitoring of raw material conversions. Detection of crop diseases, and pathogens in plants, Detection of soil nutrients, pesticide, and its residual detection.

Unit VI **7h**

Nanomaterials in biosensors: Carbon-based Nano Material, Metal oxide nanoparticles, Quantum dots, polymer nanocomposites. Methods and measurements of electrode modification. Role of nanomaterial in Signal Amplifications, Detection and Transducer Fabrication.

5 CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO3
CO 1	3	-	-	-	-	-	-	-	3	-	-	-
CO 2	3	3	-	-	-	-	-	-	-	3	-	-
CO 3	3	3	-	-	-	-	-	-	3	2	-	3
CO 4	-	-	-	2	-	-	-	-	3	-	-	-
CO 5	-	-	3	2	-	-	-	-	3	2	-	-
3: High Influence, 2: Moderate Influence, 1: Low Influence												

6 Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		20
Demonstrations		08
1. Demonstration using Videos	03	
2. Demonstration using Physical Models /Laboratory prototype	05	
3. Demonstration on a Computer		
Numeracy		02
1. Solving Numerical Problems	02	
Practical Work		04
1. Course Laboratory		
2. Computer Laboratory		
3. Engineering Workshop / Course/Workshop / Kitchen	04	
4. Clinical Laboratory		
5. Hospital		
6. Model Studio		
Others		06
1. Case Study Presentation	02	
2. Guest Lecture	02	
3. Industry / Field Visit	01	
4. Brain Storming Sessions		
5. Group Discussions	01	
6. Discussing Possible Innovations		
Term Test and Written Examination		05
Total Duration in Hours		45

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7 Course Assessment and Reassessment

The components and subcomponents of course assessment are presented in the Academic Regulations document pertaining to the Programme. The procedure to determine the final course marks is also presented in the Academic Regulations document as well.

The assessment questions are set to test the course learning outcomes. In each component or subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

Focus of Course Learning Outcomes in each component assessed				
	CE (50% Weightage)			SEE (50% Weightage)
	SC1	SC2	SC3	
	50 Marks	25 Marks	25 Marks	100 Marks
CO-1	x	x		x
CO-2	x	x		x
CO-3	x	x		x
CO-4	x		x	x
CO-5			x	x
CO-6			x	x

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of course outcomes in each component assessed in the above template at the beginning of the semester. Course reassessment policies are also presented in the Academic Regulations document.

8 Achieving Course Learning Outcomes

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

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9 Course Resources

a. References

1. Webster, J.G. (ed.), Medical instrumentation: application and design. 4th ed. Hoboken: John Wiley & Sons.
2. Inamuddin, Khan, R., Mohammad, A. and Asiri, A., 2019. Advanced biosensors for health care applications. 1st ed.
3. Chaki, J., Dey, N. and De, D., 2020. Smart biosensors in medical care. 1st ed.
4. Altintas, Z., 2017. Biosensors and nanotechnology: applications in health care diagnostics.
5. Gorton, L. (ed.), 2005. Biosensors and modern bio-specific analytical techniques. Volume XLIV. Elsevier.
6. Malhotra, B.D. and Turner, A.P.F. (eds), 2003. Advances in biosensors. Volume 5. Elsevier Science.

b. Text Books

1. Yoon, J.-Y., 2016. Introduction to biosensors. Springer-Verlag, New York.
2. Zourob, M., 2010. Recognition receptors in biosensors. Springer-Verlag, New York.

c. Magazines and Journals

1. Hunt, R. and Garland, C. (Directors), Naturally Obsessed: The Making of a Scientist [Film]. New York: Larkin McPhee Productions.
2. Articles from journals like Biosensors, Biosensors and Bioelectronics.

d. Online resources

1. NPTEL Course: Introduction to Biomedical Engineering. Available at: https://nptel.ac.in/courses/102101054
2. NPTEL Online Course: Biomedical Nanotechnology (NOC20_PH13). Available at: https://onlinecourses.nptel.ac.in/noc20_ph13/preview
3. NPTEL Online Course: Introduction to Quantum Mechanics (NOC22_PH01). Available at: https://onlinecourses.nptel.ac.in/noc22_ph01/preview

