RAMAIAH UNIVERSITY OF APPLIED SCIENCES

M S Ramaiah University of Applied Sciences

Programme Structure and Course Details

of

M.Sc. in Molecular and Cellular Biology

Programme Code: 092

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

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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. Molecular and Cellular Biology

Faculty	Life and Allied Health Sciences
Department	Biotechnology
Programme Code	092
Programme Name	M.Sc. Molecular and Cellular Biology
Dean of the Faculty	Dr Soma Chaki
Head of the Department	Dr. Shruti Mathur

1. **Title of the Award:** M.Sc. Molecular and Cellular Biology
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 2026
9. **Programme Approving Regulating Body and Date of Approval:**
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

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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.
M.Sc. Molecular and Cellular Biology is a postgraduate degree programme offered to all branches of B.Sc. Life Science student viz. Botany, Zoology, Microbiology, Life Science, Biotechnology and Genetics. The M.Sc. programme will help students understand the fundamentals and applied aspects purifying, modifying and analysing DNA, RNA and proteins, analysing microscopy with in situ hybridization, immunocytochemistry and fluorescent protein technologies to analyse gene and protein expression and function. It will also develop skills preparing and dispensing precisely formulated solutions even at microliter quantities, using electrophoresis, blotting, chromatography and centrifugation techniques.

15. Programme Mission

This PG course in Molecular and Cellular Biology, would concentrate on the study of applied technologies in Life Science as well as researching on reliable, viable, and good quality Bioprocess solution to the society. Pursuing a research based PG course in Molecular Biology will lead to development of new concepts in Bio therapeutics. This knowledge gained shall produce manpower required by the Biopharmaceutical industries and also encourage entrepreneurship. Candidates with a Master of Science in this discipline are uniquely equipped to take on jobs in industries and academia. Thus, RUAS offers this programme with an updated curriculum, excellent infrastructure and highly experienced and knowledgeable faculty members.

16. Graduate Attributes

GA-1. Ability to apply fundamental knowledge of Biology, Biochemistry, Chemistry, Microbiology for understanding Molecular and Cellular Biology.
GA-2. Ability to analyse and correlate the cellular and molecular pathways for drug targets.
GA-3. Ability to work in basic and advanced molecular biology research laboratory environment.
GA-4. Ability to perform administrative duties in government, semi-government, private and public sector organizations
GA-5. Ability to teach in schools, colleges and universities with additional qualification and training
GA-6. Ability to understand and solve scientific problems by conducting experimental investigations

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GA-7. Ability to apply appropriate tools, techniques and understand utilization of resources appropriately in various laboratories

GA-8. Ability to understand the effect of scientific solutions on legal, cultural, social and public health and safety aspects

GA-9. Ability to develop sustainable solutions and understand their effect on society and environment

GA-10. Ability to apply ethical principles to scientific practices and professional responsibilities

GA-11. 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-12. Ability to make effective oral presentations and communicate technical ideas to a broad audience using written and oral means

GA-13. 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 molecular biology 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.

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18. Programme Goal

Molecular and Cellular Biology is a potential subject that introduces fundamental mechanisms and 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 understand the molecular basis of diseases and develop new diagnostics and therapeutic solutions. New tools and products developed by molecular biologists are useful in research, agriculture, industry and the clinic. These modern approaches provides breakthrough products and technologies to combat debilitating and rare diseases.

19. Programme Educational Objectives (PEO):

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

PEO 1: To acquire basic knowledge and expertise necessary for professional practice in Molecular Biology for higher studies and research.

PEO 2: To attain and practice technical skills to identify, analyze and solve complex problems and issues related to cell and molecular biology.

PEO 3: To possess a professional attitude as an individual or a team member with consideration for society, professional ethics, environmental factors and motivation for life-long learning.

20. Programme Specific Outcomes (PSO)

PSO 1: Understand the foundational concepts of molecular biology, 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: Demonstrate proficiency in basic laboratory skills common to clinical and non-clinical research laboratories, including aseptic technique, making accurate and precise measurements using balances and macro- and micro-pipetting, using a microscope, preparing solutions, operating current instrumentation, preparing samples for various analyses, and maintaining a proper scientific laboratory notebook.

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PSO 4: Apply the fundamentals of molecular biology theories, methodologies, and techniques by critically analyzing, interpreting, and presenting a recent and relevant scientific research paper that has been published in a refereed scientific journal.

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21. Programme Structure

SEMESTER I

SL.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	1	1		50
5	BTD515A	Biostatistics and Data Analysis	2	2			50
6	CBL511 A	Practical I: Cell Biology & Molecular Genetics	3			6	100
7	CBL512A	Practical II: Microbiology & Biochemistry	3			6	100
Total			20	13	1	12	600
Total number of contact hours per week			**25 hours**				

SEMESTER II

SL.NO	Code	Course Title	Credit	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Max Marks
1	CBC511A	Genomics and Proteomics	4	4			100
2	CBC512A	Molecular Biology I	3	3			100
3	BTD516A	Immunology and Immuno techniques	3	3			100

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4	BTD517A	Bioinformatics and Structural Biology	2	2			50
5	BTD518A	Research: Methodology, Ethics and Safety	2	2			50
6	CBL513A	Practical III: Molecular Biology and Immunology	3			6	100
7	CBL514A	Practical IV: Genomics, Proteomics and Bioinformatics	3			6	100
Total			20	14		12	**600**
Total number of contact hours per week			**26 hours**				

SEMESTER III

Sl. No	Code	Course Title	Credit	Theory (h/W/s)	Tutorials (h/W/S)	Practical (h/W/S)	Max. Marks
1	CBC601A	Molecular Biology II	4	4			100
2	CBL601A	Practical V: Molecular Biology II	3			6	100
3	CBE6XXA	Elective1	3	3			100
4	CBE6XXA	Elective2	3	3			100
5	CBM601 A	Introduction to Management, Entrepreneurship and IPR	2	2			50
6	CBP601A	Group Project	5			10	100
		Total	**20**	**12**	1	**16**	**550**
Total number of contact hours per week			**28 hours**				

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SEMESTER IV

S. No.	Code	Course Title	Credit	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Max. Marks
1	CBP602A	Dissertation and Publication	20			40	300
TOTAL CREDITS (4 semesters)			80	TOTAL MARKS			2050

Elective Course

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

Stream/ specialization	Course Code	Elective Courses
Stream 1	CBE601A	Integrated Organ Systems
	CBE602A	Molecular Carcinogenesis
	CBE603A	Molecular Basis of Diseases and Diagnosis
	CBE604A	Foundations of Cognitive Neurosciences
Stream 2	CBE605A	AI /ML in Healthcare
	CBE606A	Stem Cell and Regenerative Medicine
	CBE607A	Biosensors: Fundamentals and Applications
	CBE608A	Drug design and development

Group Project

CBP601A

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

CBP602A

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. Face to Face Lectures using Audio-Visuals
2. Workshops, Group Discussions, Debates, Presentations
3. Demonstrations
4. Guest Lectures
5. Laboratory work/Field work/Workshop
6. Industry Visit
7. Seminars
8. Group Exercises
9. Project Work
10. Project
11. Exhibitions
12. 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.

25.1. Theory Courses

The following are the CE components:

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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:

a) Online Test
b) Assignments/Problem Solving
c) Field Assignment
d) Open Book Test
e) Portfolio
f) Reports
g) Case Study
h) Group Task
i) Laboratory / Clinical Work Record
j) Computer Simulations
k) Creative Submission
l) Virtual Labs
m) Viva / Oral Exam
n) Lab Manual Report
o) Any other

25.3 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:

a) Laboratory / Clinical Work Record
b) Experiments
c) Computer Simulations
d) Creative Submission
e) Virtual Labs
f) Viva / Oral Exam
g) Lab Manual Report
h) 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

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)

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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	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
1	Bio-Analytical Techniques	3	2	3		2				3	1	2	
1	Biostatistics and Data Analysis		2	3	3	2					2	2	3
2	Genomics and Proteomics	3		2							3		
2	Molecular Biology I		3	2	3	2				3	3	2	1
2	Immunology and Immuno techniques			3								3	
2	Bioinformatics and Structural Biology	3	2	3	2						3		
2	Research: Methodology, Ethics and Safety		3		2				3		3		3
2	Practical III: Molecular Biology and Immunology	3											3
2	Practical IV: Genomics, Proteomics and Bioinformatics	3	2	3		2		2	2	3	1	1	3
3	Molecular Biology II	3		3						3			
3	Practical V: Molecular Biology II		2	3					3		3	3	3
3	Introduction to Management, Entrepreneurship and IPR				3		3					3	
3	Group Project					3	3	3	3		3	3	3
ELECTIVE 1													
3	Integrated Organ Systems	2		3								3	
3	Molecular Carcinogenesis		3	3									3
3	Molecular Basis of Diseases and Diagnosis	3								3			
3	Foundations of Cognitive Neuroscience	3								3			

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Semester	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
ELECTIVE 2													
3	AI/ML in Healthcare		3										3
3	Stem Cell and Regenerative Medicine		3	2								3	3
3	Biosensors: Fundamentals and Applications	3	2	2						3			3
3	Drug Design and Development	3									3		
4	Dissertation and Publication		3	3			3	3	3				3

27. 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.

