RAMAIAH UNIVERSITY OF APPLIED SCIENCES

M. S. Ramaiah University of Applied Sciences

Programme Structure and Course Details

of

B.Sc. in Biotechnology

B.Sc. (Honours) in Biotechnology

B.Sc. (Honours with Research) in Biotechnology

Programme Code: 018

BATCH 2022 onwards

M S Ramaiah University of Applied Sciences
Faculty of Life and Allied Health Sciences
Department of Biotechnology

Approved by the Academic Council Meeting at its 26th meeting held on 14th July 2022
Revised and Approved by the 28th, 31st and 36th ACM held on the 3rd April 2023
22nd March 2024 and 27th September 2025 respectively

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

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

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

Programme Specifications: B.Sc. (Hons.) in Biotechnology

Faculty	Life and Allied Health Sciences
Department	Biotechnology
Programme Code	018
Programme Name	B.Sc. in Biotechnology B.Sc. (Honours) in Biotechnology B.Sc. (Honours with Research) in Biotechnology
Dean of the Faculty	Dr. Soma Chaki
Head of the Department	Dr. Shruti Mathur

1. **Title of the Award:** B.Sc. in Biotechnology
   B.Sc. (Honours) in Biotechnology
   B.Sc. (Honours with Research) in Biotechnology
2. **Mode of Study:** Full Time
3. **Awarding Institution /Body:** M. S. Ramaiah University of Applied Sciences
4. **Joint Award:** Not Applicable
5. **Teaching Institution:** Department of Biotechnology, Faculty of Life and Allied Health Sciences, M. S. Ramaiah University of Applied Sciences, Bengaluru
6. **Date of Programme Specifications:** July 2022
7. **Date of Programme Approval by the Academic Council of MSRUAS:** 14-07-2022
8. **Next Review Date:** June 2026
9. **Programme Approving Regulating Body and Date of Approval:** Academic Council of MSRUAS on 14-07- 2022
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 for the Programme**

B.Sc. (Honours) in Biotechnology is an undergraduate degree Programme designed to create innovative problem solvers with a multi-disciplinary approach, entrepreneurs and leaders that apply their knowledge, understanding, cognitive abilities, practical skills and transferable skills gained through systematic, flexible and rigorous learning in the chosen academic domain towards betterment of society.

With the current trends of National Education Policy (NEP) – 2020 and Self-Employment, there is a tremendous need for a young workforce with skillset that will make the students readily employable, for various roles in academia and industry. The objective is to bridge the gap between the current system of education and what is required in the 21st century. It is to have

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

Dean-Academics
Faculty of Life & Allied Health Sciences
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

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

Holistic and Multidisciplinary UG Education to produce employable graduates with well-rounded personality. The Government of Karnataka had constituted a Task to suggest an Implementation Framework for NEP-2020. It had also constituted two sub- committees, one on Curriculum Reforms in Higher Education and the other on Governance and Regulations.

B.Sc. (Hons) in Biotechnology is an undergraduate degree that imparts knowledge and understanding of biological systems and their behaviour for various inputs/stimuli originating from the surrounding environment. The Programme also provides sufficient understanding and cognitive abilities to design, B.Sc. (Hons) Biotechnology-Programme Specification develop and incorporate scientific methods, techniques, and processes for biological systems of study to achieve the desired results. In addition, the programme imparts knowledge and training to develop transferable skills and entrepreneurship abilities.

The Task Force has suggested NEP-2020 Implementation Framework for Karnataka. The State Government has accepted the action plan and initiated steps to implement NEP-2020, as per the Roadmap suggested by the Task Force. The curriculum is outcome based and it imbibes required theoretical concepts and practical skills in the domain. By undergoing this Programme, students develop critical, analytical thinking and problem-solving abilities for a smooth transition from academic to real-life work environment. Special emphasis shall also be provided to Ability and Skill Enhancement/Vocational Courses as well as Value Added Courses. Opportunities are provided for the students to do internship in Life science and Biotechnology institutes and industry, research & development and also execute a well-defined project independently as well as in a team to enhance practical skills and problem-solving abilities. The students are required to submit a well written project report as partial fulfilment for the award of the degree, which will help develop skills of documenting scientific research methods and outcome. This Undergraduate Programme is meant to highlight systemic change in the higher education system in MSRUAS and align itself with the National Education Policy - 2020.

15. Programme Mission

The purpose of the programme is to create innovative problem solvers with a multi-disciplinary approach, entrepreneurs and leaders that apply their knowledge, understanding, cognitive abilities, practical skills and transferable skills gained through systematic, flexible and rigorous learning in the chosen academic domain towards betterment of society.

16. Graduate Attributes

GA-1. Ability to apply fundamental knowledge of Biology, Chemistry, Mathematics, Statistics and computer to solve real life problems in their chosen domain
GA-2. Ability to perform administrative duties in government, semi-government, private and public sector organizations
GA-3. Ability to teach in schools, colleges and universities with additional qualification and training
GA-4. Ability to understand and solve scientific problems by conducting experimental investigations
GA-5. Ability to apply appropriate tools, techniques and understand utilization of resources appropriately in various Laboratories
GA-6. Ability to apply basic programming concepts in their chosen domains
GA-7. Ability to understand the effect of scientific solutions on legal, cultural, social and public health and safety aspects
GA-8. Ability to develop sustainable solutions and understand their effect on society and environment
GA-9. Ability to apply ethical principles to scientific practices and professional responsibilities

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

GA-10. Ability to work in a team, to plan and to integrate knowledge of various disciplines and to lead teams in multidisciplinary settings
GA-11. Ability to effectively convey scientific ideas and concepts to a broad audience using both written and verbal means
GA-12. Ability to adapt to the changes and advancements in science and engage in independent and lifelong learning.

17. Programme Outcomes (POs)

B.Sc. (Hons) Biotechnology graduates will be able to:

PO 1. Knowledge and Understanding: Gain knowledge of life science fundamentals and applied biotechnological aspects with an understanding of their applications towards solving real life problems.

PO 2. Design research involving appropriate methodology and develop novel solutions leading to new Knowledge Creation: Identify real life problems in areas of basic biology, agriculture, medicine, industry, environment and collect appropriate data for analysis; Analyse the identified problem, design a logical experimental work flow, and develop innovative, novel and long-term solutions to real life problems in basic biology, agriculture, medicine, industry, and environment; Create new knowledge including discovery of foundational principles, new methods, strategies, tools.

PO 3. Application of modern laboratory tools, techniques: Gain skills enabling effective use of laboratory tools, techniques and resources.

PO 4. Programming and Data analysis: Apply programming and data analytical tools and techniques to solve scientific problems.

PO 5. Multidisciplinary approach: Evaluate problems through multiple perspectives and apply knowledge of various disciplines to effectively define a research problem and design a study based on research.

PO 6. Communication: Disseminate knowledge effectively through scientific writing and verbal communication.

PO 7. Leadership and teamwork: Apply professional ethics, leadership, and team building skills in profession and entrepreneurial initiatives.

PO 8. Understand system processes and manage tasks: Apply scientific knowledge to execute industrial projects and administration to minimize errors.

PO 9. Social Responsibility and Ethics: Apply ethical principles in scientific research, profession and become aware of societal responsibilities.

PO 10. Environment and Sustainability: Understand the impact of the scientific research on society and environment and select judicious modes of application for sustainable development.

PO 11. Entrepreneurial Skills: Enhancing self-employability by applying the basic and applied scientific knowledge acquired.

PO 12. Lifelong learning: Adapt to advancements in science and engage in independent life-long learning aimed towards up-skilling and maintaining relevance to changing times and trends in a continuous manner.

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore

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

18. Programme Goal

The programme acts as a foundation degree and helps to develop critical, analytical and problem-solving skills at first level. The foundation degree makes the graduates employable in scientific organisations and also to assume administrative positions in various organisations. With additional qualifications and training help the graduates to pursue various career paths in academics, research and industries.

The goals of the Programme include:

- Promote holistic development
- Ability to choose learning trajectories and programmes
- Eliminate harmful hierarchies among disciplines/fields of study and silos between different areas of learning
- Multidisciplinary and holistic education to ensure unity and integrity of knowledge
- Promote creativity and critical thinking to encourage logical decision-making along with appreciating ethical, human & constitutional values
- Promote multilingualism and power of language in learning and teaching
- Impart life skills such as communication, cooperation, teamwork, and resilience
- Facilitate outstanding research as a co-requisite for outstanding education and development

19. Programme Educational Objectives (PEOs)

The Bachelor of Science honours degree programme in Biotechnology imparts knowledge and understanding of biological systems and their behaviour for various inputs/stimuli originating from the surrounding environment. The Programme also provides sufficient understanding and cognitive abilities to design, develop and incorporate scientific methods, techniques, and processes for biological systems of study to achieve the desired results. In addition, the programme imparts knowledge and training to develop transferable skills and entrepreneurship abilities.

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

PEO-1: To prepare graduates for their professional career in Biotechnology domain towards employment and /or academic progression

PEO-2: To introduce graduates to a multidisciplinary approach, research-based higher order thinking to drive novel solution creation to alleviate real life problems.

PEO-3: To impart various abilities and skills, that enhance holistic development, and promote lifelong learning

20. Programme Specific Outcomes (PSOs)

PSO 1: Create an inclusive environment in which theories of fundamental and applied courses in Biotechnology are explored to learn along with integration of knowledge towards a better tomorrow.

PSO 2: Enable program audience for channelizing efforts in identifying the requirements and problems in Biotechnology in order to earn appropriate solutions for a progressive society.

PSO 3: Provide an environment with opportunity to obtain various abilities and skills promoting holistic development, employability and lifelong learning.

Head
Department of Biotechnology
Ramaiah University of Applied Sciences
Bangalore - 560 054

21. Programme Structure

Semester 1

Sl.No.	Code	Course Title	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Total Credits	Max. Marks
1	BTC101A	Macromolecular structure and analysis	3		4	5	100
2	BTC102A	Biological Techniques and Instrumentation	3		4	5	100
3	BTC103A	Biomathematics and MATLAB	2	1		3	100
4	BTO101A	Fundamentals in Biology	3			3	100
6	TSM101A	English for Communication 1	3			3	100
7	CSM101A	Digital Fluency	1		2	2	50
		Total	**15**	**1**	**10**	**21**	**550**
		Total number of contact hours per week		**26**			

**(h/W/S): Hours/week/semester*

Semester 2

Sl.No	Code	Course Title	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Total Credits	Max. Marks
1	BTC104A	General Chemistry 1	3		4	5	100
2	BTC105A	Principles of Microbiology	3		4	5	100
3	BTC106A	Organic Mechanisms in Biology	3			3	100
4	BTO102A	Biotechnology for Human Welfare	3			3	100
5	BTN101A	Environmental Studies	2			2	50
6	AHU101A	Health and wellness/ social and emotional learning	1		2	2	50
		Total	**15**		**10**	**20**	**500**
		Total number of contact hours per week		**25**			

**(h/W/S): Hours/week/semester*

Semester 3

Sl.No.	Code	Course Title	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Total Credits	Max. Marks
1	BTC201A	General Chemistry 2	3		4	5	100
2	BTC202A	Principles of Genetics	3		4	5	100
3	BTC203A	Biostatistics	3			3	100
4	BTO201A	Applications of Biotechnology in Agriculture	3			3	100
5	TSM102A	English for Communication 2	3			3	100
6	CSM201A	AI	1		2	2	50
7	BAU201A	Innovation and Entrepreneurship	1	1	2	3	100
		Total	**17**	**1**	**12**	**24**	**650**
		Total number of contact hours per week		**30**			

**(h/W/S): Hours/week/semester*

Semester 4

Sl.No.	Code	Course Title	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Total Credits	Max. Marks
1	BTC204A	Cell Structure and Signaling	3		4	5	100
2	BTC205A	Molecular Biology	3		4	5	100
3	BTC206A	Molecular Genetics	3			3	100
4	BTO202A	Applications of Biotechnology in Medicine	3			3	100
5	LAN101A	Constitution of India and Human Rights	2			2	50
6	TSU202A	Professional Communication	2			2	50
7	TSU101A	Ethics and Self awareness	1		2	2	50
		Total	**17**		**10**	**22**	**550**
		Total number of contact hours per week		**27**			

**(h/W/S): Hours/week/semester*

Dean - Academics, M.S. Ramaiah University of Applied Sciences, Bangalore - 560 054

Head, Department of Biotechnology, M.S. Ramaiah University of Applied Sciences, Bangalore - 560 054

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

Semester 5

Sl.No.	Code	Course Title	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Total Credits	Max. Marks
1	BTC301A	Recombinant DNA Technology	3		4	5	100
2	BTC302A	Immunology and Immunotechnology	3		4	5	100
3	BTC303A	Computer Programming: Python and R	1	2		3	100
4	BTE301A	Environmental Biotechnology	3			3	100
5	BTE302A	Agricultural Biotechnology					
6	BTE303A	Medical Biotechnology					
7	TSN201A	Project Management	3			3	50
8	CSM301A	Cyber security	1		2	2	50
9	PTU101A	Sports	1		2	2	50
	BNE101A	Yoga					
		NSS/Cultural					
		Total	**15**		**12**	**23**	**550**
		Total number of contact hours per week		**27**			

Semester 6

Sl.No.	Code	Course Title	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Total Credits	Max. Marks
1	BTC304A	Animal Biotechnology and Animal tissue culture	3			5	100
2	BTC305A	Plant Biotechnology and Plant tissue culture	3			5	100
3	BTC306A	Biosafety, Bioethics and IPR	3			3	100
4	BTE304A	Industrial Biotechnology	3			3	100
5	BTE305A	Pharmaceutical Biotechnology					
6	TSN302A	Personality Development and Soft Skills	2			2	50
7	BTM301A	Competitive Exam Training	1	1		2	50
8	BTN301A	Seminar		2		2	50
		Total	**15**	**2**	**12**	**22**	**550**
		Total number of contact hours per week		**29**			
		Exit Option after Three Years with a B.Sc. in Biotechnology					

**(h/W/S): Hours/week/semester*

For students opting for the fourth year B.Sc. Honours programme, eligibility for the respective degree track shall be determined in accordance with the NEP 2020 guidelines.

1. Students who have completed 132 credits at the end of the first three academic years and secured a minimum CGPA of 7.5/10 shall be eligible for the B.Sc. (Honours with Research) in Biotechnology and shall undertake an individual 21-credit research project in the eighth semester.
2. Students who have completed the required credits but do not meet the CGPA criterion shall be awarded the B.Sc. (Honours) in Biotechnology and shall undertake the prescribed coursework of 13 credits along with a group project of 8 credits in the eighth semester.

Semester 7

B.Sc. (Hons with Res) in Biotechnology and B.Sc. (Hons) in Biotechnology							
Sl.No.	Code	Course Title	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Total Credits	Max. Marks
1	BTC401A	Bioinformatics	3		4	5	100
2	BTC402A	Genomics and Proteomics	3		4	5	100
3	BTC403A	Research Methodology	3			3	100
4	BTE401A	Stem cells and Regenerative medicine	3			3	100
5	BTE402A	Nanobiotechnology					
6	BTE403A	Green Energy Technologies					
7	BTS401A	Internship/Training program/Mini Project)			6	3	100
		Total	**12**	**2**	**14**	**19**	**500**
		Total number of contact hours per week		**28**			

**(h/W/S): Hours/week/semester*

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

Semester 8

B.Sc. (Hons. with Research) in Biotechnology

B.Sc. (Hons. with Research) in Biotechnology							
Sl.No.	Code	Course Title	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Total Credits	Max. Marks
1	BTP401A	Research Project			42	21	400
		Total			**42**	**21**	**400**
		Total number of contact hours per week		**42**			

**(h/W/S): Hours/week/semester*

B.Sc. (Hons) in Biotechnology

B.Sc. (Hons.) in Biotechnology							
Sl.No.	Code	Course Title	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Total Credits	Max. Marks
1	BTC404A	Data Management in Biotechnology	3		4	5	100
2	BTC405A	Food Biotechnology and Nutraceuticals	3		4	5	100
3	BTC406A	Good Manufacturing Practices and Quality Control	3			3	100
4	BTP402A	Group Project			16	8	100
		Total	**9**		**24**	**21**	**400**
		Total number of contact hours per week		**40**			

**(h/W/S): Hours/week/semester*

22. Ability and Skill Enhancement Courses

- **Ability Enhancement Compulsory Courses (AECC): AECC courses** are the courses based upon the content that leads to knowledge enhancement through various areas of study, which will be mandatory for all disciplines:
    1. Language and Literature
    2. Environmental Science and Sustainable Development/ Environmental Studies
    3. Constitution of India and Human Rights, Human rights
    4. Project Management
    5. Competitive Exam Training

- **Skill Enhancement Courses (SEC)/ Vocational Courses**: These are skill-based courses in all disciplines and are aimed at providing hands-on-training, competencies, skills, etc. SEC courses may be chosen from the pool of courses designed to provide skill-based instruction:
    1. Digital Fluency
    2. Artificial Intelligence & ML
    3. Cyber Security
    4. Professional Communication
    5. Industry visit/ Vocational Course
    6. Internship/training
    7. Innovation and Entrepreneurship

- **Value Added courses**: These courses are value-based courses which are meant to inculcate ethics, culture, soft skills, sports education and such similar values to students which will help in all round development of students.
    1. Health & Wellness/ Social & Emotional Learning
    2. Sports/ Yoga/NCC/NSS
    3. Ethics & Self Awareness

Dean Academics, Faculty of Life & Allied Health Sciences, M.S. RAMAIAH UNIVERSITY OF APPLIED SCIENCES, Bangalore

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

Head, Department of Biotechnology, M S Ramaiah University of Applied Sciences, Bangalore - 560 054

- **Open Elective Courses:** A number of Open Elective Courses from various Faculties of RUAS are offered as mentioned in the University's website. Students can choose the Open Electives of their choice. The students are permitted to choose online electives from the list approved by the respective HOD and Dean.

- **Innovation Courses in Lieu of Open Elective Courses:** Students can earn 3-credits by participating in innovation activities as per the approved guidelines in lieu of Open Elective Courses. The activities could be related to any of the following:
    1. Design Thinking and Innovation
    2. Skill Development
    3. Industrial Problem Solving and Hackathons

23. Course Delivery: As per the Timetable

24. 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

25. Major Features

- 3rd year: Bachelors in Biotechnology
- 4th year: Bachelor (Honors) in Biotechnology
- 4th year: Bachelor (Honors with Research) in Biotechnology

26. Assessment and Grading (Subject to endorsement of revised unified academic regulations for 2022-23- report submitted)

26.1 Components of Grading

There shall be **two components** of grading in the assessment of each course:

Component 1, Continuous Evaluation (CE): This component involves multiple subcomponents (SC1, SC2, etc.) of learning and experiential 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 60:40 weightage (CE: 60% and SEE: 40%) in determining the final marks obtained by a student in a Course.

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

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

26.2 Continuous Evaluation Policies

Continuous evaluation depends on the type of course as discussed below:

26.2.1 Theory Courses

For Theory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		Component 2: SEE (40% Weightage)
Subcomponent Type →	Terms Tests	Assignments	
CO-1			
CO-2			
CO-3			
CO-4			
CO-5			
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

- CE components should have a mix of term tests, quiz and assignments
- Two Tests (15 each), Two Assignments (20 marks). (One written and another to be MCQs/Poster presentation/Seminar etc.)
- Course leaders to declare the assessment components before the commencement of the session and get approval from HoD and Dean

26.2.2 Laboratory Course

For Laboratory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		Component 2: SEE (40% Weightage)
Subcomponent Type →	Conduct of Experiments	Laboratory Report + Viva	Laboratory SEE
CO-1			
CO-2			
CO-3			
CO-4			
CO-5			
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document			

The subcomponents can be of any of the following types:

- Laboratory / Clinical Work Record
- Experiments
- Computer Simulations
- Creative Submission
- Virtual Labs
- Viva / Oral Exam
- Lab Manual Report
- Any other (e.g. combinations)

Course leaders to declare the assessment components before the commencement of the session and get approval from HoD and Dean

26.2.3 Course Having a Combination of Theory and Laboratory

For a course that contains the combination of theory and laboratory sessions, the scheme for determining the CE marks is as under:

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

For Combined Courses (Theory + Laboratory)					
Focus of COs on each Component or Subcomponent of Evaluation					
Course Outcome	CE (Weightage: 60 %) Four components including one Lab component			SEE (Weightage: 25 %)	Lab (Weightage: 15 %)
	Tests (30 %)	Written Assignments + Lab (20 %)	Assignment +Lab CE (10%)	Written exam	LSEE: SEE
CO-1					
CO-2					
CO-3					
CO-4					
CO-5					
CO-6					
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.					

- CE components should have a mix of term tests, quiz and assignments
- Two Tests (15 each), Two Assignments (20 marks). (One written and another to be MCQs/Poster presentation/Seminar etc.)
- In case of courses where laboratory is combined with theory, laboratory components to be assessed in both CE and SEE.
- Course leaders to declare the assessment components before the commencement of the session and get approval from HoD and Dean

26.2.4 Ability Enhancement courses

For AECC Only		
Focus of COs on each Component or Subcomponent of Evaluation		
	Component 1: CE (60% Weightage)	Component 2: SEE (40% Weightage)
Subcomponent Type →	Terms Tests or Assignments	
CO-1		
CO-2		
CO-3		
CO-4		
CO-5		
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.		

- Course leaders to declare the assessment components before the commencement of the session and get approval from HoD and Dean

Schedule of CE Components in a Semester

Week 6	Week 8	Week 10	Week 12	Week 13
Test-1 for 25 marks reduced to 15	Multiple choice questions Tests on the topic covered – reduced to 10 marks		Test-1 for 25 marks reduced to 15	Written assignment for 40 marks reduced to 20 marks

SEE

- For Non-NEP SEE for 100 marks, reduced to 40 marks
- For NEP Programme– SEE for 50 marks, reduced to 40 marks

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

After all the subcomponents are evaluated, the CE component marks are consolidated to attain 60% Weightage. The Semester End Examination shall be a 90 minute theory paper of 50 marks with a weightage of 40% in case of theory courses. In summary, the ratio of Formative (Continuous Evaluation-CE) Vs Summative (Semester End Examination-SEE) should be 60:40.

27. 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. Staff Support

28. 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. Board of Examination (BoE)

29. Curricular Map

SEM	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	Macromolecular structure and analysis	3	2	3	1	2	1						2	3	2	2
1	Biological techniques and Instrumentation	2	2	3	1	2	1						2	3	2	2
1	Biomathematics and MATLAB	2	2	1	3	2							2	2	2	3
1	Fundamentals in Biology	3	1	1	1								2	3	1	2
1	English for Communication 1						3	2					2	1	1	3
1	Digital Fluency	1			2				2				2	1	1	3
2	General Chemistry 1	3	1	2		1							2	3	1	2
2	Principles of Microbiology	3	2	2		2							2	3	2	2
2	Organic Mechanisms in Biology	3	2	1		2							2	3	2	2
2	Biotechnology for Human Welfare	2	2			2	1			2	2	1	2	2	3	2
2	Environmental Studies	2	1			2				2	3		2	2	2	2
2	Health and Wellness	1						2		2			2	1	1	3
3	General Chemistry 2	3	2	2		1							2	3	2	2
3	Principles of Genetics	3	2	2		2							2	3	2	2
3	Biostatistics	2	2	1	3	2							2	2	2	3
3	Applications of Biotechnology in Agriculture	2	2	1		3					2	1	2	2	3	2
3	English for Communication 2						3	2					2	1	1	3
3	AI	1	2		3	2						1	2	1	2	3
3	Innovation and Entrepreneurship	1	2			2	2	2				3	2	1	2	3
4	Cell Structure and Signalling	3	2	2		2							2	3	2	1
4	Molecular Biology	3	2	3		2							2	3	2	1
4	Molecular Genetics	3	2	2		2							2	3	2	1
4	Applications of Biotechnology in Medicine	3	2	2		3	1			2	2	1	2	3	3	2

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

SEM	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
4	Constitution of India and Human Rights						2	1	1	3	2		2	1	1	3
4	Professional Communication						3	2					2	1	1	3
4	Ethics and self-awareness						1	2		3	2		2	1	1	3
5	Recombinant DNA Technology	3	3	3		2						2	2	3	3	2
5	Immunology and Immuno-technology	3	2	3		2						2	2	3	3	2
5	Computer Programming; Python and R	2	2	2	3	2						2	3	2	2	3
5	Environmental Biotechnology	3	2	2		3				2	3		2	3	3	2
5	Agricultural Biotechnology	3	2	2		3				2	2	2	2	3	3	2
5	Medical Biotechnology	3	2	2		3				2	2	2	2	3	3	2
5	Project Management		2			2	2	3	3			2	2	1	2	3
5	Cyber security				2				2				2	1	1	2
5	Sports/Yoga/NSS/Cultural						1	2		2	1		2	1	1	3
6	Animal Biotechnology	3	2	2		3				2		2	2	3	3	2
6	Plant Biotechnology	3	2	2		3				2		2	2	3	3	2
6	Biosafety, Bioethics and IPR	2	2			2			1	3	2	2	2	2	3	3
6	Industrial Biotechnology	3	2	3		3			3			3	2	3	3	2
6	Pharmaceutical Biotechnology	3	2	3		3			3			3	2	3	3	2
6	Personality Development and Soft Skills						2	3				2	3	1	1	3
6	Competitive Exam Training	2											3	2	1	3
6	Seminar	2	2				3	2					3	2	2	3
Exit Option after Three Years with a B.Sc. in Biotechnology																
B.Sc. (Hons. with Res) in Biotechnology and B.Sc. (Hons) in Biotechnology																
7	Bioinformatics	3	2	2	3	2						2	3	3	2	3
7	Genomics and Proteomics	3	2	3	2	2						2	3	3	3	2
7	Research Methodology	2	3	2	2	2	2			2			3	2	3	3
7	Stem cells and Regenerative medicine	3	2	2		3				2		2	2	3	3	2
7	Nanobiotechnology	3	2	2		3						3	2	3	3	2
7	Green Energy Technologies	2	2			3					3		2	2	3	2
7	Internship/Training/Project/Vocational course	3	3	3	2	3	2	3	3	2	2	3	3	3	3	3
B.Sc. (Hons. by Res) in Biotechnology																
8	Research Project	3	3	3	2	3	3	2	2	3	2	3	3	3	3	3
B.Sc. (Hons.) in Biotechnology																
8	Data Management in Biotechnology	2	2		3	2			2			2	3	2	2	3
8	Food Biotechnology and Nutraceuticals	3	2	2		3				2	2	3	2	3	3	2
8	Good Manufacturing Practices and Quality Control	2	2	3		2			3	2		3	2	2	3	2
8	Group Project	2	3	2		2	3	3	2	2		2	3	2	3	3

30. 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.

31. 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.

32. 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.

Head
Department of Biotechnology
M S Ramaiah University of Applied Scienc
Bangalore - 560 054

RAMAIAH UNIVERSITY OF APPLIED SCIENCES

M. S. Ramaiah University of Applied Sciences

Course Specifications

of

B.Sc. in Biotechnology

B.Sc. (Honours) in Biotechnology

B.Sc. (Honours with Research) in Biotechnology

Programme Code: 018

BATCH 2022 onwards

Department of Biotechnology
Faculty of Life and Allied Health Sciences
M S Ramaiah University of Applied Sciences

Head
Department of Biotechnology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

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

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

RAMAIAH UNIVERSITY OF APPLIED SCIENCES

M. S. Ramaiah University of Applied Sciences

Course Specifications

of

B.Sc. in Biotechnology

B.Sc. (Hons.) in Biotechnology

B.Sc. (Hons. with Research) in Biotechnology

Programme Code: 018

SEMESTER 1

Department of Biotechnology
Faculty of Life and Allied Health Sciences
M S Ramaiah University of Applied Sciences

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

Course Title	Macromolecular Structure and Analysis
Course Code	BTC101A
Department	Biotechnology
Faculty	Faculty of Life and Allied Health Sciences

1. Course Summary

The course aims to provide an advanced understanding of the core principles and topics of bio molecules and their roles in life. The laboratory component of the course aims to train students on estimation, characterization and analysis of bio molecules like protein, carbohydrate, lipid and nucleic acids.
Students will be able to describe the structure and function of basic macromolecules in biological system like carbohydrate, protein, lipid and nucleic acid and explain functional complexity of them. Students will be trained to differentiate and characterize nucleic acids involved in gene expression. They will also be taught to categorize and relate the most important and active macromolecules of the biological system like enzymes and hormones. They will be able to establish the link between the complexities of these molecules at a chemical level with biological context.
Students will be able to explain properties of various bio molecules found in living systems by performing experiments involving isolation, separation and characterization. Students will be trained to calculate, analyze and interpret the data to enter in laboratory record book.

2. Course Size and Credits:

Number of Credits	5
Total Hours of Classroom Interaction	45
Number of laboratory Hours	60
Number of Semester Weeks	16
Department Responsible	Biotechnology
Course Marks	100
Pass Requirement	As per university regulations
Attendance Requirement	As per university regulations

Teaching, Learning and Assessment

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO 1. List the function of different macromolecules in biological system such as carbohydrate, protein, lipid and nucleic acid.

CO 2. Explain and illustrate the structural and functional complexity of macromolecules and their monomers with respect to their structure and functions.

CO 3. Examine the chemical nature of enzymes and their function in biochemical reactions and explain regulation of enzyme activity.

CO 4. Analyze the coordination between the bio molecules which maintain the biological functions such as gene expression.

CO 5. Perform experiments to analyze and study the chemical and biochemical properties of Sugars, nucleic acids, protein and enzymes.

CO 6. Separate bio molecules in a mixture following standard protocols.

CO 7. Calculate and plot the results and analyze data.

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

M.S. Ramaiah University of Applied Sciences
Dean - Academic
Bangalore - 560 054

4. Course Contents

Theory

Unit 1 Carbohydrates: Structural aspects – Introduction & Occurrence, Classification of Mono-, Di- and Polysaccharides, Reducing & Non-reducing Sugars, Constitution of Glucose & Fructose, Osazone formation, Pyranose & Furanose forms, Determination of ring size, Inter-conversion of monosaccharides

Unit 2 Proteins: Structural aspects – General introduction, Classification & General characteristics, Structure of Primary, Secondary, Tertiary & Quaternary proteins (elementary idea), Classification of Amino acids

Unit 3 Lipids: Structural aspects – General introduction, Classification & Structure of Simple & Compound lipids, Properties of Lipid aggregates, Biological membrane, Membrane protein – structural aspects, Lipoproteins

Unit 4 Nucleic acid: Structural aspects – Components of DNA and RNA, Nucleosides & Nucleotides (introduction, structure & bonding), Double helical structure of DNA (Watson-Crick model), various forms of DNA

Unit 5 Chemical & Enzymatic Kinetics: An introduction to enzyme; How enzyme works; Reaction rate; Principles of catalytic power and specificity of enzymes; Enzyme kinetics – Approach to mechanism; Thermodynamic definitions

Unit 6 DNA as the genetic material: DNA replication is semi conservative, mutations change the sequence of DNA, a gene codes for a single polypeptide, recombination occurs by physical exchange of DNA, genetic code

Practical

1. Estimation of protein by Folin Lowry method
2. Separation of Amino acids by Paper chromatography
3. Separation of Amino acids by TLC
4. Separation of sugars by Paper chromatography /sugars
5. Separation of sugars by TLC
6. Estimation of total sugar by Anthrone method sugar
7. Estimation of Reducing sugar by DNS method
8. Determination of Km and V max of amylase
9. Determination of Iodine number of a fat
10. Determination Acetyl number of a fat
11. Estimation of RNA by Orcinol method
12. Estimation of DNA by Diphenyl amine (DPA) method

Head
Department of Biotechnology
Ramaiah University of Applied Sciences
Bangalore - 560 054

5. CO-PO PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	1	–	–	1	–	–	–	–	–	–	1	3	1	1
CO-2	3	2	–	–	2	–	–	–	–	–	–	1	3	2	1
CO-3	3	2	1	–	2	–	–	–	–	–	–	1	3	2	1
CO-4	3	2	–	–	2	–	–	–	–	–	–	1	3	2	1
CO-5	2	2	3	1	2	–	–	1	–	–	–	1	2	2	3
CO-6	2	2	3	–	2	–	–	1	–	–	–	1	2	2	3
CO-7	2	2	1	3	2	–	–	–	–	–	–	2	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		36
Demonstrations		03
1. Demonstration using Videos	02	
2. Demonstration using Physical Models	01	
3. Demonstration on a Computer		
Numeracy		
1. Solving Numerical Problems		
Practical Work		56
1. Course Laboratory	56	
2. Computer Laboratory		
3. Engineering Workshop / Course/Workshop / Kitchen		
4. Clinical Laboratory		
5. Hospital		
6. Model Studio		
Others		02
1. Case Study Presentation		
2. Guest Lecture		
3. Industry / Field Visit		
4. Brainstorming Sessions		
5. Group Discussions	01	
6. Discussing Possible Innovations	01	
Term Test and Written Examination		04+04
Total Duration in Hours		105

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

Dean - Academic
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

7. Method of Assessment

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 (60% Weightage)			SEE (40% Weightage)	
	SC1 (Term Tests) 30%	SC2 (Innovative + Lab assignment) 10%	SC3 (Written + Lab Assignment) 20%	SEE (Theory) 25%	SEE (Lab) 15%
	(25 + 25 Marks)	10 Marks	40 Marks	50 Marks	30 Marks
CO-1	X	X		X	
CO-2	X	X		X	
CO-3	X		X	X	
CO-4			X	X	
CO-5		X			X
CO-6		X	X		X
CO-7			X		X

8. Achieving Course Learning Outcome

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, Examination
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	–

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

9. Course Resources

a. Essential Reading

1. Nelson, D. L., Cox, M. M., 2008, *Lehninger principles of biochemistry*. 7th Edition, W.H. Freeman.
2. Jain, J.L., Jain, S., Jain, N., 2016, *Fundamentals of Biochemistry*, S. Chand and Company.
3. Das D., 2014, *Biochemistry*, Academic publishers.
4. Satyanarayana, U., 2013, *Biochemistry*, Elsevier, India.
5. Fernandez, G., Scott, T.P., 2015, *Biochemistry Laboratory Manual For Undergraduates: An Inquiry-Based Approach*, Open Access, De Gruyter.
6. Pandey, A.S., Shreevastva, N.K., Neupane, D.P., Pandey, A., 2015, *Biochemistry Laboratory Manual 1st Edition*, Jaypee Brothers Medical Publishers.

b. Recommended Reading

1. Voet, D., Voet, J.G., 2011, *Biochemistry,* 4th Edition, John Wiley & Sons.
2. Boyer, R.F., 2011, *Biochemistry Laboratory: Modern Theory and Techniques,* Pearson Publisher.
3. Berg J.M., Tymoczko J.L., Stryer L., 2011, *Biochemistry,* 7th revised international Edition, W.H. Freeman.
4. Zubay, G., 1997, *Principles of Biochemistry,* 4th Edition, Brown (William C.) Co., U.S.