10 Course Organization

Course Code	BTE607A	
Course Title	Biosensors: Fundamentals and Applications	
Course Leader/s Name	As per time table	
Course Leader Contact Details	**Phone:**	08045366666
	E-mail:	Hod.bt.ls@msruas.ac.in
Course Specifications Approval Date	Feb 2025	
Next Course Specifications Review	Jan 2027	

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Course Specifications: Drug Design and Development

Course Title	Drug Design and Development
Course Code	BTE608A
Department	Biotechnology
Faculty	Life and Allied Health Sciences

1. Course Summary

This course provides concepts of the basics of microbiology, the pharmacology and principles of antimicrobial use and the use of synthetic chemistry to alter the properties of drugs. The course follows the evolution of drugs through time covering the principles of drug discovery in the areas of pharmacognosy and natural products; synthetic medicinal chemistry and the development of medicinal substances; the development of modern and innovative therapeutic substances including biopharmaceuticals; and future trends in drug discovery. The course will focus on chemistry of molecules/compounds and in particular how the chemical structure of a drug relates to its biological activity. Structure-activity relationships of drug families will include the discovery, development and design of antibiotics.
The drug development pipeline from lead discovery to clinical trials will be introduced. Introductory concepts around regulatory affairs, patenting, registration and marketing will be covered in the context of new drug discovery.

2. Course Size and Credits:

Number of credits	03
Total hours of class room interaction	45
Number of tutorial hours	00
Number of semester weeks	16
Department responsible	Department of Biotechnology
Course marks	Total: 100
Pass requirement	As per Academic Documents
Attendance requirement	As per Academic Documents

Teaching, Learning and Assessment

3. Course Outcome (CO)

After undergoing this course students will be able to:

CO 1. Describe key principles of pharmacognosy and natural products and their role in shaping the pharmaceutical industry, including Traditional, Complementary and Alternative Medicines

CO 2. Explain the role of synthetic chemistry in the development of pharmaceutical agents; and the modification of chemical structures to develop new drug molecules

CO 3. Explain the chemical structure of a pharmaceutical agent and determine the chemical group/s responsible for a given biological effect

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CO 4. Delineate the modern and innovative discovery of biopharmaceuticals as it relates to today's healthcare and future trends in modern drug discovery globally

CO 5. Develop an understanding of drug targets as a recognition site for pharmaceutical agents; how the chemical structure of a substance influences interaction with a drug target; and the identification of new drug targets for future drug discovery

CO 6. Develop key concepts of the drug discovery process including regulatory affairs, patenting, registration and marketing in a global context

4. Course Content

Unit I **6h**

Introduction to Drug Discovery and Development: An Overview of Modern Methods and Principles, Target Selection: The First Step Forward, Hit Identification: Finding a Starting Point, Identify a Clinical Candidate: Juggling the Properties

Unit II **7h**

Classical Targets in Drug Discovery: Protein Structure, Enzymes, Inhibition of Enzymes, G-Protein-Coupled Receptors (GPCRs) Ion Channels, Membrane Transport Proteins (Transporters), Emerging Targets

Unit III **8h**

In vitro Screening Systems: The Language of Screening: Basic Terms, Streptavidin and Biotin, Biochemical versus Cellular Assays, Assay Systems and Methods of Detection, Radioligand Assay Systems, Enzyme-Linked Immunosorbent Assay (ELISA), Fluorescence-Based Assay Systems, Reporter Gene Assays, Kinetic Fluorescent Measurement Systems

Unit IV **8h**

Medicinal Chemistry: Structure–Activity Relationships and Structure–Property relationships, The Role of Chirality, Push and Pull in structure–activity relationships, Quantitative Structure–Activity Relationships, The Pharmacophore, Developing an SAR Data Set, Structure–Activity Relationship, Selectivity And Physicochemical Properties

Unit V **8h**

In vitro ADME and In vivo Pharmacokinetics: Absorption, Distribution, Elimination Pathways, In vitro ADME Screening Methods, In Vivo Pharmacokinetics

Unit VI **8h**

Basics of Clinical Trials and Patenting: Before the Clinic, Drug Supply, Delivery Methods, Formulation, Investigational New Drug Application, Different Phases of Clinical Trials; Regulatory affairs, patenting, registration