28. 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.

29. 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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Course Specifications
of
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Programme Code: 092

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

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

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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.

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.

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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	-	-	-	-	-	-	-	2	-	-	-
CO 4	3	-	-	-	-	-	-	-	2	2	-	-
CO 5	-	-	2	-	-	-	-	-	-	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		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		

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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.

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

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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*, 6thEdition, John Wiley & Sons. Inc.
4. Cooper, G.M. and Hausman, R.E. 2009, *The Cell: A Molecular Approach*, 5th Edition, ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
5. De Robertis, E.D.P., and De Robertis, E.M.F., 2006, *Cell and Molecular Biology,* 8th Edition, Lippincott Williams and Wilkins, Philadelphia.
6. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P., 2009,*The World of the Cell*,7thEdition. 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*,10thEdition, 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		

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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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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

5. CO-PO-PSO mapping

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	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

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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	--

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

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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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.

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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, 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

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

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	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

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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

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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.

4. Course Content

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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												

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		22
Demonstrations		

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1. Demonstration using Videos	2	02
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

8. Achieving Course Learning Outcomes

The following skills are directly or indirectly imparted to the students in the following teachingand 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	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.
6. Upadhyaya, A., Upadhyaya, K. and Nath, N., 2009. Biophysical Chemistry: Principles and Techniques. Meerut: Himalaya Publishing House.

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:

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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 **5h**

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 **5h**

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 **5h**

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 **5h**

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 **5h**

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

Unit VI **5h**

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

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

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	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

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

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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	
	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 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

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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		5
1. Demonstration using Videos	5	
2. Demonstration using Physical Models/Systems		
3. Demonstration on a Computer		
Numeracy		
1. Solving Numerical Problems		
Practical Work		
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		120

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.

Focus of Course Learning Outcomes in each component assessed			
	CE (50% Weightage)	SEE	(50%

	SC1	SC2	Weightage)
	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
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	CBL511A		
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	

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Course Specifications: Practical II: Microbiology & Biochemistry

Course Title	Practical II: Microbiology & Biochemistry
Course Code	BTL512A/CBL512A
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	60
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

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Final Approval by the Academic Council in its 34th meeting held on 27th March 2025

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

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

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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												

5. 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

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Total Duration in Hours		90

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	
	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.

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	--

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

8. 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

9. Course Organization

Course Code	CBL512A	
Course Title	Practical II: Microbiology & Biochemistry	
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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SEMESTER II

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Course Specifications: Genomics and Proteomics

Course Title	Genomics and Proteomics
Course Code	CBC511A
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	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

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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

4. Course Contents

Unit I

Genome and manipulation of genetic material: **8h**

Organisation of prokaryotic and eukaryotic genomes, plasmids, DNA cloning basics, Polymerase chain reaction (PCR), Genome editing: CRiSPR/ Cas; DNA fingerprinting, DNA sequencing – Sanger sequencing, Pyrosequencing; Tools for genome analysis- restriction mapping, RFLP

Unit II

Genome analysis : **9h**

Genome maps – physical and genetic maps, Definition of Genomics, Comparative genomics, functional genomics, Genome Sequencing: Human Genome Project, Shotgun & Hierarchical (clone contig) methods, genome assembly. NGS techniques – Illumina, Oxford Nanopore etc. Genome annotation: genome sequence analysis tools. Promoter prediction methods.

Unit III

Protein measurement and separation: **8h**

Physical interactions that determine the property of proteins, Analytical techniques to study proteins: Sedimentation analysis, gel filtration, SDS-PAGE, Native PAGE; Determination of protein sequence

Unit IV

Proteomics: **8h**

Basic concepts, Tools of proteomics- SDS PAGE, 2D PAGE, Liquid chromatography, Mass Spectrometry (ESI and MALDI), Protein identification by peptide mass fingerprinting, Applications of proteomics.

Unit V

Applications of genomics and proteomics : **7h**

Microarrays, Protein-protein interaction (Two hybrid interaction screening), mapping protein modifications, future directions

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Unit VI

Other -Omics techniques : **8h**

Transcriptomics, Search for transcription factor binding sites, RNA-Seq, Metabolomics - Fundamental concept, Tools of metabolomics- Capillary electrophoresis, Gas chromatography, Electrochemical detectors, Case studies. degradomics - Approaches to identify the protease and protease-substrate repertoires, application of the same in the clinic, PROTAC.

5. CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO-1	-	-	3	-	-	-	-	-	3	-	-	-
CO-2	-	-	3	-	-	-	-	-	-	3	-	-
CO-3	-	-	2	2	-	-	-	-	-	3	-	-
CO-4	-	-	3	2	-	-	-	-	-	3	-	-
CO-5	-	2	-	2	1	-	-	-	-	3	-	-
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		48
Demonstrations		02
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		

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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		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

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.

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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.

b. Magazines and Journals

1. https://www.nature.com/ncb/
2. http://mcb.asm.org/
3. https://bmccellbiol.biomedcentral.com/

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4. https://www.cellsalive.com/
5. http://www.biology.arizona.edu/cell_bio/cell_bio.html
6. https://www.ncbs.res.in/course/jan-term-2018/cell-biology

10. Course Organization

Course Code	CBC511A	
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	Sept 2024	
Next Course Specifications Review	August 2027	

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Course Specifications: Molecular Biology I

Course Title	Molecular Biology I
Course Code	CBC512A
Department	Biotechnology
Faculty	Life and Allied Health Sciences

1. Course Summary

The aim of the course is to familiarize students with the concepts involved in cellular processes at the molecular level. Students will be able to illustrate tools involved in plant genetic engineering. Also, they will be able to outline plant tissue culture techniques and applications. They will also be able to explain the various strategies applied in plant genetic engineering and will be able to utilize biotechnological methods for maintenance of soil quality and crop health.

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. Illustrate the replication of genetic material

CO 2. Compare processes involved in recombination and repair of the genome

CO 3. Identify the regulatory differences in transcription of prokaryotes and eukaryotes

CO 4. Explain the processes involved in the post-transcriptional processing of RNA and regulation of transcription

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CO 5. Summarize the mechanisms involved in the synthesis and regulation of proteins

CO 6. Outline the mechanisms involved in the regulation of genome expression

4. Course Content

Unit I

DNA replication in prokaryotes and eukaryotes **6h**

Modes of replication, Discovery of replication, DNA polymerase, trombone model of replication, end replication problem of linear DNA, telomerase and the Shelterin complex, early and late replicating DNA

Unit II

DNA repair and recombination **4h**

Photoreactivation, excision, recombination, and SOS pathways, recombination and transposition, models for homologous recombination- the Holliday, Meselson- Radding and RecBCD pathways, meiotic recombination- mechanism, the double-stranded DNA breaks; site-specific recombination and transposition; non-homologous recombination.

Unit III

Prokaryotic & Eukaryotic Transcription **8h**

Prokaryotic Transcription; Transcription unit; Promoters- Constitutive and Inducible; Operators; RNA polymerase, Regulatory elements, Attenuation; Anti-termination; Operon concept-lac, trp, ara, his, and gal operons; Transcriptional control in lambda phage; Eukaryotic promoters and enhancers; Transcription factors; TATA binding proteins (TBP) and TBP associated factors (TAF); Activators and repressors

Unit IV

Post-transcriptional processing **5h**

mRNA processing: Splicing, spliceosome assembly, role of RNA polymerase II CTD, self-splicing RNAs, mRNA capping, mRNA polyadenylation, tRNA splicing; processing of rRNA; RNA editing: editing by nucleotide deamination; mRNA stability; gene silencing by RNA interference, siRNA, miRNA Translation Repression, CRISPR/Cas9, mRNA Degradation, mRNA stability

Unit V

Translation **5h**

Ribosome composition; structure of tRNA, proof reading and editing by amino-acyl-tRNA synthetases; prokaryotic and eukaryotic translation, direction of polypeptide synthesis, genetic code and codon bias, structure of EF-Tu and EF-G, regulation by GTPases, termination codons, release factors, Post-translational processing of proteins: Polypeptide cleavage, post-translational modifications.