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Course Title	Biological Techniques and Instrumentation
Course Code	BTC102A
Department	Biotechnology
Faculty	Life and Allied Health Sciences

1. Course Summary

The aim of the course is to orient students on the mode of different types of instrumentation that is important for studies of biological macromolecules, cells and other molecules.
The course summarizes the description of components that the instrumentation consists of as well as a theoretical and practical understanding of the operation of the instrument, including calibration procedures and maintenance. Students will be able to distinguish between the principles and objectives of techniques like chromatography, electrophoresis, centrifugation, microscopy, spectroscopy etc. Students will be taught to describe and interpret data of each instrument with examples of high-quality recent research data.

The course aims to train students on calibration and optimization methods of General laboratory instrumentation in Biotechnology lab and their application. Students will be oriented on principles and operation of general laboratory instrumentation used in Biotechnology lab. The students will also be able to calibrate, operate and interpret data obtained from the experiments involving the core laboratory instrumentation.

2. Course Size and Credits:

Number of Credits	05
Total Hours of Classroom Interaction	45
Number of laboratory Hours	60
Number of Semester Weeks	16
Department Responsible	Biotechnology
Course Marks	Total Marks: 100
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 of various biophysical techniques and define common terms in biophysical techniques
CO2. Explain the basic concepts and principles behind these techniques and description of different sub-types of each technique
CO 3. Illustrate the instrumentation of each technique and understand the role of different parts of an instrument
CO 4. Analyze the results obtained from these techniques and thus interpret its applications
CO 5. Derive formulae and solve numerical problems in biophysical techniques
CO 6. Calibrate and optimize the basic and analytical instruments in biotechnology lab
CO 7. Perform experiments using these instruments, observe, analyze, interpret and report the data.

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

4. Course Contents

Theory

Unit 1 Introduction to Biophysics – What is biophysics and its branches, Quantum theory of light, wave theory of light, Photo electric effect, de Broglie wave equation, wave function, atomic models.

Unit 2 Separation & Identification of Biomolecules – concept of Chromatography and different types (Partition Chromatography, Paper Chromatography, Adsorption Chromatography, TLC, GLC, Ion Exchange Chromatography, Gel Chromatography, HPLC, Affinity Chromatography); Electrophoresis .

Unit 3 Centrifugation – Basic Principle of Centrifugation, Instrumentation of Ultracentrifuge (Preparative, Analytical), Factors affecting Sedimentation velocity, Standard Sedimentation Coefficient, Centrifugation of associating systems, Rate-Zonal centrifugation, Equilibrium Centrifugation.

Unit 4 Microscopy – Light microscopy, Bright & Dark Field microscopy, Phase Contrast microscopy, Fluorescence microscopy, TEM, SEM.

Unit 5 Spectroscopy – Absorption Spectroscopy – Simple theory of the absorption of light by molecules, Beer-Lambert law, Spectrophotometry (UV-visible), Colorimetry, Chromophores, Fluorescence and Phosphorescence.

Practical

1. Microscopy - Light microscopy and dissection microscopy: principles, parts & function, operation.
2. Fluorescent microscope - Principles, parts & function, Operation.
3. Microscopic measurements, micrometer (ocular and stage).
4. Microscopic counting of cells using a hemocytometer.
5. Principle & operation of Colorimeter.
6. Principle & operation of UV-Visible spectrophotometer.
7. Principle & operation of pH meter.
8. Principle & operation of centrifuge.
9. Sterilization: principles & operations – Autoclave.
10. Principle & operation of Laminar Airflow hood.
11. Principles & operations Hot Air Oven, Filtration.
12. Principles & operations of Incubators & Shakers.

5. CO-PO PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	–	–	1	–	–	–	–	–	–	1	3	1	1
CO2	3	2	1	–	2	–	–	–	–	–	–	1	3	2	1
CO3	3	2	2	–	2	–	–	–	–	–	–	1	3	2	1
CO4	2	3	2	1	2	–	–	–	–	–	–	1	2	3	2
CO5	2	2	1	3	2	–	–	–	–	–	–	2	2	2	3
CO6	2	2	3	–	2	–	–	2	–	–	–	1	2	2	3
CO7	2	3	3	1	2	2	1	2	1	–	–	2	2	3	3
	3: High Influence, 2: Moderate Influence, 1: Low Influence														

Dean - Academics
M.S. Ramaiah University of Applied Sciences

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

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

6. Course Teaching and Learning Methods:

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		36
Demonstrations		03
1. Demonstration using Videos	02	
2. Demonstration using Physical Models	01	
3. Demonstration on a Computer		
Numeracy		02
1. Solving Numerical Problems	02	
Practical Work		56
1. Course Laboratory	56	
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. Brainstorming Sessions		
5. Group Discussions		
6. Discussing Possible Innovations		
Term Test and Written Examination		**04+04**
Total Duration in Hours		**105**

7. Method of Assessment

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 (60% Weightage)			SEE (40% Weightage)	
	SC1 (Term Tests) 30%	SC2 (Innovative + Lab assignment) 10%	SC3 (Written + Lab Assignment) 20%	SEE (Theory) 25%	SEE (Lab) 15%
	(25 + 25 Marks)	10 Marks	40 Marks	50 Marks	30 Marks
CO-1	X	X		X	
CO-2	X	X		X	
CO-3	X			X	
CO-4	X		X	X	
CO-5			X	X	

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

CO-6		X	X		X
CO-7			X		X

8. Achieving Course Learning Outcome

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. Essential Reading

1. Nelson, P., 2013, *Biological Physics*, Updated Edition, W. H. Freeman.
2. Bialek, W., 2012, *Biophysics: Searching for Principles*, Princeton University Press.
3. Glaser, R., 2012, *Biophysics: An Introduction*, 2nd Edition, Springer.
4. Narayanan, P., 2016, *Essentials of Biophysics*, New Age International, New Delhi, India.
5. Kumar, P., 2010, Introduction to Biophysics, S. Chand and Company, India.
6. Cantor, C.R., Schimmel, P.R., 1980, *Biophysical Chemistry Part I, Part II and Part III*, W.H. Freeman.
7. Roy, R.N., 2001, *A Textbook of Biophysics: For Medical Science and Biological Science Students*, New Central Book Agency Pvt. Ltd, New Delhi, India.
8. Kumar, P., 2016, *Fundamentals and Techniques of Biophysics and Molecular Biology*, Pathfinder Publication, India.
9. Kumaresan, V., 2012, *Principles and Techniques in Biophysics*, Saras Publication, India.
10. Laboratory manual.
11. Wilson, K., (ed.), Walker, J., (ed.) 2010, *Principles and Techniques of Biochemistry and Molecular Biology*, 7th edition, Cambridge University Press.
12. Hofmann, A., (ed.), Clokie, S., (ed.), 2018, *Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology*, 8th edition, Cambridge University Press.
13. Fernandez, G., Scott, T.P., 2015, *Biochemistry Laboratory Manual For Undergraduates: An Inquiry-Based Approach*, Open Access, De Gruyter.
14. Pandey, A.S., Shreevastva, N.K., Neupane, D.P., Pandey, A., 2015, *Biochemistry Laboratory Manual 1st Edition*, Jaypee Brothers Medical Publishers

Head Department of Biotechnology M S Ramaiah University of Applied Sciences Bangalore - 560 054

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

Dean - Academics M.S. Ramaiah University of Applied Sciences Bangalore - 560 054

b. Recommended Reading

1. Daniel, M., 2003, Basic *Biophysics for Biologists*, Agrobios, Jodhpur, India.
2. Okotore, R.O., 1998, *Basic separation techniques in Biochemistry*, New Age International, India.
3. Sharma, R.K., 2010, *Basic techniques in Biochemistry and Molecular Biology*, I.K. International Publishing house Pvt. Ltd, Delhi, India.
4. Claycomb, J., 2011, *Introductory Biophysics: Perspectives on the Living State*. Jones & Bartlett.
5. Cotterill, R., 2014, *Biophysics – An Introduction*, Wiley.
6. Phyllips, R., Kondev, J., Theriot, J., Garcia, H., 2012, *Physical Biology of the Cell*, 2nd Edition, Garland Science.
7. Jackson, M.B., 2006, *Molecular and cellular Biophysics*, Cambridge University Press, UK.
8. Boyer, R.F., 2011, *Biochemistry Laboratory: Modern Theory and Techniques*, Pearson Publisher.

c. Magazines and Journals

1. http://www.cell.com/biophysj/homewww.journals.elsevier.com/biophysical-journal/

d. Websites

1. https://www.biophysics.org
2. http://www.biophysics.org/education-careers/education-resources/selected-topics-in-biophysics/biophysical-techniques
3. https://www.nature.com/subjects/biophysical-methods

e. Other Electronic Resources

https://www.biophysics.org/what-is-biophysics

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

Course Title	Biomathematics and MATLAB
Course Code	BTC103A
Department	Biotechnology
Faculty	Faculty of Life and Allied Health Sciences

1. Course Summary

The aim of the course is to provide an understanding of basic mathematics and its applications in biotechnology. The course introduces students to the basic concepts and techniques in trigonometry and analytical geometry. Students are taught the concepts of derivative, continuity, limits, functions and integral calculus. This course introduces the students to the basic concepts of linear algebra, vector calculus and its applications in biotechnology. This course also introduces the students to the basics of programming using MATLAB.

2. Course Size and Credits:

Number of Credits	3
Total Hours of Classroom Interaction	25
Number of laboratory Hours	20
Number of Semester Weeks	16
Department Responsible	Mathematics and Statistics (FMPS)
Course Marks	Total Marks: 100
Pass Requirement	As per university regulations
Attendance Requirement	As per university regulations

Teaching, Learning and Assessment

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO 1. Explain the principles of trigonometry, differential, integral calculus, linear algebra and vector calculus
CO 2. Solve simple problems associated with trigonometry, differential, integral calculus, linear algebra and vector calculus
CO 3. Apply the appropriate methods from trigonometry, differential, Integral calculus, linear algebra and vector calculus in solving application problems of biotechnology
CO 4. Solve real world mathematical problems associated with trigonometry, differential, Integral calculus, linear algebra and vector calculus
CO 5. Perform basic operations and plot graphs using built-in commands in MATLAB
CO 6. Implement algorithms and execute programs and solve simple mathematical problems using MATLAB

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bengaluru - 560 054

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

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bengaluru - 560 054

4. Course Contents

Unit 1 Differential Calculus: limit, continuity and derivatives of standard functions. Rules of differentiation applications in Population Biology and enzyme kinetics.

Unit 2 Integral Calculus: Indefinite integrals of standard functions, definite integrals and their properties, Fundamental Theorem of Integral Calculus. Different methods of integration and applications in Biology.

Unit 3 Linear Algebra: Introduction to matrices: Types, Operation, Transpose of a matrix, Matrix Multiplication, Determinants, Properties of determinants, Product of determinants, Minors and co- Factors, Adjoint or adjugate of a square matrix, Singular and non-singular matrices, Inverse of a matrix, Solution of system of linear of equations using matrix method, Cramer's rule, Characteristic equation and roots of a square matrix, Cayley–Hamilton theorem and applications. Linear algebra in Population Genetics

Unit 4 Vector Calculus: Vectors in 2 and 3 dimensions. Dot product and cross product. Lines and planes in 3 dimensions. Vector functions - limit, continuity and differentiability of vector functions. Curves - velocity and acceleration, arc length, curvature, radius of curvature and torsion. Gradient of a scalar field, directional derivatives, curl and divergence of a vector field. Derivatives in determiningthe rate of muscle concentration, the rate of dissolution of drugs in blood stream and the growth rateof bacteria.

MATLAB

1. Basic arithmetic operations in MATLAB
2. Matrix operations in MATLAB
3. 2D and 3D plots
4. Symbolic computations: Differentiation and integration
5. Scripts and functions
6. Relational and logical operators
7. Looping and Control structures in MATLAB,
8. Row Operations and echelon form
9. Solution of Linear system of equations
10. Iterative Methods for linear systems: Gauss Jacobi and Gauss Seidel

5. CO-PO PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	–	–	1	2	–	–	–	–	–	–	1	3	1	1
CO2	2	–	–	2	2	–	–	–	–	–	–	1	2	1	2
CO3	2	2	–	3	3	–	–	–	–	–	–	2	2	3	2
CO4	2	3	–	3	3	–	–	–	–	–	–	2	2	3	2
CO5	1	–	1	3	2	–	–	–	–	–	–	2	2	2	3
CO6	1	2	1	3	3	–	–	–	–	–	–	3	2	3	3
	3: High Influence, 2: Moderate Influence, 1: Low Influence														

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		21
Demonstrations		5
1. Demonstration using Videos		
2. Demonstration using Physical Models /		
3. Demonstration on a Computer	5	
Numeracy		
1. Solving Numerical Problems		
Practical Work		15
1. Course Laboratory		
2. Computer Laboratory	15	
3. Engineering Workshop / Course/Workshop / Kitchen		
4. Clinical Laboratory		
5. Hospital		
6. Model Studio		
Others		0
1. Case Study Presentation		
2. Guest Lecture		
3. Industry / Field Visit		
4. Brainstorming Sessions		
5. Group Discussions		
6. Discussing Possible Innovations		
Term Test and Written Examination		**4**
Total Duration in Hours		**45**

7. Method of Assessment

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 (60% Weightage)			SEE (40% Weightage)
	SC1 Term Tests 30 %	SC2 Assignments 10%	SC3 Assignments 20%	
	25 + 25 Marks	10 Marks	40 Marks	50 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

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

Dean - Academics
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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 Outcome

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. Stewart, J., 2015, *Calculus: Early Transcendentals*, 8th Edition, Boston, Cengage Learning.
2. Weir, M.D., Hass, J., 2017, *Thomas Calculus*, 13th Edition, New Jersey, Pearson.

b. Recommended Reading

1. Apostal, T.M., 2007, *Calculus: One-Variable Calculus with An Introduction to Linear Algebra*, Vol. 1, 2nd Edition, New Delhi, Wiley.
2. Apostal, T.M., 2007, *Calculus: Multi-Variable Calculus and Linear Algebra with Applications to Differential Equations and Probability*, Vol. 2, 2nd Edition, New Delhi, Wiley.
3. Spivak, M., 2006, *Calculus*, 3rd Edition, Cambridge, Cambridge University Press

c. Magazines and Journals

1. http://rsos.royalsocietypublishing.org/collection/biomathematics
2. Letters in Biomathematics:https://doaj.org/toc/2373-7867

d. Websites

1. http://nptel.ac.in/
2. https://ocw.mit.edu/index.htm

e. Other Electronic Resources

1. https://www.khanacademy.org/
2. tutorial.math.lamar.edu/

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

Course Title	Fundamentals of Biology
Course Code	BTO101A
Department	Biotechnology
Faculty	Faculty of Life and Allied Health Sciences

1. Course Summary

The aim of this course is to introduce the students to the major themes in biology. Students will explore the fundamentals of evolution, the flow of information, the correlation of structure and function, the exchange of energy and matter, and the interactions and interconnections in the biological system.
Students will be able to emphasize on the connections of biology to their lives, and apply their knowledge though scientific inquiries on the nature of science and basic processes governing biological systems.

2. Course Size and Credits:

Number of Credits	3
Total Hours of Classroom Interaction	45
Number of laboratory Hours	0
Number of Semester Weeks	16
Department Responsible	Biotechnology
Course Marks	Total Marks: 100
Pass Requirement	As per university regulations
Attendance Requirement	As per university regulations

Teaching, Learning and Assessment

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO 1. Explain basic chemistry and the molecules of life through cellular structures to cellular respiration and photosynthesis.
CO 2. Identify the relationship between DNA, chromosomes, cells and organisms.
CO 3. Analyse the principles of evolution and its relevance in all fields of biology.
CO 4. Explore biological diversity in prokaryotes and eukaryotes.
CO 5. Assess the fundamental principles of ecology and apply their principles on solving environmental problems

4. Course Contents

Unit 1 Life of the cell: Chemical basis of life- ionic bonds, covalent bonds, hydrogen bonds, role of water in reactions. Molecules of life- carbohydrates, proteins, fats

Unit 2 Introduction to cell- Basic principles of Microscopy, structure and function of cell and cell organelles, Cellular basis of reproduction- Cell cycle, mitosis, meiosis
Unit 3 Genetic Information flow: Structure of genetic material- nucleic acids. Flow of information-central dogma

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Unit 4 Life and Evolution: Theories of Origin of Life, Concepts of evolution: Darwin's theory of evolution, Microevolution. Species and mechanism of speciation.

Unit 5 Biological diversity: Microbial life- Prokaryotes and protists, Plant, fungal and animal diversity, Structure and function of plant and animal tissues

Unit 6 Ecology: Biosphere: Aquatic and terrestrial biomes, Behavioral Adaptations to the Environment Communities and Ecosystems, Conservation Biology

5. CO-PO PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	–	–	2	–	–	–	–	1	–	1	3	1	1
CO2	3	1	–	–	2	–	–	–	–	–	–	1	3	1	1
CO3	3	2	–	–	2	–	–	–	–	1	–	1	3	2	1
CO4	3	1	–	–	2	–	–	–	–	1	–	1	3	1	1
CO5	3	2	–	–	2	–	–	–	1	3	–	1	3	3	2
	3: High Influence, 2: Moderate Influence, 1: Low Influence														

6. Course Teaching and Learning Methods:

Teaching and Learning Methods	Duration in hours	Total Duration inHours
Face to Face Lectures		37
Demonstrations		03
1. Demonstration using Videos	03	
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. Engineering Workshop / Course/Workshop / Kitchen		
4. Clinical Laboratory		
5. Hospital		
6. Model Studio		
Others		01
1. Case Study Presentation	01	
2. Guest Lecture		
3. Industry / Field Visit		
4. Brainstorming Sessions		
5. Group Discussions		
6. Discussing Possible Innovations		
Term Tests, Laboratory Examination/Written Examination, Presentations		04
Total Duration in Hours		**45**

Head
Department of Biotechnology
M S Ramaiah University of Applied Science
Bangalore - 560 054

7. Method of Assessment

The components and subcomponents of course assessment are 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 (60% Weightage)			SEE (40% Weightage)
	SC1 Term Tests 30 %	SC2 Assignments 10%	SC3 Assignments 20%	
	25 + 25 Marks	10 Marks	40 Marks	50 Marks
CO-1	X	X		X
CO-2	X	X		X
CO-3	X	X	X	X
CO-4	X		X	X
CO-5			X	X

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

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

8. Achieving Course Learning Outcome

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	Class room lectures, Assignments
2	Understanding	Class room lectures, Assignments
3	Critical Skills	Class room lectures, Assignments
4	Analytical Skills	Class room lectures, Assignments
5	Problem Solving Skills	
6	Practical Skills	
7	Group Work	Assignment/ Class Presentations
8	Self-Learning	Assignment, Examination
9	Written Communication Skills	Assignment
10	Verbal Communication Skills	Class Presentations
11	Presentation Skills	Class Presentations
12	Behavioral Skills	
13	Information Management	Assignment
14	Personal Management	Assignment, Examination
15	Leadership Skills	Effective management of learning, time management, achieving the learning outcomes

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences

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

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

9. Course Resources

a. Essential Reading

1. Course Notes
2. Campbell Biology: Concepts and connections, Pearson, 9th edition
3. Concepts of Biology by Samantha Fowler, Rebecca Roush, James Wise

---

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences

Course Title	**English for Communication** 1
Course Code	TSM101A
Course Type	Ability Enhancement Compulsory Course
Department	Directorate of Transferable Skills and Leadership Development
Faculty	FLAHS/FMC/FMPS/FAD/SSS

1. Course Summary

The course aims at equipping the students with skills essential for effective communication in termsof speaking, writing and comprehension.
The course gives practical exposure to the students by equipping them to use appropriate body language and tone for conversation. It focusses on comprehension of words and building of the wordrepertoire for meaningful communication. Students are instructed on the ways to construct grammatically correct sentences and compose paragraphs and essays.

2. Course Size and Credits:

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	3:0:0
Total Hours of Interaction	45
Number of Weeks in a Semester	15
Department Responsible	Directorate of Transferable Skills and Leadership Development
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO 1. Identify the nuances of communication skills
CO 2. Apply the concepts of grammar in written communication
CO 3. Apply professional etiquette as appropriate
CO 4. Practice extempore and basic conversation skills
CO 5. Practice comprehension skills
CO 6. Compose precise paragraphs as per the given topic

4. Course Contents

Unit 1 (Communication Skills)
Process of communication, terminologies used in communication process, active listening, communication barriers, types of communication – verbal and non-verbal

Unit 2 (Grammer)
Sentence formation, sentence types, different parts of speech, adjectives and articles, verbs andpreposition, present and past tense, future tense, use of participles in different tenses, usage of tenses, rules of subject verb agreement

Unit 3 (Essentials of Speaking Skills)
Importance of spoken skills, appropriate use of language, appropriate use of tone, pitch and volume

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Unit 4 (Extempore)
Preparation for extempore, mind mapping for speaking readiness, Content of extempore – beginning, body and conclusion, Delivery of extempore – body language and paralanguage

Unit 5 (Conversation Skills)
Body language in conversation, tones in conversation, conversation manners, stages of conversation – Introduction, feed forward, close, order of introduction, conversation barriers

Unit 6 (Reading and the Techniques)
Skimming, scanning and reading in detail

Unit 7 (Paragraph Writing)
Structure of paragraph – topic sentence, supporting sentence, conclusion sentence, functions ofparagraph, paragraph patterns, paragraph writing principles – coherence, unity, order, length

Unit 8 (Comprehension)
Purpose of comprehension, low-level comprehension, high-level comprehension

Unit 9 (Précis Writing)
Paraphrasing techniques, Usage of appropriate words

Unit 10 (Professional Etiquette and Goal Setting)
Etiquette and its importance, types of etiquette – workplace, meeting, telephone, dining, norms of etiquette, goals, types of goal, setting SMART goal

5. CO-PO PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	1	–	–	–	–	3	1	–	1	–	–	2	1	1	3
CO-2	1	–	–	–	–	3	–	–	–	–	–	2	1	–	3
CO-3	–	–	–	–	–	2	3	–	2	–	2	2	–	1	3
CO-4	–	–	–	–	–	3	2	–	1	–	–	2	–	1	3
CO-5	1	–	–	–	–	2	–	–	–	–	–	2	1	–	3
CO-5	1	–	–	–	–	3	–	–	–	–	–	2	1	–	3
	3: High Influence, 2: Moderate Influence, 1: Low Influence														

6. Course Teaching and Learning Methods:

Teaching and Learning Methods	Duration in hours	Total Durationin Hours
Face to Face Lectures		15
Demonstrations		02
1.Demonstration using Videos	02	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		0
1. Solving Numerical Problems	00	

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

Practical Work		04
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop /Kitchen	04	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		14
1. Case Study Presentation	04	
2. Guest Lecture	02	
3. Industry / Field Visit	00	
4. Brainstorming Sessions	04	
5. Group Discussions	04	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		**45**

7. Method of Assessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the UG Programme (B.Sc. / B.Com/ BBA). The procedure to determine the final course marks is also presented in the Programme Specifications document.
The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of CO's on each Component or Subcomponent of Evaluation:

	Component 1: CE (60% Weightage)		Component 2:SEE (40% Weightage) 50 Marks
Subcomponent	**SC1**	**SC2**	
Subcomponent Type	**Practical Assessment**	**Assignment**	
Maximum Marks	**30**	**30**	
CO-1	X	X	X
CO-2			X
CO-3		X	X
CO-4	X		X
CO-5	X	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 COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

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

Department of Biotechnology
M S Ramaiah University of Applied Sciences

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

M S Ramaiah University of Applied Sciences
Bangalore - 560 054

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Face to face lectures
2.	Understanding	Face to face lectures, group discussions
3.	Critical Skills	--
4.	Analytical Skills	Face to face lectures, activities, , group discussions, assignment
5.	Problem Solving Skills	--
6.	Practical Skills	Face to face lectures, activities, , group discussions, course work
7.	Group Work	Course work, practice, assignment, group discussion
8.	Self-Learning	Course work, practice, assignment, group discussion
9.	Written Communication Skills	Face to face lectures, Course work, practice, assignment, group discussion
10.	Verbal Communication Skills	Face to face lectures, Course work, practice, assignment, group discussion
11.	Presentation Skills	--
12.	Behavioral Skills	Course work, practice, assignment, group discussion, presentation practice, role plays
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Raman M and Sharma S (2004) Technical Communication: Principles and Practice. New Delhi: Oxford University Press
2. Hory Sankar Mukherjee, (2013), Business Communication, Oxford University Press
3. Kroehnert, Gary (2004), Basic Presentation Skills, Tata McGraw Hill

b. Recommended Reading

1. Sathya Swaroop Debashish and Bhagaban Das, (2014), Business Communication, PHI, New Delhi
2. Young, Dona J (2006) Foundations of Business Communications: An Integrated Approach, Tata McGraw Hill
3. Kaul, Asha (2007) Effective Business Communication, Prentice Hall India
4. Bienvenu, Sherron (2008) The Presentation Skills Workshop, Prentice Hall
5. KavitaTyagi and Padma Misra (2011) Professional Communication, PHI Learning Private Limited, New Delhi

c. Websites

1. www.myenglishpages.com
2. www.britishcouncil.com
3. www.englishmagazine.com
4. www.justenglishmagazine.com

d. Other Electronic Resources

1. Electronic resources on the course area are available on RUAS library

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

RAMAIAH UNIVERSITY OF APPLIED SCIENCES

M. S. Ramaiah University of Applied Sciences

Course Specifications

of

B.Sc. in Biotechnology

B.Sc. (Hons.) in Biotechnology

B.Sc. (Hons. with Research) in Biotechnology

Programme Code: 018

SEMESTER 2

Department of Biotechnology
Faculty of Life and Allied Health Sciences
M S Ramaiah University of Applied Sciences

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

Dean - Academics
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

Course Title	General Chemistry 1
Course Code	BTC104A
Department	Biotechnology
Faculty	Faculty of Life and Allied Health Sciences

1. Course Summary

The aim of this course is to introduce students to fundamentals concepts and basic applications of Chemistry. The laboratory component of the course aims to train students on estimation and analysis of various chemical compounds and their physical parameters.
Student are taught the concepts of the acid-base chemistry, ionic equilibria and chemical bonding. This course emphasizes on the periodic properties of elements and laws of electrochemistry. Students are introduced to the principles of quantitative and qualitative analysis, organic reactions and their applications to real world problems. Students will be able to explain properties and nature of various chemical compounds by performing experiments involving quantitative analysis, estimation and calculations. Students will be trained to calculate, analyse and interpret the data to enter in laboratory record book.

2. Course Size and Credits:

Number of Credits	05
Total Hours of Classroom Interaction	45
Number of laboratory Hours	60
Number of Semester Weeks	16
Department Responsible	Biotechnology
Course Marks	100
Pass Requirement	As per university regulations
Attendance Requirement	As per university regulations

Teaching, Learning and Assessment

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO 1. Describe the structure of atoms, Kh, Kw, Ka, Kb, properties of chemical bonds and reagents, elements and electrolytes.

CO 2. Explain the principles of acid-base concept, periodicity of elements and theory of electrolytes, solubility products of the salts, concepts of bonding in organic molecules, factors affecting bonding, role of reagents in organic reactions.

CO 3. Select suitable method to carryout dissolution of solids, qualitative and quantitative chemical analysis.

CO 4. Determine the accuracy, precision, errors and standard deviations in quantitative analysis.

CO 5. Solve problems on pH, Ka, ionization energy, conductance and transport number.

CO 6. Conduct experiments as per the standard procedures and tabulate the measured values/results to Interpret and draw conclusions.

CO 7. Develop a laboratory report as per the prescribed format

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

4. Course Contents

Theory

Unit 1 Chemical bonds in Organic Chemistry: Hybridization, Bond Lengths and Bond Angles, Bond Energy, Localized and Delocalized Chemical Bonding, Homolytic and Heterolytic bond fission, Van Der Waals Interactions, Inclusion Compounds, Clatherates, Resonance, Hyperconjugation, Aromaticity, Inductive and Field Effects, Hydrogen Bonding.

Unit 2 Reagents in Organic Chemistry: Types of reagents – electrophiles and nucleophiles, Reactive intermediates – Carbocations, carbanions, free radicals, carbenes, arynes and nitrenes (with examples), Types of organic reactions: Addition reactions; Elimination reactions; substitution reactions and rearrangements.

Unit 3 Electrochemistry: Electrolytes and their conductance, determination of molar conductance. Conductometric titrations (only acid-base type). Transport numbers – determination by moving boundary method, abnormal transport numbers, ionic mobility, numerical on transport numbers.

Conductivity of water, Kohlrausch's law and its applications: (i) evaluation of + and (ii) degree of dissociation of a weak electrolyte (iii) of a weak electrolyte (iv) determination of solubility from conductance of saturated solutions of sparingly soluble salts (AgCl and $BaSO_4$) and numerical.

Unit 4 Ionic equilibria: Acid-base concept, Hydrolysis of salts of weak acids and weak bases. Ionic product of water. Relationship between Kh, Kw, Ka and Kb. Degree of hydrolysis and its relationship with Kh. Effect of temperature and dilution on degree of hydrolysis, pH of salt solutions, numerical. Common-ion effect, buffers, buffer action and buffer capacity. pH of buffers. Henderson's equation and its derivation, Solubility product and ionic product in precipitation and in qualitative analysis, Theories of indicators.

Unit 5 Properties of Periodic Table: Modern periodic table with respect to classification of elements based on outer electronic configuration. Periodic properties: Atomic and ionic radii, ionization energy, electron affinity and electronegativity. Effective nuclear charge, shielding or screening effect, Trends in the periodic properties. Determination of electronegativity by Pauling's method, diagonal relationship between beryllium and aluminum.

Unit 6 Chemical Analysis: Gravimetric Analysis: Solubility product and common ion effect, requirement of gravimetry, Techniques of Precipitations, filtration, washing, drying, igniting and weighing precipitates. Gravimetric estimation of chloride & nickel. Volumetric analysis – primary and secondary standard substance / (solution). Principles of acid-base, oxidation-reduction and complexometric titration. Acid-Base, redox and metal ion indicators. Analysis of real samples: Sampling techniques, methods of dissolution of solid samples for chemical analysis. Determination of hardness water. Estimation of glucose & phenol. Accuracy and precision in quantitative analysis, errors, standard deviations.

Practical

1. Determination of concentration of unknown NaOH using std. Oxalic acid.
2. Determination of concentration of unknown $KMnO_4$ using std. Oxalic acid.
3. Conductometric estimation of amount of HCl present in the given solution using NaOH.
4. Determination of pKa value of a weak acid using pH meter.
5. Determination of buffer capacity of acetic acid-sodium acetate buffer using pH meter.
6. Iodometric estimation of copper in unknown sample.
7. Estimation of hardness of water using complexometric titration.