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5. CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO3
CO 1	1	3	-	-	-	-	-	-	-	1	-	3
CO 2	-	3	3	-	-	-	-	-	-	-	-	3
CO 3	-	3	-	-	-	-	-	-	-	-	-	3
CO 4	-	-	3	-	-	-	-	-	-	-	2	-
CO 5	-	2	3	-	-	-	-	-	-	-	-	3
CO 6	-	2	3	-	-	-	-	-	-	-	-	3
3: High Influence, 2: Moderate Influence, 1: Low Influence												

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		29
Demonstrations		
1. Demonstration using Videos	05	06
2. Demonstration using Physical Models /	01	
3. Demonstration on a Computer		
Numeracy		
1. Solving Numerical Problems		
Practical Work		
1. Course Laboratory		
2. Computer Laboratory		
3. Engineering Workshop / Course/Workshop / Kitchen		
4. Clinical Laboratory		
5. Hospital		
6. Model Studio		
Others		
1. Case Study Presentation		
2. Guest Lecture	02	05
3. Industry / Field Visit		
4. Brain Storming Sessions		
5. Group Discussions	02	
6. Discussing Possible Innovations	01	
Term Test and Written Examination		05
Total Duration in Hours		45

7. Course Assessment and Reassessment

The components and subcomponents of course assessment are presented in the Academic Regulations document pertaining to the Programme. The procedure to

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determine the final course marks is also presented in the Academic Regulations document as well.

The assessment questions are set to test the course learning outcomes. In each component or subcomponent, certain Course Outcomes are assessed as illustrated in the following Table.

Focus of Course Learning Outcomes in each component assessed				
	CE (50% Weightage)			SEE (50% Weightage)
	SC1	SC2	SC3	
	50 Marks	25 Marks	25 Marks	100 Marks
CO-1	x	x		x
CO-2	x	x		x
CO-3	x	x		x
CO-4	x		x	x
CO-5			x	x
CO-6			x	x

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of course outcomes in each component assessed in the above template at the beginning of the semester.

Course reassessment policies are also presented in the Academic Regulations document.

8. Achieving Course Learning Outcomes

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

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9. Course Resources

a. References

1. Blass, B. (2015) Basic Principles of Drug Discovery and Development. Academic Press, Elsevier. ISBN 012411508X, 9780124115088.
2. Mochly-Rosen, D. & Grimes, K. (eds.) (2014) A Practical Guide to Drug Development in Academia: The SPARK Approach. Springer. ISBN 3319022008, 9783319022000.
3. Wu-Pong, S. (2010) Biopharmaceutical Drug Design and Development. Springer. ISBN 8184897022, 9788184897029.
4. Stokes, A. (ed.) (2016) Drug Safety and Pharmacoepidemiology. Foster Academics. ISBN 1632425785, 9781632425782.

b. Magazines and Journals

1. Nature Reviews Drug Discovery (n.d.) Nature Reviews Drug Discovery. Available at: https://www.nature.com/nrd/
2. Hill, R. (2012) Drug Discovery and Development. Elsevier. Available at: https://www.elsevier.com/books/drug-discovery-and-development/hill/978-0-7020-4299-7

10. Course Organization

Course Code	BTE608A	
Course Title	Drug Design and Development	
Course Leader/s Name	As per time table	
Course Leader Contact Details	**Phone:**	
	E-mail:	Hod.bt.ls@msruas.ac.in
Course Specifications Approval Date	Feb 2025	
Next Course Specifications Review	Jan 2027	

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RAMAIAH UNIVERSITY OF APPLIED SCIENCES

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Course Specifications

of

M.Sc. in Biotechnology

Programme Code: 091

SEMESTER 4

Department of Biotechnology

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Course Specifications: Dissertation and Publication

Course Title	Dissertation and Publication
Course Code	BTP602A
Programme	M.Sc. Biotechnology
Department	Biotechnology
Faculty	FLAHS

1. Course Summary

This Course is intended to give an insight to the students on application of principles of research methodology, preparation of research project proposal, research project management, execution of research project and effective technical communication and presentation. It also emphasizes the need and the relevance of a structured approach to identify a research topic and undertake research. This course provides an opportunity for students to apply theories and techniques learnt during programme work. It involves in-depth work in the chosen area of study.