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Unit VI

Gene regulation **8h**

Basic concepts of gene regulation, cis and trans regulators, positive and negative gene regulation; Expression of the genome: activators and repressors, DNA-binding motifs, promoter proximal elements, enhancers, insulators and barrier elements, mediators, transcription factories, chromatin remodeling; epigenetic modifications in gene expression: DNA modifications and histone modifications, histone code; molecular basis of imprinting and X-inactivation; the role of transcription factors in cellular differentiation, identity and reprogramming.

5. CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO-1	3	-	-	-	-	-	-	-	-	3	-	-
CO-2	3	-	-	-	-	-	-	-	-	3	-	-
CO-3	3	-	-	-	-	-	-	-	-	3	-	-
CO-4	-	1	-	-	-	-	-	-	-	-	2	-
CO-5	-	2	-	-	-	-	-	-	-	-	2	-
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		24
Demonstrations		06
1. Demonstration using Videos	05	
2. Demonstration using Physical Models / Systems	01	
3. Demonstration on a Computer		
Numeracy		
1. Solving Numerical Problems		
Practical Work		
1. Course Laboratory		
2. Computer Laboratory		
3. 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	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.

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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. Karp, G., 2010, *Cell and Molecular Biology: Concepts and Experiments*, 6th Edition, John Wiley & Sons. Inc.
3. De Robertis, E.D.P., and De Robertis, E.M.F., 2006, *Cell and Molecular Biology,* 8th Edition, Lippincott Williams and Wilkins, Philadelphia.
4. Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts, K., Watson, J.D., 1994, *Molecular Biology of the Cell*, 3rd Edition, Garland Publishing.
5. Cooper, G.M. and Hausman, R.E. 2009, *The Cell: A Molecular Approach*, 5th Edition, ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
6. Krebs, J. E., Goldstein, E. S. and Kilpatrick, S. T. (2018) Lewin's GENES XII. Jones and Bartlett Learning.

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7. Watson, J. D. et al. (2017) Molecular Biology of Gene. 7th edition. Pearson.

b. **Magazines and Journals** https://www.cell.com/molecular-cell/home https://www.nature.com/nrm/

10. Course Organization

Course Code	CBC512A	
Course Title	Molecular Biology I	
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	Sep 2024	
Next Course Specifications Review	Aug 2029	

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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.

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

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.

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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.

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

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

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Course Specifications Approval Date	September 2024	
Next Course Specifications Review	August 2027	

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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. 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/10.1177/011542650301800645l

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	

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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	32
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 (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 **4h**

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 **8h**

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	-

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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 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

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Proteomic & Pathway Analysis: Protein-protein interaction network analyses (Cytoscape, DAVID, STRING), Pathway enrichment (KEGG & Reactome using gProfileR).

5. CO-PO-PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO-1	3	-	-	-	-	-	-	-	3	-	-	-
CO-2	3	-	-	-	-	-	-	-	3	-	-	-
CO-3	3	-	-	-	-	-	-	-	2	-	-	-
CO-4	3	-	2	-	-	-	-	-	2	3	-	-
CO-5	-	3	2	-	-	-	-	-	-	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		28
Demonstrations		03
1. Demonstration using Videos	02	
2. Demonstration using Physical Models /		
3. Demonstration on a Computer	01	
Numeracy		
1. Solving Numerical Problems		
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		05
1. Case Study Presentation		
2. Guest Lecture	02	
3. Industry / Field Visit		
4. Brain Storming Sessions		
5. Group Discussions	02	

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4. Course Contents

Unit I

Introduction to Cancer **6h**

Classification of cancer based on tissue type, grade and stage. Causes of Cancer: Hereditary, Environmental, Viruses. Hallmarks of Cancer: Basic mechanisms regulating normal tissue homeostasis: regulation of cell-proliferation, growth, differentiation and apoptosis.

Unit II **7h**

Progression of tumorigenesis

Genetic, epigenetic changes and immortality, angiogenesis, invasion and metastasis. Enabling and emerging characteristics of cancer: metabolic reprogramming in human cancers, immune destruction and tumour promoting inflammations.

Unit III **6h**

Tumour microenvironment (TME)

Principles underlying the formation of the TME, Major cellular and non-cellular components of the TME, Functions of TME, Interaction of cancer cells with tumour microenvironment, Role of TME in cancer progression.

Unit IV **8h**

Cancer Diagnostics

Cancer Cytogenetic techniques i.e Chromosomal banding techniques, Karyotyping, Fluorescence in situ hybridization (FISH), Spectral karyotyping (SKY). Chromosome markers found in different Lymphomas and leukaemia (CML, AML, APML, and solid tumors (Sarcomas and carcinomas). Immunophenotyping in lymphoma, Imaging techniques: X-Ray imaging, Computed Tomography (CT) scans, Molecular and Nuclear Imaging (PET and SPECT), Radiation Risk, Ultrasound Magnetic Resonance Imaging (MRI), Biomarker: Diagnostic (screening) biomarker, Prognostic biomarker, Stratification (predictive) biomarker

Unit V **7h**

Cancer Treatment & its Types

Chemotherapy, Radiation, Surgery, Hormonal Therapy, Targeted Therapy & Immunotherapy. Chemo resistance: intrinsic chemoresistance, acquired chemoresistance, molecular mechanism and strategies to combat chemoresistance. Current developments in treating: novel strategies and personalised medicine.

Unit VI **9h**

Computational Oncology

Cancer genomic databases: TCGA, COSMIC, cBioPortal, Cancer genomics and variant analysis: Variant calling and annotation, MutSig, VEP (Variant Effect Predictor), Transcriptomics in Cancer: Tools to analyze Cancer RNASeq datasets, GEO2R, EdgeR, DeSeq.

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Course Specifications: Molecular Carcinogenesis

Course Title	Molecular Carcinogenesis
Course Code	CBE602A
Department	Biotechnology
Faculty	Life and Allied Health Sciences

1. Course Summary

The course aims to familiarize students with the field of cancer pathogenesis, providing insights into the latest developments in cancer research, therapeutics. Students will gain an understanding of the molecular and genetic mechanisms underlying cancer development and progression while exploring how computational approaches enhance research and therapeutic development.

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. Understand the basic classifications and processes underlying the transformation of a normal cell to its malignant counterpart, and the consequences of malignant transformation on the cellular and organism level.

CO2 Relate chromosomal aberrations, metabolic reprogramming and immune evasion to progression of oncogenesis.

CO3 Summarize the components and role of niche in oncogenesis.

CO4 Outline the current processes and developments in cancer diagnostics.

CO5. Outline the current processes and developments in cancer treatment.

CO6 Understand intersection of computer science, data analysis and machine learning to address key challenges in oncology and clinical care.