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences

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

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

8. Determination of concentration of unknown KMnO4 using std. ferrous ammonium sulphate.
9. Functional group identification of any four organic compounds (alcohols, amines, halides, carboxylic acids, phenols, alkanes, aldehydes and ketones)

5. CO-PO PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	1	–	–	1	–	–	–	–	–	–	1	3	1	1
CO-2	3	2	–	–	2	–	–	–	–	–	–	1	3	2	1
CO-3	2	2	3	–	1	–	–	–	–	–	–	1	3	2	2
CO-4	2	2	–	2	–	–	–	–	–	–	–	2	2	1	2
CO-5	2	1	–	2	–	–	–	–	–	–	–	2	2	1	2
CO-6	2	2	3	–	–	–	–	1	–	–	–	2	3	2	3
CO-7	1	–	–	–	–	3	–	–	–	–	–	2	1	–	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		36
Demonstrations		03
1. Demonstration using Videos	02	
2. Demonstration using Physical Models / Systems		
3. Demonstration on a Computer	01	
Numeracy		
1. Solving Numerical Problems		
Practical Work		56
1. Course Laboratory	56	
2. Computer Laboratory		
3. Engineering Workshop / Course/Workshop / Kitchen		
4. Clinical Laboratory		
5. Hospital		
6. Model Studio		
Others		02
1. Case Study Presentation	02	
2. Guest Lecture		
3. Industry / Field Visit		
4. Brainstorming Sessions		
5. Group Discussions		
6. Discussing Possible Innovations		
Term Test and Written Examination		**04+04**
Total Duration in Hours		**105**

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

7. Method of Assessment

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 (60% Weightage)			SEE (40% Weightage)	
	SC1 (Term Tests) 30%	SC2 (Innovative + Lab assignment) 10%	SC3 (Written + Lab Assignment) 20%	SEE (Theory) 25%	SEE (Lab) 15%
	(25 + 25 Marks)	20 Marks	40 Marks	50 Marks	30 Marks
CO-1	X	X		X	
CO-2	X	X		X	
CO-3	X		X	X	
CO-4			X	X	
CO-5		X		X	
CO-6		X	X		X
CO-7			X		X

8. Achieving Course Learning Outcome

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, Assignment
2	Understanding	Classroom lectures, Assignment
3	Critical Skills	Classroom lectures, Assignment
4	Analytical Skills	Classroom lectures, Assignment
5	Problem Solving Skills	--
6	Practical Skills	--
7	Group Work	Assignment/ Class Presentations
8	Self-Learning	Assignment, Examination
9	Written Communication Skills	Assignment
10	Verbal Communication Skills	Class Presentations
11	Presentation Skills	Class Presentations
12	Behavioral Skills	--
13	Information Management	Assignment
14	Personal Management	Assignment, Examination
15	Leadership Skills	Effective management of learning, time management, achieving the learning outcomes

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

Dean - Academics
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

9. Course Resources

5. Essential Reading

1. Course notes
2. Lab Manual
3. Puri, B.R., Sharma, L.R., Pathania, M.S., 2017, Principles of Physical Chemistry, 47th Edition, Vishal Publishing Co.
4. Soni P.L., 1983, Textbook of Physical Chemistry, 14th Edition, New Delhi, Sultan Chand & Sons
5. Puri, B.R., Sharma, L.R., Kalia, K.C., 2017, Principles of Inorganic Chemistry, 33rd Edition, Milestone Publishers and Distributors/Vishal Publishing Co.
6. Vogel, A.I., Jeffery, G.H., 1989, Vogel's text book of quantitative chemical analysis, Longman Scientific & Technical.

6. Recommended Reading

1. Huheey, J.E., 2006, Inorganic Chemistry, Derling Kindersley (India) Pvt. Ltd.
2. Atkins, P. De Paula, J., 2014, Atkins' Physical chemistry, 10th Edition, Oxford University Press.
3. Smith, M. B., 2013, Advanced Organic Chemistry: Reaction, Mechanism and Structure, 7th Edition, Wiley.

c. Magazines and Journals

1. https://ccj.springeropen.com/
2. https://www.elsevier.com/physical-sciences/chemistry/chemistry-journals

d. Websites

1. http://chemguide.co.uk/

e. Other Electronic Resources

1. http://www.chemistryonline.com/slides.html

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

Course Title	Principles of Microbiology
Course Code	BTC105A
Department	Biotechnology
Faculty	Faculty of 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, applications and pathogenicity.
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 and viruses. The course will familiarize students with the general principles of microbial growth, evolution, classification, description and pathogenicity.
The students will have training based on 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.

2. Course Size and Credits:

Number of Credits	5
Total Hours of Classroom Interaction	45
Number of laboratory Hours	60
Number of Semester Weeks	16
Department Responsible	Biotechnology
Course Marks	100
Pass Requirement	As per university regulations
Attendance Requirement	As per university regulations

Teaching, Learning and Assessment

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO 1. Discuss the history of microbiology and classification of microorganisms.
CO 2. Describe the structural similarities and differences among microbes and the unique structure/function relationships.
CO 3. Describe sterilization approaches for controlling the growth of microorganisms and biosafety regulatory framework for prokaryotes.
CO 4. Illustrate the basic concept of virology with comparison to bacteriology.
CO 5. Explicate the pathogenicity of microorganisms.
CO 6. Apply the tools and techniques of microbiology in conducting basic research.
CO 7. Comprehend the various methods for identification of unknown microorganisms.

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

4. Course Contents

Theory

Unit 1 History and scope of Microbiology: Biogenesis and abiogenesis, Germ Theory, Contributions of Anton Von Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Alexander Fleming, Edward Jenner.

Unit 2 Systematics of bacteria: Systems of classification, Identifying characters for classification, General properties and criteria for classification of microorganisms. Classification based on oxygen, temperature and nutritional requirement. Bergey's Manual of systematic bacteriology.

Unit 3 Sterilization, Staining and Biochemical characterization: Definition of sterilization, disinfection, sanitization, antisepsis, and fumigation. Methods of sterilization - Dry and moist heat, pasteurization, tyndallization, radiation, filtration and Chemical methods. Theories and mechanism of gram staining, acid fast staining, negative staining, capsule staining, and endospore staining. Biochemical test: IMViC test, catalase and oxidase test.

Unit 4 Microbial Growth & Physiology: Ultrastructure of Bacteria, differences in gram positive and negative cell wall. Nature, special features of the thermophilic, methanogenic and halophilic Archaea; photosynthetic bacteria, Cyanobacteria, chemosynthetic bacteria, Actinomycetes, Unicellular Eukaryotes (Yeast), Microbial growth kinetics and estimation.

Unit 5 Basic concepts of Virology: General characteristics of viruses, differences between bacteria and viruses. Classification of viruses, Physical and chemical Structures of different Viruses on the basis of capsid symmetry and envelope. Structure of T4, TMV and HIV, Replication of T4 bacteriophage, lytic and lysogenic cycle. Structure and importance of Viroids and Prions.

Unit 6 Microbial Interactions and Infection: Host-Pathogen interactions; Microbes infecting humans, veterinary animals and plants; Pathogenicity islands and their role in bacterial virulence. Introduction to Gut Microbiome: Gut Microbiota in health and disease.

Practical

1. Sterilization, disinfection, safety in microbiological laboratory.
2. Preparation of media for growth of various microorganisms.
3. Sampling and quantification of microorganisms in air, soil and water.
4. Isolation and plating of bacteria - Streak plate, spread plate, and pour plate.
5. Staining and enumeration of microorganisms - Simple staining and differential staining.
6. Staining and enumeration of microorganisms - Capsule staining and Endospore staining.
7. Staining of eukaryotic microorganisms - Fungal staining.
8. Study of bacterial growth and motility.
9. Biochemical characterization of Bacteria - IMViC test.
10. Biochemical characterization of Bacteria - Catalase test and oxidase test.

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

5. CO-PO PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	–	–	–	–	–	–	–	–	–	–	1	3	1	1
CO-2	3	–	–	–	–	–	–	–	–	–	–	1	3	1	1
CO-3	2	1	–	–	–	–	–	–	3	–	–	1	2	2	1
CO-4	2	–	–	–	–	–	–	–	–	–	–	1	2	1	1
CO-5	2	2	–	–	–	–	–	–	3	–	–	1	3	3	1
CO-6	2	2	3	–	1	–	–	–	–	–	–	1	3	2	3
CO-7	2	2	3	–	1	–	–	–	–	–	–	1	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		36
Demonstrations		03
1. Demonstration using Videos	02	
2. Demonstration using Physical Models / Systems	01	
3. Demonstration on a Computer		
Numeracy		
1. Solving Numerical Problems		
Practical Work		56
1. Course Laboratory	55	
2. Computer Laboratory		
3. Engineering Workshop / Course/Workshop / Kitchen		
4. Clinical Laboratory		
5. Hospital		
6. Model Studio		
Others		02
1. Case Study Presentation		
2. Guest Lecture		
3. Industry / Field Visit		
4. Brainstorming Sessions		
5. Group Discussions	01	
6. Discussing Possible Innovations	01	
Term Test and Written Examination		**04+04**
Total Duration in Hours		**105**

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

7. Method of Assessment

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 (60% Weightage)			SEE (40% Weightage)	
	SC1 (Term Tests) 30%	SC2 (Innovative + Lab assignment) 10%	SC3 (Written + Lab Assignment) 20%	SEE (Theory) 25%	SEE (Lab) 15%
	(25 + 25 Marks)	20 Marks	40 Marks	50 Marks	30 Marks
CO-1	X	X		X	
CO-2	X	X		X	
CO-3	X		X	X	
CO-4			X	X	
CO-5				X	
CO-6		X	X		X
CO-7		X	X		X

8. Achieving Course Learning Outcome

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, Examination
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	--

Head
Department of Biotechnology
M S Ramaiah University of Applied Scienc

9. Course Resources

a. Essential Reading

1. Pelczar, M.J., Reid, R.D., Chan, E.C.S., 2010, Microbiology, Oxford University Press, UK.
2. Prescott, L.M., Harley, J.P., Klein, D.A., 2005, Microbiology, McGraw-Hill Higher Education.
3. Willey, J.M., Sherwood, L.M., Woolverton, C.J., 2008, Prescott, Harley and Klein's
4. Microbiology, 7th edition. McGraw Hill Higher Education.
5. Powar, C.B., and Daginawala, H.F., 1987, General Microbiology: volume I & II, Himalaya Pub. House.
6. Sullia, S.B., Shantharam, S., 2004, General Microbiology, 2nd edition (revised), Oxford and IBH Publishing.
7. Baveja, C.P., 2017, Textbook of Microbiology, Arya Publishing Company, India.

b. Recommended Reading

1. Tortora, G.J., Funke, B.R., Case, C.L., 2000, Microbiology: An introduction, 12th Edition, Benjamin-Cummings pub co, UK.
2. Brooks, G., Carroll, K.C., Butel, J., Morse, S., 2013, Medical Microbiology, 26th Edition (LANGE Medical book), Mc Graw Hill, UK.

c. Magazines and Journals

1. https://www.springer.com/life+sciences/microbiology/journal/12275
2. https://www.hindawi.com/journals/ijmicro/
3. http://mic.microbiologyresearch.org/content/journal/micro
4. https://www.journals.elsevier.com/microbiological-research/

d. Websites

1. http://microbiologyonline.org/
2. https://www.hhmi.org/biointeractive

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Course Title	Organic mechanisms in Biology
Course Code	BTC106A
Department	Biotechnology
Faculty	Faculty of Life and Allied Health Sciences

1. Course Summary

The course aims to acquaint students on complex organic mechanisms of life. Students will be familiarized in the underlying mechanisms of biochemical processes that governs life. Students will be equipped to differentiate, characterize and correlate between the complex metabolic processes of the macromolecules in biological life.

2. 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	100
Pass Requirement	As per university regulations
Attendance Requirement	As per university regulations

Teaching, Learning and Assessment

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO 1. Elucidate the complexity of the organic mechanisms involved in carbohydrate metabolism.

CO 2. Elucidate and relate the mechanisms of amino acid metabolism.

CO 3. Illustrate the fatty acids and glycerol with relevance to their complex mechanisms of metabolism.

CO 4. Give details on the biosynthesis and metabolic processes involving nucleotides.

CO 5. Categorize the structure, function and relate the coordination of biochemical messengers.

4. Course Contents

Theory

Unit 1 Common Mechanisms in Biological Chemistry: Metabolism (Anabolism and Catabolism); An overview of Photosynthesis (Light and Dark reactions); Overview of Nutrition, Digestion, respiration, absorption and excretion. An overview of thermodynamics of biochemical reactions: Laws of thermodynamics, Properties of Pure Substance, Thermodynamic Relations, Thermodynamics Cycles and Ideal Gas Mixtures.

Unit 2 Carbohydrate Metabolism: Aerobic & Anaerobic glycolysis, sequence of reactions in glycolysis, regulation in glycolysis, citric acid cycle, glycogenesis, glycogenolysis (sequence of reactions & regulation), Pentose-phosphate pathway (sequence of reactions & regulation), extraction of energy from food sources.

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

Unit 3 Amino acid Metabolism: Amino acid breakdown (amino acid deamination, Urea cycle, metabolic breakdown of individual amino acids – glucogenic & ketogenic amino acids), amino acids as biosynthetic precursors (haeme biosynthesis & degradation, biosynthesis of epinephrine, dopamine, serotonin, GABA, histamine, glutathione); biosynthesis of essential & non-essential amino acids

Unit 4 Lipid Metabolism: Structures and roles of Fatty acids & Glycerols, beta oxidation of saturated fatty acids, oxidation of unsaturated fatty acids, oxidation of odd chain fatty acids, energy yield, ketone bodies

Unit 5 Nucleotide Metabolism: Biosynthesis of purine & pyrimidine (de novo & salvage pathway); degradation of purine & pyrimidine

Unit 6 Hormone & Vitamins: Chemical nature of Hormone, Molecular mechanism of Hormone action, Function of trophic Hormone (FSH,TSH, ACTH, GH), Insulin, testosterone ,Estrogen, progesterone, HCG, Disease related to hormone –Diabetes mellitus, diabetes insipidus, Vitamins (classification, functions of vitamins in bio-systems)

5. CO-PO PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	1	–	–	2	–	–	–	–	–	–	1	3	2	1
CO-2	3	1	–	–	2	–	–	–	–	–	–	1	3	2	1
CO-3	3	1	–	–	2	–	–	–	–	–	–	1	3	2	1
CO-4	3	1	–	–	2	–	–	–	–	–	–	1	3	2	1
CO-5	2	2	–	–	2	–	–	–	–	–	–	2	3	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		36
Demonstrations		03
1. Demonstration using Videos	02	
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. Engineering Workshop / Course/Workshop / Kitchen		
4. Clinical Laboratory		
5. Hospital		

Head
Department of Biotechnology
M.S Ramaiah University of Applied Sciences
Bangalore-560 054

DEAN
Faculty of Life & Allied Health Sciences
M.S. RAMAIAH UNIVERSITY OF APPLIED SCIENCE

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

6. Model Studio		
Others		02
1. Case Study Presentation		
2. Guest Lecture		
3. Industry / Field Visit		
4. Brainstorming Sessions		
5. Group Discussions	01	
6. Discussing Possible Innovations	01	
Term Test and Written Examination		**04**
Total Duration in Hours		**45**

7. Method of Assessment

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 (60% Weightage)			**SEE (40% Weightage)**
	SC1 (Term Tests) 30%	**SC2 (Assignments) 10%**	**SC3 (Assignments) 20%**	
	(25 + 25 Marks)	10 Marks	40 Marks	50 Marks
CO-1	X	X		X
CO-2	X	X		X
CO-3	X	X	X	X
CO-4	X		X	X
CO-5			X	X

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

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

8. Achieving Course Learning Outcome

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

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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. Berg J.M., Tymoczko J.L., Stryer L., 2011, Biochemistry, 7th revised international Edition, W.H. Freeman.
2. Nelson, D. L., & Cox, M. M., 2008, Lehninger principles of biochemistry. 7th Edition,W.H. Freeman, N. Y.; N. D.
3. Jain, J.L., Jain, S., Jain, N., 2016, Fundamentals of Biochemistry, S. Chand and Company.
4. Das D., 2014, Biochemistry, Academic publishers.
5. Satyanarayana, U., 2013, Biochemistry, Elsevier, India.
6. Zubay, G., 1997, Principles of Biochemistry, 4th edition, Brown (William C.) Co.,U.S.

b. Recommended Reading

1. Voet, D., Voet, J.G., 2011, Biochemistry, 4th edition, John Wiley & Sons.

c. Magazines and Journals

1. https://www.journals.elsevier.com/metabolism/

d. Websites

1. http://www.csun.edu/~hcchm001/biosites.htm
2. https://library.med.utah.edu/NetBiochem/titles.htm
3. http://www.themedicalbiochemistrypage.org/#nogo
4. https://basicbiology.net/micro/biochemistry/

e. Other Electronic Resources

1. http://www.ias.ac.in/Journals/Overview/

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

DEAN
M.S. Ramaiah Institute of Allied Health Sciences

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Course Title	Biotechnology for Human Welfare
Course Code	BTO102A
Department	Biotechnology
Faculty	Faculty of Life and Allied Health Sciences

1. Course Summary

The course aims to provide a basic understanding of application of biotechnology in agriculture, animal husbandry, environment, human health and sustainable development.

Students will be able to acquire knowledge about the scientific and technological advances in agriculture, animal breeding, environmental science and medicine for enhancement of human health and welfare.

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	100
Pass Requirement	As per university regulations
Attendance Requirement	As per university regulations

Teaching, Learning and Assessment

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO 1. Explain the use of enzymes, microorganisms, and plants to produce bio-based products in sectors such as textiles, food ingredients and biofuels.

CO 2. Understand the contribution of biotechnology in the field of agriculture towards ensuring higher quality, yield, nutrition and global food security.

CO 3. Describe the contributions of animal biotechnology in developing improved livestock, poultry, and fisheries towards higher production of food, and transgenic animals for molecular pharming of therapeutics.

CO 4. Identify factors causing environmental pollution, problems associated with waste management, and various methods of bioremediation towards safe resolution of environmental hazards.

CO 5. Discuss the impact of biotechnology in developing enhanced diagnostic tools, novel therapeutic drugs and approaches for uplifting human health and quality of life.

4. Course Contents

Theory

Unit 1 Basic Molecular Biology Techniques: PCR, DNA fingerprinting, RAPD, Sequencing-applications in forensics and genetics

Unit 2 Industry: Enzymes for textile industry, breweries, food processing, biodegradable plastics, biofuels.

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

Unit 3 Environment: Waste management, biodegradation of heavy metals, water cleaning, removing oil spills, air and soil pollution, bioremediation, biomining.

Unit 4 Agriculture: N2 fixation, Overview of transgenic crops with improved agronomic traits and food security, interaction between plants and microbes, biofertilisers and organic farming.

Unit 5 Animal husbandry: Recombinant DNA technology, Transgenic animals, animal vaccine production, increased milk production, artificial insemination, poultry and fisheries.

Unit 6 Human Health: Antibiotic production, Molecular diagnostics, recombinant vaccines, gene therapy, HGP and its applications.

5. CO-PO PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	2	–	–	3	–	–	–	2	–	2	1	3	3	2
CO-2	3	2	–	–	3	–	–	–	2	3	–	1	3	3	2
CO-3	3	2	–	–	3	–	–	–	2	–	2	1	3	3	2
CO-4	3	2	–	–	3	–	–	–	3	3	–	1	3	3	2
CO-5	3	2	–	–	3	–	–	–	3	–	2	1	3	3	2
	3: High Influence, 2: Moderate Influence, 1: Low Influence														

6. Course Teaching and Learning Methods:

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		36
Demonstrations		03
1. Demonstration using Videos	02	
2. Demonstration using Physical Models / Systems	01	
3. Demonstration on a Computer		
Numeracy		
1. Solving Numerical Problems		
Practical Work		00
1. Course Laboratory		
2. Computer Laboratory		
3. Engineering Workshop / Course/Workshop / Kitchen		
4. Clinical Laboratory		
5. Hospital		
6. Model Studio		
Others		02
1. Case Study Presentation		
2. Guest Lecture		
3. Industry / Field Visit		
4. Brainstorming Sessions		

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

Dean - Academic
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

5. Group Discussions	01	
6. Discussing Possible Innovations	01	
Term Test and Written Examination		**04**
Total Duration in Hours		**45**

7. Method of Assessment

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 (60% Weightage)			**SEE (40% Weightage)**
	SC1 (Term Tests) 30%	**SC2 (Assignments) 10%**	**SC3 (Assignments) 20%**	
	(25 + 25 Marks)	10 Marks	40 Marks	50 Marks
CO-1	X	X		X
CO-2	X	X		X
CO-3	X	X	X	X
CO-4	X		X	X
CO-5			X	X

8. Achieving Course Learning Outcome

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	–

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

9. Course Resources

a. Essential Reading

1. Bhasin, M.K. and Nath, S. 2002. Role of Forensic Science in the New Millennium, University of Delhi.
2. Crueger Wand Crueger, A. 2000. Biotechnology: A textbook of Industrial Microbiology. 2nd edition. Panima Publishing Co. New Delhi.
3. Hans-Joachim Jordening and Jesef Winter, 2005. Environmental Biotechnology Concepts and Applications.
4. James, S.H. and Nordby, J.J. 2005. Forensic Science: An Introduction to Scientific and Investigative Techniques, 2nd Edition, CRC Press, Boca Raton.
5. Patel, A.H. 1996. Industrial Microbiology.1st edition, Macmillan India Limited.
6. Pradipta Kumar Mohapatra, 2020. Environmental Biotechnology, Dreamtech Press.
7. Saha Tand Tiwary,B.K. 2020, Microbes, Environment and Human Welfare. Nova Science Publishers.
8. Prasad, R., Gill, S.S and Tuteja N. 2018.New and Future Developments in Microbial Biotechnology and Bioengineering. Elsevier

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Course Title	Environmental Studies
Course Code	BTN101A
Department	Biotechnology
Faculty	Faculty of Life and Allied Health Sciences

1. Course Summary

The aim of this course is to invoke awareness among students about the burning global environmental issues.
The course exposes the students to various problems associated with abuse of natural resources. The concepts of ecosystems, biodiversity and its conservation and environmental pollution will be discussed. The course emphasizes social issues associated with the environment, and the impact of human population on the environment.

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	50
Pass Requirement	As per university regulations
Attendance Requirement	As per university regulations

Teaching, Learning and Assessment

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO 1. Illustrate the multidisciplinary nature of environmental studies and recognize the need for public awareness.
CO 2. Explain the various natural resources and their associated problems, ecosystem, and environmental pollution.
CO 3. Analyse the concept of ecosystem and classify various types.
CO 4. Compare biodiversity at local, national and global levels.
CO 5. Discuss various social issues pertaining to environment including sustainable development and energy issues.

4. Course Contents

Theory

Unit 1 Natural resources: Forest resources: Use and over-exploitation, deforestation, Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams- benefits and problems, Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity. Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

Head
Department of Biotechnology
M S Ramaiah University of Applied Science

Unit 2 Ecosystems: Concept of an ecosystem, Structure and function of an ecosystem, Producers, consumers and decomposers, Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of the following ecosystem: Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, streams, lakes, rivers, ocean estuaries).

Unit 3 Biodiversity and its conservation: Definition: genetic, species and ecosystem diversity, Biogeographical classification of India, Value of biodiversity: consumptive use, productive use, social, ethical aesthetic and option values Biodiversity at global, national and local levels, India as a mega- diversity nation, Hot-spots of biodiversity, Threats to biodiversity: habitat loss, poaching of wildlife, man wildlife conflicts, Endangered and endemic species of India, Conservation of biodiversity: In-situ and Ex- situ conservation of biodiversity.

Unit 4 Environmental Pollution: Definition, causes, effects and control measures of: Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear pollution, Solid waste management: Causes, effects and control measures of urban and industrial wastes, Role of an individual in prevention of pollution.

Unit 5 Disaster management: floods, earthquake, cyclone and landslides

Unit 6 Social Issues and the Environment: From unsustainable to sustainable development, Urban problems and related to energy, Water conservation, rain water harvesting, watershed management, Resettlement and rehabilitation of people; its problems and concerns.Human Health: Antibiotic production, Molecular diagnostics, recombinant vaccines, gene therapy, HGP and its applications.

Unit 8 Environmental ethics: Issues and possible solutions, climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, Case studies, Wasteland reclamation, Consumerism and waste products, Environmental Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act, Issues involved in enforcement of environmental legislation, Public awareness. Human Population and the Environment: Population growth, variation among nations, Population explosion.

5. CO-PO PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	2	–	–	–	3	–	–	–	3	3	–	1	2	3	1
CO-2	2	–	–	–	3	–	–	–	3	3	–	1	2	3	1
CO-3	2	1	–	–	3	–	–	–	3	3	–	1	2	3	1
CO-4	2	–	–	–	3	–	–	–	3	3	–	1	2	3	1
CO-5	2	–	–	–	3	–	–	–	3	3	–	1	2	3	1
	3: High Influence, 2: Moderate Influence, 1: Low Influence														

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

Dean - Academics
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

6. Course Teaching and Learning Methods:

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		25
Demonstrations		03
1. Demonstration using Videos	03	
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		
1. Case Study Presentation		
2. Guest Lecture		
3. Industry / Field Visit		
4. Brainstorming Sessions		
5. Group Discussions		
6. Discussing Possible Innovations		
Term Test and Written Examination		02
Total Duration in Hours		30

7. Method of Assessment

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 (60% Weightage)	SEE (40% Weightage)
	Innovative assignment	
	30 Marks	20 Marks
CO-1	X	X
CO-2	X	X
CO-3	X	X
CO-4		X
CO-5		X

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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 Outcome

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. Bharucha, E., 2004, Environmental Studies, New Delhi: University Grants.
2. Ahluwalia, V.K., 2013, Environmental Studies: Basic concepts, The Energy and ResourcesInstitute (TERI).

b. Recommended Reading

1. Jadhav, H., Bhosale, V.M., 1995, Environmental Protection and Laws, Delhi:Himalaya Publishing House.

c. Magazines and Journals

1. https://www.omicsonline.org/environmental-sciences-journals-impact-factor-ranking.php

d. Websites

1. https://www.sciencedaily.com/news/earth_climate/environmental_science/

e. Other Electronic Resources

1. http://www.globalissues.org/issue/168/environmental-issues

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

Dean - Academics
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

Course Title	Health and well being
Course Code	AHU101A
Department	Allied Health Sciences
Faculty	Faculty of Life and Allied Health Sciences

1. Course Summary

The course is intended to introduce the concept of health and wellbeing and the ways in which it could be achieved through integrative lifestyle. Students undergo various health issues during their student period. Hence, it is imperative for them to maintain optimum health through proper diet, healthy lifestyles, and adequate physical activity. This course will provide simple and practical guidance to the students with latest scientific evidence in the field of lifestyle medicine (modern medicine), Ayurveda, and Yoga, and Meditation. The course also intends to equip students with handy tool as a continuous resource to facilitate lifestyle changes.
The course aims to provide knowledge to students to enhance health and wellbeing through integrative lifestyle.

2. Course Size and Credits:

Number of Credits	02
Total Hours of Classroom Interaction	15
Number of tutorial Hours	15
Number of Semester Weeks	16
Department Responsible	Allied Health Sciences (Division of Integrative Health Sciences)
Course Marks	50
Pass Requirement	As per university regulations
Attendance Requirement	As per university regulations

Teaching, Learning and Assessment

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO 1. To understand the definitions and scope of health, wellbeing and quality of life, and how they are changing in current times.

CO 2. To understand the relationship between lifestyles and health and wellbeing; and science of Integrative Lifestyle based on modern and traditional approaches.

CO 3. To apply tools and methods related to different aspects of Integrative Lifestyle.

CO 4. To apply the concepts of comprehensive Integrative Lifestyle for improving health and wellbeing.

4. Course Contents

Theory

Unit 1 Health, wellbeing, and integrative lifestyle: Definitions, determinants, and dimensions, changing paradigms of lifestyles, reasons for change in lifestyle paradigms, effects of changing lifestyles on health and wellbeing, understanding integrative lifestyle (definition and components).

Head
Department of Biotechnology
Ramaiah University of Applied Sciences
Bangalore - 560 054

Unit 2 Science and practice of healthy lifestyle: Nutrition: Energy, metabolism, healthy and balanced diet, Calories, understanding through charts and scales, Healthy sleep: Science of sleep, importance, sleep hygiene, Physical activity and its benefits, Substance use (tobacco, alcohol), healthy habits and healthy lifestyles, Stress management and Sleep hygiene as part of Healthy lifestyle.

Unit 3 Science and practice of Ayurvedic lifestyle: Individual's unique body – mind constitution, Variations in individual's constitutions (diurnal effects, seasonal effects, age related effects and effects of food), Recommendations (Daily, Seasonal) for Ayurvedic lifestyle customized to individual constitution.

Unit 4 Philosophy, Science and Practice of Yoga based lifestyle: Philosophy and Science of Yoga and Meditation, Practical demonstration of simple yoga techniques, Heartfulness meditation and supportive practices demonstration.

5. CO-PO PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	1	–	–	–	–	2	2	–	3	–	–	2	1	1	3
CO-2	1	–	–	–	–	2	2	–	3	–	–	2	1	1	3
CO-3	–	–	–	–	–	2	3	–	2	–	–	2	–	1	3
CO-4	–	–	–	–	–	2	3	–	2	–	–	2	–	1	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		
2. Demonstration using Physical Models / Systems	02	
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		13

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

Dean - Academics
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

1. Case Study Presentation	02	
2. Guest Lecture	05	
3. Industry / Field Visit		
4. Brainstorming Sessions	02	
5. Group Discussions	04	
6. Discussing Possible Innovations		
Term Test and Written Examination		**05**
Total Duration in Hours		**30**

7. Method of Assessment

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 (60% Weightage)		**SEE (40% Weightage)**
	SC1 (Practical Assessment) 30%	**SC2 (Assignments) 30%**	
	30 Marks	30 Marks	50 Marks
CO-1			X
CO-2			X
CO-3	X	X	X
CO-4	X		

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester. The overall 40% is required to clear the course that incudes CE and SEE components.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving Course Learning Outcome

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, Group discussions
3	Critical Skills	--
4	Analytical Skills	Classroom lectures, Activities, Group discussions, Assignment
5	Problem Solving Skills	--
6	Practical Skills	Classroom lectures, Activities, Group discussions, Assignment

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

7	Group Work	Course work, Practice, Group discussions, Assignment
8	Self-Learning	Course work, Practice, Group discussions, Assignment
9	Written Communication Skills	Course work, Practice, Group discussions, Assignment
10	Verbal Communication Skills	Course work, Practice, Group discussions, Assignment
11	Presentation Skills	--
12	Behavioral Skills	Course work, Practice, Group discussions, Assignment
13	Information Management	Assignment
14	Personal Management	--
15	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Science and practice of Integrative Health and Wellbeing Lifestyle Simple Heartfulness Practices Chandola H M. Lifestyle disorders: Ayurveda with lots of potential for prevention. Year : 2012 / Volume: 33 | Issue Number: 3 / Page: 327-327
2. Cohen, M. Challenges and Future Directions for Integrative Medicine in Clinical
3. Practice. Evid-Based-Integrative-Med2. 117-122 (2005).
4. Diet, nutrition and the prevention of chronic diseases: report of a Joint WHO/FAO Expert Consultation. WHO Technical Report Series, No. 916. Geneva: World Health Organization; 2003.
5. Horst R, Jaeger M, Smeekens S et al. Host and Environmental Factor Influencing Individual Human Cytokine Responses. 2016, Cell167, 1111-1124
6. Irwin, M., Opp, M. Sleep Health: Reciprocal Regulation of Sleep and Innate Immunity. Neuropsychopharmacol 42, 129-155 (2017)
7. What is Integrative Healthcare? - Duke Integrative Medicine. (2020),. Retrieved 23 August 2020, from https:/dukeintegrativemedicine.org/ leadership-program/what-is-integrative-healthcare/
8. Kamlesh D Patel. The Profound Beauty of Yoga. Heartfulness Collector's Edition. December 2018
9. Kamlesh D Patel. Yogic Psychology. Heartfulness Collectors' edition. December 2019

b. Recommended Reading

1. Heartfulness Way Designing Destiny Disease burden and mortality estimates. (2020). Retrieved 23 August 2020, from https://www.who.int/healthinfo/global burdendisease/estimates/en/index1.html
2. Garaulet, M., Gómez-Abellán, P., Alburquerque-Béjar, J. et al. Timing of food intake predicts weight loss effectiveness. Int Obes 37, 604-611 (2013)
3. H. (2020). The 4 most important types of exercise Harvard Health. Retrieved 23 August 2020, from https:/l,www.health.harvard.edu/exercise-and- fitness/the-4-most-important-types-of-exercise
4. Johnstone AM, Murison SD, Duncan JS, Rance KA, Speakman J. Factors influencing variation in basal metabolic rate include fat-free mass, fat mass, age, and circulating thyroxine but not sex, circulating leptin, or triiodothyronine. Am J Clin Nutr. 2005 Nov; 82(5):941-8
5. Medicine, U. (2020). Why does Integrative Medicine Matter? Explore Integrative Medicine. Retrieved 23 August 2020, from https://exploreim.ucla.edu/video/why-integrative-medicine- matters/
6. Megari K. Quality of life in chronic disease patients. Heal Psychol Res. 2013

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

Dean - Academics
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

7. PILCHER et al. Sleep quality versus sleep quantity: relationships between sleep and measures of health, well-being and sleepiness in college students. Journal of Psychosomatic Research, Vol. 42, No. 6, pp. 583 596. 1997
8. Rebel DK, Greeson JM, Brainard GC, Rosenzweig S. Mindfulness-based stress reduction and health-related quality of life in a heterogeneous patient population. Gen Hosp Psychiatry. 2001
9. Tolahunase, Madhuri R. et al. 'Yoga- and Meditation-based Lifestyle Intervention Increases Neuroplasticity and Reduces Severity of Major Depressive Disorder: A Randomized Controlled Trial'. 1 Jan. 2018: 423 - 442.
10. Types of Stressors (Eustress vs. Distress). (2020). Retrieved 23 August 2020, from https://www.mentalhelp.net/articles/ types-of-stressors-eustress-vs- distress/
11. Vasant Lad. The Complementary Book of Ayurvedic Home Remedies. London. 2006.
12. Wang C (2014). Challenges for the Future of Complementary and Integrative Care. Health Care Current Reviews 2: e102.doi:10.4172/2375- 4275.1000e102

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

RAMAIAH UNIVERSITY OF APPLIED SCIENCES

M. S. Ramaiah University of Applied Sciences

Course Specifications

of

B.Sc. in Biotechnology

B.Sc. (Hons.) in Biotechnology

B.Sc. (Hons. with Research) in Biotechnology

Programme Code: 018

SEMESTER 3

Department of Biotechnology
Faculty of Life and Allied Health Sciences
M S Ramaiah University of Applied Sciences

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

Dean - Academics
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

Course Title	General Chemistry 2
Course Code	BTC201A
Department	Biotechnology
Faculty	Faculty of Life and Allied Health Sciences

1. Course Summary

This course aims to train students with the concepts and principles of coordination chemistry, miscibility and properties of liquids & liquid mixtures along with the chemistry of alkanes, alkenes, alkynes, cycloalkanes and aromatic compounds. The laboratory component of the course aims to train students on estimation, preparation and analysis of various chemical species.