2. Course Size and Credits:

Number of credits	20
Total hours of interaction	600
Department responsible	Biotechnology
Course marks	300
Pass requirement	A student is required to score overall 40% for successful completion of the course and learning of the credits.
Attendance requirement	As per Academic Regulations

Teaching, Learning and Assessment

3. Course Outcome (CO)

After undergoing this course students will be able to:

CO 1. Critically review scholarly literature collected from various sources for the project purpose and formulate a research problem
CO 2. Prepare and present a research proposal
CO 3. Conduct research to achieve research objectives
CO 4. Propose new ideas/methodologies or procedures for further improvement of the research undertaken
CO 5. Create research document and write research papers for publications
CO 6. Defend the research findings in front of scholarly audience

4. **Course Contents**

The Dissertation will cover the following:

3. Defining / Identification of the Research Problem
4. Literature review/ Information search, retrieval and review
5. Framing Research hypothesis, experimental designs and Methodology
6. Problem solving - Evaluation, Interpretations and drawing conclusions
7. Proposing ideas or methods for further work
8. Thesis writing Oral presentation/ Viva voce

Publishing will cover the following:

11. Journal / Conference Identification
12. Writing a journal paper based on research findings
13. Submission to Journal / Conference

5. CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO3
CO 1	-	-	3	-	3	3	-	3	1	3	-	-
CO 2	3	-	3	-	-	3	-	-	-	2	-	-
CO 3	-	3	3	-	-	-	3	-	3	-	3	3
CO 4	-	-	3	-	-	-	-	3	-	3	3	3
CO 5	-	-	3	-	3	-	-	3	-	-	-	3
3: High Influence, 2: Moderate Influence, 1: Low Influence												

6. Course Teaching and Learning Methods

Topics	Teaching methods	Hours
Information search, retrieval and review, Project definition and project planning	Reading Journal papers, books and other relevant materials and problem formulation	100
	Presentation to Reviewers	40
Use of methodology and execution of experiments	Individual work with supervisors guidance	100

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Problem solving and Evaluation	Individual work with supervisors guidance	100
Interpretations and drawing conclusions	Individual work with supervisors guidance	100
Proposing ideas or methods for further work	Individual work with supervisors guidance	40
Presentation, Thesis/Report Writing and Viva Voce, Authoring Research paper/ preparing manuscript/ poster presentation/conference publication	Presentation and Viva voce	20
	Thesis/Report writing, Authoring research paper/	80
Tests/ Examinations/presentations		20
Total		600

7. Method of Assessment

There are two components for assessment in this Course:

Component-1: 50% weight (150 marks)

Synopsis submission, Interim presentation, & Manuscript publication

Component-2: 50% weight (150 marks)

Final presentation and Dissertation submission (Will be moderated by the student's internal supervisor)

The assessment questions are set to test the learning outcomes. In each component a certain learning outcomes are assessed. The following table illustrates the focus of learning outcome in each component assessed:

Course Outcome	CO1	CO2	CO3	CO4	CO5	CO6
Component-1	X	X	X	X	X	X
Component-2	X	X	X	X	X	X

8. Achieving Course Learning Outcomes

The various skills are directly or indirectly imparted to the students using the teaching and learning methods as follows:

S.No	Curriculum and Capabilities	How imparted during the Course
1.	Knowledge	Dissertation work
2.	Understanding	Dissertation work
3.	Critical Skills	Dissertation work
4.	Analytical Skills	Dissertation work
5.	Problem Solving Skills	Dissertation work
6.	Practical Skills	Dissertation work
7.	Group Work	Dissertation work
8.	Self-Learning	Dissertation work

9.	Written Communication Skills	Report writing
10.	Verbal Communication Skills	Presentation
11.	Presentation Skills	Presentation
12.	Behavioural Skills	Dissertation work
13.	Information Management	Dissertation work
14.	Leadership Skills	Effective management of learning, time management, achieving the learning outcomes

9. Course Resources

a. Essential Reading

1. Lecture Sessions on Dissertation, Thesis Preparation delivered by the concerned Head of Department

10. Course Organization

Course Code	BTP602A	
Course Title	Dissertation and Publication	
Project Supervisors Name	Allotted on project basis	
Project Supervisors Contact Details	**Phone:**	080-49066666
	E-mail:	hod.bt.ls@msruas.ac.in
Course Specifications Approval Date	Feb 2025	
Next Course Specifications Review Date:	Jan 2027	

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