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1. American Physiological Society (https://www.physiology.org/career/teaching-learning-resources/student-resources/what-is-physiology?SSO=Y)
2. Khan Academy (https://www.khanacademy.org/science/health-and-medicine)

Course Organization

Course Code	CBE601A		
Course Title	Integrated Organ Systems		
Course Leader/s Name		Sahadev Shankarappa	
Course Leader Contact Details		**Phone :**	08045366666
		E-mail:	sahadev.bt.ls@msruas.ac.in
Course Specifications Approval Date		Feb 2025	
Next Course Specifications Review		Jan 2027	

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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	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

References

i. Guyton and Hall Textbook of Medical Physiology, International Edition, Elsevier, 14e, 2021

ii. Ganong's Review Of Medical Physiology, Barrett, McGraw Hill, Lange, 2019

Magazines and Journals

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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	01	
2. Guest Lecture	03	11
3. Industry / Field Visit		
4. Brain Storming Sessions	02	
5. Group Discussions	03	
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

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Unit V: Hepatobiliary and Gastrointestinal Synergy 7h

Liver architecture and its functional zones, portal circulation and its role in nutrient processing, production, secretion, and concentration of bile, hepatobiliary system and its interaction with the gastrointestinal tract, pancreatic function in digestion, integration of liver, pancreas, and gastrointestinal system in metabolic processes, gastrointestinal motility and absorption of nutrients. Advancements in liver and pancreas bioengineering for regenerative medicine

Unit VI: Fluid Regulation and Renal Function 8h

Renal architecture and structure of the nephron, components of the nephron, vasa recta function in concentrating urine, filtration at the glomerulus and the concept of glomerular filtration rate, mechanisms of solute and water reabsorption, renal regulation of fluid and electrolyte balance, renin-angiotensin-aldosterone system and its role in blood pressure regulation, acid-base balance and kidney function. Advances in renal dialysis technologies, including hemodialysis and peritoneal dialysis,

5. CO-PO-PSO mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO2	PSO3	PSO4
CO-1	3	2	-	-	-	-	-	2	3	-	2	-
CO-2	3	1	-	-	-	-	-	2	3	-	2	-
CO-3	3	2	3	-	-	-	-	2	2	-	2	-
CO-4	3	2	-	-	-	-	-	2	2	-	2	-
CO-5	3	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		24
Demonstrations		05
1. Demonstration using Videos	05	
2. Demonstration using Physical Models /	0	

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CO4: Evaluate the impact of diseases and disorders on the function of individual organ systems and their interrelationships.

CO5: Interpret recent biomedical advancements and research findings in the context of integrated organ system function and pathology.

4. Course Contents

Unit I: Water Homeostasis and Electrolyte Regulation in Organ Systems 6h

Body fluid compartments: extracellular, intracellular, and transcellular fluids, regulation of water balance, osmoregulation, and fluid homeostasis, factors affecting water movement across membranes, sodium and potassium homeostasis, salt regulation. Utilization of wearable sensors for real-time fluid and electrolyte monitoring and the development of artificial kidneys and dialysis technologies for managing fluid imbalances in renal disorders.

Unit II: Circulatory and Hematologic Dynamics in Systemic Function 8h

Components of blood: red blood cells, white blood cells, platelets, plasma, and their functions, regulation of blood cell production, blood coagulation and clotting mechanisms, role of platelets and clotting factors, lymphatic system structure and function, cardiovascular system: heart, arteries, veins, and capillaries, electrical activity of the heart, electrocardiogram interpretation, cardiac cycle and its phases, pressure-volume changes in the heart. Advancements in point-of-care diagnostic devices like wearable ECG monitors for continuous cardiac health monitoring and early detection of arrhythmias.

Unit III: Air Movement and the Mechanics of Ventilation 8h

Layers of the lungs, mechanics of ventilation: inspiration and expiration, role of inspiratory and expiratory muscles, lung volumes and capacities, pulmonary compliance and elasticity, airway resistance and its effect on ventilation, flow rate-volume curves and their interpretation, gas exchange and diffusion across alveolar membranes, control of breathing. Development of portable ventilators and respiratory monitoring devices using wearable sensors.

Unit IV: Neural Networks and Signal Transmission 7h

Neuron structure and function: dendrites, axons, soma, myelin, Ion movements in neurons, resting membrane potential and its maintenance, action potential generation and propagation, ion channels involved in action potential, synaptic transmission and synaptic vesicle release, neurotransmitter release, receptor binding, and removal, types of neurotransmitters, excitatory and inhibitory postsynaptic potentials, signal transduction mechanisms, brain-machine interface and its applications.

Course Specifications: Integrated Organ Systems

Course Title	Integrated Organ Systems
Course Code	CBE601A
Department	Biotechnology
Faculty	Life and Allied Health Sciences

1. Course Summary

This course expands on foundational physiology by exploring the interconnected nature of individual organ systems, focusing on their design, structure, and function. Emphasis will be placed on understanding how tissue and cellular hierarchies, along with their architectural and functional processes, contribute to the integrated homeostasis of the entire body. We will examine each organ system from both an individual and an integrated perspective, highlighting the interplay between systems. Additionally, the course will cover recent biomedical advancements and how they influence our understanding and treatment of these integrated organ systems.

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 Academic Regulations
Attendance Requirement	As per Academic Regulations

Teaching, Learning and Assessment

3. Course Outcomes

After undergoing this course students will be able to:

CO1: Explain the fundamental physiological processes of major organ systems and how they contribute to the overall functioning of the human body.

CO2: Evaluate the cellular and tissue architecture within organ systems and explain how these contribute to overall system functionality and health.

CO3: Apply knowledge of organ system integration to assess how disruptions in one system can affect the function and health of other systems.

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

   Panima Publishing Corporation

b. Magazines and Journals

1. https://www.elsevier.com/life-sciences/biochemistry-genetics-and-molecular- biology
2. https://www.cell.com/trends/genetics/fulltext/

10. Course Organization

Course Code	CBL601A	
Course Title	Practical V: Molecular Biology II	
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	

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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

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

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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. Demonstration using Physical Models/Systems		
3. Demonstration on a Computer		
Numeracy		
1. Solving Numerical Problems		
Practical Work		
1. Course Laboratory	84	
2. Computer Laboratory		84
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		6
Total Duration in Hours		90

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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CO 6. Analyse and visualize cellular structures and proteins using fluorescence microscopy

4. Course Contents

1. Isolation, quantification and characterization of RNA from mammalian cells/plants.
2. cDNA synthesis and Polymerase chain reaction.
3. Real time PCR (qPCR) analysis
4. Elution of DNA from agarose gel
5. Site directed mutagenesis
6. Preparation of electrocompetent cells and electroporation.
7. Expression and Purification of recombinant protein in bacteria/yeast.
8. Southern blotting
9. Cell Culture Techniques- Demonstration of subculturing, freezing and thawing mammalian cell lines.
10. Fluorescence microscopy- Visualization of GFP-expressing cells.

5. CO-PO-PSO mapping

	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4
CO-1	1	2	1	-	-	-	-	-	-	3	-	-
CO-2	1	2	1	-	-	-	-	-	-	3	-	-
CO-3	1	2	1	-	-	-	-	-	-	3	-	-
CO-4	1	2	1	-	-	-	-	-	-	-	-	3
CO-5	1	2	2	-	-	-	-	-	-	-	-	3
CO-6	1	2	2	-	-	-	-	-	-	-	-	3
3: High Influence, 2: Moderate Influence, 1: Low Influence												

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Next Course Specifications Review	Jan 2027

Course Specifications: Practical V: Molecular Biology II

Course Title	Practical V: Molecular Biology II
Course Code	CBL601A
Department	Biotechnology
Faculty	Life and Allied Health Sciences

1. Course Summary

This course provides students with hands-on experience in essential molecular biology techniques, preparing them for careers in genetic engineering and fundamental research. Students will gain practical knowledge in experimental design and commonly used techniques, including nucleic acid isolation and characterization, gene amplification through PCR-based methods, gene cloning, and protein expression and purification. The course also covers cell culture maintenance, fluorescence microscopy, and the integration of bioinformatics tools for data analysis.

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. Apply techniques in isolating and characterizing RNA.
CO 2. Apply qPCR for quantitative assessment of gene expression
CO 3. Perform and analyze Southern Blotting experiments for detecting specific DNA sequences.
CO 4. Demonstrate skills in protein expression and purification of recombinant proteins.
CO 5. Demonstrate the ability to maintain and handle mammalian cell lines

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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 References

1. Primrose, S. B. and Twyman, R. M., 2006, *Principles of Gene Manipulation and Genomics*, Blackwell Scientific Publications.
2. Brown,TA., 2006, *Gene Cloning and DNA Analysis. An Introduction*, Blackwell Scientific Publications.
3. Janitz,M., 2008, *Next-Generation Genome Sequencing* , Wiley-Blackwell Publications. 4. Sambrook, J., Russell, D.W., 2001, *Molecular cloning: A Laboratory Manual* , Cold Spring Harbor Laboratory Press, Cold Spring Harbor, New York.