Students will be familiarized with the detailed concepts of classification and characteristic features of coordination compounds. Students will be taught the concepts of chemical kinetics, ideal and non-ideal solutions. The students will be trained to analyse kinetics of chemical reactions. They will be acquainted with theories to predict the order, molecularity and rate constants. Students will be taught the chemistry of aliphatic and aromatic hydrocarbons. Students will be able to explain properties and nature of various chemical compounds by performing experiments involving quantitative analysis, estimation and calculations. Students will be trained to analyse, identify the chemical species, and further interpret the data to enter in laboratory record book.

2. Course Size and Credits:

Number of Credits	5
Total Hours of Classroom Interaction	45
Number of laboratory Hours	60
Number of Semester Weeks	16
Department Responsible	Biotechnology
Course Marks	100
Pass Requirement	As per university regulations
Attendance Requirement	As per university regulations

Teaching, Learning and Assessment

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO 1. Describe the properties of liquids, liquid mixtures and hydrocarbons, Raoult's law, Nernst's distribution law.

CO 2. Classify the coordinating ligands, ideal and non-ideal solutions based on their chemical properties, chemical reactions based on order and molecularity and aliphatic/aromatic hydrocarbons.

CO 3. Explain the concepts of coordination complexes, Werner's theory, Spectrochemical series, rate of reactions, miscibility of liquids, CST, solubility concept and chemical reactivity.

CO 4. Determine order, molecularity of chemical reactions, stability of complexes and CFSE.

CO 5. Interpret the relation between nature of bonding and properties of coordination

Head
Department of Biotechnology
University of Applied Sciences

compounds, temperature and miscibility of liquid mixtures & chemical/physical properties of hydrocarbons.

CO 6. Conduct experiments as per the standard procedures and tabulate the measured values/results to Interpret and draw conclusions.

CO 7. Develop a laboratory report as per the prescribed format

4. Course Contents

Theory

Unit 1 Coordination Compounds: Coordination compounds, ligands and ambidentate ligands, classification of ligands (mono, bi, tri, tetra, penta and hexa dentate ligands), nomenclature, coordination number, stability of complexes and factors contributing to the stability, Valence bond theory postulates and limitations, Werner's theory and its limitations

Unit 2 CFT and spectrochemical series of coordination compounds: Crystal field theory for octahedral, tetrahedral and square planar complexes, crystal field splitting and crystal field stabilization energies, limitations of Crystal field theory and limitations, factors affecting Spectrochemical series

Unit 3 Chemicals Kinetics: Rate, rate law, order and molecularity of a reaction, rate constants of first and second order reactions, approximation methods, half-life period, influence of temperature on reaction rate, activation energy, determination of order of a reaction. Catalysis, Enzyme catalysis, effect of temperature on enzyme catalysis and Michaelis-Menten equation

Unit 4 Liquids and liquid mixtures: Review of Raoult's law, ideal and non-ideal solutions. Completely miscible liquids-Fractional distillation, azeotropic mixtures -examples. Completely miscible liquids- Critical solution temperature (Three types), examples, Effect of addition of salt on CST of phenol- water system, Distribution law-partition coefficient and condition for validity of distribution of distribution law, Numerical problems

Unit 5 Chemistry of alkanes, alkenes, alkynes and cycloalkanes: Sources, preparations, physical properties and chemical reactions of alkanes, alkenes, alkynes and cycloalkanes. Wurtz reaction, Kolbe's synthesis and use of Grignard reagent. Saytzeff's rule, oxidation & reduction chemistry, Ozonolysis, Baeyer's strain theory and its limitations. Alkyl Halides: Nucleophilic Substitution, reactions of alkenes and alcohols. Elimination versus substitution

Unit 6 Aromatic Hydrocarbons and Aryl Halides: Sources, preparations, physical properties and chemical reactions, Electrophilic substitution: nitration, halogenation and sulfonation. Friedel- Craft's reaction, Side chain oxidation of alkyl benzenes.

Aromatic nucleophilic substitution (replacement by –OH group) and effect of nitro substituent. Benzyne Mechanism: KNH2/NH3 (or NaNH2/NH3)

Practical

1. Determination of relative viscosity coefficient of given liquid using Oswald's viscometer.
2. Colorimetric determination of concentration of metal ion by complexing and using Beer-Lambert's law
3. Solid phase synthesis of trans- bis glycinato copper (II) complex
4. Preparation of K3[Cr(C2O4)3] potassium tris-oxalato chromate (III) trihydrate complex

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

M.S. Ramaiah - Dean - Academics
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

5. Preparation of manganese dioxide (MnO2) nanoparticle
6. Preparation of lyophilic and lyophobic starch sols
7. Preparation of Iodoform
8. Qualitative analysis: Identification of cations and anions in a mixture of salts containing not more than four ions (Two cations and two anions) (Five combinations to be analysed) Cations: Pb^{2+}, Fe^{2+} or Fe^{3+}, Al^{3+}, Zn^{2+}, Mn^{2+}, Ba^{2+}, Sr^{2+}, Ca^{2+}, Mg^{2+}, NH4, K^{+} Anions: CO3 , S^{2-}, CH_3COO^-, NO3 , Cl^-, Br^-, I^-, SO4 , C_2O_4

5. CO-PO PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	–	–	–	1	–	–	–	–	–	–	1	3	1	1
CO-2	3	2	–	–	2	–	–	–	–	–	–	1	3	2	1
CO-3	3	2	–	–	2	–	–	–	–	–	–	1	3	2	1
CO-4	2	2	2	–	–	–	–	–	–	–	–	2	2	1	2
CO-5	2	2	–	–	1	–	–	–	–	–	–	1	2	1	1
CO-6	3	–	–	–	1	–	–	–	–	–	–	1	3	1	1
CO-7	3	2	–	–	2	–	–	–	–	–	–	1	3	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		36
Demonstrations		03
1. Demonstration using Videos	02	
2. Demonstration using Physical Models	01	
3. Demonstration on a Computer		
Numeracy		
1. Solving Numerical Problems		
Practical Work		56
1. Course Laboratory	56	
2. Computer Laboratory		
3. Engineering Workshop / Course/Workshop / Kitchen		
4. Clinical Laboratory		
5. Hospital		
6. Model Studio		
Others		02
1. Case Study Presentation		
2. Guest Lecture		
3. Industry / Field Visit		
4. Brainstorming Sessions		
5. Group Discussions	01	

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

6. Discussing Possible Innovations	01	
Term Test and Written Examination		**04+04**
Total Duration in Hours		**105**

7. Method of Assessment

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 (60% Weightage)			SEE (40% Weightage)	
	SC1 (Term Tests) 30%	SC2 (Innovative + Lab assignment) 10%	SC3 (Written + Lab Assignment) 20%	SEE (Theory) 25%	SEE (Lab) 15%
	(25 + 25 Marks)	10 Marks	40 Marks	50 Marks	30 Marks
CO-1					
CO-2	X	X		X	
CO-3	X	X		X	
CO-4			X	X	
CO-5	X		X	X	
CO-6	X			X	
CO-7		X	X		X

8. Achieving Course Learning Outcome

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, Assignments
2	Understanding	Classroom lectures, Assignments
3	Critical Skills	Classroom lectures, Assignments
4	Analytical Skills	Classroom lectures, Assignments
5	Problem Solving Skills	--
6	Practical Skills	--
7	Group Work	Assignment/ Class Presentations
8	Self-Learning	Assignment, examination
9	Written Communication Skills	Assignment
10	Verbal Communication Skills	Class presentations
11	Presentation Skills	Class presentations
12	Behavioral Skills	--

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

13	Information Management	Assignment
14	Personal Management	Assignment, Examination
15	Leadership Skills	Effective management of learning, time management, achieving the learning outcomes

9. Course Resources

a. Essential Reading

1. Lab Manual
2. Puri, B.R., Sharma, L.R., Pathania, M.S., 2017, Principles of Physical Chemistry, 47th Edition, Vishal Publishing Co.
3. Puri, B.R., Sharma, L.R., Kalia, K.C., 2017, Principles of Inorganic Chemistry, 33rd Edition, Milestone Publishers and Distributors/Vishal Publishing Co.
4. Bahl, B. S and Arun Bahl (2014) Advanced Organic Chemistry. 7th Edition. Bangalore, S. Chand & Company Ltd
5. Kalsi, P.S., 1996, Organic Reactions and Their Mechanisms, New Delhi, New Age International.
6. Vogel, A.I., Jeffery, G.H., 1989, Vogel's textbook of quantitative chemical analysis, Longman Scientific & Technical.

b. Recommended Reading

1. Soni P.L., 1983, Textbook of Physical Chemistry, 14th Edition, New Delhi, Sultan Chand & Sons
2. Atkins, P. De Paula, J., 2014, Atkins' Physical chemistry, 10th Edition, Oxford University Press.
3. Smith, M. B., 2013, March Advanced Organic Chemistry: Reaction S, Mechanism, And Structure.7th Edition. New Jersey - USA, Wiley

c. Magazines and journals

1. https://ccj.springeropen.com/
2. https://www.elsevier.com/physical-sciences/chemistry/chemistry-journals

d. Websites

1. http://chemguide.co.uk/

e. Other electronic resources

1. http://www.chemistryonline.com/slides.htm

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

Course Title	Principles of Genetics
Course Code	BTC202A
Department	Biotechnology
Faculty	Faculty of Life and Allied Health Sciences

1. Course Summary

The aim of this course is to familiarize students with the fundamentals of Genetics. Students will be introduced to basic principles of heredity. They will be exposed to concepts that deviate from the classical inheritance patterns. They will also be introduced to aberrations in the chromosomal composition and its impact on the health of an organism.

The course also aims to train students in the practical aspects of Cytogenetics. The students will be trained to culture and study model organisms, prepare biological materials to study chromosomes and apply theoretical concepts to solve problems.

2. Course Size and Credits:

Number of Credits	5
Total Hours of Classroom Interaction	45
Number of laboratory Hours	60
Number of Semester Weeks	16
Department Responsible	Biotechnology
Course Marks	100
Pass Requirement	As per university regulations
Attendance Requirement	As per university regulations

Teaching, Learning and Assessment

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO 1. Define basic concepts in Mendelism and non-Mendelian inheritance
CO2. Explain principles of heredity at the organismal and population level
CO3. Illustrate linkage and mechanism of crossing over
CO4. Distinguish types of chromosomal variations
CO5. Examine utility of model organisms in understanding genetic principles
CO6. Demonstrate experimental methods using model organism
CO7. Apply principles of genetics to solve problems

4. Course Contents

Theory

Unit 1 History of Genetics, Mendelism, Chromosome Theory and deviations from Mendelism: History of Genetics, Mendel's principles - Dominance, segregation, independent assortment, Chromosome Theory of Heredity (Sutton-Boveri), Inheritance patterns (Sex-linked and Autosomal inheritance). Deviations from Mendelism - Multiple allele (Blood group), Genetic interaction, Epistasis interactions, non-Epistatic inter- allelic genetic interactions, Atavism/Reversion, Penetrance and expressivity, complementary and supplementary gene interactions, multi-factorial inheritance, Cytoplasmic inheritance.

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

M.S. Ramaiah University of Applied Sciences
Dean - Academics
Bangalore - 560 054

Unit 2 Population Genetics: Populations, Gene pool, Gene frequency; Hardy-Weinberg Law; concepts and rate of change in gene frequency through natural selection, migration, and random genetic drift; Speciation; Allopatricity and Sympatricity

Unit 3 Linkage and crossing over: Chromosome theory of Linkage, kinds of linkage, linkage groups, types of Crossing over, mechanism of Meiotic Crossing over, theories about the mechanism of Crossing over, cytological detection of Crossing over, significance of Crossing over.

Unit 4 Chromosomal variations and Sex determination: Human Karyotype; Structural and numerical chromosomal aberrations - Deletion, Duplication, Inversion, Translocation, Position Effect; Euploidy; Aneuploidy; allosomes and autosomes; Disorders associated with chromosomal aberrations – Allosomal and Autosomal.

Unit 5 Drosophila Genetics: *Drosophila melanogaster* as a genetic model – life cycle, Early experiments, Discovery of sex-linked inheritance and crossing-over, Identification, naming and utility of mutants, mutant generation, Genetic screens, unusual interphase chromosomes, non-disjunction and its relation to chromosomal aneuploidy

Practical

1. Culturing and Handling of Drosophila
2. Study of Drosophila Life cycle and Sexual dimorphism
3. Study of Drosophila eye mutants
4. Study of Drosophila body color mutants
5. Study of Drosophila wing mutants
6. Salivary gland dissection from third instar larva of Drosophila
7. Preparation of temporary squash of Drosophila salivary glands to observe polytene chromosome.
8. Study of multiple allelism: Human ABO blood typing
9. Study of translocation: Meiosis in Rhoeo discolor
10. Solve Problems applying genetic principles.
11. Design an experiment to illustrate mendelian principles of monohybrid inheritance.

5. CO-PO PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	–	–	–	–	–	–	–	–	–	–	1	3	1	1
CO-2	3	2	–	–	1	–	–	–	–	–	–	1	3	2	1
CO-3	3	2	–	–	–	–	–	–	–	–	–	1	3	2	1
CO-4	3	1	–	–	–	–	–	–	–	–	–	1	3	1	1
CO-5	2	2	–	–	2	–	–	–	–	–	–	1	3	2	1
CO-6	2	2	3	–	–	–	–	1	–	–	–	1	3	2	2
CO-7	2	3	–	–	–	–	–	–	–	–	–	2	3	3	2
		3: High Influence, 2: Moderate Influence, 1: Low Influence													

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

6. Course Teaching and Learning Methods:

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		36
Demonstrations		05
1. Demonstration using Videos	02	
2. Demonstration using Physical Models		
3. Demonstration on a Computer	03	
Numeracy		
1. Solving Numerical Problems		
Practical Work		56
1. Course Laboratory	56	
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. Brainstorming Sessions		
5. Group Discussions		
6. Discussing Possible Innovations		
Term Test and Written Examination		**04+04**
Total Duration in Hours		**105**

7. Method of Assessment

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 (60% Weightage)			SEE (40% Weightage)	
	SC1 (Term Tests) 30%	SC2 (Innovative + Lab assignment) 10%	SC3 (Written + Lab Assignment) 20%	SEE (Theory) 25%	SEE (Lab) 15%
	(25 + 25 Marks)	10 Marks	40 Marks	50 Marks	30 Marks
CO-1	X	X		X	
CO-2	X	X		X	
CO-3	X			X	
CO-4	X		X	X	
CO-5			X	X	
CO-6		X	X		X
CO-7			X		X

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

M.S. Ramaiah University of Applied Sciences
Dean - Academics
Bangalore - 560 054

8. Achieving Course Learning Outcome

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	Assignments
4	Analytical Skills	Assignments
5	Problem Solving Skills	Assignments, examination
6	Practical Skills	Assignments
7	Group Work	--
8	Self-Learning	self-study
9	Written Communication Skills	Assignment, examination
10	Verbal Communication Skills	--
11	Presentation Skills	--
12	Behavioral Skills	Assignment
13	Information Management	--
14	Personal Management	--
15	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Laboratory manual.
2. Klug, W.S., Cummings, M.R., Spencer, C.A., Palladino, M.A., 2016, *Concepts of Genetics*, 10th edition, Pearson Education India.
3. Gardner, E.J., Simmons, M.J., Snustad, D.P., 2006, *Principles of Genetics*, 8th edition, Wiley.

b. Recommended Reading

1. Sturtevant, A.H., 1965, A History of Genetics, Harper and Row New York.
2. Orel, V., 1996, Gregor Mendel: The First Geneticist, Oxford University Press, New York.
3. Tamarin, R.H., 2017, Principle of Genetics, 7th Edition, McGraw Hill Education.
4. Hart, D., and Jones, E.W., 1998, Genetics, Principles and Analysis, 4th Edition, Jones and Bartlett Publication.
5. Strickberger, M.W., 2015, Genetics, 3rd edition, Pearson Education IndiaSoni P.L., 1983, Textbook of Physical Chemistry, 14th Edition, New Delhi, Sultan Chand & Sons

c. Magazines and journals

1. http://www.genetics.org/

d. Websites

1. http://learn.genetics.utah.edu/
2. https://ghr.nlm.nih.gov/

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bengaluru - 560 054

Course Title	Biostatistics
Course Code	BTC203A
Department	Biotechnology
Faculty	Faculty of Life and Allied Health Sciences

1. Course Summary

This course aims to train students on the application of statistical methods (summarizing data and drawing valid inferences based on limited information) to biological systems. This course deals with statistical concepts and terminology and basic analytic techniques.

Students will be taught the fundamental concepts in the design and analysis of biomedical studies, including the difference between observational and experimental studies, units of randomization, the comparisons of the sample with control group, and adjustments for error explaining the logic behind statistical confidence intervals and hypothesis tests.

2. Course Size and Credits:

Number of Credits	3
Total Hours of Classroom Interaction	45
Number of laboratory Hours	-
Number of Semester Weeks	16
Department Responsible	Biotechnology
Course Marks	100
Pass Requirement	As per university regulations
Attendance Requirement	As per university regulations

Teaching, Learning and Assessment

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO 1. Explain the use of mathematical and statistical concepts in f biological data analysis
CO2. Demonstrate the central concepts of modern statistical theory and their probabilistic foundation
CO3. Communicate the results of statistical analyses accurately and effectively
CO4. Analyze the complex statistical computations and calculations of the experimental data
CO5. Develop analytical skills to identify patterns and build practical models

4. Course Contents

Theory

Unit 1 Measures of central tendency and measures of dispersion: Statistics – Definition, Types of Data, Collection of data; Primary & Secondary data, Graphical representation of data, Measures of Central Tendency – Mean, Median, Mode, Measures of Dispersion – Range, Quartile deviation, Mean deviation, Standard deviation, Variance, Skewness – Kurtosis

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Unit 2 Correlation and regression analysis: Correlation – Types, scatter diagram – Karl Pearson's coefficient of correlation, Spearman's Rank Correlation – Regression – Formation of Regression lines – Uses of Regression lines

Unit 3 Basics of probability: Basics of Probability Theory – Addition & Multiplication Rule – Binomial, Poisson and Normal Distribution and their uses in biological sciences

Unit 4 Large sample test: Methods of sampling, confidence level, critical region, testing of hypothesis and standard error, large and small sample test. Test for Mean, Small sample Tests: Student's t-test, F- test, chi-square test for goodness of fit – Analysis of variance (one-way and two-way – Basic Ideas only); Correlation and Regression- Emphasis on examples from Biological Sciences

Unit 5 Tools and Languages in Statistics: Introduction to SAS, SPSS and R Programming and their applications in statistics

5. CO-PO PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	2	1	–	3	–	–	–	–	–	–	–	2	2	1	3
CO-2	2	2	–	3	–	–	–	–	–	–	–	2	3	2	3
CO-3	1	–	–	2	–	3	–	–	–	–	–	2	2	1	3
CO-4	1	3	–	3	2	–	–	–	–	–	–	2	3	3	3
CO-5	1	2	–	3	2	–	–	–	–	–	–	2	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		28
Demonstrations		03
1. Demonstration using Videos	02	
2. Demonstration using Physical Models	01	
3. Demonstration on a Computer		
Numeracy		10
1. Solving Numerical Problems	10	
Practical Work		
1. Course Laboratory		
2. Computer Laboratory		
3. Engineering Workshop / Course/Workshop / Kitchen		
4. Clinical Laboratory		
5. Hospital		
6. Model Studio		

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences

Others		
1. Case Study Presentation		
2. Guest Lecture		
3. Industry / Field Visit		
4. Brainstorming Sessions		
5. Group Discussions		
6. Discussing Possible Innovations		
Term Test and Written Examination		**04**
Total Duration In Hours		**45**

7. Method of Assessment

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 (60% Weightage)			**SEE (40% Weightage)**
	SC1 (Term Tests) 30%	**SC2 (assignments) 10%**	**SC3 (Assignments) 20%**	
	(25 + 25 Marks)	10 Marks	40 Marks	50 Marks
CO-1	X	X		X
CO-2	X	X		X
CO-3	X	X	X	X
CO-4	X		X	X
CO-5	X		X	X

8. Achieving Course Learning Outcome

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	Assignments
4	Analytical Skills	Assignments
5	Problem Solving Skills	Assignment, examination
6	Practical Skills	Assignments
7	Group Work	--
8	Self-Learning	self- study
9	Written Communication Skills	Assignment, examination

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

Dean - Academics
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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. Class notes.
2. Khan, I.A., Khanum, A., 2004, Fundamentals of Biostatistics, Ukaaz publications, Hyderabad.
3. Khan, I.A., Khanum, A., 2007, Biostatistics for pharmacy, Ukaaz publications, Hyderabad.
4. Gupta, S.P., 2011, Statistical methods, 4th Edition, Sultan Chand & Sons.
5. Sharma, A.K., 2005, Text book of Biostatistics II, DPH, New Delhi.
6. Rastogi, V.B., 2015, Biostatistics, 3rd Edition, Medtech.
7. Pranab Kumar, B., 2007, Introduction to Bio-statistics, 3rd Revision, S Chand & Company.
8. Rao, P.S.S.S., Richard, J., 2012, Introduction to Biostatistics and Research methods, 5th Edition, Prentice Hall India Learning Private Limited.
9. Daniel, W.W., Cross, C.L., 2014, Biostatistics: Basic Concepts and Methodology for the Health Sciences, 10th Edition, Wiley.

b. Recommended Reading

1. Zar, J.H., 2009, Bio-statistical Analysis, 4th Edition, Pearson Education Inc., Dorling Kindersley, India, Pvt. Ltd., New Delhi.
2. Antonisamy, B., Christopher, S., Samuel, P., 2011, Bio-Statistics Principles and Practice,

c.Magazines and journals

1. https://academic.oup.com/biostatistics

d. Websites

1. https://www.nature.com/subjects/biostatistics

e. Other electronic resources

1. https://ocw.mit.edu/courses/mathematics/18-05-introduction-to-probability-and-statistics-spring-2014/

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

Course Title	Applications of Biotechnology in Agriculture
Course Code	BTO201A
Department	Biotechnology
Faculty	Faculty of Life and Allied Health Sciences

1. Course Summary

The course aims to provide an understanding of core principles and applications of agricultural Biotechnology. Students will be acquainted with basic concepts of plant growth regulators, plant tissue culture, gene transfer techniques which form the basis of agricultural biotechnology. Students also learn strategies involved in crop improvement and storage. They also will become acquainted with applications of agricultural biotechnology in the production of pharmaceuticals.

2. Course Size and Credits:

Number of Credits	3
Total Hours of Classroom Interaction	45
Number of laboratory Hours	0
Number of Semester Weeks	16
Department Responsible	Biotechnology
Course Marks	100
Pass Requirement	As per university regulations
Attendance Requirement	As per university regulations

Teaching, Learning and Assessment

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO 1. Identify the importance and applications of agricultural biotechnology
CO2. Describe techniques that enable agricultural biotechnology
CO3. Explain strategies to enhance agronomic value of crops
CO4. Discuss significance of biopesticides and biofertilizers
CO5. Summarize efforts made to utilize the plants for biopharming

4. Course Contents

Theory

Unit 1 Agricultural Biotechnology: History, Basic concepts, applications, significance, food security, food safety; Ethical and Environment concerns

Unit 2 Methods in Agricultural Biotechnology: Plant tissue culture, applications in biotechnology; Gene transfer techniques

Unit 3 Crop improvement and Transgenic crops: Golden rice, BT crops, Roundup crops, pathogen resistant crops, Blue carnations; Post Harvest Technology - Extending shelf life of fruits; Flavr-Savr Tomato.

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

Unit 4 Biopesticides and Biofertilizers: Bt Toxin, Baculovirus, Trichoderma; Nitrogen fixing organisms, Vermicompost, Significance of biopesticides and biofertilizers

Unit 5 Biopharming in plants: Therapeutic proteins, edible vaccines, secondary metabolites.

5. CO-PO PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	1	–	–	3	–	–	–	2	3	–	1	3	3	2
CO-2	3	2	–	–	3	–	–	–	2	–	–	1	3	3	2
CO-3	3	2	–	–	3	–	–	–	2	–	–	1	3	3	2
CO-4	3	2	–	–	3	–	–	–	3	3	–	1	3	3	2
CO-5	3	2	–	–	3	–	–	–	2	–	2	1	3	3	2
		3: High Influence, 2: Moderate Influence, 1: Low Influence													

6. Course Teaching and Learning Methods:

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		30
Demonstrations		10
1. Demonstration using Videos	06	
2. Demonstration using Physical Models		
3. Demonstration on a Computer	04	
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		01
1. Case Study Presentation		
2. Guest Lecture		
3. Industry / Field Visit		
4. Brainstorming Sessions	01	
5. Group Discussions		
6. Discussing Possible Innovations		
Term Test and Written Examination, presentations	**04**	**04**
Total Duration in Hours		**45**

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

7. Method of Assessment

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 (60% Weightage)			SEE (40% Weightage)
	SC1 (Term Tests) 30%	SC2 (assignments) 10%	SC3 (Assignments) 20%	
	(25 + 25 Marks)	10 Marks	40 Marks	50 Marks
CO-1	X	X		X
CO-2	X	X		X
CO-3	X	X	X	X
CO-4	X		X	X
CO-5			X	X

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

8. Achieving Course Learning Outcome

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	Assignments
4	Analytical Skills	Assignments
5	Problem Solving Skills	Assignment, examination
6	Practical Skills	Assignments
7	Group Work	--
8	Self-Learning	self- study
9	Written Communication Skills	Assignment, examination
10	Verbal Communication Skills	--
11	Presentation Skills	--
12	Behavioral Skills	--
13	Information Management	Assignment
14	Personal Management	--
15	Leadership Skills	--

9. Course Resources

1.Slater, A., Scott, N.W., Fowler, M.R., 2015, Plant Biotechnology: the genetic manipulation of plant, 2nd Edition, Oxford University Press.

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

Dean-Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

RAMAIAH UNIVERSITY OF APPLIED SCIENCES

M. S. Ramaiah University of Applied Sciences

Course Specifications

of

B.Sc. in Biotechnology

B.Sc. (Hons.) in Biotechnology

B.Sc. (Hons. by Research) in Biotechnology

Programme Code: 018

SEMESTER 4

Department of Biotechnology
Faculty of Life and Allied Health Sciences
M S Ramaiah University of Applied Sciences

Head
Department of Biotechnology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Course Title	Cell Structure and Signalling
Course Code	BTC204A
Department	Biotechnology
Faculty	Faculty of Life and Allied Health Sciences

1. Course Summary

The aim of the course is to familiarize students with the structure and function of basic components of cells. Students will be able to understand the dynamic roles of each structure in a cell that results in coordinated function to regulate cellular life.
Students will be able to carry out basic cell biology experiments. The students will be able to utilize these experiments to further their understanding of basic cell biology and familiarize themselves with experimental methods and techniques applied in research.

2. Course Size and Credits:

Number of Credits	5
Total Hours of Classroom Interaction	45
Number of laboratory Hours	60
Number of Semester Weeks	16
Department Responsible	Biotechnology
Course Marks	100
Pass Requirement	As per university regulations
Attendance Requirement	As per university regulations

Teaching, Learning and Assessment

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO1. Understand the structure and properties of cell

CO2. Explain the organization of eukaryotic organisms to understand the gradual evolution of complex structures

CO3. Relate the different structures that comprise cell membranes with their specific role in maintenance of cellular life

CO4. Analyse the molecular events in the cell cycle and assess the effect of its dysregulation

CO5. Interpret the complex molecular events of cell signaling and its effects on gene expression

CO6. Demonstrate eukaryotic cell structure and division using microscope

CO7. Analyse techniques to assess various cell functions.

4. Course Contents

Theory

Unit 1 Microscopy and Cell structure: Microscopy- Concept of Magnification and Resolution, Bright field, Dark field, Phase contrast and Fluorescence microscopy, Discovery of Cells, Cell theory, Prokaryotic and eukaryotic cells, Plant and animal cells

Unit 2 Eukaryotic cell organelles: Cell wall, Plasma membrane, Mitochondria, ER, Golgi complex, Lysosome, Peroxisome, Ribosome, Centriole, Nucleus, Vacuole and Chloroplast

Head Department of Biotechnology M S Ramaiah University of Applied Sciences Bangalore - 560 054

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

Dean - Academics M.S. Ramaiah University of Applied Sciences Bangalore - 560 054

Unit 3 Membrane structure and Function: Models of membrane structure, Chemical composition of membranes, Membrane function, Membrane transport- Solute transport by Simple diffusion, Facilitated diffusion and Active transport, Protein trafficking

Unit 4 Cytoskeleton and Cellular matrix: Microtubules, Cilia and Flagella, Intermediate Filaments, Microfilaments, ECM- Cell adhesion molecules, Cell junctions-Gap junctions and Tight junctions

Unit 5 Cell cycle: Mitosis, Meiosis, Cell cycle Regulation- role of cyclins and CDKs, Cell cycle checkpoints, Overview of Autophagy, Apoptosis- Intrinsic & Extrinsic pathways of cell death, Hallmarks of Cancer, Oncogenes and tumor suppressor genes

Unit 6 Cell Signaling: General Principles of cell signaling, Mechanism of molecular transduction, Overview of Major receptor classes and signaling pathways, GPCRs, Receptor tyrosine kinases, second messengers.

Practical

1. Microscopy- Light Microscopy and Fluorescence Microscopy- principle, parts and function, Operation
2. Microscopic measurements, micrometer (ocular and stage)
3. Microscopic counting of cells using a hemocytometer and cell viability assay
4. Isolation of chloroplasts and determining the purity of chlorophyll a and b.
5. Study of Diffusion and Osmosis across semipermeable membrane
6. Nuclear Staining by DAPI

7a. Study of mitosis in onion root tip cell
7b. To calculate mitotic index in onion root tip cell
7c. To study inhibition of mitosis using colchicine in onion root tip cell

8. Study of meiosis in plant cell

5. CO-PO PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	–	–	–	–	–	–	–	–	–	–	1	3	1	1
CO-2	3	1	–	–	1	–	–	–	–	–	–	1	3	1	1
CO-3	3	2	–	–	1	–	–	–	–	–	–	1	3	2	1
CO-4	2	3	–	–	2	–	–	–	–	–	–	2	3	3	2
CO-5	2	3	–	–	2	–	–	–	–	–	–	2	3	3	2
CO-6	2	2	3	–	–	–	–	1	–	–	–	1	3	2	2
CO-7	2	2	3	–	–	–	–	–	–	–	–	1	3	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		36
Demonstrations		

Head
Department of Biotechnology
M.S. Ramaiah University of Applied Sciences
Bengaluru - 560 054

1. Demonstration using Videos	02	03
2. Demonstration using Physical Models	01	
3. Demonstration on a Computer		
Numeracy		
1. Solving Numerical Problems		
Practical Work		
1. Course Laboratory	56	
2. Computer Laboratory		
3. Engineering Workshop / Course/Workshop / Kitchen		56
4. Clinical Laboratory		
5. Hospital		
6. Model Studio		
Others		
1. Case Study Presentation		
2. Guest Lecture		
3. Industry / Field Visit		
4. Brainstorming Sessions		02
5. Group Discussions	01	
6. Discussing Possible Innovations	01	
Term Test and Written Examination		**04+04**
Total Duration in Hours		**105**

7. Method of Assessment

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 (60% Weightage)			**SEE (40% Weightage)**	
	SC1 (Term Tests) 30%	**SC2 (Innovative + Lab assignment) 10%**	**SC3 (Written + Lab Assignment) 20%**	**SEE (Theory) 25%**	**SEE (Lab) 15%**
	(25 + 25 Marks).	10 Marks	40 Marks	50 Marks	30 Marks
CO-1	X	X		X	
CO-2	X	X		X	
CO-3	X		X	X	
CO-4			X	X	
CO-5		X			X
CO-6		X	X		X
CO-7			X		X

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

M.S. Ramaiah University of Applied Sciences
Dean - Academics
Bangalore - 560 054

8. Achieving Course Learning Outcome

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, Examination
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. Karp, G., 2010, Cell and Molecular Biology: Concepts and Experiments, 6th Edition, John Wiley & Sons. Inc.
2. De Robertis, E.D.P., and De Robertis, E.M.F., 2006, Cell and Molecular Biology, 8th Edition, Lippincott Williams and Wilkins, Philadelphia.
3. Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts, K., Watson, J.D., 1994, Molecular Biology of the Cell, 3rd Edition, Garland Publishing.
4. 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.
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. Lab manual

b. Recommended Reading

1. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P., 2009, The World of the Cell, 7th Edition. Pearson Benjamin Cummings Publishing, San Francisco.
2. Lodish, H., Baltimore, D., Berk, A., Zipursky, B.L., Mastsydaira, P., Darnell, J., 2004, Molecular Cell Biology, Scientific American Books Inc. NY.
3. Lodish, H., Berk, A., Kaiser, C.A., Krieger, M., Bretscher, A., 2016, Molecular Cell Biology, 8th Edition, W.H. Freeman & Co.
4. Tobin, A.J. and Morel, R.E., 1997, Asking about cells, Saunders College Publisher.
5. Wolfe, S.L., 1991, Molecular and Cellular Biology, Wordsworth Pub. Co.
6. Hunt, T., Wilson, J., 2014, The Problems Book – for Molecular Biology of the Cell, 6th Edition, W. W. Norton & Company.

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences

c. Magazines and Journals

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

d. Websites

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

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Course Title	Molecular Biology
Course Code	BTC205A
Department	Biotechnology
Faculty	Faculty of Life and Allied Health Sciences

1. Course Summary

The course aims to familiarize students with the concepts of Molecular Biology and its applications.

Students will be acquainted with the central principles and fundamental mechanisms for the organization, replication, expression, variation, and evolution of the genetic material, as well on methods for molecular biology analyses and gene technology. Students will be trained on the principles of recent methods and tools so that they can relate those in areas like recombinant DNA technology, medical genetics, cancer biology and molecular taxonomy.

2. Course Size and Credits:

Number of Credits	5
Total Hours of Classroom Interaction	45
Number of laboratory Hours	60
Number of Semester Weeks	16
Department Responsible	Biotechnology
Course Marks	100
Pass Requirement	As per university regulations
Attendance Requirement	As per university regulations

Teaching, Learning and Assessment

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO1. Describe the structure and properties of DNA with reference to its structure and replication.

CO2. Illustrate the processes of DNA repair and recombination to maintain the integrity of DNA and chromosomes.

CO3. Explain the comprehensive mechanism involved in transcription and RNA processing.

CO4. Distinguish between the molecular mechanisms involved in prokaryotic and eukaryotic protein synthesis.

CO5. Compare and contrast the process of prokaryotic and eukaryotic gene regulation

CO6. Apply the tools and techniques to isolate DNA from various sources.

CO7. Analyze DNA and protein isolated using modern technologies.

4. Course Contents

Theory

Unit 1 DNA structure and replication: DNA as genetic material, Structure of DNA, Types of DNA, Replication of DNA in prokaryotes and eukaryotes: Semiconservative nature of DNA replication, Bi- directional replication, DNA polymerases, the replication complex: Pre-priming proteins, primosome, replisome, Rolling circle replication, Unique aspects of eukaryotic chromosome replication, Fidelity of replication.

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

Unit 2 DNA damage, repair and homologous recombination: DNA damage and repair: causes and types of DNA damage, mechanism of DNA repair: Photoreactivation, base excision repair, nucleotide excision repair, mismatch repair, recombinational repair, nonhomologous end joining. Homologous recombination: models and mechanism.

Unit 3 Transcription in prokaryotes and eukaryotes: RNA structure and types of RNA, Transcription in prokaryotes: Prokaryotic RNA polymerase, role of sigma factor, promoter, Initiation, elongation, and termination of RNA chains. Transcription in eukaryotes: Eukaryotic RNA polymerases, transcription factors, promoters, enhancers, mechanism of transcription initiation, promoter clearance and elongation. RNA splicing and processing: processing of pre-mRNA: 5' cap formation, polyadenylation, splicing, rRNA and tRNA splicing.

Unit 4 Translation: Structure and role of t-RNA in protein synthesis, ribosome structure and assembly, basic features of genetic code, Charging of tRNA, aminoacyl tRNA synthetases, Mechanism of initiation, elongation, and termination of polypeptides in prokaryotes and eukaryotes. Fidelity of translation, Inhibitors of translation.

Unit 5 Post Translational modification and Protein Targeting: Glycosylation, Disulphide bond formation, protein folding and proteolytic cleavage. Export of secretory proteins- signal hypothesis, Transport, and localization of proteins to mitochondria and chloroplast.

Unit 6 Regulation of gene expression- Regulation of gene expression in prokaryotes: Operon concept (inducible and repressible system) Regulatory strategies in Eukaryotes: transcriptional activation, galactose metabolism in yeast.

Practical

1. Genomic DNA isolation from Plant tissue
2. Genomic DNA isolation from animal tissue
3. Genomic DNA isolation from bacteria
4. Isolation of plasmid DNA from bacteria
5. Separation of DNA by Agarose Gel electrophoresis
6. Estimation of DNA by colorimetric method
7. Quantification of DNA by spectroscopic analysis
8. Separation of Protein by SDS-PAGE
9. Determination of Molecular weight of DNA and Protein.

5. CO-PO PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	–	–	–	–	–	–	–	–	–	–	1	3	1	1
CO-2	3	2	–	–	–	–	–	–	–	–	–	1	3	2	1
CO-3	3	2	–	–	–	–	–	–	–	–	–	1	3	2	1
CO-4	3	2	–	–	–	–	–	–	–	–	–	1	3	2	1
CO-5	3	2	–	–	–	–	–	–	–	–	–	1	3	2	1
CO-6	2	2	3	–	–	–	–	1	–	–	–	1	3	2	2
CO-7	2	2	3	–	–	–	–	1	–	–	–	1	3	2	2
		3: High Influence, 2: Moderate Influence, 1: Low Influence													

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

Dean - Academics
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

6. Course Teaching and Learning Methods:

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		33
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		56
1. Course Laboratory	56	
2. Computer Laboratory		
3. Engineering Workshop / Course/Workshop / Kitchen		
4. Clinical Laboratory		
5. Hospital		
6. Model Studio		
Others		02
1. Case Study Presentation		
2. Guest Lecture		
3. Industry / Field Visit		
4. Brainstorming Sessions		
5. Group Discussions	01	
6. Discussing Possible Innovations	01	
Term Test and Written Examination		**04+04**
Total Duration in Hours		**105**

7. Method of Assessment

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 (60% Weightage)			SEE (40% Weightage)	
	SC1 (Term Tests) 30%	SC2 (Innovative + Lab assignment) 10%	SC3 (Written + Lab Assignment) 20%	SEE (Theory) 25%	SEE (Lab) 15%
	(25 + 25 Marks)	10 Marks	40 Marks	50 Marks	30 Marks
CO-1	X	X		X	
CO-2	X	X		X	
CO-3	X		X	X	

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

CO-4			X	X	
CO-5				X	
CO-6		X	X		X
CO-7		X	X		X

8. Achieving Course Learning Outcome

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. Lodish, H., Baltimore, D., Berk, A., Zipursky, B.L., Mastsydaira, P., Darnell, J., 2004, Molecular Cell Biology, Scientific American Books Inc. NY.
2. Karp, G., 2010, Cell and Molecular Biology: Concepts and Experiments, 6th Edition, John Wiley & Sons. Inc.
3. Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., Losick, R., 2008, Molecular Biology of the Gene, 10th Edition, Cold Spring Harbour Lab., Press, Pearson Pub.
4. De Robertis, E.D.P., De Robertis, E.M.F., 2006, Cell and Molecular Biology, 8th Edition, Lippincott Williams and Wilkins, Philadelphia.
5. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P., 2009, The World of the Cell, 7 Edition, Pearson Benjamin Cummings Publishing, San Francisco.
6. 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.
7. Sambrook, J., Fritsch, E.F., Maniatis, T., 2001, Molecular Cloning-A Laboratory Manual, 3rd Edition, Cold Spring Harbor Laboratory Press.

b. Recommended Reading

1. Russell, P. J., 2009, Genetics- A Molecular Approach, 3rd Edition, Benjamin Cummings.
2. Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C., Carroll, S.B., 2007, 9th Edition, Introduction to Genetic Analysis, W. H. Freeman & Co.
3. Clark, D.P., Pazdernik, N.J., 2009, Biotechnology-Applying the Genetic Revolution, Elsevier Academic Press, USA..

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

Dean
Faculty of Life & Allied Health Sciences
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

c. Magazines and Journals

1. https://www.nature.com/ncb/

d. Websites

1. https://cmbl.biomedcentral.com/
2. http://mcb.asm.org/

e. Other Electronic Resources

1. http://www.web-books.com/MoBio/

Head
Department of Biotechnology
M.S. Ramaiah University of Applied Sc

Course Title	Molecular Genetics
Course Code	BTC206A
Department	Biotechnology
Faculty	Faculty of Life and Allied Health Sciences

1. Course Summary

The course aims to acquaint students in concepts and theories, leading to an understanding of genetics at the molecular level. Students will be familiarized with the structural complexities involved in packaging of DNA into chromosomes and the nucleus. They will be taught the different mechanisms involved in genetic recombination in bacteria. They will also be familiarized with the mechanism of sex determination and dosage compensation. The students will be taught about various types and mechanisms involved in mutations. They will be familiarized with the role of transposable elements.

2. Course Size and Credits:

Number of Credits	3
Total Hours of Classroom Interaction	45
Number of laboratory Hours	0
Number of Semester Weeks	16
Department Responsible	Biotechnology
Course Marks	100
Pass Requirement	As per university regulations
Attendance Requirement	As per university regulations

Teaching, Learning and Assessment

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO1. List and describe the structural, functional, and topological features of DNA within the genome

CO2. Compare and contrast the mechanisms of genetic recombination in bacteria and bacteriophages

CO3. Discuss molecular basis of mutation and its role in human genetic disorders

CO4. Illustrate and describe molecular basis of DNA repair and recombination

CO5. Distinguish the molecular nature of sex determination and dosage compensation mechanisms in model organisms

CO6. Describe mechanisms of epigenetic regulation of gene expression

4. Course Contents

Theory

Unit 1 DNA Structure and Organization in Chromosomes: Discovery of and evidence for DNA as genetic material, Analytical techniques used in investigation of DNA, Structure of viral, bacterial and eukaryotic chromosomes, DNA topology, DNA organization in nucleosomes, Mitotic and unusual interphase chromosomes and their significance, Sequence organization in eukaryotic chromosomes, Chromosomal territories in eukaryotes and their significance.

Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

Dean - Academics
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

Unit 2 Genetic Analysis and Gene Mapping in Bacteria and Bacteriophages: Genetic recombination in bacteria and its evolutionary significance, Transformation, Conjugation and Transduction, Methods to study recombination in bacteria, Genetics of bacteriophages, Mapping genes in bacteria using genetic data, Antibiotic resistance in bacteria

Unit 3 Molecular Basis of Mutation: Types of mutations and their effect on gene expression and phenotype, Spontaneous mutations, Induced mutations (chemical and radiation), Ames Test to assess mutagenicity, Single- gene mutations in human diseases, Transposable elements as agents of mutation, Somatic vs Germline mutations. Mutation as a random and non-adaptive process

Unit 4 Molecular Basis of DNA Repair and Recombination: DNA repair mechanisms to counteract mutations, Inherited human diseases with defects in DNA repair, DNA recombination mechanisms (Holliday and Whitehouse model), Significance of recombination events, DNA recombination in meiosis and in repair of DNA damage, Gene conversion

Unit 5 Molecular Basis of Sex Determination: Sex determination mechanisms in invertebrates and vertebrates; Dosage compensation mechanisms in invertebrates and vertebrates; Effect of environment on sex-determination mechanisms

Unit 6 Epigenetics: Epigenetics mechanisms involved in gene regulation; DNA methylation; Histone modifications and their role in epigenetic gene regulation; RNA interference; Epigenetics and imprinting; Role of epigenetics in cancer; Projects underway to map the human epigenome.

5. CO-PO PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	–	–	–	–	–	–	–	–	–	–	1	3	1	1
CO-2	3	2	–	–	–	–	–	–	–	–	–	1	3	2	1
CO-3	3	2	–	–	–	–	–	–	2	–	–	1	3	2	1
CO-4	3	2	–	–	–	–	–	–	–	–	–	1	3	2	1
CO-5	3	2	–	–	–	–	–	–	–	–	–	1	3	2	1
CO-6	3	2	–	–	–	–	–	–	–	–	–	2	3	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		36
Demonstrations		03
1. Demonstration using Videos	02	
2. Demonstration using Physical Models	01	

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

3. Demonstration on a Computer		
Numeracy		
1. Solving Numerical Problems		
Practical Work		
1. Course Laboratory		
2. Computer Laboratory		
3. Engineering Workshop / Course/Workshop / Kitchen		
4. Clinical Laboratory		
5. Hospital		
6. Model Studio		
Others		
1. Case Study Presentation		
2. Guest Lecture		
3. Industry / Field Visit		
4. Brainstorming Sessions		
5. Group Discussions	01	02
6. Discussing Possible Innovations	01	
Term Test and Written Examination		**04**
Total Duration in Hours		**45**

7. Method of Assessment

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 (60% Weightage)			**SEE**
	SC1	**SC2**	**SC3**	**(40% Weightage)**
	(Term Tests) 30%	**(Innovative assignment) 10%**	**(Written Assignment) 20%**	50 Marks
	(25 + 25 Marks)	10 Marks	40 Marks	
CO-1	X	X		X
CO-2	X	X		X
CO-3	X	X	X	X
CO-4	X		X	X
CO-5				X
CO-6		X	X	X

8. Achieving Course Learning Outcome

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

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

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, Examination
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. Snustad, D.P., Simmons, M.J., 2012, Principles of Genetics, 6th Edition, John Wiley & Sons Inc.
2. Klug, W.S., Cummings, M.R., Spencer, C.A., Palladino, M.A., 2012, Concepts of Genetics, 10th Edition, Pearson Education Inc.
3. Alberts, B., Johnson, A., Lewis, J., Morgan, D., Raff, M., Roberts, K., Walter, P., 2015, Molecular Biology of the Cell, 6th Edition, Garland Science
4. Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C., Carroll, S.B., 2007, 9th Edition, Introduction to Genetic Analysis, W. H. Freeman & Co.
5. Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., Losick, R., 2008, Molecular Biology of the Gene, 10th Edition, Cold Spring Harbour Lab., Press, Pearson Pub.

b. Recommended Reading

1. Watson J.D., Hopkins, N.H., Roberts, J.W., Steitz, J.A., Weiner, A.M., 1987, Molecular Biology of the Gene, 4th Edition, Benjamin/Cummings.
2. Darnell, J., Lodish, H., Baltimore, D., 1990, Molecular cell Biology, 2nd edition, Scientific American Books, New York.

c. Magazines and Journals

1. https://academic.oup.com/hmg

d.Websites

1. https://www.nature.com/scitable/

e. Other Electronic Resources

2. https://www.britannica.com/science/molecular- genetics

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

Course Title	Applications of Biotechnology in Medicine
Course Code	BTO202A
Department	Biotechnology
Faculty	Faculty of Life and Allied Health Sciences

1. Course Summary

This course aims to familiarize students with the biotechnological advancements in medicine, including diagnostics, therapeutics and health care strategies.

The students will get acquainted with the emerging trends in the field of medical biotechnology. They will also gain insight on the future trends and prospects in biotechnological research pertaining to the field of medicine.

2. Course Size and Credits:

Number of Credits	3
Total Hours of Classroom Interaction	45
Number of laboratory Hours	0
Number of Semester Weeks	16
Department Responsible	Biotechnology
Course Marks	100
Pass Requirement	As per university regulations
Attendance Requirement	As per university regulations

Teaching, Learning and Assessment

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO1. Discuss the importance of clinical research in medicine
CO 2. Distinguish various molecular therapeutic approaches to diseases
CO 3. Explain the role of microbes in therapeutic applications
CO 4. Summarize the recent trends in medical biotechnology
CO 5. Illustrate strategies and techniques used in drug development
CO 6. Outline the biotechnological tools in disease diagnosis

4. Course Contents

Theory

Unit 1 Disease diagnosis-probe: PCR, LCR immunological assay. Detection of genetic, Neurogenetic disorders involving Metabolic and Movement disorders. Detection of mutations in neoplastic diseases PCR, SSCP, DGGE, etc.

Unit 2 Molecular therapeutics: Gene therapy, overview of inherited and acquired diseases for gene therapy. Cellular therapy; use of stem cells. Medical products developed by using biotechnology tools -Antibiotics, Recombinant Insulin, Erythropoietin, Vaccines, Monoclonal antibodies

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

Dean - Academics
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

Unit 3 Application of microbes in Medical biotechnology: Antimicrobial drugs, Antibiotic production, Penicillin production, Streptomycin production, Synthesis of vitamin B12 using microbes, Production of enzymes by using microbes

Unit 4 Trends in Medical biotechnology: Embryonic stem cells, Human genome project and its significance, RNA interference technology, Phage therapy, Recombinant DNA technology, Biochips, Liposome-based drug delivery, Nanobiotechnology

Unit 5 Drug development: Drugs, drug receptors, Conventional drug design approaches, irrational vs rational, Lipinski's rule of five, ADME, Calculation of LD 50 and ED 50. Drug development process (Preclinical, clinical and toxicological studies).

5. CO-PO PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	2	–	–	3	–	–	–	2	–	–	1	3	3	2
CO-2	3	2	–	–	3	–	–	–	2	–	–	1	3	3	2
CO-3	3	2	–	–	3	–	–	–	2	–	–	1	3	3	2
CO-4	3	2	–	–	3	–	–	–	2	–	–	1	3	3	2
CO-5	3	2	–	–	3	–	–	–	–	–	2	1	3	3	2
CO-6	3	2	–	–	3	–	–	–	–	–	–	1	3	3	2
		3: High Influence, 2: Moderate Influence, 1: Low Influence													

6. Course Teaching and Learning Methods:

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		36
Demonstrations		04
1. Demonstration using Videos	03	
2. Demonstration using Physical Models	01	
3. Demonstration on a Computer		
Numeracy		
1. Solving Numerical Problems		
Practical Work		
1. Course Laboratory		
2. Computer Laboratory		
3. Engineering Workshop / Course/Workshop / Kitchen		
4. Clinical Laboratory		
5. Hospital		
6. Model Studio		
Others		
1. Case Study Presentation		
2. Guest Lecture		

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

3. Industry / Field Visit		
4. Brainstorming Sessions		
5. Group Discussions		
6. Discussing Possible Innovations		
Term Test and Written Examination		**04**
Total Duration in Hours		**45**

7. Method of Assessment

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 (60% Weightage)			**SEE (40% Weightage)**
	SC1 (Term Tests) 30%	**SC2 (Innovative assignment) 10%**	**SC3 (Written Assignment) 20%**	**SEE (Theory) 40%**
	(25 + 25 Marks)	10 Marks	40 Marks	50 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	

8. Achieving Course Learning Outcome

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

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

Dean
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

14	Personal Management	--
15	Leadership Skills	--

9. Course Resources

a. Essential Reading

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

b. Recommended Reading

1. Medical Biotechnology by Bernard R. Glick, Cheryl L. Patten, Terry L. Delovitch, ASM Press
2. Fundamentals and Advances in Medical Biotechnology by Mumtaz Anwar, Riyaz AhmadRather, Zeenat Farooq, Springer

c. Magazines and Journals

1. https://www.pulsus.com/medical-biotechnology.html

d. Websites

1. https://catalog.uic.edu/gcat/colleges-schools/medicine/mbt/

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

RAMAIAH UNIVERSITY OF APPLIED SCIENCES

M. S. Ramaiah University of Applied Sciences

Course Specifications

of

B.Sc. in Biotechnology

B.Sc. (Hons.) in Biotechnology

B.Sc. (Hons. with Research) in Biotechnology

Programme Code: 018

SEMESTER 5

Department of Biotechnology
Faculty of Life and Allied Health Sciences
M S Ramaiah University of Applied Sciences

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Course Title	Recombinant DNA Technology
Course Code	BTC301A
Department	Biotechnology
Faculty	Faculty of Life and Allied Health Sciences

1. Course Summary

The course aims to acquaint the students to the principles and methodologies of the versatile techniques employed in genetic engineering and recombinant DNA technology.

Students will be familiarized with the methodological repertoire of the basic and applied fields of recombinant DNA technology. This course will provide theoretical and practical concepts on the properties and applications of versatile DNA modifying enzymes, cloning strategies, vector types, host genotype specificities for selection and screening of recombinants. The students will be facilitated with a strong foundation for more advanced cutting-edge technologies.

2. Course Size and Credits:

Number of Credits	5
Total Hours of Classroom Interaction	45
Number of laboratory Hours	60
Number of Semester Weeks	16
Department Responsible	Biotechnology
Course Marks	100
Pass Requirement	As per university regulations
Attendance Requirement	As per university regulations

Teaching, Learning and Assessment

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO 1. Explain creative use of modern tools and technologies for manipulation of genomic sequences.

CO 2. Describe methodologies involved in in vitro construction of recombinant DNA molecules.

CO 3. Illustrate the methodologies involved in in-vitro construction of gene libraries.

CO 4. Elaborate on the techniques used in gene transfer and selection of recombinants.

CO 5. Elucidate the application of RDT in Biotechnology, medicine and research.

CO 6. Demonstrate the qualitative and quantitative analysis of DNA using modern technologies.

CO 7. Acquire hands-on experience on gene cloning, protein expression and detection.

4. Course Contents

Theory

Unit 1 Tools for RDT I-Enzymes: Restriction endonucleases, DNA ligases, Alkaline phosphatase, Polynucleotide kinase, Exonuclease III, DNase I, DNA polymerase and Klenow fragment, Terminal nucleotidyl transferase, RNA polymerase.

Head
Department of Biotechnology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Unit 2 Tools for RDT II-Vectors: Properties of an ideal vector, Cloning and expression vectors. Prokaryotic vectors: Plasmids- pBR 322, pUC 18, Bacteriophages- Lambda phage, M13 and Cosmids. Eukaryotic vectors: Yeast expression vectors and YAC vector; Shuttle vectors- Yeast and E. coli. Plants: Agrobacterium vectors- Ti plasmid-Binary and Co integrated vectors, Plant viral vectors (CaMV). Animal viral vectors- SV 40 and retroviral vectors. Expression vectors in Prokaryotes and Eukaryotes.

Unit 3 In vitro construction of recombinant DNA molecules: Isolation of gene of interest, generating DNA fragments. Terminal modification of DNA – linkers, Adaptors, Homopolymer tailing. Construction and Applications of Genomic and c DNA libraries.

Unit 4 Transformation and Selection of recombinants: Direct gene transfer methods: Chemical methods, Lipofection, Electroporation, Microinjection, Ballistic method (Particle shot gun method). Direct methods of Selection-Insertion inactivation, Visual screening method, Plaque detection, Complementation of mutation /nutrition. Indirect methods- Colony hybridization, Immunochemical detection. Selectable genes: Plants- npt ; Animals-TK. Scorable genes Plants-Gus; Animals-lux.

Unit 5 Techniques and Applications of RDT: Gel electrophoresis: AGE and SDS-PAGE. Blotting: Southern; Northern; Western. Autoradiography, DNA sequencing: Sanger's Dideoxy method, Maxam Gilbert and Pyrosequencing. Labeling probes (radioactive & non-radioactive), Site directed mutagenesis, Polymerase Chain Reaction, Purification of His tag proteins. Applications: Transgenic microbes, Plants and Animals: - Production of recombinant insulin, human growth hormone and vaccine.

Practical

1. Isolation of chromosomal DNA from plant cells and AGE
2. Isolation of chromosomal DNA from E.coli and AGE
3. Qualitative and quantitative analysis of DNA using spectrophotometer
4. Restriction digestion/restriction mapping of DNA
5. Ligation of DNA to construct recombinant DNA
6. Preparation of competent cells using E.coli
7. Transformation of competent cells using PUC vector
8. Amplification of DNA using PCR
9. Random amplification of polymorphic DNA
10. SDS PAGE and Western blotting.

5. CO-PO PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	2	3	–	2	–	–	–	–	–	–	1	3	2	2
CO-2	3	3	2	–	2	–	–	–	–	–	–	1	3	3	2
CO-3	3	3	2	–	2	–	–	–	–	–	–	1	3	3	2
CO-4	3	3	3	–	2	–	–	–	–	–	–	1	3	3	2
CO-5	3	2	–	–	3	–	–	–	2	3	–	1	3	3	2
CO-6	2	2	3	–	–	–	–	–	–	–	–	1	3	2	2
CO-7	2	2	3	–	–	–	2	–	–	–	–	2	3	2	3
	3: High Influence, 2: Moderate Influence, 1: Low Influence														

DEAN

Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

Dean - Academics
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

6. Course Teaching and Learning Methods:

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		33
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		56
1. Course Laboratory	56	
2. Computer Laboratory		
3. Engineering Workshop / Course/Workshop / Kitchen		
4. Clinical Laboratory		
5. Hospital		
6. Model Studio		
Others		02
1. Case Study Presentation		
2. Guest Lecture		
3. Industry / Field Visit		
4. Brainstorming Sessions		
5. Group Discussions	01	
6. Discussing Possible Innovations	01	
Term Test and Written Examination		**04+04**
Total Duration in Hours		**105**

7. Method of Assessment

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 (60% Weightage)			SEE (40% Weightage)	
	SC1 (Term Tests) 30%	SC2 (Innovative + Lab assignment) 10%	SC3 (Written + Lab Assignment) 20%	SEE (Theory) 25%	SEE (Lab) 15%
	(25 + 25 Marks)	20 Marks	40 Marks	50 Marks	30 Marks
CO-1	X	X		X	
CO-2	X	X		X	
CO-3	X		X	X	
CO-4			X	X	
CO-5				X	
CO-6		X	X		X
CO-7		X	X		X

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

8. Achieving Course Learning Outcome

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, Examination
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. Brown, T.A., 2006, Gene Cloning and DNA Analysis, 5th Edition, Blackwell Publishing, Oxford, U.K.
2. Glick, B.R., Pasternak, J.J., 2003, Molecular Biotechnology - Principles and Applications of Recombinant DNA, ASM Press, Washington.
3. Primrose, S.B., Twyman, R.M., 2006, Principles of Gene Manipulation and Genomics, 7th edition, Blackwell Publishing, Oxford, U.K.
4. Sambrook, J., Fritsch, E.F., Maniatis, T., 2001, Molecular Cloning-A Laboratory Manual, 3rd edition, Cold Spring Harbor Laboratory Press.
5. Singh, B.D., 2017, Biotechnology for B.Sc., Kalyani Publishers.
6. Gupta P.K., 2005, Elements of Biotechnology, Rastogi Publication.

b. Recommended Reading

1. Wink, M., 2011, An Introduction to Molecular Biotechnology: Molecular Fundamentals, Methods and Applications in Modern Biotechnology, Wiley & Sons.

c. Magazines and Journals

1. https://www.scitechnol.com/advances-in-genetic-engineering-biotechnology.php

5. Websites

1. https://www.britannica.com/science/recombinant-DNA-technology

6. Other Electronic Resources

1. https://facultystaff.richmond.edu/~lrunyenj/bio554/lectnotes/chapter14.pdf

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Course Title	Immunology and Immuno-technology
Course Code	BTC302A
Department	Biotechnology
Faculty	Faculty of Life and Allied Health Sciences

1. Course Summary

The aim of the course is to acquaint students with 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 the 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	5
Total Hours of Classroom Interaction	45
Number of laboratory Hours	60
Number of Semester Weeks	16
Department Responsible	Biotechnology
Course Marks	100
Pass Requirement	As per university regulations
Attendance Requirement	As per university regulations

Teaching, Learning and Assessment

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO 1. Describe immune response by explaining the key components and properties involved.

CO 2. Explain the complex mechanism of gene expression pertaining to diversity and specificity of the immune response.

CO 3. Describe the role of immunity in tissue histocompatibility and relate with modern day therapeutic approach.

CO 4. Differentiate the consequences of autoimmunity, hypersensitivity and AIDS.

CO 5. Develop the basic concept in immunization and relate to its application in modern vaccine development.

CO 6. Apply the concept into disease diagnosis and identification.

CO 7. Demonstrate techniques in immunology.

4. Course Contents

Theory

Unit 1 Immune Response: An overview, components of mammalian immune system,

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

molecular structure of Immuno-globulins or Antibodies, Humoral & Cellular immune responses, B & T lymphocytes & immune response (cytotoxic T-cell, helper T-cell, suppressor T-cells), T-cell receptors.

Unit 2 Regulation of immunoglobulin gene expression: Clonal selection theory, allotypes & idiotypes, allelic exclusion, immunologic memory, heavy chain gene transcription, genetic basis of antibody diversity, hypotheses (germ line & somatic mutation), genome rearrangements during B-lymphocyte differentiation, Antibody class switching, somatic recombination.

Unit 3 Major Histocompatibility Complexes: Class I & class II MHC antigens, antigen processing, immune response in organ transplantation, Cytokines & Lymphokines.

Unit 4 Immune disorders: Auto-immune diseases, factors contributing to the development of auto-immune diseases, diagnosis & treatment. Hypersensitivity: Types and mechanisms, diagnosis and treatment, Immunodeficiency, HIV infection, AIDS.

Unit 5 Vaccines & Vaccination: Adjuvants, cytokines, DNA vaccines, recombinant vaccines, bacterial vaccines, viral vaccines, passive & active immunization, immunization programs & role of WHO in immunization programs.

Unit 6 Concepts of immunotechniques: Blood grouping, Antigen-Antibody reactions: agglutination, precipitation, immuno-electrophoresis, ELISA, RIA, diffusion (ODD, RID), Hybridoma technology

Practical

1. Counting of Leucocytes or reticulocytes
2. Antigen-Antibody reactions – Agglutination (Blood grouping testing)
3. Antigen-Antibody reactions- Radial Immunodiffusion
4. Antigen-Antibody reactions- Rocket Immuno-Electrophoresis
5. Antigen-Antibody reactions and Titration – Dot ELISA
6. Antigen-Antibody reactions and Titration – Sandwich ELISA
7. Antibody titration and identity (Ouchterlony Double Diffusion)
8. Antigen-Antibody reactions- Immunoprecipitation Reaction
9. Isolation of Immunoglobulin from serum

5. CO-PO PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	2	1	-	1	–	–	–	2	–	–	1	3	2	1
CO-2	3	3	2	-	1	–	–	–	–	–	–	1	3	3	1
CO-3	1	3	2	-	2	–	–	–	2	–	–	1	3	3	1
CO-4	3	2	2	-	2	–	–	–	3	–	–	1	3	3	1
CO-5	1	1	2	-	3	–	–	–	2	3	–	1	3	3	2
CO-6	1	3	2	-	2	–	–	–	–	–	–	1	3	3	2
CO-7	2	3	3	-	–	–	–	–	–	–	–	1	3	2	2
	3: High Influence, 2: Moderate Influence, 1: Low Influence														

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

Dean - Academic
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

6. Course Teaching and Learning Methods:

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		36
Demonstrations		03
1. Demonstration using Videos	02	
2. Demonstration using Physical Models	01	
3. Demonstration on a Computer		
Numeracy		
1. Solving Numerical Problems		
Practical Work		56
1. Course Laboratory	55	
2. Computer Laboratory		
3. Engineering Workshop / Course/Workshop / Kitchen		
4. Clinical Laboratory		
5. Hospital		
6. Model Studio		
Others		02
1. Case Study Presentation		
2. Guest Lecture		
3. Industry / Field Visit		
4. Brainstorming Sessions		
5. Group Discussions	01	
6. Discussing Possible Innovations	01	
Term Test and Written Examination		**04+04**
Total Duration in Hours		**105**

7. Method of Assessment

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 (60% Weightage)			**SEE (40% Weightage)**	
	SC1 (Term Tests) 30%	**SC2 (Innovative + Lab assignment) 10%**	**SC3 (Written + Lab Assignment) 20%**	**SEE (Theory) 25%**	**SEE (Lab) 15%**
	(25 + 25 Marks)	20 Marks	40 Marks	50 Marks	30 Marks
CO-1	X	X		X	
CO-2	X	X		X	
CO-3	X		X	X	
CO-4			X	X	
CO-5				X	

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
560 054

CO-6		X	X		X
CO-7		X	X		X

8. Achieving Course Learning Outcome

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, Examination
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. Class notes
2. Goldsby, R.A., Kindt, T.J., Osborne, B.A., 2007, Kuby's Immunology, 6th Edition, W.H. Freeman and Company, New York.
3. Abbas, A.K., Lichtman, A.H., Pillai, S., 2007, Cellular and Molecular Immunology, 6th Edition, Saunders Publication, Philadelphia.
4. Delves, P., Martin, S., Burton, D., Roitt, I.M., 2006, Roitt's Essential Immunology, 11th Edition, Wiley-Blackwell Scientific Publication, Oxford.

b. Recommended Reading

1. Murphy, K., Travers, P., Walport, M., 2008, Janeway's Immunobiology, 7th Edition, Garland Science Publishers, New York.
2. Peakman, M., Vergani, D., 2009, Basic and Clinical Immunology, 2nd Edition, Churchill Livingstone Publishers, Edinberg.
3. Richard, C., Geiffrey, S., 2009, Immunology, 6th Edition, Wiley Blackwell Publication.

c. Magazines and Journals

1. www.jimmunol.org

e. Websites

1. http://journals.sagepub.com/doi/pdf/10.1177/011542650301800645

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

Course Title	Computer Programming: Python and R
Course Code	BTC303A
Department	Biotechnology
Faculty	Faculty of Life and Allied Health Sciences

1. Course Summary

This course aims to teach students how to program in three languages popular with the scientific community: bash, R and python, while also using these languages as tools for scientific investigation. Knowing how to program is an indispensable skill within the field of biology which is increasingly becoming data-driven and interdisciplinary. Fluency in any programming language will give students a competitive advantage against their colleagues who cannot code. Further, these skills will equip our students to start careers in technical fields outside biology, if they so choose. Students taking this course will master the basic concepts required for programming in any language: syntax, if/else statements, loops, functions, recursion, and data input/processing/output. Students will also study elementary algorithm design and complexity (big O notation). Students will work in a linux environment, which is the standard in academia. An introduction to the operating system and use of the terminal / bash scripting will be provided at the beginning of the course. Students will also be taught the R programming language, with a focus on statistical analysis and data visualization.