5. Comprehensive Biotechnology (Vol.1-4) (2004) by Moo-Young, Robinson Howell.

Magazines and Journals

1. https://ocw.mit.edu/courses/biology/7-01sc-fundamentals-of-biology-fall-2011/recombinant-dna/development-of-recombinant-dna/
2. http://mcb.asm.org/
3. https://bmccellbiol.biomedcentral.com/

10. Course Organization

Course Code	CBC601A		
Course Title	Molecular Biology II		
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	

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Final Approval by the Academic Council in its 34th meeting held on 27th March 2025

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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

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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		47
Demonstrations		
1. Demonstration using Videos		
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		
1. Case Study Presentation	02	
2. Guest Lecture	01	08
3. Industry / Field Visit		
4. Brain Storming Sessions		
5. Group Discussions	05	
6. Discussing Possible Innovations		
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.

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Unit IV

Advanced genetic engineering techniques and applications **8h**

Gene Editing Technologies: CRISPR/Cas9, TALENs, ZFNs, and base editing; mechanisms and applications of gene knockout, knock-in, and gene correction. Synthetic Biology: Engineering genetic circuits, biosensors, and synthetic operons for novel biological functionalities.

Unit V

Genetic engineering in Agriculture and Environmental Sustainability **5h**

Genetic manipulation in plants, selectable markers and reporter genes. Agrobacterium tumefaciens and Ti plasmid. Genetically Modified Organisms (GMOs): Development of genetically engineered crops for improved yield, disease resistance, and nutritional content (e.g., Bt corn, Golden Rice, FlavrSavr tomatoes). Engineering microorganisms for biofuel production, biodegradable plastics, and other renewable resources, Using engineered microorganisms for the cleanup of environmental pollutants and waste.

Unit VI

Application in Human medicine **6h**

Gene Therapy: Techniques for delivering genes to correct genetic disorders, including viral and non-viral delivery methods; Recombinant Protein Production: Engineering microorganisms for industrial-scale production of therapeutic proteins (e.g., insulin, growth factors, monoclonal antibodies); Vaccines and Immunotherapy: Genetic engineering for vaccine development, including mRNA vaccines, and gene-based cancer immunotherapy; Ethical, Legal, and Social Implications: Challenges surrounding gene therapy, CRISPR, and other advanced biotechnologies in medicine

5. CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4
CO-1	3	-	-	-	-	-	-	-	3	-	-	-
CO-2	3	-	-	-	-	-	-	-	3	-	-	-
CO-3	3	-	-	-	-	-	-	-	3	-	-	-
CO-4	-	-	3	-	-	-	-	-	-	2	-	-
CO-5	-	-	3	-	-	-	-	-	-	2	-	-
CO-6	-	-	3	-	-	-	-	-	3	-	-	-
3: High Influence, 2: Moderate Influence, 1: Low Influence												

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CO 2. Enumerate the strategies of cloning in E. Coli and yeast with reference to applications.

CO 3. Elucidate the diverse protein expression and purification strategies

CO 4. Illustrate various gene manipulation techniques in plants, Understand the Role of Biotechnology in Agriculture and Environmental Sustainability

CO 5. Applications of Recombinant genome technology in human welfare and future directions.

4. Course Content:

Unit I

Molecular Cloning Methods : **10h**

Introduction to Gene Cloning: Principles of recombinant DNA technology, DNA manipulation using Restriction enzymes, polymerases and ligases. Vector Systems for Bacterial Cloning: Plasmids, bacteriophages, cosmids, and bacterial artificial chromosomes (BACs). Vector systems for cloning in Yeast : Shuttle vectors, yeast episomal plasmids (YEps), yeast integrative plasmids (YIps), yeast centromeric plasmids (YCps), comparing yeast and bacterial cloning systems. Polymerase Chain Reaction (PCR) and variants such as RT-PCR, qPCR, Nested PCR and Site-directed mutagenesis. Transformation and Selection in Bacteria: Chemical transformation, electroporation, blue-white screening, antibiotic selection.

Unit II

Expression of Cloned Genes **8h**

Bacterial Expression vectors : elements needed for gene expression, addition of appropriate tags for protein purification – affinity tags, solubility tags, signal peptides; pET system, inducible gene expression, challenges of prokaryotic protein expression and purification. Expression in eukaryotes: mammalian gene expression, viral vectors.

Unit III

Molecular Tools for Studying Genes and Gene Activity **10h**

Molecular Separation : Gel electrophoresis, 2D-PAGE, Chromatography techniques. Tracers: radiolabelled and non-radioactive probes Hybridization : Southern Blot – identifying specific DNA sequences, DNA fingerprinting, In Situ hybridization, Immunoblots (Western Blots), Northern Blots – Primer Extension, RACE, DNA Sequencing – Sanger sequencing, restriction mapping, Analysing DNA-Protein interactions : Gel Mobility Shift, EMSA, Footprinting assays, Chromatin Immuno Precipitation (ChIP) Assaying Protein-Protein interactions – Co-IP, FRET, SPR

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Course Specifications: Molecular Biology II

Course Title	Molecular Biology II
Course Code	CBC601A
Department	Biotechnology
Faculty	Life and Allied Health Sciences

1. Course Summary

This course offers an advanced exploration of molecular biology, focusing on genetic engineering and biotechnology applications. Students will learn the molecular mechanisms of gene expression, regulation, and genetic manipulation, with a strong emphasis on modern techniques such as CRISPR/Cas9, synthetic biology, and recombinant DNA technologies. The course covers both fundamental molecular biology and the latest advancements in the biotechnology field, including their applications in medicine, agriculture, and environmental sustainability. Through lectures, discussions, and case studies, students will develop a comprehensive understanding of the principles, applications, and challenges in these rapidly evolving fields.

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. Understand and describe the principles of molecular cloning and gene manipulation using modern genetic engineering tools.

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SEMESTER III

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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

10. Course Organization

Course Code	CBL514A	
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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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.

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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		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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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

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Course Specifications: Practical IV: Genomics, Proteomics & Bioinformatics

Course Title	Practical IV: Bioinformatics and Structural Biology
Course Code	CBL514A
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

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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
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	CBL513A		
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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Total Duration in Hours		90

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

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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

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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

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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Course Specifications: Practical III: Molecular Biology & Immunology

Course Title	Practical III: Molecular Biology & Immunology
Course Code	CBL513A
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.

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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.

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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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

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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

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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 **4h**

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 **4h**

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 **4h**

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 **4h**

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 **4h**

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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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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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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CO 2	x	x	x
CO 3	x	x	x
CO 4	x	x	x
CO 5		x	x
CO 6		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. (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

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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		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 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

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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. **Class Notes**
2. **Weinberg, R. A., 2013, The Biology of Cancer, 2nd edition, Garland Science.**
3. **Alberts, B., et al., 2014, Molecular Biology of the Cell, 6thedition, W. W. Norton & Co.**
4. **Ross, D.W., 1998, Introduction to Oncogenes and Molecular Cancer Medicine, Springer-Verlag.**
5. **Franks, L. M., Teich, N.M., 1997, Introduction to Cellular and Molecular Biology of Cancer,**
6. **Oxford University Press.**
7. **Larionow, L., 2003, Cancer Chemotherapy, Pergamon Press.**

b. Magazines and Journals

https://www.cell.com/cancer-cell/home

https://cancerres.aacrjournals.org/

10.Course Organization

Course Code	CBE602A		
Course Title	Molecular Carcinogenesis		
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 Date:	Jan 2027		

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Course Specifications: Molecular Biology of Disease and Diagnostics

Course Title	Molecular Biology of Disease and Diagnostics
Course Code	CBE603A
Department	Biotechnology
Faculty	Life and Allied Health Sciences

1. Course Summary

To decipher the origin and mechanism of development of various diseases and use biotechnology is designing effective tools for diagnosis.

To study infectious, physiological, metabolic diseases and the genetic basis of inherited diseases applying the knowledge of anatomy, physiology, pathology, immunology, molecular biology, genetics and biochemistry.

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 mechanisms, symptoms, prevention, and treatment strategies of infectious and physiological diseases.

CO 2. Understand the basis of genetic and metabolic disorders and discuss their diagnostic and therapeutic approaches based on current molecular biology and biochemical techniques

CO 3. Comprehend the molecular biology of acute and inflammation and cancer and molecular-based therapeutic approaches to cancer detection

CO 4. Demonstrate proficiency in advanced biochemical, immunological, DNA based diagnostic techniques and genetically engineered immunotherapeutics for diseases

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CO 5. Outline the principles of Gene therapy, its applications, prospects and Challenges

4. Course Content

Unit I:

Infectious and Non communicable Diseases **7h**

Mechanisms, symptoms, prevention, and cure of Infectious Diseases: bacterial, viral, protozoan, and fungal infections, antibiotic resistance mechanisms, Emerging infectious diseases. **Lateral Flow Immunoassays**: Point-of-care testing for infectious diseases like **COVID-19**, **HIV**, and **malaria**. Mechanisms, symptoms, prevention, and cure of Cardiovascular diseases, glaucoma.