2. Course Size and Credits:

Number of Credits	3
Total Hours of Classroom Interaction	45
Number of laboratory Hours	00
Number of Semester Weeks	16
Department Responsible	Biotechnology
Course Marks	100
Pass Requirement	As per university regulations
Attendance Requirement	As per university regulations

Teaching, Learning and Assessment

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO 1. Work in a linux environment. Handle data entry and manipulation. Execute commands via the terminal.

CO 2. Create simple programs using if/else statements and loops in python.

CO 3. Create advanced programs in Python using data structures, functions, classes and objects.

CO 4. Design an algorithm to solve any simple computational task. Understand the algorithm's complexity and optimization avenues.

CO 5. Perform statistical analysis on real-world data using R.

4. Course Contents

Unit 1 Navigating a linux environment: Use of the terminal for navigation and executing programs in a Linux environment (Ubuntu); Use of cd, ls, and pwd commands; File and directory organization: touch, mkdir, rm, mv, and cp commands; Viewing file contents; Using

Head
Department of Biotechnology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

text editors: vim, nano, gedit; Using shell: cat, less, more, head, tail, fold; Searching for file contents: grep and egrep; Data manipulation: cut, paste, sed, awk piping and writing files using bash.

Unit 2 Python: basic syntax. Elementary syntax and variable types; Scope, and the use of whitespace to control scope; If/else/elif statements, and/or/not operators, nested statements; Switches as an alternative for if/else statements.

Unit 3 Python: advanced syntax. While/for loops: understanding the concept of iteration; Data structures: lists and dictionaries; Functions; Classes and objects; Data input and output.

Unit 4 Elementary algorithms with python: Understanding space and time complexity, big-O notation; Prime and fibonacci number generation; sieve of eratosthenes; Pascals triangle and fractals; Binary search; Sorting algorithms: bozosort, bubblesort, and quicksort; Introduction to Numpy: matrices, and vectorization; Introduction to graph theory: implementing and traversing a graph in python.

Unit 5 Statistics with R: Data input and processing with R: Elementary data visualization in R: Scatterplots, histograms, barplots, boxplots, and vioplots; Elementary statistics with R: mean, median, mode, quartiles, percentiles, correlation, regression lines; Generalized linear models (GLMs): fitting data to a model in R; Hypothesis testing: Understanding P-values. Student's T-test, Fisher's test, ANOVA.

5. CO-PO PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	2	1	1	1	1	1	1	1	1	1	1	3	2	1
CO-2	3	3	2	1	1	1	1	1	1	1	1	3	3	2	2
CO-3	3	3	2	1	1	1	1	1	1	1	1	3	3	2	2
CO-4	3	3	2	1	1	1	1	1	1	1	1	3	3	2	2
CO-5	3	3	2	1	1	1	1	1	1	1	1	3	3	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		15
Demonstrations		10
1. Demonstration using Videos		
2. Demonstration using Physical Models		
3. Demonstration on a Computer	10	
Numeracy		
1. Solving Numerical Problems	00	
Practical Work		
1. Course Laboratory		

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

2. Computer Laboratory	16	16
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. Brainstorming Sessions		
5. Group Discussions		
6. Discussing Possible Innovations		
Term Test and Written Examination		**04**
Total Duration in Hours		**45**

7. Method of Assessment

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 (60% Weightage)			**SEE (40% Weightage)**
	SC1 (Term Tests) 30%	**SC2 (Assignment) 10%**	**SC3 (Assignment) 20%**	**SEE (Theory) 25%**
	(25 + 25 Marks)	10 Marks	40 Marks	50 Marks
CO-1	X	X		X
CO-2	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 COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving Course Learning Outcome

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

Head
Department of Biotechnology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 058

2	Understanding	Classroom lectures, Group discussions
3	Critical Skills	Coding Assignment
4	Analytical Skills	Coding Assignment
5	Problem Solving Skills	Coding Assignment
6	Practical Skills	--
7	Group Work	Course work, practice, assignment, group discussion
8	Self-Learning	Course work, practice, assignment, group discussion
9	Written Communication Skills	--
10	Verbal Communication Skills	--
11	Presentation Skills	--
12	Behavioral Skills	Course work, practice, assignment, group discussion
13	Information Management	Coding Assignment
14	Personal Management	--
15	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Class Notes
2. Brown, Martin C. Python: the complete reference. McGraw-Hill Professional, 2001.
3. Newham, Cameron. Learning the bash shell: Unix shell programming. " O'Reilly Media, Inc.", 2005.
4. Grolemund, Garrett. Hands-on programming with R: Write your own functions and simulations. " O'Reilly Media, Inc.", 2014.

b. Recommended Reading

1. Lutz, Mark. Programming python. " O'Reilly Media, Inc.", 2001.
2. Dougherty, Dale, and Arnold Robbins. sed & awk: UNIX Power Tools. " O'Reilly Media, Inc.", 1997.
3. Chambers, John M. Software for data analysis: programming with R. Vol. 2. New York: Springer, 2008.
4. Schmuller, Joseph. Statistical Analysis with R For Dummies. John Wiley & Sons, 2017.

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

M.S. Ramaiah University of Applied Sciences
Dean Academics
Bangalore - 560 054

Course Title	Environmental Biotechnology
Course Code	BTE301A
Department	Biotechnology
Faculty	Faculty of Life and Allied Health Sciences

1. Course Summary

This course aims to familiarize students on the principles, techniques and current applications of biotechnology to environmental quality evaluation, monitoring, remediation of contaminated environments and energy production.Students will be taught the basic concepts of environment and climate. They will be acquainted on the biotechnological approaches for remedies of global environmental problems. Students will be taught the concepts of Bioremediation. They will also be familiarized with the protection acts and control management strategies on various forms of environmental pollution.

2. Course Size and Credits:

Number of Credits	3
Total Hours of Classroom Interaction	45
Number of laboratory Hours	00
Number of Semester Weeks	16
Department Responsible	Biotechnology
Course Marks	100
Pass Requirement	As per university regulations
Attendance Requirement	As per university regulations

Teaching, Learning and Assessment

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO 1. Describe the role of microorganisms in biogeochemical cycles.
CO 2. Describe environmental pollutants and their microbial degradation.
CO 3. Explain the fundamentals of bioremediation and the strategies of application.
CO 4. Explain different strategies involved in environmental management with biotechnology approaches.
CO 5. Illuminate on the Environmental Protection Acts and their implication.

4. Course Contents

Theory

Unit 1 Introduction to Environmental Biotechnology: Key-microorganisms, role of microorganisms in biogeochemical cycles. Environmental pollutants and their microbial transformation: Organic and inorganic pollutants, Mechanisms of microbial degradation of pollutants.

Unit 2 Bioremediation: Fundamentals, methods and strategies of application (biostimulation, bioaugmentation) – examples, bioremediation of metals (Cr, As, Se, Hg), radionucleides (U, Te), organic pollutants (PAHs, PCBs, Pesticides, TNT etc), technological aspects of bioremediation (in situ, ex situ). Application of bacteria and fungi in bioremediation: White rot fungi vs specialized degrading bacteria: examples, uses and advantages vs disadvantages. Phytoremediation: Fundamentals and description of major methods of application

Head
Department of Biotechnology
M.S Ramaiah University of Applied Sciences

(phytoaccumulation, phytovolatilization, rhizofiltration phytostabilization).

Unit 3 Environmental Biotechnology and Agriculture: Bioinsecticides: Bacillus thuringienis, Baculoviruses, uses, genetic modifications and aspects of safety in their use. Biofungicides: Description of mode of actions and mechanisms (e.g. Trichoderma, Pseudomonas fluorescens). Biofertilizers: Symbiotic systems between plants – microorganisms (nitrogen fixing symbiosis, mycorrhiza fungi symbiosis), Plant growth promoting rhizobacteria (PGPR) – uses, practical aspects and problems in application.

Unit 4 Bio-waste treatment: Microorganisms involved in the degradation of plant fibre, cell wall, lignin, fungal de-lignification and pulping of wood. Pitch problems in pulp and paper processes and solving by enzymes or fungi. Hemicellulases in pulp bleaching. Solving slime problem in the pulp and paper industry. Reduction of organochlorine compounds in bleach plant effluents. Solid wastes: Sources and management, waste as a source of energy. Production of oils and fuels from solid waste, composting, vermiculture, Biogas production, methanol production from organic wastes, byproducts of sugar industries.

Unit 5 Environmental Protection Act: Environmental Laws, national movements, sustainable development, environmental policies, environmental economics, environmental ethics – holistic approach of environmental protection and conservation, IUCN – role in environmental protection. Environmental Protection Agency (EPA).

5. CO-PO PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	1	–	–	2	–	–	–	2	3	–	1	3	3	2
CO-2	3	2	–	–	3	–	–	–	2	3	–	1	3	3	2
CO-3	3	3	–	–	3	–	–	–	2	3	–	1	3	3	2
CO-4	3	2	–	–	3	–	–	–	3	3	–	1	3	3	2
CO-5	2	1	–	–	–	–	–	–	3	3	–	1	2	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		36
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		
1. Course Laboratory		
2. Computer Laboratory		

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

3. Engineering Workshop / Course/Workshop / Kitchen		
4. Clinical Laboratory		
5. Hospital		
6. Model Studio		
Others		02
1. Case Study Presentation		
2. Guest Lecture		
3. Industry / Field Visit		
4. Brainstorming Sessions		
5. Group Discussions	01	
6. Discussing Possible Innovations	01	
Term Test and Written Examination		**04**
Total Duration in Hours		**45**

7. Method of Assessment

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 (60% Weightage)			SEE (40% Weightage)
	SC1 (Term Tests) 30%	SC2 (Assignment) 10%	SC3 (Assignment) 20%	
	(25 + 25 Marks)	10 Marks	40 Marks	50 Marks
CO-1	X	X		X
CO-2	X	X		X
CO-3	X	X	X	X
CO-4	X		X	X
CO-5		X	X	X

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

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

8. Achieving Course Learning Outcome

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

Head
Department of Biotechnology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

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. Hurst, C.J., Crawford, R.L., Garland, J.L., Lipson, D.A., Mills, A.L., 2007, Manual of Environmental Microbiology, 3rd edition, ASM Press
2. Rittman, B., McCarty, P.L., 2000, Environmental Biotechnology: Principles and Applications, 2nd Edition, McGraw-Hill.
3. Maier, R.M., Pepper, I.L., Gerba, C.P., 2000, Environmental Microbiology, Academic Press.
4. Alexander, M., 1999, Biodegradation and Bioremediation, 2nd Edition, Academic Press.
5. Murugesan A.G., Rajakumari, C., 2005, Environmental Science and Biotechnology: Theory and Techniques, 1st Edition, MJP Publishers.
6. Sharma, P.D., 2005, Environmental Microbiology, Alpha Science International Ltd.
7. Ramesh, V.K., 2008, Environmental Microbiology, MJP Publishers.
8. Trivedi, P.R., 2004, Environmental pollution and control, APH Publishing Corporation.

b. Recommended Reading

1. Bitton, G., 1999, Wastewater Microbiology, 2nd Edition, Wiley-Liss.

c. Magazines and Journals

1. https://www.omicsonline.org/environmental-biotechnology-open-access-journals.php
2. http://journals.plos.org/plosone/browse/environmental_biotechnology
3. https://publons.com/journal/23661/journal-of-petroleum-environmental-biotechnology

d. Websites

1. www.dbtindia.nic.in/environment
2. http://www.biotechonweb.com/environmental-biotechnology.html
3. http://www.biologydiscussion.com/biotechnology/environmental-biotechnology/environmental-biotechnology-meaning-applications-and-other-details/8528

e. Other Electronic Resources

1. https://www.nature.com/subjects/environmental-biotechnology
2. https://www.scitechnol.com/scholarly/environmental-biotechnology-journals-articles-ppts-list.php

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Course Title	Agricultural Biotechnology
Course Code	BTE302A
Department	Biotechnology
Faculty	Faculty of Life and Allied Health Sciences

1. Course Summary

The course aims to acquaint students with fundamental concepts in plant biology and their application in agricultural biotechnology. The course will explore the developmental programs involved in generation of body plan in plants, basic biochemistry and physiology unique to the plant system, and the strategies plants employ in countering abiotic and biotic stresses. The course will introduce students to gene cloning in agriculture, and to practical considerations in the development and usage of genetically modified plants relevant to agriculture.

2. Course Size and Credits:

Number of Credits	3
Total Hours of Classroom Interaction	45
Number of tutorials Hours	00
Number of Semester Weeks	16
Department Responsible	Biotechnology
Course Marks	100
Pass Requirement	As per university regulations
Attendance Requirement	As per university regulations

Teaching, Learning and Assessment

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO 1. Summarize the key features of plant cell structure and dynamics that govern their general developmental and growth patterns.

CO 2. Explain the ecological and physiological considerations that determine photosynthetic output in plants under varying conditions.

CO 3. Describe contributions of abiotic and biotic stress-mediated adaptations on plant productivity.

CO 4. Discuss the methods of plant breeding.

CO 5. Describe the techniques and tools in biotechnology used for crop improvement.

4. Course Contents

Theory

Unit 1 Overview of Plant Cells and Body Plan: Plant life – unifying principles and deviations; Plant cell structure and organelles; Cell wall construction and maintenance; Independently-dividing organelles and their roles; Plasmodesmata; Major tissue systems in plants; Basic body plan and its establishment during embryogenesis; Lifecycle of model plant species; Meristematic tissues – foundations for indeterminate growth; Senescence and programmed cell death.

Unit 2 Essentials of Plant Physiology: Photosynthesis reactions and regulation; Ecological and physiological aspects of photosynthesis in crop plants; Water, solute, and mineral transport and balance; Overview of plant respiration; Importance of select secondary metabolites in plant health.

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

Unit 3 Plant Responses and Adaptations to Abiotic and Biotic Stresses: Adaptation and phenotypic plasticity; Abiotic environment and its impact on plant biology; Light-mediated effects on plant growth; Effect of high light stress; Drought and Flooding; Temperature stress; Imbalances in soil minerals; Inherent physiological mechanisms of plants to combat extreme abiotic stresses; Innate immunity in plants; Systemic acquired resistance; Response to plant pathogens; Response to insect pests; Effect of stress on agricultural crop yields.

Unit 4 Plant Breeding: Central concepts in plant breeding, simple vs complex inheritance; Mating systems, varieties, land races, Pure lines; Methods of plant breeding, self-pollinated species, Outcrossing species, Synthetic varieties, Hybrid varieties, clonally propagated species; Breeding enhancements.

Unit 5 Strategies for crop improvement: Conventional approaches in plant breeding; Gene cloning and DNA analysis in agriculture; Gene addition; Gene subtraction; Problems with genetically modified plants; Beneficial plant-microbe interactions and their potential in crop improvement; Alternative ways of biological control of crop improvement; Field-testing of genetically modified plants; Future of agricultural biotechnology.

5. CO-PO PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	2	2	-	2	1	-	-	-	1	-	1	3	2	1
CO-2	3	3	1	-	3	-	-	-	-	1	-	1	3	3	2
CO-3	3	2	3	-	3	2	-	-	-	1	-	1	3	3	2
CO-4	3	3	3	1	2	-	-	-	-	3	-	1	3	2	1
CO-5	3	3	3	-	3	3	-	-	3	3	-	1	3	3	2
	3: High Influence, 2: Moderate Influence, 1: Low Influence														

6. Course Teaching and Learning Methods:

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		36
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		
1. Course Laboratory		
2. Computer Laboratory		
3. Engineering Workshop / Course/Workshop / Kitchen		
4. Clinical Laboratory		
5. Hospital		

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

Registrar
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

6. Model Studio		
Others		02
1. Case Study Presentation		
2. Guest Lecture		
3. Industry / Field Visit		
4. Brainstorming Sessions		
5. Group Discussions	01	
6. Discussing Possible Innovations	01	
Term Test and Written Examination		**04**
Total Duration in Hours		**45**

7. Method of Assessment

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 (60% Weightage)			**SEE (40% Weightage)**
	SC1 (Term Tests) 30%	**SC2 (Assignment) 10%**	**SC3 (Assignment) 20%**	
	(25 + 25 Marks)	10 Marks	40 Marks	50 Marks
CO-1	X	X		X
CO-2	X	X		X
CO-3	X	X	X	X
CO-4	X		X	X
CO-5		X	X	X

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

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

8. Achieving Course Learning Outcome

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

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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. Hurst, C.J., Crawford, R.L., Garland, J.L., Lipson, D.A., Mills, A.L., 2007, Manual of Environmental Microbiology, 3rd edition, ASM Press
2. Taiz, L., Zeiger, E., 2010, Plant Physiology, 5th Edition, Sinauer Associates Inc., Publishers Sunderland, Massachusetts U.S.A.
3. Leyser, O. and Day, S., 2003, Mechanisms in Plant Development, Willey-Blackwell
4. Chrispeels, M. J., Sadava, D.F., (eds.), 2003, Plants, Genes and Crop Biotechnology,
5. 2nd Edition, Jones and Bartlett Press.
6. Neal Stewart, C. Jr., 2008, 1st Edition, Plant Biotechnology and Genetics: Principles, Techniques and Applications, John Wiley and Sons, Inc.

b. Recommended Reading

1. Brown, T.A., 2010, Gene Cloning and DNA Analysis – An Introduction, 6th Edition, John Wiley and Sons, Ltd.

c. Magazines and Journals

1.https://www.omicsonline.org/scholarly/agricultural-biotechnology-journals-articles-ppts-list.php

d. Websites

1. http://www.fao.org/biotech/biotech-news/en/

e. Other Electronic Resources

2. https://agfundernews.com/what-is-agriculture-biotechnology.html

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

Course Title	Medical Biotechnology
Course Code	BTE303A
Department	Biotechnology
Faculty	Faculty of Life and Allied Health Sciences

1. Course Summary

The course aims to acquaint students with fundamental concepts in molecular biology of diseases and the application of biotechnology in the production of therapeutics for diagnosis, prevention and treatment of human diseases and disorders. It encompasses the study of various biological processes, molecular techniques, and emerging nanotechnology approaches that contribute to advancements in therapeutics design and personalized medicine. The course will also introduce basic concepts in drug discovery and clinical research.

2. Course Size and Credits:

Number of Credits	3
Total Hours of Classroom Interaction	45
Number of tutorials Hours	00
Number of Semester Weeks	16
Department Responsible	Biotechnology
Course Marks	100
Pass Requirement	As per university regulations
Attendance Requirement	As per university regulations

Teaching, Learning and Assessment

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO 1. Summarize the techniques and applications of biotechnology in disease diagnoses.
CO 2. Explain the production strategies and use of biopharmaceuticals in therapy.
CO 3. Describe, compare, and contrast the strategies used in personalized medicine.
CO 4. Describe the types of and production process of modern vaccines.
CO 5. Explain the principles, technology, and application of nanotechnology in human health care sector.
CO 6. Explain the principles and approaches for drug discovery and clinical research.

4. Course Contents

Theory

Unit 1 Diagnostic Techniques in Medical Biotechnology: Introduction to clinical diagnosis; Enzymes used for diagnoses; Peptide- and protein-based diagnoses including antibodies; Nucleic acid analysis as diagnostic tool; Features, use, design, preparation, and application of DNA probes; Gene tracking in genetic diseases; medical devices, Applications of the Human Genome Project in clinical diagnoses.

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

Unit 2 Therapeutic Applications of Biotechnology: Antibiotics; Therapeutic proteins – role of enzymes as digestive aid, anti-cancer therapeutics, anticoagulants, anti-allergens, antimicrobials, enzyme replacement therapy, role of therapeutic protein hormones, role of therapeutic cytokines, lymphokines and interferons; Production of biopharmaceuticals from non-recombinant and recombinant organisms; Artificial tissues and organs; Therapeutic oligonucleotides.

Unit 3 Gene Therapy, Antisense Therapy and Personalized Medicine: Approaches in gene therapy; Somatic vs germline therapy; Targeted gene transfer via viral and non-viral vectors; Disease case studies of successful therapies; Challenges for gene therapy; Basic concept and mechanism involved in antisense therapy; Delivery, stability, bioavailability, and target specificity; Applications and advantages of antisense drugs; precision medicine and electroceuticals, Ethical issues related to personalized medicine.

Unit 4 Biotechnology in Health Care: Conventional vaccines; Antigen, Recombinant, Live recombinant, peptide, DNA and RNA vaccines; Learnings from COVID epidemic in modern vaccine development; Fertility control; DNA fingerprinting in forensic medicine; DNA Profiling, interpretation of results and applications.

Unit 5 Nanotechnology in medicine: Introduction; Types and synthesis of nanomaterials; Protein-based nano structures; DNA-based nano structures; Applications of nanomaterial – Nano-biosensors, Drug and gene delivery, Disease diagnostics and therapy, Risk potential of nanomaterial.

Unit 6 Drug Discovery and Clinical Research: Introduction to drugs, receptors, agonists; Dose response curve, half-life, and clearance; Drug design approaches; Concept and significance of ADME, LD 50 and ED 50, TI; Drug development process (Preclinical, clinical and toxicological studies); Novel Drug Development approaches - QSAR (quantitative structure activity relationship); Clinical trials phases, Regulatory agencies.

5. CO-PO PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	2	3	-	3	-	-	-	1	1	–	3	3	3	2
CO-2	3	3	3	-	3	-	-	-	2	1	2	3	3	3	2
CO-3	3	3	3	-	3	-	-	-	1	1	–	3	3	3	2
CO-4	3	3	3	-	3	1	-	-	1	1	–	3	3	3	2
CO-5	3	2	3	-	3	1	-	-	2	1	–	3	3	2	2
CO-6	3	3	3	-	3	1	-	-	2	1	2	3	3	3	3
	3: High Influence, 2: Moderate Influence, 1: Low Influence														

6. Course Teaching and Learning Methods:

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		36
Demonstrations		

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

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

7. Method of Assessment

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 (60% Weightage)			**SEE (40% Weightage)**
	SC1 (Term Tests) 30%	**SC2 (Assignment) 10%**	**SC3 (Assignment) 20%**	
	(25 + 25 Marks)	10 Marks	40 Marks	50 Marks
CO-1	X	X		X
CO-2	X	X		X
CO-3	X	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.

Head
Department of Biotechnology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

8. Achieving Course Learning Outcome

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. Jogdand, S.N., 2008, Medical Biotechnology, 2nd Edition, Himalaya publishers.
2. Brown, T.A., 2010, Gene Cloning and DNA Analysis – An Introduction, 6th Edition, John Wiley and Sons, Ltd.
3. Singh, B.D., 2012, Biotechnology: Expanding Horizons, 4th Edition, Kalyani Publishers Pvt. Ltd.
4. Pongracz, J., Keen, M., 2008, Medical Biotechnology, 1st Edition, Elsevier publications.
5. Katzung, B.G., 2004, Basic & Clinical Pharmacology, 9th Edition, Mc Graw Hill Publications.
6. Niemeyer, C.M., Mirkin, C.A., 2003, Introduction to Nanobiotechnology, Wiley VCH publishers.

b. Recommended Reading

1. David, S L., 1994, Genetics to Gene Therapy – the molecular pathology of human disease, 1st Edition, BIOS scientific publishers.
2. Levinson, W., Jawetz, E., 2003, Medical Microbiology and Immunology: Examination and Board Review, 7th Edition, McGraw Hill Publications.

c. Magazines and Journals

1. https://www.pulsus.com/medical-biotechnology.html
2. http://www.niscair.res.in/sciencecommunication/researchjournals/rejour/jsir/jsir0.asp

d. Websites

1. https://www.nature.com/subjects/biotechnology

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

M S Ramaiah University of Applied Sciences
Bangalore - 560 054

2. https://www.allaboutcareers.com/careers/career-path/biotechnology
3. https://www.bio.org/what-biotechnology

e. Other Electronic Resources

1. https://nickrath.weebly.com/openstax-biotechnology.html

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

RAMAIAH UNIVERSITY OF APPLIED SCIENCES

M. S. Ramaiah University of Applied Sciences

Course Specifications

of

B.Sc. in Biotechnology

B.Sc. (Hons.) in Biotechnology

B.Sc. (Hons. with Research) in Biotechnology

Programme Code: 018

SEMESTER 6

Department of Biotechnology
Faculty of Life and Allied Health Sciences
M S Ramaiah University of Applied Sciences

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

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

Course Title	Animal Biotechnology and Animal tissue culture
Course Code	BTC304A
Department	Biotechnology
Faculty	Faculty of Life and Allied Health Sciences

1. Course Summary

The aim of this course is to equip students with animal cell and tissue culture methodologies and safe practices and acquaint students with principles and use of biotechnology in the area of transgenic animal products and health care. The course also aims to facilitate students on practical aspects of cell culture used in the biotechnology industry for culturing cells and tissue. The students will be trained to develop skills in each step of cell/tissue culture techniques such as aseptic techniques, methods for measuring viability and cytotoxicity, cell culture environment (substrate, gas phase, medium), and the culturing of specific cell lines. The laboratory training emphasizes on hands-on training to gain the skills the principles and practices of initiation, cultivation, maintenance, and the preservation of cell lines. Students will be familiarized with a broad range of technical know-how for the genetic improvement and therapeutic intervention of animal species, by understanding and implementing critical technologies of cloning and genetic engineering.

2. Course Size and Credits:

Number of Credits	5
Total Hours of Classroom Interaction	45
Number of laboratory Hours	60
Number of Semester Weeks	16
Department Responsible	Biotechnology
Course Marks	100
Pass Requirement	As per university regulations
Attendance Requirement	As per university regulations

Teaching, Learning and Assessment

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO 1. Explain the theoretical and practical principles of cell culture practices.
CO 2. Explain the various components and techniques of cell and tissue culture media
CO 3. Describe the principles and methods of transgenesis.
CO 4. Illustrate the transgenic techniques used to harness animal products for human welfare.
CO 5. Explain the application of animal biotechnology for animal and human health care
CO 6. Demonstrate basic cell culture techniques including aseptic practices and maintenance of primary and cell line culture
CO 7. Assess cytotoxicity in monolayer cells in culture using suitable cytotoxic agents.

4. Course Contents

Theory

Unit 1 Introduction to Cell Culture Techniques: Basic instruments of cell culture laboratory, Aseptic techniques- Aseptic Work Station, Precautions to maintain Aseptic Conditions. Media

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

and supplements, Serum and Serum Free Media, Balanced Salt Solutions. Cell viability, cell survival, cytotoxicity. Overview of importance of tissue/cell culture in biotechnology.

Unit 2 Cell Culture techniques: Primary culture, Methods of disaggregation (mechanical and chemical) and culturing with example of normal and tumour cell culture. Cell line culture, methods of maintenance and preservation of monolayer and suspension culture. Contamination and eradication.

Unit 3 Cell Characterisation: Overview of parameters of characterisation including DNA profile, Karyotype, Isoenzyme analysis Genome analysis, Gene expression analysis Proteomics, Cell surface Cytoskeleton Immunocytochemistry.

Unit 4 Transgenic animals: methodologies: Overview of gene transfer techniques: physical, chemical and biological. Genetic Modification: Cre–loxP Recombination System, Transgenesis with High-Capacity Vectors , RNA Interference, CRISPR.

Unit 5 Transgenic animals: models: Animal models for tackling human diseases. Cloning and their importance with reference to livestock and endangered animals. IVF-technology for livestock and humans, Embryo transfer techniques.

Unit 6 Applications of Animal Biotechnology: Improvement of biomass: Transgenic poultry and fish. Improving Milk Quality, disease resistant livestock, Production of Pharmaceutical products, Production of Donor organs.

Practical

1. Packing and sterilization of glass and plastic wares for cell culture
2. Preparation of animal cell culture medium
3. Isolation of human mononuclear cells and culture of Lymphocyte-Primary culture.
4. Cell counting – Quantitation of cells in culture
5. Thawing, culturing, sub-culturing and Cryo-preservation of adherent cell line culture.
6. Cell viability assay for both primary and cell line culture (trypan blue dye exclusion method)
7. Cytotoxicity assay (MTT assay) for adherent cell line culture.

5. CO-PO PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	1	-	-	2	-	-	-	-	-	-	1	3	2	1
CO-2	3	2	2	-	2	-	-	1	-	-	1	1	3	2	1
CO-3	3	2	1	-	3	2	2	-	1	1	1	1	3	3	1
CO-4	3	3	2	-	3	2	2	2	1	1	1	1	3	3	2
CO-5	3	2	2	-	3	-	-	2	-	-	1	1	3	3	2
CO-6	2	2	2	-	–	-	-	3	-	-	1	1	3	2	2
CO-7	2	3	2	2	–	-	-	3	-	-	1	2	3	2	3
		3: High Influence, 2: Moderate Influence, 1: Low Influence													

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

M.S. Ramaiah University of Applied Sciences
Dean - Academics
Bangalore - 560 054

6. Course Teaching and Learning Methods:

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		36
Demonstrations		03
1. Demonstration using Videos	02	
2. Demonstration using Physical Models	01	
3. Demonstration on a Computer		
Numeracy		
1. Solving Numerical Problems		
Practical Work		56
1. Course Laboratory	56	
2. Computer Laboratory		
3. Engineering Workshop / Course/Workshop / Kitchen		
4. Clinical Laboratory		
5. Hospital		
6. Model Studio		
Others		02
1. Case Study Presentation		
2. Guest Lecture		
3. Industry / Field Visit		
4. Brainstorming Sessions		
5. Group Discussions	01	
6. Discussing Possible Innovations	01	
Term Test and Written Examination		**04+04**
Total Duration in Hours		**105**

7. Method of Assessment

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 (60% Weightage)			SEE (40% Weightage)	
	SC1 (Term Tests) 30%	SC2 (Innovative + Lab assignment) 10%	SC3 (Written + Lab Assignment) 20%	SEE (Theory) 25%	SEE (Lab) 15%
	(25 + 25 Marks)	10 Marks	40 Marks	50 Marks	30 Marks
CO-1	X	X		X	
CO-2	X	X		X	
CO-3	X		X	X	
CO-4			X	X	
CO-5		X			X
CO-6		X	X		X
CO-7			X		X

Head
Department of Biotechnology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

8. Achieving Course Learning Outcome

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, Examination
7	Group Work	Seminar
8	Self-Learning	Self-study
9	Written Communication Skills	Assignment, examination
10	Verbal Communication Skills	--
11	Presentation Skills	Assignment
12	Behavioral Skills	Group project/seminar
13	Information Management	Assignment
14	Personal Management	--
15	Leadership Skills	Group Project/seminar

9. Course Resources

a. Essential Reading

1. Class Notes
2. NPTEL: Module 6, lecture 1
3. ATCC® ANIMAL CELL CULTURE GUIDE tips and techniques for continuous cell lines.
4. Saurabh Bhatia, Tanveer Naved and Satish Sardana,2019.Introduction to Pharmaceutical Biotechnology, Volume 3 Animal tissue culture and biopharmaceuticals, IOP Publishing.
5. R. Ian Freshney,. 2010. A manual of basic technique and specialized applications 6th Edition, Wiley Blackwell.
6. Glick, B.R., Pasternak, J.J., 2003, Molecular Biotechnology - Principles and Applications of recombinant DNA, ASM Press, Washington.
7. Primrose, S.B., Twyman, R.M., 2006, Principles of Gene Manipulation and Genomics, 7th edition, Blackwell Publishing, Oxford, U.K
8. Brown, T.A., 2006, Gene Cloning and DNA Analysis, 5th Edition, Blackwell Publishing, Oxford, U.K.
9. Lab Manual
10. Portner R. 2007.Animal Cell Biotechnology. Humana Press

b. Recommended Reading

1. Butler, M., 2004, Animal cell culture and Technology, Garland Science/BIOS Scientific Publishers: London and New York
2. J.Davis. 2002, Basic Cell Culture: A Practical Approach: 254 (Practical Approach Series), OUP Oxford.
3. J, Masters, 2000, Animal Cell Culture: A Practical Approach: 232 (Practical Approach Series)

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

4. Satyanarayana, U., 2008, Biotechnology, Books & Allied Ltd.
5. Singh, B.D., 2017, Biotechnology for B.Sc., Kalyani Publishers.
6. Gupta P.K., 2005, Elements of Biotechnology, Rastogi Publication.
7. Dubey, R.C., 2014, A Textbook of Biotechnology, 5th Edition, S. Chand.
8. Clark, D.P., Pazdernik, N.J., 2009, Biotechnology-Applying the Genetic Revolution, Elsevier Academic Press, USA.

c. Magazines and Journals

1. https://www.ncbi.nlm.nih.gov/books/NBK207574/
2. i biology
3. Nature Scitable.
4. Christoph Revermann Leonhard Hennen, Animal cloning.
5. Janet Rossant, Samuel Lunenfeld Research Institute, Mount Sinai Hospital, Toronto; and by Stuart Orkin, Children's Hospital and Dana Farber Cancer Institute, Boston.,The science and application of cloning.

d. **Websites**

1. https://www.aboutbioscience.org › topics › animal-biotechnology
2. https://www.youtube.com/watch?v=RpDke-Sadzo
3. https://www.youtube.com/@thermofisher
4. https://www.acseduonline.com/courses
5. https://pubmed.ncbi.nlm.nih.gov/21390641/

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

Course Title	Plant Biotechnology and Tissue Culture
Course Code	BTC305A
Department	Biotechnology
Faculty	Life and Allied Health Sciences

1. Course Summary

The course aims to provide an advanced understanding of the core principles in plant biotechnology with emphasis on applications in agriculture and human welfare. The course will cover techniques in plant cell, tissue and organ culture and plant genetic engineering. The course will include demonstrations and hands-on training in aseptic culture techniques, usage of cell culture equipment and molecular techniques of generation and selection of genetically modified organisms.

2. Course Size and Credits:

Number of Credits	5
Total Hours of Classroom Interaction	45
Number of laboratory Hours	60
Number of Semester Weeks	16
Department Responsible	Biotechnology
Course Marks	100
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. Outline the growth processes in plants under in vivo and in vitro conditions
CO 2. Describe the conditions required to culture plant tissues and cells aseptically
CO 3. Compare and contrast the various types of tissue and cell culture techniques and their usage
CO 4. Explain the design of suitable DNA constructs in plant genetic engineering and usage of molecular markers in plant breeding
CO 5. Describe the applications of plant tissue culture in industry and healthcare
CO 6. Describe the applications of plant tissue culture and genetic engineering in agriculture
CO 7. Demonstrate the techniques used in plant tissue culture

4. Course Contents

Theory

Unit 1 Introduction to Plant Tissue Culture: Basic body plan, growth features and developmental processes in plants; Role of hormones, biosynthesis and signalling in plant development and physiology; Origin and concept of cellular totipotency and polarity; Introduction to callus and suspension cultures

Unit 2 Techniques in Tissue Culture and Culture types: Laboratory requirements, reagents and equipment, design of working spaces; General techniques; Concept of asepsis; Methods of sterilization; Types of tissue culture media and selection; Media constituents and their role; Small and large-scale cultures; Types of bioreactors

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

M.S. Ramaiah University of Applied Sciences
Dean - Academics

Unit 3 Culture Types and Processes: Single-cell culture, organ culture, meristem culture, anther/microspore culture, embryo culture, protoplast culture; Uses and applications of different types of cultures; Selection and preparation of explants; Pathways of regeneration – somatic embryogenesis and *de novo* organogenesis; Somatic hybridization and cybridization; Somaclonal variation

Unit 4 Techniques in Plant Genetic Engineering: Basic concepts in plant gene regulation; *Agrobacterium*-mediated plant transformation, Ti and Ri plasmids; Design of vectors for plant transformation; Chloroplast transformation; Analysis and confirmation of transgene integration; Direct gene transfer methods; RNAi technology; Introduction to types and usage of molecular markers – RFLP, RAPD, SSR, SNP

Unit 5 Plant Tissue Culture Applications: Haploid/Triploid plants; Pathogen/virus-free plants; Micropropagation; Germplasm storage and Cryopreservation; Production of secondary metabolites – strategies for enhancing production; Production of edible vaccines; Synthetic seed technology; Basic concepts in metabolic engineering

Unit 6 Applications in Agriculture: Engineering resistance to abiotic (temperature, drought, salinity) and biotic stresses (bacterial, viral, fungal, pest); Engineering quality enhancement (nutritional improvement, biofortification, post-harvest shelf life); Status of transgenic research in India; Safety regulations; Terminator seed technology; Role of Biofertilizers, Biopesticides, Biofungicides and Plant Growth Promoting Rhizobia

Practical

1. Aseptic culture techniques – Sterilization of workspace, tools, glassware and media; preparation of explant, surface sterilization of plant material, basic procedures for aseptic tissue transfer, incubation of culture,
2. Preparation of culture media - Media composition, Nutrients, Hormones
3. Initiation of callus culture
4. Isolation of plant protoplasts
5. Isolation of plant genomic DNA from pea shoot tip/cauliflower by CTAB method
6. Agrobacterium culture, selection of transformants
7. Colony PCR of agrobacterium
8. DNA finger printing method – RAPD
9. DNA finger printing method – RFLP
10. Visualization of Vesicular Arbuscular Mycorrhiza

5. CO-PO PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	1	1	-	2	-	-	-	-	1	-	1	3	2	1
CO-2	3	2	3	-	2	-	-	-	-	1	-	1	3	2	1
CO-3	3	2	3	-	3	-	-	-	-	1	-	1	3	3	1
CO-4	3	3	3	-	3	1	1	-	-	1	-	1	3	3	2
CO-5	3	2	3	-	3	1	1	-	-	3	1	1	3	3	2
CO-6	3	2	2	-	3	1	1	-	2	3	1	1	3	3	2
CO-7	3	2	2	-	–	3	3	-	-	1	1	1	3	2	2
		3: High Influence, 2: Moderate Influence, 1: Low Influence													

Department of Biotechnology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

6. Course Teaching and Learning Methods:

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		36
Demonstrations		05
1. Demonstration using Videos	02	
2. Demonstration using Physical Models		
3. Demonstration on a Computer	03	
Numeracy		
1. Solving Numerical Problems		
Practical Work		56
1. Course Laboratory	56	
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. Brainstorming Sessions		
5. Group Discussions		
6. Discussing Possible Innovations		
Term Test and Written Examination		**04+04**
Total Duration in Hours		**105**

7. Method of Assessment

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 (60% Weightage)			SEE (40% Weightage)	
	SC1 (Term Tests) 30%	SC2 (Innovative + Lab assignment) 10%	SC3 (Written + Lab Assignment) 20%	SEE (Theory) 25%	SEE (Lab) 15%
	(25 + 25 Marks)	10 Marks	40 Marks	50 Marks	30 Marks
CO-1	X	X		X	
CO-2	X	X		X	
CO-3	X			X	

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

CO-4	X		X	X	
CO-5			X	X	
CO-6		X	X		X
CO-7		X	X		X

8. Achieving Course Learning Outcome

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. Lecture Handouts.
2. Laboratory manual.
3. Sawahel, W.A., 2017, *Plant genetic transformation technology*, Daya Publishing House, Delhi.
4. Slater, A., Scott, N.W., Fowler, M.R., 2015, *Plant Biotechnology: the genetic manipulation of plant*, 2nd Edition, Oxford University Press.
5. Bhojwani, S.S., Razdan M.K., 1986, *Plant Tissue Culture: Theory & Practice*, Elsevier Health Sciences.
6. Bhojwani, S.S., Dantu, P.K., 2013, *Plant tissue culture: An Introductory text*, Springer, India.

b. Recommended Reading1

1. Smith, R.H., 2012, Plant tissue culture: Techniques and Experiments, 3rd Edition, Academic Press.
2. Hammond, J., McGravey, P., Yusibov, V., 2000, Plant Biotechnology, Springer verlag.
3. Purohit S.D., 2013, Introduction to Plant Cell, Tissue and Organ Culture, PHI Learning India Pvt. Ltd.
4. Hammond, J., McGarvey, P., Yusibov, V., 2000, Plant Biotechnology: new products and applications; Springer.

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

c. Magazines and Journals

1. https://onlinelibrary.wiley.com/journal/14677652
2. http://www.kspbtjpb.org/main_eng.html
3. https://www.nature.com/subjects/plant-biotechnology
4. https://www.omicsonline.org/scholarly/agricultural-biotechnology-journals-articles-ppts-list.php

d. Websites

1. https://www.ibiology.org/
2. https://www.nature.com/scitable/

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

DEAN
Faculty of Life & Allied Health Sciences

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Course Title	Bioethics, IPR and Biosafety
Course Code	BTC306A
Department	Biotechnology
Faculty	Life and Allied Health Sciences

1. Course Summary

The course aims to familiarize students with the essential concepts of Biosafety, Bioethics and Intellectual Property Rights related to Biotechnology products.
Students will be taught to understand the ethical, social, and legal aspects of biotechnology, and they will be familiarized with the importance of biosafety in this field.

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	100
Pass Requirement	As per university regulations
Attendance Requirement	As per university regulations

Teaching, Learning and Assessment

3. Course Outcomes (COs)

After undergoing this course, the student will be able to:
CO 1. Describe ethical concerns in various field of Biotechnology
CO 2. Describe the Biosafety rules and regulations implied to Biotechnology products
CO 3. Explain the concepts of IPR related to Biotechnology process and practice
CO 4. Explain the principles of patenting law and protection in the field of Biotechnology

4. Course Contents

Unit 1 Bioethics: Bioethics in Biodiversity, ethics of resource management, impact of patenting on biodiversity rich developing countries. Ethical issues associated with consumptions of genetically modified foods. Ethical implication of human genome project, international ethical and legal issues connected with human genome diversity research.

Unit 2 Ethics in Animal Biotechnology: for testing of drugs on human volunteers, use of animals for research and testing; animal and human cloning-ethical and social issues, organ transplantation and xeno transplantation

Unit Biosafety: Biosafety levels, Laboratory safety, Chemical safety, The Cartagena protocol on biosafety. Biosafety management: Key to the environmentally responsible use of biotechnology. Ethical implications of biotechnological products and techniques. Social and ethical implications of biological weapons, Biosafety regulations and national and international guidelines with regard to rDNA technology, transgenic science, GM crops. Experimental protocol approvals, levels of containment. Guidelines for research in transgenic plants

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

Unit 4 Good Manufacturing Practice and Good Lab Practices (GMP and GLP): Use of genetically modified organisms (crippling organisms) and their release to environment, Hazardous waste management

Unit 5 Intellectual property rights - patent, copyright, trade mark, Trade Related aspects of Intellectual Property Rights (TRIPS), General Agreement on Tariffs and Trade (GATT) and Plant Breeders' Right (PBR), World Trade Organization (WTO). IPRs– implications for India

Unit 6 Patents and Patent Laws Patent system – patenting laws - Legal development- Patentable subjects and protection in biotechnology - patenting living organisms

5. CO-PO PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	3	1	1	2	1	1	1	3	1	1	1	2	2	2
CO-2	3	3	1	1	2	1	1	3	3	1	1	1	2	2	2
CO-3	3	3	1	1	2	1	1	2	1	1	3	1	2	2	2
CO-4	3	3	1	1	3	1	1	2	1	1	3	1	2	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		36
Demonstrations		03
1. Demonstration using Videos	02	
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		02
1. Case Study Presentation		
2. Guest Lecture		
3. Industry / Field Visit		
4. Brainstorming Sessions		
5. Group Discussions	01	
6. Discussing Possible Innovations	01	

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Term Test and Written Examination	**04**
Total Duration in Hours	**45**

7. Method of Assessment

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 (60% Weightage)			**SEE (40% Weightage)**
	SC1 (Term Tests) 30%	**SC2 Assignment 10%**	**SC3 Assignment 20%**	
	(25 + 25 Marks)	10 Marks	40 Marks	50 Marks
CO-1	X	X		X
CO-2	X	X		X
CO-3	X	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 Outcome

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	--

Head
Department of Biotechnology
M.S. Ramaiah University of Applied Sciences
Bangalore

9. Course Resources

a. Essential Reading

1. Stanley, S.A., 2008, *Bioethics*, Wisdom educational service.
2. Sateesh, M.K., 2008, Bioethics and Biosafety, I.K International Pvt. Ltd.
3. Das, H.K., 2010, Text book of Biotechnology, Wiley Publishers.
4. Goel, D., Parashar, S., 2013, IPR, Biosafety and Bioethics, Pearson Education India.
5. Nambisan, P., 2017, An Introduction to Ethical, Safety and Intellectual Property Rights Issues in Biotechnology, 1st edition, Academic press, Elsevier.

b. Recommended Reading

1. Singh, B.D., 2009, *Biotechnology*, Kalyani publishers.

c. Magazines and Journals

1. https://www.sciencedaily.com/terms/bioethics.htm

d. Websites

1. http://www.ipindia.nic.in/
2. http://cipam.gov.in/national-ipr-policy/

e. Other Electronic Resources

1. http://www.nguyenthanhmy.com/courses/2013/IP-Bioethics-WIPO.pdf

---

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Course Title	Industrial Biotechnology
Course Code	BTE304A
Department	Biotechnology
Faculty	Faculty of Life and Allied Health Sciences

1. Course Summary

This course aims to instill in students a critical awareness and in-depth understanding of the principles, practices, and key concepts relevant to industrial biotechnology.
The course aims to provide fundamental insights to exploit enzymes and microbes for the manufacturing of products that have a huge industrial significance. Students will be trained on the theoretical concepts of upstream and downstream processing of industrial products. Considering the tremendous commercial potential of bioprocesses as cost-competitive and environment-friendly alternatives to chemical processes, the course mainly emphasizes on Industrial design and operations

2. Course Size and Credits:

Number of Credits	03
Total Hours of Classroom Interaction	45
Number of laboratory Hours	00
Number of Semester Weeks	16
Department Responsible	Biotechnology
Course Marks	100
Pass Requirement	As per university regulations
Attendance Requirement	As per university regulations

Teaching, Learning and Assessment

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO 1. Illustrate the process that underlie major unit operations used in upstream processing of Industrial products.
CO 2. Explain the methods of strain improvement for the production of economically important microbial products
CO 3. Describe the principles, types, operations, and limitations of Bioreactors.
CO 4. Distinguish the principles involved in the operations used in downstream processing of biotechnological and biopharmaceuticals products.
CO 5. Apply the concepts of downstream processing in the industrial production of primary and secondary metabolites

4. Course Contents

Unit 1 Upstream processing: Criteria for good medium, medium requirements for fermentation processes, carbon, nitrogen, minerals, vitamins and other complex nutrients, oxygen requirements, medium formulation of optimal growth and product formation, examples of simple and complex media, design of various commercial media for industrial fermentations, medium sterilization, sterilization of fermenter and other ancillaries, filter sterilization of air and media, Microbial growth kinetics: Microbial growth cycle, measurement of growth.

Head
Department of Biotechnology
Ramaiah University of Applied Sciences

Unit 2 Microbial Strain improvement: Strain improvement for the selected organism: mutation and screening of improved cultures, random and strategic screening methods, strategies of strain improvement for primary, secondary metabolites with relevant examples. Use of recombinant DNA technology, protoplast fusion techniques for strain improvement of primary and secondary metabolites. Preservation of cultures after strain improvement programme.

Unit 3 Design of bioreactors: Basic objective of fermenter design, aseptic operation & containment, body construction, agitator and sparger design, baffles, stirrer glands and bearings. Process parameters and measurement techniques: measurement of temperature, pressure and pH, DO, foam etc.; flow rate of liquid and gases; Automation (processes computerization). Validation of Fermenter.

Unit 4 Bioreactor configurations and types: Bubble column, airlift reactor, packed bed, fluidized bed, trickle bed, Membrane reactor, Photobioreactor, Solid state fermenter, Animal and plant cell bioreactors. Scale up and Scale down studies of bioreactors. Heat and Mass transfer in Bioprocess.

Unit 5 Downstream processing: Role and importance of downstream processing in biotechnological processes. Problems and requirements of bioproduct purification. Process economy: Economics & Cost cutting strategies, process design criteria for various classes of bioproducts. Downstream processing strategies– extraction, separation, concentration, recovery & purification.

Unit 6 Microbial Products: Industrial production of Ethyl alcohol, Organic acids (Acetic Acid/ Citric acid/ lactic acid), Enzymes (αamylase, protease), Antibiotics (penicillin, tetracycline) vitamin B12, Insulin and vaccines.

5. CO-PO PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	3	-	-	2	-	-	3	-	1	-	1	3	2	2
CO-2	3	3	-	-	2	-	-	3	-	1	-	2	3	3	2
CO-3	3	3	2	-	3	-	-	3	1	1	-	2	3	2	2
CO-4	3	3	2	-	3	-	-	3	-	2	-	2	3	2	2
CO-5	3	3	-	-	3	-	-	3	-	-	2	2	3	3	3
		3: High Influence, 2: Moderate Influence, 1: Low Influence													

6. Course Teaching and Learning Methods:

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		31
Demonstrations		02
1. Demonstration using Videos	01	
2. Demonstration using Physical Models / Systems	01	
3. Demonstration on a Computer		
Numeracy		
1. Solving Numerical Problems		

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

Registrar
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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	06	08
4. Brainstorming Sessions		
5. Group Discussions	01	
6. Discussing Possible Innovations	01	
Term Test and Written Examination		**04**
Total Duration in Hours		**45**

7. Method of Assessment

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 (60% Weightage)			**SEE (40% Weightage)**
	SC1 Term Tests 30%	**SC2 Assignments 10%**	**SC3 Assignments 20%**	
	25 + 25 Marks	10 Marks	40 Marks	50 Marks
CO-1	X	X		X
CO-2	X	X		X
CO-3	X	X	X	X
CO-4	X		X	X
CO-5			X	X

8. Achieving Course Learning Outcome

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

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore

3	Critical Skills	Assignment
4	Analytical Skills	Assignment
5	Problem Solving Skills	Assignment, Examination
6	Practical Skills	Assignment, Examination
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. Casida, L.E., 1991., Industrial Microbiology, 1st Edition, Wiley Eastern Limited.
2. Crueger, W., Crueger, A., 2000., Biotechnology: A textbook of Industrial Microbiology, 2nd Edition, Panima Publishing Co., New Delhi.
3. Patel, A.H., 1996, Industrial Microbiology, 1st Edition, Macmillan India Limited.
4. Stanbury, P.F., Whitaker, A., Hall, S.J., 2006, Principles of Fermentation Technology, 2nd Edition, Elsevier Science Ltd

b. Recommended Reading

1. Lee, S.Y., Nielsen, J. and Stephanopoulos, G., "Industrial Biotechnology: Products and Processes", John Wiley & Sons, 2016.
2. Waites, M.J., Morgan,N.L., Rockey,J.S., Higton, G., "Industrial Microbiology: An Introduction" Blackwell, 2001.
3. Pandey, A., Negi, S., Soccol, C.R., "Current Developments in Biotechnology and Bioengineering: Production, isolation and purification of industrial products", Elsevier, 2016

c. Magazines and Journals

1. https://www.liebertpub.com/loi/ind
2. https://link.springer.com/journal/10295
3. http://www.heraldopenaccess.us/journals/Advances-in-Industrial-Biotechnology/

d. Websites

1. https://www.bio.org/
2. https://www.sciencelearn.org.nz/topics/biotechnology

e. Other Electronic Resources

1. https://www.wiley.com/WileyCDA/Section/id-420434.html
2. https://www.omicsonline.org/scholarly/industrial-biotechnology-journals-articles-ppts

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

Dean - Academics
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

Course Title	Pharmaceutical Biotechnology
Course Code	BTE305A
Department	Biotechnology
Faculty	Faculty of Life and Allied Health Sciences

1. **Course Summary**

This course aims to familiarize students on the details of current status and future prospects in biopharmaceuticals.
The course aims exposing students to various topics in biopharmaceuticals, including drug design, drug modelling and drug delivery Systems.
This course will also discuss the requirement of regulatory bodies in clinical research and ethical issues associated with the same.

2. **Course Size and Credits:**

Number of Credits	03
Total Hours of Classroom Interaction	45
Number of laboratory Hours	00
Number of Semester Weeks	16
Department Responsible	Biotechnology
Course Marks	100
Pass Requirement	As per university regulations
Attendance Requirement	As per university regulations

Teaching, Learning and Assessment

3. **Course Outcomes (COs)**

After the successful completion of this course, the student will be able to:

CO 1. Explain the importance of biopharmaceutical research and development.
CO 2. Summarize the aspects of drug discovery and designing.
CO 3. Explain molecular modelling in drug discovery process.
CO 4. Outline the concepts involved in drug delivery and drug metabolism.
CO 5. Summarize the ethical issues and regulatory bodies involved in clinical trials.

4. Course Contents Theory

Unit 1. Introduction to Pharmaceutical Biotechnology: Introduction to Biopharmaceuticals and pharmaceutical biotechnology, Biopharmaceuticals: current status and future prospects, generic and branded biopharmaceuticals, overview of life history for development of biopharmaceuticals

Unit 2. Drug discovery and designing: Configuration and conformation of drug molecules, rational drug design, various approaches in drug discovery, drug targets and pharmacophores. Physical properties of drugs - physical form, polymorphism, particle size, shape, density, wetting, dielectric constant, solubility, dissolution, organoleptic property and their effect on formulation, dissolution, organoleptic property and their effect on formulation

Unit 3. Molecular Modeling in Drug Discovery: Drug discovery process, Lipinski "rule of 5", partition coefficient. Target identification and validation, lead optimization and validation, Structure and ligand based drug design, Modeling of target-small molecule interaction, Structure Activity Relationship - QSARs and QSPRs

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

Unit 4. Pharmacokinetics and Pharmacodynamics of Biopharmaceuticals: Definition, rationales, absorption, distribution and metabolism pathway. Factors governing absorption of drug. Phase I and Phase II pathways of metabolism in liver. Dose response relationship, interspecies scaling. Therapeutic proteins, types, production and heterogeneity of therapeutic proteins

Unit 5. Biopharmaceuticals Based Delivery Systems: Novel drug delivery systems for biopharmaceuticals (rate controlled and site specific), concept of responsive or smart drug delivery system, Nanotechnology based delivery of biopharmaceuticals and therapeutics, peptides for intracellular targeting

Unit 6. Regulatory bodies & requirements: WHO GMP, U.S FDA, Drug regulatory authorities in India, US and Europe, their role and responsibilities. Schedule-Y. Pre-clinical study requirements. Clinical trial phases, Types of trials. Bioethics, ethical principles, Ethical dilemmas in biotechnology research, Institutional ethics committee. Bioavailability and Bio equivalence studies

5. CO-PO PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	2	2	2	3	-	-	-	-	-	2	1	3	3	2
CO-2	3	3	2	3	3	-	-	-	-	-	2	1	3	3	2
CO-3	3	3	2	3	3	-	-	-	-	-	–	1	3	3	2
CO-4	2	2	2	2	2	-	-	-	-	-	–	1	3	2	2
CO-5	2	1	2	2	2	-	-	-	3	-	–	2	2	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		36
Demonstrations		02
1. Demonstration using Videos	01	
2. Demonstration using Physical Models		
3. Demonstration on a Computer	01	
Numeracy		01
1. Solving Numerical Problems	01	
Practical Work		
1. Course Laboratory		
2. Computer Laboratory		
3. Engineering Workshop / Course/Workshop / Kitchen		
4. Clinical Laboratory		
5. Hospital		
6. Model Studio		
Others		

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

Registrar (Academics)
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

1. Case Study Presentation		02
2. Guest Lecture		
3. Industry / Field Visit		
4. Brainstorming Sessions		
5. Group Discussions	01	
6. Discussing Possible Innovations	01	
Term Test and Written Examination		**04**
Total Duration in Hours		**45**

7. Method of Assessment

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 (60% Weightage)			**SEE (40% Weightage)**
	SC1 Term Tests 30%	**SC2 Assignment 10%**	**SC3 Assignment 20%**	
	25 + 25 Marks	10 Marks	40 Marks	50 Marks
CO-1	X	X		X
CO-2	X	X		X
CO-3	X	X	X	X
CO-4	X		X	X
CO-5			X	X

8. Achieving Course Learning Outcome

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, Assignments
2	Understanding	Classroom lectures, Assignments
3	Critical Skills	Assignments
4	Analytical Skills	Assignments
5	Problem Solving Skills	Assignments
6	Practical Skills	–
7	Group Work	Assignments
8	Self-Learning	Assignments
9	Written Communication Skills	Assignment, written examination
10	Verbal Communication Skills	--
11	Presentation Skills	Assignments

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

12	Behavioral Skills	--
13	Information Management	Assignment
14	Personal Management	Classroom lectures, Assignments
15	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Walsh, G., 2003, Biopharmaceuticals: Biochemistry and Biotechnology, 2nd Edition, John Wiley & Sons, Inc.
2. Crommelin, Daan J. A., Sindelar, Robert D., Meibohm, Bernd (Eds.), 2013, Pharmaceutical Biotechnology, 2nd Edition, Taylor & Francis Group.
3. Rodney J. Y. Ho, 2013, Biotechnology and Biopharmaceuticals: Transforming Proteins and Genes into Drugs, 2nd Edition, John Wiley & Sons, Inc.
4. Walsh, G., 2007, Pharmaceutical Biotechnology: Concepts and Applications, John Wiley & Sons, Inc.
5. Kayser, O., Warzecha, H., 2012, Pharmaceutical Biotechnology: Drug Discovery and Clinical Applications, 2nd Edition. John Wiley & Sons, Inc.

b. Recommended Reading

1. Sindelar, R.D., 2002, Pharmaceutical Biotechnology, New York: Taylor & Francis.
2. Crommelin D. J.A., 1998, Pharmaceutical Biotechnology: An Introduction for Pharmacists and Pharmaceutical Scientist, New York: Taylor & Francis.
3. Stewart, C.F., & Fleming, R.A., 1989, Biotechnology products: New opportunities and responsibilities for the pharmacist, American Journal of Hospital Pharmacy.

c. Magazines and Journals

1. https://benthamscience.com/journals/current-pharmaceutical-biotechnology/

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

Dy. Registrar (Academics)
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Course Title	Competitive Examination Training
Course Code	BTM301A
Department	Biotechnology
Faculty	Faculty of Life and Allied Health Sciences

1. Course Summary

This course is designed to prepare students to develop the fundamental skills, problem-solving skills, and research-based analytical skills to compete at the national level entrance examination for their admission into the premier technological and research-oriented Institutes in India. The students will be given the highest level of exposure to how to analyze and solve brainstorming questions in the field of Life Science and Biotechnology in a time-bound slot. It will certainly enhance their fundamental thought process to be a research-mind in their upcoming career.

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	50
Pass Requirement	As per university regulations
Attendance Requirement	As per university regulations

Teaching, Learning and Assessment

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO 1. Apply their concepts to solve fundamental questions at the national level entrance (IIT-JAM, GATE and GAT-B) for their master's programme (MS by Research/ MSc) at premier technological and research-based institutes in India.

CO 2. Analyze the research-based problems at the national level entrance (IIT-JAM, GATE and GAT-B) for their master's programme (MS by Research/ MSc) at premier technological and research-based institutes in India

CO 3. Evaluate the analytical questions at the national level entrance (IIT-JAM and JGEEBILS) for their integrated PhD (Int-PhD) programme at premier technological and research-based institutes in India.

CO 4. Solve the aptitude questions at various national level job recruitment processes in the field of Indian Patent and Design or Bureau of Indian Standards etc.

4. Course Contents

UNIT 1: Problem-solving, High throughput analysis and Analytical solutions, Biochemistry, Molecular Biology, Recombinant DNA Technology

UNIT 2: Problem-solving, High throughput analysis and Analytical solutions, Methods in Biology, Genetics, Microbiology

UNIT 3: Problem-solving, High throughput analysis and Analytical solutions, Cell Biology, Animal Biology, Plant Biology

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

UNIT 4: Problem-solving, High throughput analysis and Analytical solutions, Ecology, Evolution, Environmental Science

5. CO-PO PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	2	2	3	2	-	-	-	-	-	-	3	3	2	3
CO-2	3	3	3	3	2	-	-	-	-	-	-	3	3	3	3
CO-3	3	3	3	3	2	-	-	-	-	-	-	3	3	3	3
CO-4	2	2	3	3	3							3	2	2	3
		3: High Influence, 2: Moderate Influence, 1: Low Influence													

6. Course Teaching and Learning Methods:

Topics	Teaching methods	Hours
Assessment and Evaluation	Workshop on entrance preparation strategy	02
	Fundamental problem solving and PYQ discussions	12
	Analytical problem solving	10
	Term Test (4)	04
	SEE	02
	Total	30

7. Method of Assessment

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 (60% Weightage)				SEE (40% Weightage)
	25	25	25	25	50 Marks
CO-1	X				X
CO-2	X				X
CO-3	X				X
CO-4	X				X

8. Achieving Course Learning Outcome

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	Fundamental concepts

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

Dean-Academics
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

2	Understanding	Analysis and Discussions
3	Critical Skills	Analysis and Discussions
4	Analytical Skills	Analysis and Discussions
5	Problem Solving Skills	Analysis and Discussions
6	Practical Skills	Analysis and Discussions
7	Group Work	
8	Self-Learning	Analysis and Discussions
9	Written Communication Skills	
10	Verbal Communication Skills	
11	Presentation Skills	
12	Behavioral Skills	
13	Information Management	
14	Personal Management	
15	Leadership Skills	

9. Course Resources

a. Essential Reading

1. Lehninger Principles of Biochemistry – Nelson and Cox
2. Molecular Biology of the Gene - Watson
3. Gene Cloning and DNA Analysis – TA Brown
4. Microbiology – Prescott
5. Cell Biology – Gerald Karp
6. Genetics – Sunstad and Simmons
7. Ecology – Robert Leo Smith
8. Medical Physiology – Guyton and Hall
9. Plant Physiology – Taiz and Zeiger

b. Recommended Reading

1. Kar, D. (2023). Mega Question Bank Life Science, Biotechnology & Microbiology (for CSIR, DBT, ICMR, IIT-JAM, GATE, GAT-B & CUET-PG). Scientific Publishers, India. ISBN 978-9392590467.
1. Kar, D. (2021). UGC-CSIR NET Life Sciences, Revised Edition: Explanations and Solutions. Viva Books Originals. ISBN 978-9390054923.
2. Kar, D. (2022). DBT-JRF Biotechnology: Previous Years' Questions, Solutions and Explanations. Viva Books Originals. ISBN 978-9393329363.
3. Kar, D. (2021). Elements of ICMR-JRF Life Science. Atlantic Publishers & Distributors (P) Ltd. ISBN 978-8126933372.
4. Kar, D. (2021). Elements of GATE Biotechnology. Notion Press. ISBN: 978-1639976645.
5. Kar, D. (2023). Rainbow Series GATE Microbiology. Current Books International (P&D), ISBN 978 8196480226.
6. Kar, D. (2023). Chemistry for GATE Life Science. Current Books International (P&D), ISBN 978 8196480271.
7. **Kar, D.** (2023). *Rainbow Series GATE Microbiology*. Current Books International (P&D), ISBN 9788196480226

Course Title	Seminar
Course Code	BTS301A
Department	Biotechnology
Faculty	Faculty of Life and Allied Health Sciences

1. Course Summary

This course is aimed to give students a practice in the critical reading of research articles from scientific journals, and in the oral and visual presentation of scientific information. Students will familiarized with the technical advances in biotechnology. They will be acquainted with the emerging social, ethical and legal considerations related to Biotechnology Research and Development. The student will be taught to conduct a literature review, study methodology, technology, tools, processes used for the implementation of research in Biological/ Life Science. They will be familiarized to summarize and prepare a report followed by a seminar presentation.

2. Course Size and Credits:

Number of Credits	02
Total Hours of Classroom Interaction	00
Number of tutorial Hours	30
Number of Semester Weeks	16
Department Responsible	Biotechnology
Course Marks	50
Pass Requirement	As per university regulations
Attendance Requirement	As per university regulations

Teaching, Learning and Assessment

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO 1. After undergoing this course students will be able to: Identify a Biotechnology topic in their area of study for seminar through literature review
CO 2. Discuss the importance of topic selected with respect to research, relevance and its applications in the global and local context
CO 3. Justify the importance of the topic selected to the society.
CO 4. Prepare a detailed essay on the selected topic.