Unit II:

Genetic, Metabolic Disorders and Inflammation **8h**

Genetic Disorders: Single gene inheritance, Multifactorial inheritance, Chromosome abnormalities, Mitochondrial inheritance. Metabolic Disorders: Glucose, lipid, iron, and water-electrolyte imbalances. Inflammation: Acute and chronic inflammation: Mechanism, mediators, and systemic effects.

Unit III:

Biochemical Diagnostics **9h**

Biochemical Diagnostics: POC Diagnostics: Continuous Glucose Monitoring (CGM), HbA1c (diabetes). Portable devices for urea, creatinine (kidney function). Handheld systems for protein, albumin analysis. Laboratory Diagnostics: HPLC for proteins, vitamins. Protein electrophoresis (albumin, globulin). Electrochemiluminescence immunoassay (ECLIA) for globulin. Advanced Methods: Automated assays for inborn errors of metabolism. CLIA for thyroid (TSH, T3, T4) and reproductive hormones Estradiol, Testosterone, LH, FSH).

Unit IV: Immunological and DNA Diagnostics **9h**

Immunological Diagnostics: Multiplex ELISA and rapid POC ELISA for infectious disease monitoring. HLA Typing: Next-Generation Sequencing (NGS) for organ transplantation and autoimmune disorders. Flow Cytometry: Immunophenotyping for immune disorders, and transplantation monitoring. DNA Diagnostics: Portable PCR platforms for infectious disease diagnosis. CRISPR-based POC diagnostics for rapid genetic analysis. Advanced Techniques: Fluorescence In Situ Hybridization (FISH) for chromosomal studies, Digital PCR and Real-Time PCR for genetic and infectious disease diagnostics, Next-Generation Sequencing (NGS) for disease screening and genetic mutation identification.

Unit V: Genetically Engineered Therapeutics **6h**

Genetically Engineered Immunotherapeutics: Fusion proteins, antibody production in E. coli, and their purification and applications. Chemically linked monoclonal antibodies, human monoclonal antibodies, hybrid human-mouse monoclonal antibodies, and catalytic antibodies.

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Treatment products from recombinant and non-recombinant organisms (e.g., interferons, cell-penetrating peptides, antisense therapy).

Unit VI: Gene Therapy and Future Directions **6h**

Gene Therapy: Approaches to discovering disease-causing genes, Gene-based medicines, Human somatic cell gene therapy (ex-vivo and in-vivo), Germline gene therapy, HIV therapy, CRISPR-based therapies. Future prospects of gene therapy, Ethical issues and societal fears related to gene therapy: **germline gene editing, gene patenting, and privacy implications**

5. **CO-PO Mapping**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4
CO-1	3	-	-	-	-	-	-	-	-	-	-	3
CO-2	3	-	-	-	-	-	-	-	-	-	-	3
CO-3	3	-	-	-	-	-	-	-	-	-	-	3
CO-4	-	-	-	3	-	-	-	-	-	-	2	3
CO-5	-	-		3	-	-	-	-	-	-	2	-
CO-6	1	-	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		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	--

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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. Kumar, V., Abbas, A.K., Fausto, N. and Aster, J. (2015) *Robbins and Cotran Pathologic Basis of Disease*. 9th edn. Elsevier Saunders.
2. Zipes, D.P., Libby, P., Bonow, R.O., Mann, D.L. & Tomaselli, G.F., 2019. Braunwald's Heart Disease: A Textbook of Cardiovascular Medicine. 12th ed. Philadelphia: Elsevier.
3. Buckingham, L. and Maribeth, L.F. (2007) *Molecular Diagnostics: Fundamentals, Methods and Clinical Applications*. F.A. Davis.
4. Wong, R. & Tse, H., 2008. Lateral Flow Immunoassay. 1st ed. Totowa: Humana Press.
5. Luppa, P.B. & Junker, R., 2018. Point-of-Care Testing: Principles and Clinical Applications. 2nd ed. Berlin: Springer.
6. Buckingham, L. & Flaws, M.L., 2019. Molecular Diagnostics: Fundamentals, Methods, and Clinical Applications. 4th ed. Philadelphia: F.A. Davis.
7. Rees, A.R., 2021. Protein Therapeutics: Methods and Protocols. 1st ed. New York: Springer.
8. Barrangou, R. & Doudna, J., 2016. The CRISPR Revolution: Genome Editing and Beyond. 1st ed. Cambridge: Harvard University Press.
9. Saghai, Y., 2018. Gene Editing, Precision Medicine, and Ethics. 1st ed. Cham: Springer.

b. Magazines and Journals

1. Nature Cell Biology. Available at: https://www.nature.com/ncb/.
2. Molecular and Cellular Biology. Available at: http://mcb.asm.org.
3. BMC Cell Biology. Available at: https://bmccellbiol.biomedcentral.com/.

10. Course Organization

Course Code	CBE603A

Course Title	Molecular Biology of Disease and Diagnostics		
Course Leader/s Name		As per time table	
Course Leader Contact Details		**Phone :**	08045366666
		E-mail:	
Course Specifications Approval Date		Feb 2025	
Next Course Specifications Review		Jan 2027	

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Course Specifications: Foundations of Cognitive Neuroscience

Course Title	Foundations of Cognitive Neuroscience
Course Code	CBE604A
Department	Biotechnology
Faculty	Life and Allied Health Sciences

1. Course Summary

This course provides an interdisciplinary exploration of the relationship between cognitive neuroscience and consciousness. Students will gain a basic understanding of cognitive processes and their neural basis including attention, emotion, perception of the senses, and memory. The course will also touch upon the interface between cognitive neuroscience and consciousness studies, integrating scientific findings with philosophical perspectives.

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: Establish a foundational understanding of cognitive neuroscience and its significance in the study of consciousness.

CO2: Comprehend the fundamental principles of perceptual awareness and its neural correlates.

CO3: Analyze the hierarchical processing of visual perception within the brain.

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CO4: Gain insight into the neural mechanisms underlying attention, memory, and emotions.

CO5: Investigate contemporary theories and empirical research on consciousness through the lens of cognitive neuroscience.

4. Course Contents

Unit I: Introduction: **7h**

Definition of cognitive neuroscience and consciousness, basic concepts in cognitive neuroscience (e.g., perception, attention, memory, learning), neural mechanisms underlying cognitive functions, historical perspectives on consciousness (e.g., Cartesian dualism, early theories of mind-body interaction).

Unit II: Basic neurophysiology: **8h**

Electrical properties of neurons, resting membrane potential, generation of action potentials, membrane excitability and its role in signal transmission, ion channels and their function in neurons, depolarization and repolarization, synaptic transmission and neurotransmitter release, signal coding and interpretation in the brain, role of the brain in processing electrical signals, mechanisms of signal integration in the nervous system, neural circuits and their contribution to cognition, voltage-gated ion channels and their pharmacological signifi cance.

Unit III: Attention, perception, and hemispheric specialization: **7h**

The relationship between attention and conscious awareness, neural mechanisms of selective attention, theories of attention, perception processes in the brain, sensory pathways for visual and auditory perception, neural mechanisms in the visual system (e.g., retinal processing, cortical visual areas), auditory processing in the brain (e.g., cochlear pathways, auditory cortex), hemispheric specialization in brain functions (left vs. right hemisphere), and the impact of attention on perception and awareness.

Unit IV: Memory, learning, and language processing: **7h**

The role of memory and learning in conscious experience, neural mechanisms of memory (e.g., hippocampus, amygdala), models of memory (e.g., multi-store model, working memory), types of memory (e.g., declarative, procedural), processes of language acquisition and comprehension, the mental lexicon and its neural organization, neural basis of language processing.

Unit V: Cognitive control and social cognition: **8h**

The role of the frontal lobe in cognitive control, neural networks for goal-directed behavior and decision making, executive functions (planning, inhibition, working memory), social cognition and theory of mind, brain regions involved in social interactions and empathy, and decision-making processes in complex environments.

Unit VI: Theories of consciousness: **8h**

Examination of major theoretical frameworks explaining consciousness (e.g., integrated information theory, global workspace theory), neural mechanisms underlying self-referential processing, exploration of altered states of consciousness induced by meditation, and a

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discussion on Advaita philosophy and its perspective on non-duality and the nature of consciousness.

CO-PO-PSO mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO2	PSO3	PSO4
CO-1	3	-	3	-	-	-	-	2	3	-	-	-
CO-2	3	-	3	-	-	-	-	2	3	-	-	-
CO-3	3	2	3	-	-	-	-	2	2	-	-	-
CO-4	3	2	3	-	-	-	-	2	2	-	-	-
CO-5	2	2	3	-	-	-	-	2	3	-	-	-
3: High Influence, 2: Moderate Influence, 1: Low Influence												

7. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		24
Demonstrations		05
1. Demonstration using Videos	05	
2. Demonstration using Physical Models /	0	
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	00	
2. Guest Lecture	02	11

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3. Industry / Field Visit		
4. Brain Storming Sessions	02	
5. Group Discussions	05	
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 assessments 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.

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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	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

References

i. Cognitive neuroscience: The Biology of The Mind. 4th Edition, Michael S. Gazzaniga, Richard B. Ivry, George R. Mangun

ii. Consciousness: An Introduction. 3rd Edition, Susan Blackmore, Emily Troscianko

a. Magazines and Journals

i. Mapping the Unconscious Brain: Insights From Advanced Neuroimaging, Journal of Clinical Neurophysiology Volume 39(1):p 12-21, January 2022.

ii. An adversarial collaboration protocol for testing contrasting predictions of global neuronal workspace and integrated information theory, PLOS ONE, Feb 2021

Course Organization

Course Code	CBE604A
Course Title	Foundations of Cognitive Neuroscience

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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	February 2025	
Next Course Specifications Review	January 2027	

ELECTIVE II

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Course specifications: AI/ML in Health Care

Course Title	**AI /ML in Health Care**
Course Code	BTE605A/CBE605A
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.

Course size and credits

Number of credits	3
Total hours of classroom interaction	45
Number of tutorial hours	00
Number of semester weeks	16
Department responsible	Biotechnology
Course marks	As described in the program specifications
Pass requirement	A minimum of 40% in SEE is required for a pass
Attendance requirement	75% attendance is mandatory

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2. 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

3. Course Contents

Unit I **7h**

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

Unit II **8h**

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 **7h**

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 **8h**

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 **8h**

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

Unit VI **7h**

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

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4. CO-PO PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	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															

5. 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		

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5. Hospital		
6. Model Studio		
Others		
1. Case Study Presentation		5
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		04
Total Duration in hours		**45**

6. 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.

		Type of Assessment			
No.	**Intended Learning Outcome**	**Component-I(Continuous Evaluation)**			**Component-II (Examination)**
		Mid Term Test	**Seminar**	**Assignment**	
1	Understand the differences between AI, machine learning, and deep learning. Understand the strengths and limitations of AI	X	X		X
2	Understand elementary algorithms in AI	X	X		X

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3	Understand elementary algorithms in machine learning		X	X	X
4	Understand the role of AI in diagnostics		X	X	X
5	Understand the role of AI in pathology and radiology		X	X	X
6	Understand the ethical and social ramifications of AI	X	X	X	X

7. Achieving learning outcomes

	Curriculum and Capabilities Skills	How it will be imparted during the course
1	Knowledge	Classroom lectures
2	Understanding	Classroom lectures
3	Critical skills	Classroom lectures
4	Analytical skills	Classroom lectures
5	Problem solving skills	Assignment, examination
6	Practical skills	Assignment
7	Group work	–
8	Self-learning	Self-study
9	Written communications 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

1. Mahajan MD, Parag Suresh (2018) Artificial Intelligence in Healthcare, Paperback.
2. Panesar, Arjun (2019), Machine learning and AI for Healthcare-Big Data for Improved Health Outcomes, APress.
3. Recommended Journal Papers.

9. Course Organization

Course Code	AI/ML in Healthcare		
Course Title	BTE605A/CBE605A		
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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Course Specifications: Stem Cell and Regenerative Medicine

Course Title	Stem Cell and Regenerative Medicine
Course Code	CBE606A
Department	Biotechnology
Faculty	Life and Allied Health Sciences

1. Course Summary

This course provides a comprehensive understanding of key concepts in developmental biology, and explores the fundamentals of stem cell biology, covering their regulation, and microenvironment. It examines the clinical applications and ethical considerations of stem cell research. It highlights the principles of tissue engineering, such as biomaterials, scaffolds, and 3D bioprinting with applications in regenerative medicine for various tissues.

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 key concepts in developmental biology and the role of signalling pathways in cell-cell communication.

CO 2. Identify characteristic features of Stem cells, their origin, maintenance and regulation.

CO 3. Evaluate the applications of stem cells in cell and gene therapy

CO 4. Assess ethical concerns in stem cell research

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CO 5. Design strategies using principles of tissue engineering to address challenges in regenerative medicine.

CO 6. Formulate innovative solutions for unmet medical challenges by integrating concepts of stem cell biology, tissue engineering, and cancer research, contributing to advancements in personalised medicine.

4. Course Contents

Unit I **7h**

Developmental biology

Concept of model organisms. Early mammalian development – Cleavage, Blastulation, Gastrulation, Lineage commitment. Cell-Cell communication in Development – the signaling pathways.

Unit II **7h**

Biology of stem cells

Basics of stem cells and principle of potency. Different stem cell types. Cell cycle regulation in stem cells. Process of asymmetric cell division: intrinsic and extrinsic. Biological, physio-mechanical properties of stem cell micro-environment. Master regulators in stem cell maintenance. Extrinsic factors in the regulation of stem cell division and function.

Unit III **9h**

Tissue Specific stem cells

Hematopoietic stem cell- HSC niche. Differentiation of hematopoietic stem cell lineages. Isolation and characterisation of HSC. Transcriptional regulation of HSC. *In vitro* and *in vivo* assays. Application of HSCs in clinical use. Stem cell Plasticity. Mesenchymal Stem cell and induced pluripotent stem cells (iPSCs) - Characteristics and applications.

Unit IV **9h**

Clinical applications and Ethics in Stem Cell Research

Principle of cell and gene therapy. Different vector system for gene delivery. Gene editing tools. Use of stem cells for metabolic diseases, genetic diseases, wound healing and eye disorders. Stem cell therapy guidelines, Ethics of gene editing, Stem cell banking.

Unit V **6h**

Cancer stem cells

Stem cell origin of cancer. Properties of CSCs. Cancer stem cell Niches. Isolation and characterisation of CSCs. Signaling Pathways in CSCs regulation. CSCs and Chemoresistance. Therapeutic targeting of CSCs.

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Unit VI **7h**

Tissue engineering

Principles of Regenerative medicine. Biomaterials and scaffolds. 3D bioprinting. Examples in Bone, Skin, Eye, Cardiovascular and Neural tissue engineering.

5. CO-PO Mapping

	PO 1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO2	PSO 3	PSO4
CO-1	3	2	-	-	-	-	-	-	3	-	-	-
CO-2	3	2	-	-	-	-	-	-	3	-	-	-
CO-3	2	3	1	-	-	-	-	-	3	-	-	-
CO-4	2	-	-	-	-	3	-	-	3	-	-	-
CO-5	1	1	3	-	-	-	-	-	3	-	-	2
CO-6	1	2	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		31
Demonstrations		03
1. Demonstration using Videos	03	
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		

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Final Approval by the Academic Council in its 34th meeting held on 27th March 2025

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Others		
1. Case Study Presentation		
2. Guest Lecture	02	06
3. Industry / Field Visit		
4. Brain Storming Sessions		
5. Group Discussions	03	
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	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.

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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

Essential Reading

1. Lanza, R. and Atala, R(2013). Essentials of Stem Cell Biology (Eds.). 3rd Edition. Academic Press
2. Black, JMW. (2017). The science of stem cells. 1st, Edition, Wiley Blackwell publishers.
3. Warburton, D. (2014). Stem Cells, Tissue Engineering and Regenerative Medicine. 1st Edition. World Scientific publishing Co. Pvt. Ltd.
4. Sell, S. (2013). Stem Cells Handbook. 1st edition. 2013.
5. Burgess, R. (2016). Stem Cells: A Short Course . 1stEdition, Wiley Blackwell Publishers.

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6. Lanza, R. Langer, R. Vacanti, J. Principles of Tissue Engineering (2013). 4th edition. Academic Press.
7. Bronzino, JD., Peterson, DR. (2015). The Biomedical Engineering Handbook 4th edition. CRC Press Taylor & Francis.

Magazines and Journals

1. https://www.nature.com/ncb/
2. http://mcb.asm.org/
3. https://bmccellbiol.biomedcentral.com/

Websites

1. https://www.cellsalive.com/
2. http://www.biology.arizona.edu/cell_bio/cell_bio.html

10. Course Organization

Course Code	CBE606A	
Course Title	Stem Cell and Regenerative Medicine	
Course Leader/s Name	As per time table	
Course Leader Contact Details	**Phone :**	08045366666
	E-mail:	hod.bt.bl@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/CBE607A
Department	Biotechnology
Faculty	Life and Allied Health Sciences

13. 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.

14. 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

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15. 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.

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.

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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

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO4
CO-1	3	-	-	-	-	-	-	-	3	-	-	-
CO-2	3	3	-	-	-	-	-	-	-	3	-	-
CO-3	3	3	-	-	-	-	-	-	3	2	-	3
CO-4	-	-	-	2	-	-	-	-	3	-	-	-
CO-5	-	-	3	-	-	-	-	-	3	2	-	-
CO-6	-	2	3	-	-	-	-	-	3	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		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

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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	--

10. Course Resources

a. References

1. Webster, J. G. (ed.), "Medical instrumentation: application and design", Fourth edition, John Wiley & Sons, Hoboken.
2. Dr. Inamuddin, Raju Khan, Ali Mohammad, Abdullah Asiri, "Advanced Biosensors for Health Care Applications", 1st Edition - June 15, 2019.
3. Jyotismita Chaki, Nilanjan Dey, Debashis De, "Smart Biosensors in Medical Care", 1st Edition - February 18, 2020.
4. Zeynep Altintas, "Biosensors and Nanotechnology: Applications in Health Care Diagnostics", 2017.
5. Biosensors and modern bio-specific analytical techniques, L. Gorton (ed) Volume XLIV Elsevier 2005.
6. Advances in biosensors, B. D. Malhotra & A. P. F. Turner (eds), Volume 5, Elsevier science 2003.

b. Text Books

1. Jeong-Yeol Yoon, Introduction to Biosensors, Springer-Verlag New York Ed. 2016
2. Mohammed Zourob, Recognition Receptors in Biosensor; Publisher: Springer-Verlag New York Ed. 2010

c. Magazines and Journals

1. Movie: Naturally Obsessed, The Making of a Scientist.
2. Articles from journals like Biosensors, Biosensors and Bioelectronics.

d. Online resources

1. https://www.youtube.com/watch?v=kQ6CY1qpGjY
2. https://nptel.ac.in/courses/102101054
3. https://onlinecourses.nptel.ac.in/noc20_ph13/preview

4. https://onlinecourses.nptel.ac.in/noc22_ph01/preview

11. Course Organization

Course Code	Biosensors: Fundamentals and Applications	
Course Title	BTE607A/CBE607A	
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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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

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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

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,
registering and marketing in a global context

4. Course Content

Unit I

Introduction to Drug Discovery and Development: **4h**

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

Classical Targets in Drug Discovery: **6h**

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

Medicinal Chemistry: **5h**

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

In vitro ADME and In vivo Pharmacokinetics: **5h**

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

Unit VI

Basics of Clinical Trials and Patenting: **8h**

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

5. CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
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		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		
1. Case Study Presentation		05
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.

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Focus of Course Learning Outcomes in each component assessed					
	CE (50% Weightage)				SEE (50% Weightage)
	SC1	SC2	SC3	SC4	
	25 Marks	25 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	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 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	--

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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. **Basic Principles of Drug Discovery and Development, Academic Press, Elsevier, Blass Dr., Benjamin, ISBN-10: 012411508X, ISBN-13: 978-0124115088**
2. **A Practical Guide to Drug Development in Academia: The SPARK Approach, Springer, Editors: Daria Mochly-Rosen and Kevin Grimes, ISBN-10: 3319022008, ISBN-13: 978-3319022000**
3. Biopharmaceutical Drug Design and Development, Springer, Wu-pong, ISBN-10: 8184897022, ISBN-13: 978-8184897029
4. Drug Safety and Pharmacoepidemiology, Foster Academics, Editor: Avianna Stokes, ISBN-10: 1632425785, ISBN-13: 978-1632425782

b. Magazines and Journals

1. https://www.nature.com/nrd/
2. 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:**	08045366666
	E-mail:	hod.bt.ls@msruas.ac.in
Course Specifications Approval Date	September 2024	

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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

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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		
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-		x	x

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5			

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.

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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.

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.

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Course Specifications: Dissertation and Publication

Course Title	Group Project
Course Code	CBP601A
Programme	M.Sc. Molecular and Cellular Biology
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

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CO 3. Apply appropriate research methodology while formulating a project
CO 4. Define Specifications, Synthesize, Analyse, Develop and Evaluate a project
CO 5. Develop a report which explains the project and make a presentation and document the work

4. Course Contents

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

- Gene expression data analysis using bioinformatics, Artificial intelligence and machine learning tools
- Protein design, microbiology, remediation techniques and cell culture assays
- Clinical Research data analysis and interpretation
- Any form of experimental projects related to Biotechnology that provides exposure to data generation, analysis and interpretation
- Critical analysis of classical papers
- Team building, Teamwork, Leadership skills

5. CO-PO-PSO mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO 2	PSO 3	PSO 4
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

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M.S. RAMAIAH UNIVERSITY OF APPLIED SCIENCES
BANGALORE-560 054

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	80
	Presentation to Reviewers	04
Design	Group work with supervisors guidance	25
Analysis	Group work with supervisor guidance	25
Testing and Evaluation	Group work with supervisors guidance	20
Verification/Validation	Group work with supervisors guidance	25
Drawing Conclusions	Group work with supervisors guidance	05
Presentation , Thesis/Report Writing and Viva Voce	Presentation and Viva voce-Group	01
	Thesis/Report writing - Group	50
	Tests/Examinations/Presentations	05
	Total	240

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:

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No.	Intended Learning Outcome	Mode of Assessment	
		Component 1 (Continuous Evaluation)	Component 2
1	Work in a team and undertake a biotechnology related project, along with critical analysis of papers by using analytical research approach	X	X
2	Apply Biotechnology principles ar techniques for executing the project	X	X
3	Apply appropriate research methodology while formulating a project	X	X
4	Define Specifications, Synthesize, Analyse, Develop and Evaluate a project	X	X
5	Develop a report which explains the project and make a presentation and document the work	X	X

Meeting Programme Objectives Through Course Objectives

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
12.	Behavioural Skills	Group Project work
13.	Information Management	Group Project work

Shruti Mathur

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	CBP601A	
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	

Shruti Mathur
Head
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SEMESTER IV

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Course Specifications: Dissertation and Publication

Course Title	Dissertation and Publication
Course Code	CBP602A
Programme	M.Sc. Molecular and Cellular Biology
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	640 in 16 weeks
Department responsible	Biotechnology
Course marks	Total 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:

Defining / Identification of the Research Problem

i. Literature review/ Information search, retrieval and review
ii. Framing Research hypothesis, experimental designs and Methodology
iii. Problem solving - Evaluation, Interpretations and drawing conclusions
iv. Proposing ideas or methods for further work
v. Thesis writing Oral presentation/ Viva voce

Publishing will cover the following:

i. Journal / Conference Identification
ii. Writing a journal paper based on research findings
iii. Submission to Journal / Conference

5. CO-PO Mapping

	PO1	PO2	PO 3	PO4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO2	PSO3	PSO4
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

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Use of methodology and execution of experiments	Individual work with supervisors guidance	150
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	50
Presentation, Thesis/Report Writing and Viva Voce, Authoring Research paper/ preparing manuscript/ poster presentation/conference publication	Presentation and Viva voce	30
	Thesis/Report writing, Authoring research paper/	100
Tests/ Examinations/presentations		20
	Total	690

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	CO 1	CO 2	CO 3	CO4	CO 5	CO 6
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:

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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	CBP602A	
Course Title	Dissertation and Publication	
Project Supervisors Name	Allotted on project basis	
Project Supervisors Contact Details	**Phone:**	080-49066666
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