4. Course Contents

1. Identification of Biotechnology topic for seminar in consultation with Course Leader
2. Conducting a detailed study on the importance and the need for selecting the topic
3. Conduct literature review on the selected topic with respect to industry practices, relevance and its applications in the global context and also in the National (local) context
4. Preparation of a detailed essay on the selected topic to bring out the important concepts, outcomes of important research conducted in the selected area, relevance and applications of the topic for a suitable Biotechnology aspect

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

Dean
Faculty of Allied Health Sciences
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

5. CO-PO PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	2	2	-	-	2	-	-	-	-	-	-	3	3	2	3
CO-2	2	2	-	-	3	-	-	-	1	3	-	3	3	3	3
CO-3	1	1	2	-	2	-	-	-	3	3	-	3	2	2	3
CO-4	1	–	2		3	3	-	-	-	-	-	3	2	1	3
		3: High Influence, 2: Moderate Influence, 1: Low Influence													

6. Course Teaching and Learning Methods:

Topics	Teaching methods	Hours
Seminars	Workshop on seminar process	02
	Research work Literature search/ Library hours/ White papers/ company websites	10
	Report Preparation	10
	Presentation preparations	05
	Report and Presentation	03
	Total	30

7. Method of Assessment

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 (60% Weightage)	SEE (40%Weightage)
	30 Marks	20 Marks
CO-1	X	
CO-2	X	
CO-3	X	
CO-4		X

8. Achieving Course Learning Outcome

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	Literature review
2	Understanding	Seminar Preparation
3	Critical Skills	Seminar Preparation

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

4	Analytical Skills	Seminar Preparation
5	Problem Solving Skills	Seminar Preparation
6	Practical Skills	
7	Group Work	
8	Self-Learning	Seminar Preparation
9	Written Communication Skills	Report writing
10	Verbal Communication Skills	Presentation
11	Presentation Skills	Presentation
12	Behavioral Skills	
13	Information Management	Report writing
14	Personal Management	Seminar Preparations
15	Leadership Skills	

9. Course Resources

a. Essential Reading

1. Kothari, C., Garg, G., 2016, *Research methodology*, 4th Edition, New Delhi: New Age International (P) Limited, pp.1-183

b. Websites

1. https://pubmed.ncbi.nlm.nih.gov/
2. https://scholar.google.com/

c. Other Electronic Resources

1. EBSCO, SSRN, Google Scholar, Pubmed

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

M.S. Ramaiah University of Applied Sciences
Bangalore - 560 004

RAMAIAH UNIVERSITY OF APPLIED SCIENCES

M. S. Ramaiah University of Applied Sciences

Course Specifications

of

B.Sc. (Hons.) in Biotechnology

B.Sc. (Hons. with Research) in Biotechnology

Programme Code: 018

SEMESTER 7

Department of Biotechnology
Faculty of Life and Allied Health Sciences
M S Ramaiah University of Applied Sciences

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

Course Title	Bioinformatics
Course Code	BTC401A
Department	Biotechnology
Faculty	Faculty of Life and Allied Health Sciences

1. Course Summary

This course provides students with a foundational understanding of bioinformatics, emphasizing its practical applications in biological research. Through hands-on experience, students develop proficiency in using a variety of internet applications and biological databases for effective problem-solving. The training covers database searching, protein and DNA sequence analysis, protein function prediction, and phylogenetic tree construction, enhancing students' practical skills in bioinformatics.

2. Course Size and Credits:

Number of Credits	5
Total Hours of Classroom Interaction	45
Number of laboratory Hours	60
Number of Semester Weeks	16
Department Responsible	Biotechnology
Course Marks	100
Pass Requirement	As per university regulations
Attendance Requirement	As per university regulations

Teaching, Learning and Assessment

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO 1. Discuss basic concept of bioinformatics and its applications and various biological databases

CO2. Describe sequences analysis approaches

CO3. Discuss on phylogenetic trees and methods and software involved in the construction of phylogenetic trees

CO4. Discuss on structural data bases for analyzing structural genomics and proteomics and approaches to protein structure and function prediction

CO5. Perform sequence analysis including sequence alignment, database search, primer design and restriction mapping

CO6. Analyze protein conformation data from protein data bank

CO7. Interpret the data obtained and enter in laboratory lab note bookList the function of different macromolecules in biological system such as carbohydrate, protein, lipid and nucleic acid.

4. Course Contents

Theory

Unit 1. Introduction to bioinformatics and computational Biology: Branches of Bioinformatics, sequencing of genomes, Human Genome project, Applications of Bioinformatics, Biological databases: Introduction, Classification; Biological data retrieval system

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Unit 2. Sequence alignment & database search : DNA and protein sequence analysis, pair wise sequence alignment, Scoring matrices, FASTA algorithm, BLAST, multiple sequence alignment, database searching using BLAST

Unit 3. Introduction to phylogenetics: Basic terminology: taxa, root, leaf, node, tree, branch, clade, dendrogram, cladogram, rooted tree, unrooted tree, scaled tree. Algorithms to construct trees: UPGMA, NJ, and maximum parsimony. Use of phylogenetic trees for inferring the evolutionary relationships between organisms using examples from the literature.

Unit 4. Protein bioinformatics: Small molecule databases, protein information resources. Understanding and retrieving data from the protein data bank. Understanding backbone and sidechain dihedral angles: phi (φ), psi (ψ), omega (ω), and chi (χ). Understanding the Ramachandaran map and its applications.

Unit 5. Protein modelling and design: Molecular dynamics using GROMACS. Protein Secondary structure and tertiary structure prediction methods. Homology modeling and threading: SWISSmodel. *ab initio* approaches: Rosetta and Alphafold. Critical Assessment of Structure Prediction (CASP) competition.

Unit 6. Linux and shell scripting: Introduction to the Linux operating system as a platform for bioinformatics. Navigating via the terminal. Elementary terminal commands: cd, ls, pwd, cut, paste, touch, grep, mv, rm. Introduction to sed and awk. Understanding file I/O and how to pipe commands. Introduction to bash scripting.

Practical

1. Sequence information resource: Introduction to NCBI, Genbank, Entrez gene, Uniprot
2. Identification of genes for Primer Design
3. Restriction mapping and Primer design
4. Pair wise comparison of sequences, multiple alignments of sequences
5. Database search using BLAST
6. Protein databank retrieval and PDB file format, Visualization of protein structure using Rasmol/Pymol, Ramachandaran map generation.
7. Homology modelling using SwissMODEL
8. Bash scripting basics: navigating via the terminal.

5. CO-PO PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	1	3	2	3	-	1	-	1	1	-	2	3	2	2
CO-2	3	1	3	3	3	-	1	-	1	1	-	2	3	3	2
CO-3	3	1	3	2	3	-	1	-	1	1	-	2	3	3	2
CO-4	3	1	3	2	3	-	1	-	1	1	-	2	3	3	2
CO-5	3	1	3	3	3	-	1	-	1	1	-	2	3	3	3
CO-6	3	1	3	3	3	-	1	-	1	1	-	2	3	2	3
CO-7	3	1	3	2	3	-	1	-	1	1	-	2	2	2	3
		3: High Influence, 2: Moderate Influence, 1: Low Influence													

Head
Department of Biotechnology
Ramaiah University of Applied

6. Course Teaching and Learning Methods:

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		36
Demonstrations		05
1. Demonstration using Videos	02	
2. Demonstration using Physical Models		
3. Demonstration on a Computer	03	
Numeracy		
1. Solving Numerical Problems		
Practical Work		56
1. Course Laboratory	56	
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. Brainstorming Sessions		
5. Group Discussions		
6. Discussing Possible Innovations		
Term Test and Written Examination		**04+04**
Total Duration in Hours		**105**

7. Method of Assessment

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 (60% Weightage)			SEE (40% Weightage)	
	SC1 (Term Tests) 30%	SC2 (Innovative + Lab assignment) 10%	SC3 (Written + Lab Assignment) 20%	SEE (Theory) 25%	SEE (Lab) 15%
	(25 + 25 Marks)	10 Marks	40 Marks	50 Marks	30 Marks
CO-1	X	X		X	
CO-2	X	X		X	
CO-3	X			X	
CO-4	X		X	X	

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

Dean
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

CO-5		X	X		X
CO-6		X	X		X
CO-7		X	X		X

8. Achieving Course Learning Outcome

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. Laboratory manual and Lecture notes
2. Ghosh, Z., Bibekanand, M., 2008, *Bioinformatics: Principles and Applications*, Oxford University Press.
3. Pevsner, J., 2009, *Bioinformatics and Functional Genomics*, 2nd Edition, Wiley-Blackwell.
4. Attawood, T., Smith, P.J., 1999, Introduction to Bioinformatics, Longman Publishers.
5. Grant, G.R., Ewens, W.J., 2005, Statistical Methods in Bioinformatics: An Introduction, Springer.
6. Higgins, D., Taylor, W., 2000, Bioinformatics – Sequence, Structure and Databanks, Oxford University Press.
7. Jason Cannon, Shell Scripting: How to Automate Command Line Tasks Using Bash Scripting and Shell Programming Kindle Edition

b. Recommended Reading

1. Fry, J.C., 1993, *Biological Data Analysis. A practical Approach*, IRL Press, Oxford.

c. Websites

1. https://www.ncbi.nlm.nih.gov/
2. https://bmcbioinformatics.biomedcentral.com/
3. https://www.oxfordjournals.org/nar/database/c/

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

Course Title	Genomics and Proteomics
Course Code	BTC402A
Department	Biotechnology
Faculty	Faculty of 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. Practical skills will be honed through training in genome analysis, encompassing techniques such as DNA sequencing and leveraging cutting-edge technology like mass spectrometry.

2. Course Size and Credits:

Number of Credits	5
Total Hours of Classroom Interaction	45
Number of laboratory Hours	60
Number of Semester Weeks	16
Department Responsible	Biotechnology
Course Marks	100
Pass Requirement	As per university regulations
Attendance Requirement	As per university regulations

Teaching, Learning and Assessment

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO1. Detail the principles and methods of DNA sequencing and whole genome sequencing.
CO2. Describe the different databases available for accessing genomic data of various model organisms.
CO3. Explain the analytical techniques used for studying proteins
CO4. Explain the high-throughput analysis of gene function including Microarrays and Mass spectrophotometric analysis
CO5. Apply gene identification methods to analyze genomic data and analyze sequencing data
CO6. Extract and visualize protein-protein interaction data from databases and analyze proteome data
CO7. Estimate protein masses from mass spectrometric data and assemble protein sequences

4. Course Contents

Theory

Unit 1 Introduction to Genomics: Genomes, genomics and transcriptomics, DNA sequencing methods – manual & automated: Maxam -Gilbert and Sanger's method. Pyrosequencing, Genome Sequencing: Shotgun & Hierarchical (clone contig) methods, NGS techniques – Illumina, Oxford Nanopore etc, Discussion of case studies.

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Unit 2 Managing and Distributing Genome Data: Web based servers and software for genome analysis: ENSEMBL, NCBI genome. Selected Model Organisms' Genomes and Databases

Unit 3 Genome sequence analysis: Principle, salient features & drawbacks of methods of gene prediction / gene modeling: NCBI ORF finder, GRAIL, GENEMARK, GLIMMER. Promoter prediction methods

Unit 4 Introduction to Proteomics: Protein structure, 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 5 High-throughput analysis of gene function: 2D-PAGE, Microarrays, Mass spectrometry: LC-MS, ESI-MS, MS-MS

Unit 6 Protein–protein interactions: Large scale analysis of protein interactions-yeast two hybrid , CoIP, ChiP, post-translational modification analysis, proteomics databases

Practical

1. Introduction to Ensembl, Ensembl Genes and Transcripts
2. Comparative genomics in Ensembl
3. Model organism databases: Ecocyc, Flybase etc..
4. Identification of genes and promoters
5. Automated sanger DNA sequencing data observations and analysis
6. Extract protein-protein interactions (PPI) from PPI databases and visualize the PPI in cytoscape
7. Protein sequence assembly, and calculating protein mass from given mass spec data (m/z values)
8. Protein analysis tools: ExPASy, etc.

5. CO-PO PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	2	3	2	3	-	1	-	1	1	-	2	3	2	2
CO-2	3	2	3	2	3	-	1	-	1	1	-	2	3	3	2
CO-3	3	2	3	2	3	-	1	-	1	1	-	2	3	2	2
CO-4	3	2	3	2	3	-	1	-	1	1	-	2	3	3	2
CO-5	3	2	3	2	3	-	1	-	1	1	-	2	3	3	3
CO-6	3	2	3	2	3	-	1	-	1	1	-	2	3	3	3
CO-7	3	2	3	2	3	-	1	-	1	1	-	2	3	3	3
		3: High Influence, 2: Moderate Influence, 1: Low Influence													

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

6. Course Teaching and Learning Methods:

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		36
Demonstrations		03
1. Demonstration using Videos		
2. Demonstration using Physical Models		
3. Demonstration on a Computer	03	
Numeracy		02
1. Solving Numerical Problems	02	
Practical Work		56
1. Course Laboratory	56	
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. Brainstorming Sessions		
5. Group Discussions		
6. Discussing Possible Innovations		
Term Test and Written Examination		**04+04**
Total Duration in Hours		**105**

7. Method of Assessment

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 (60% Weightage)			SEE (40% Weightage)	
	SC1 (Term Tests) 30%	SC2 (Innovative + Lab assignment) 10%	SC3 (Written + Lab Assignment) 20%	SEE (Theory) 25%	SEE (Lab) 15%
	(25 + 25 Marks)	10 Marks	40 Marks	50 Marks	30 Marks
CO-1	X	X	X	X	
CO-2	X	X	X	X	X
CO-3	X		X	X	
CO-4	X		X	X	

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

CO-5		X	X		X
CO-6		X	X		X
CO-7		X	X	X	X

8. Achieving Course Learning Outcome

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	Classroom, Assignment
5	Problem Solving Skills	Classroom, Assignment, Examination
6	Practical Skills	Laboratory, Assignment
7	Group Work	Assignment
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. Lesk, A. 2012, Introduction to Genomics, 2nd Edition, Oxford University Press.
2. Primrose, S.B., Twyman, R.M., Old, R.W., 2001, *Principles of Gene Manipulation*, 6th Edition, Blackwell Science.
3. Primrose, S.B., 1987, *Modern Biotechnology*, 2nd Edition, Blackwell Publishing.
4. Nelson, D.L. and Cox, M.M.,"Lehninger Principles of Biochemistry", 6th edition, W.H. Freeman.
5. Voet, D. and Voet, J. G., "Biochemistry" 3rd edition, John Wiley and Sons.
6. Twyman, R. (2004). Principles of Proteomics (1st ed.). Taylor & Francis.
7. Srivasatava S., (2023), From proteins to proteomics : basic concepts, techniques, and applications, CRC Press, Taylor & Francis.
8. Liebler, Daniel C. (2002) Introduction to proteomics: tools for the new biology, Humana Press

b. Magazines and Journals

1. https://www.ncbi.nlm.nih.gov/labs/journals/hum-genomics-proteomics/
2. https://www.ncbi.nlm.nih.gov/pmc/journals/1314/
3. https://www.oxfordjournals.org/nar/database/c/

c. Websites

1. https://www.ncbi.nlm.nih.gov/
2. https://www.ensembl.org/index.html
3. https://www.expasy.org/

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences

Course Title	Research Methodology
Course Code	BTC403A
Department	Biotechnology
Faculty	Faculty of Life and Allied Health Sciences

1. Course Summary

This course aims to train the students on principles of research methodology for research in Biotechnology. The students will be trained to perform literature review, identify gaps and formulate a research problem using appropriate research methodology. They will be also taught about various types of research, sampling methodologies, data collection tools and methods, data analysis and Interpretation. Students will also be introduced to scientific writing and ethics of research.

2. Course Size and Credits:

Number of Credits	3
Total Hours of Classroom Interaction	45
Number of laboratory Hours	00
Number of Semester Weeks	16
Department Responsible	Biotechnology
Course Marks	100
Pass Requirement	As per university regulations
Attendance Requirement	As per university regulations

Teaching, Learning and Assessment

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO 1. Describe the research process.
CO 2. Identify research gap and formulate a research problem.
CO 3. Determine research design for the research objectives.
CO 4. Discuss sampling methodologies, data collection and validation methods relevant to research objectives.
CO 5. Describe methods of statistical data analysis and interpretation.
CO 6. Discuss the process of scientific writing and ethical aspects

4. Course Contents

Theory

Unit 1 Introduction to Research Methods: Definition of research, objectives and characteristics of good research, applications and types of research, various steps of a research process. Collecting and reviewing the literature, conceptualization and formulation of a research problem, identifying variables and constructing hypothesis

Unit 2 Research Design and Design survey: Selecting and defining a research problem, need for and features and types of research design. Census V/s Sample enumerations, objectives and principles of sampling, Types of sampling, Sampling and Non-sampling errors. Designing questionnaires and interviews. Determination of the sample size.

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

Dean Academics
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

Unit 3 Measurement of Scaling Concepts: Scales of measurements, nominal, ordinal, internal and ratio scales, Errors in measurements.

Unit 4 Data Collection & Analysis: Introduction, sources of data, primary and secondary data collection, differences between qualitative and quantitative Data, Designing the experiment with relevance of statistical background, Recording observations, Defining hypothesis-Null/Alternate, Statistical analysis: mean, median mode, SD, SE, ANOVA, F-test, t-test, Chi-square test etc., Interpretations of statistical parameters

Unit 5 Scientific writing and communication: Literature review, Components of a paper, writing for journals, conference proceedings, thesis; referencing and various formats for reference writing, Bibliography, journal impact factor, citation index, h-index, reading a scientific paper, presenting in seminars, posters, conferences, and workshops.

Unit 6: Ethics in research: Research Ethics, Importance, Ethical issues and codes of research conduct, role of research ethics committee.

5. CO-PO PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	3	2	-	2	-	-	2	-	1	1	2	2	2	3
CO-2	2	3	2	1	3	1	-	1	-	-	-	2	3	3	3
CO-3	-	3	-	2	3	-	-	2	-	-	1	2	3	3	3
CO-4	1	2	2	3	3	-	-	2	-	1	-	2	3	2	3
CO-5	1	2	2	3	3	-	-	2	-	1	-	2	3	3	3
CO-6	1	-	-	-	-	3	3	2	3	-	1	2	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		36
Demonstrations		02
1. Demonstration using Videos		
2. Demonstration using Physical Models	01	
3. Demonstration on a Computer	01	
Numeracy		02
1. Solving Numerical Problems	02	
Practical Work		
1. Course Laboratory		
2. Computer Laboratory		
3. Engineering Workshop / Course/Workshop / Kitchen		
4. Clinical Laboratory		
5. Hospital		
6. Model Studio		

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences

Others		03
1. Case Study Presentation		
2. Guest Lecture		
3. Industry / Field Visit		
4. Brainstorming Sessions	01	
5. Group Discussions	01	
6. Discussing Possible Innovations		
Term Test and Written Examination		**04**
Total Duration in Hours		**45**

7. Method of Assessment

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 (60% Weightage)			**SEE (40% Weightage)**
	SC1 (Term Tests) 30%	**SC2 (Innovative assignment) 10%**	**SC3 (Written Assignment) 20%**	50 Marks
	(25 + 25 Marks)	10 Marks	40 Marks	
CO-1	X	X		X
CO-2	X	X		X
CO-3	X	X	X	X
CO-4	X		X	X
CO-5			X	X
CO-6			X	X

8. Achieving Course Learning Outcome

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, Assignment
2	Understanding	Classroom lectures, Assignment
3	Critical Skills	Assignment
4	Analytical Skills	Assignment
5	Problem Solving Skills	Assignment,
6	Practical Skills	--
7	Group Work	Group discussions, Brain storming sessions
8	Self-Learning	Class material, Assignments
9	Written Communication Skills	Assignments, written examination

Head Department of Biotechnology M S Ramaiah University of Applied Sciences Bangalore - 560 054

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

Dean Faculty of Life & Allied Health Sciences M.S. Ramaiah University of Applied Sciences Bangalore - 560 054

10	Verbal Communication Skills	Group discussions, Brain storming sessions
11	Presentation Skills	Group discussions, Brain storming sessions, Assignment
12	Behavioral Skills	--
13	Information Management	Assignments
14	Personal Management	Class room lectures, Assignments
15	Leadership Skills	Group discussions

9. Course Resources

a. Essential Reading

1. Gurumani, N., 2021, Research Methodology for Biological sciences, MJP Publishers
2. RK. Jain., 2021, Research Methodology : Methods And Techniques, Vayu education of India
3. Soumitro Banerjee., 2022, Research Methodology for Natural Sciences, IISc press

b. Recommended Reading

1. Black, JMW. (2017). The science of stem cells. 1 st , Edition, Wiley Blackwell publishers.
2. Warburton, D. (2014). Stem Cells, Tissue Engineering and Regenerative Medicine. 1st Edition. World Scientific publishing Co. Pvt. Ltd.
3. Sell, S. (2013). Stem Cells Handbook. 1st edition. 2013.
4. Urgess, R. (2016). Stem Cells: A Short Course . 1 stEdition, Wiley Blackwell Publishers.
5. Lanza, R. Langer, R. Vacanti, J. Principles of Tissue Engineering (2013). 4th edition. Academic Press.
6. Bronzino, JD., Peterson, DR. (2015). The Biomedical Engineering Handbook 4 th edition. CRC Press Taylor & Francis.

c. Magazines and Journals

1. https://www.cell.com/cell/collections/stem-cells

d. Magazines and Journals

1. https://nptel.ac.in/courses/102106036

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

Course Title	Stem Cell and Tissue Engineering
Course Code	BTE401A
Department	Biotechnology
Faculty	Life and Allied Health Sciences

1. Course Summary

The aim of the course is to familiarize student with the concept of stem cells, potency and how they relate to development and homeostasis. Students will also be familiarized with the underlying developmental biology principles from fertilization to differentiated cell types. In addition, students will be able to understand the principle of tissue engineering and how stem cells can be applied in medical research and disease treatments.

2. Course Size and Credits:

Number of Credits	3
Total Hours of Classroom Interaction	45
Number of laboratory Hours	00
Number of Semester Weeks	16
Department Responsible	Biotechnology
Course Marks	100
Pass Requirement	As per university regulations
Attendance Requirement	As per university regulations

Teaching, Learning and Assessment

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO 1. Understand the basic principles of developmental biology.

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

CO 3. Develop the methods of bio-amplification of stem cells for therapeutic use

CO 4. Propose the use of stem cells in tissue engineering.

CO 5. Evaluate the ethical and social concerns associated with stem cell clinical applications.

4. Course Contents

Theory

Unit 1 Introduction to Development: Model organisms- vertebrate and invertebrates, Early development (fertilization, totipotency, and pluripotency), Gastrulation and lineage commitment, Mechanisms of cell fate determination, Specification and development of primordial germ cells.

Unit 2 Introduction to Stem cells: Basics properties of stem cells, stem cell types (embryonic, fetal, adult/tissue), Stem cell niche, Cell cycle regulation in stem cells , Stem cell markers, *in vitro* and *in vivo* assays used to identify and isolate stem cells.

Unit 3 Cell and Gene Therapy: Principle of cell and gene therapy, Hematopoietic and Mesenchymal stem cells, iPSCs, Different vector system for gene delivery, Overview of gene editing tools.

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

Dean - Academics
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

Unit 4 Clinical applications of stem cells: Uses of stem cells for metabolic diseases and genetic diseases, Plasticity and Trans-differentiation, Clinical trials, Cancer stem cells and their impact on chemotherapies.

Unit 5 Tissue engineering: Basic concept, scaffolds, bioreactors, Tissue and Organ fabrication, Use in therapeutics- bone tissue engineering, Engineered skin substitutes.

Unit 6 Ethical issues in Stem Cell Research: Stem cell therapy guidelines, Embryo Ethics, Ethics of egg donation, Ethics of gene editing, Access to stem cell therapies.

5. CO-PO PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	1	–	-	2	-	-	-	-	-	-	1	3	2	1
CO-2	3	2	–	-	2	-	-	-	-	-	-	1	3	2	1
CO-3	3	3	2	-	2	-	-	-	-	1	-	1	3	3	2
CO-4	3	3	2	-	3	-	-	-	2	2	1	1	3	3	2
CO-5	3	2	1	-	3	-	-	-	3	2	1	2	2	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		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		0
1. Course Laboratory		
2. Computer Laboratory		
3. Engineering Workshop / Course/Workshop / Kitchen		
4. Clinical Laboratory		
5. Hospital		
6. Model Studio		
Others		07
1. Case Study Presentation	01	
2. Guest Lecture	02	
3. Industry / Field Visit		
4. Brainstorming Sessions		
5. Group Discussions	03	

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

6. Discussing Possible Innovations	01	
Term Test and Written Examination		**04**
Total Duration in Hours		**45**

7. Method of Assessment

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 (60% Weightage)			SEE (40% Weightage)	
	SC1 (Term Tests) 30%	SC2 (Innovative + Lab assignment) 10%	SC3 (Written + Lab Assignment) 20%	SEE (Theory) 25%	SEE (Lab) 15%
	(25 + 25 Marks)	10 Marks	40 Marks	50 Marks	30 Marks
CO-1	X	X		X	
CO-2	X	X		X	
CO-3	X	X	X	X	
CO-4	X		X	X	
CO-5			X	X	

8. Achieving Course Learning Outcome

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	--

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

Dean
Faculty of Life & Allied Health Sciences
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

9. Course Resources

a. Essential Reading

1. Class notes
2. Gilbert, SF. Developmental Biology. Eight edition. Sinauer Associates, Inc., Publishers Sunderland, Massachusetts USA
3. Lanza, R. and Atala, R(2013). Essentials of Stem Cell Biology (Eds.). 3rd Edition. Academic Press

b. Recommended Reading

1. Black, JMW. (2017). The science of stem cells. 1st , Edition, Wiley Blackwell publishers.
2. Warburton, D. (2014). Stem Cells, Tissue Engineering and Regenerative Medicine. 1st Edition. World Scientific publishing Co. Pvt. Ltd.
3. Sell, S. (2013). Stem Cells Handbook. 1st edition. 2013.
4. urgess, R. (2016). Stem Cells: A Short Course . 1st Edition, Wiley Blackwell Publishers.
5. Lanza, R. Langer, R. Vacanti, J. Principles of Tissue Engineering (2013). 4th edition. Academic Press.
6. Bronzino, JD., Peterson, DR. (2015). The Biomedical Engineering Handbook 4th edition. CRC Press Taylor & Francis.

c. Magazines and Journals

1. https://www.cell.com/cell/collections/stem-cells

d. Websites

1. https://nptel.ac.in/courses/102106036

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

Course Title	Nanobiotechnology
Course Code	BTE402A
Department	Biotechnology
Faculty	Faculty of Life and Allied Health Sciences

1. Course Summary

This course aims to familiarize students with the latest developments in the field of nanobiotechnology. Recent developments in the design of protein, nucleotide, lipid, and inorganic nanostructures will be discussed. Computational and experimental design approaches to create such nanostructures will be strongly emphasized during this course.
Students will first be familiarized with the instrumentation required to characterize nanostructures. Emphasis will be on training students to pick the correct instrument and technique to characterize a given nanobiostructure.

Students will be introduced to protein nanostructures. Students will be familiarized with algorithms and approaches to design these nanostructures, along with their potential applications and drawbacks. DNA and lipid nanostructures will be similarly discussed. Special emphasis will be given to the application of lipid nanoparticles in mRNA vaccines.
After completing this course, students should be able to understand and apply approaches for designing nanostructures to fit an application of their choosing.

2. Course Size and Credits:

Number of Credits	3
Total Hours of Classroom Interaction	45
Number of laboratory Hours	00
Number of Semester Weeks	16
Department Responsible	Biotechnology
Course Marks	100
Pass Requirement	As per university regulations
Attendance Requirement	As per university regulations

Teaching, Learning and Assessment

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO1. Explain how a given instrument should be used to answer a given question regarding a given nanobiostructure.I concerns in various field of Biotechnology

CO2. Explain the approaches to designing protein nanostructures. Explain potential applications for protein nanocages.

CO3. Explain the approaches to designing DNA nanostructures. The student should be able to design an elementary DNA nanostructure by hand.

CO4. Explain the various types of lipid nanostructures. Understand the developmental milestones that lead to the creation of the Covid mRNA vaccines.

CO5. Explain how biomolecules interface with inorganic nanostructures.

Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

M S Ramaiah University of Applied Sciences
Bangalore - 560 054

4. Course Contents

Theory

Unit 1. Instrumentation used for studying nanostructures: Scanning electron microscopy. transmission electron microscopy, cryo electron microscopy, atomic force microscopy, nuclear magnetic resonance (NMR), small angle X-ray scattering, X-ray crystallography,Dynamic light scattering, Fast Protein Liquid Chromatography (FPLC)

Unit 2 Protein nanostructures: Principles for the design of ideal protein structures. Computational tools for protein design: Rosetta and Alphafold. Algorithms for protein design: Simulated annealing optimization and deep learning. Examples of protein nanocages and their applications in vaccine design.

Unit 3. DNA nanostructures: DNA origami: Design principles in 2 dimensions. Design principles in 3 dimensions. Elementary graph theory and the design of asymmetric DNA polyhedra. Approaches to DNA nanocage design: one-pot approach, modular assembly, hierarchical self-assembly, and DNA origami-based approaches. Functional DNA nanocages as tools for drug delivery: configurability via ligands, biomolecules, and pH inputs. Nucleic acid nanomachines: DNA walkers.

Unit 4 Lipid nanostructures: Liposomes: the synthesis of small unilamellar vesicles (SUV), large unilamellar vesicles (LUV), multilamellar vesicle (MLV), and multivesicular vesicles (MVV), and their application to drug delivery. Solid lipid nanoparticles (SLNs) and their application to drug delivery. Covid19 mRNA vaccines: lipid nanoparticles for intracellular mRNA delivery.

Unit 5 Biofunctionalized inorganic nanostructures: Bioconjugated gold nanoparticles (BGNs): conjugation with oligonucleotides, enzymes, DNA, and antibodies. Bioconjugated graphene, mica, carbon nanotubes, and fullerenes. Directed nanostructure biomineralization via calcium carbonate and silica.

4. CO-PO PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	2	2	-	-	-	-	-	-	-	-	1	3	3	2
CO-2	3	3	2	-	-	-	1	-	-	1	-	3	3	3	2
CO-3	3	3	2	-	-	-	1	-	-	1	-	3	3	3	2
CO-4	3	3	2	-	-	-	1	-	2	1	-	3	3	3	2
CO-5	3	3	2	-	-	-	1	-	-	1	-	3	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		26
Demonstrations		05
1. Demonstration using Videos	02	
2. Demonstration using Physical Models	01	
3. Demonstration on a Computer	02	
Numeracy		
1. Solving Numerical Problems		
1. Course Laboratory		
2. Computer Laboratory		
3. Engineering Workshop / Course/Workshop / Kitchen		
4. Clinical Laboratory		
5. Hospital		
6. Model Studio		
Others		10
1. Case Study Presentation	02	
2. Guest Lecture	02	
3. Industry / Field Visit		
4. Brainstorming Sessions	02	
5. Group Discussions	02	
6. Discussing Possible Innovations	02	
Term Test and Written Examination		**04**
Total Duration in Hours		**45**

7. Method of Assessment

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 (60% Weightage)			SEE (40% Weightage)
	SC1 (Term Tests) 30%	SC2 (Innovative assignment) 10%	SC3 (Written Assignment) 20%	50 Marks
	(25 + 25 Marks)	10 Marks	40 Marks	
CO-1	X	X		X
CO-2	X	X		X
CO-3	X	X	X	X
CO-4	X		X	X
CO-5	X		X	X

Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

M S Ramaiah University of Applied Sciences
Bangalore - 560 054

8. Achieving Course Learning Outcome

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. Class Notes
2. Nanoscience And Nanotechnology: Fundamentals Of Frontiers (Wiley). MSR Rao, S. Singh
3. Nanobiotechnology, First Edition (MJP Publishers). S. Balaji

b. Recommended Reading

1. Huang, Po-Ssu, Scott E. Boyken, and David Baker. "The coming of age of de novo protein design." Nature 537.7620 (2016): 320-327.
2. Koga, Nobuyasu, et al. "Principles for designing ideal protein structures." Nature 491.7423 (2012): 222-227.
3. Kaufmann, Kristian W., et al. "Practically useful: what the Rosetta protein modeling suite can do for you." *Biochemistry* 49.14 (2010): 2987-2998.
4. Divine, Robby, et al. "Designed proteins assemble antibodies into modular nanocages." *Science* 372.6537 (2021): eabd9994.
5. Hsia, Yang, et al. "Design of a hyperstable 60-subunit protein icosahedron." *Nature* 535.7610 (2016): 136-139.
6. Butterfield, Gabriel L., et al. "Evolution of a designed protein assembly encapsulating its own RNA genome." *Nature* 552.7685 (2017): 415-420.
7. Philippidis, Alex. "Icosavax: Giving VLPs the VIP Treatment: CEO Adam Simpson tells GEN Edge COVID-19 and RSV vaccines are clinic-bound with $100 M in Series B financing." *GEN Edge* 3.1 (2021): 231-237.
8. Rothemund, Paul WK. "Folding DNA to create nanoscale shapes and patterns." *Nature* 440.7082 (2006): 297-302.
9. Dey, Swarup, et al. "DNA origami." *Nature Reviews Methods Primers* 1.1 (2021): 13.
10. Chandrasekaran, Arun Richard, and Oksana Levchenko. "DNA nanocages." *Chemistry*

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

of Materials 28.16 (2016): 5569-5581.
11. Hu, Qinqin, et al. "DNA nanotechnology-enabled drug delivery systems." *Chemical reviews* 119.10 (2018): 6459-6506.
12. Bozzuto, Giuseppina, and Agnese Molinari. "Liposomes as nanomedical devices." *International journal of nanomedicine* 10 (2015): 975.
13. Lingayat, Vishal J., Nilesh S. Zarekar, and Rajan S. Shendge. "Solid lipid nanoparticles: a review." *Nanoscience and Nanotechnology Research* 4.2 (2017): 67-72.
14. Schoenmaker, Linde, et al. "mRNA-lipid nanoparticle COVID-19 vaccines: Structure and stability." *International journal of pharmaceutics* 601 (2021): 120586.
15. Giljohann, David A., et al. "Gold nanoparticles for biology and medicine." *Spherical Nucleic Acids* (2020): 55-90.
16. Sardar, Rajesh, et al. "Gold nanoparticles: past, present, and future." *Langmuir* 25.24 (2009): 13840-13851.
17. Vrieling, Engel G., et al. "Controlled silica synthesis inspired by diatom silicon biomineralization." *Journal of Nanoscience and Nanotechnology* 5.1 (2005): 68-78.

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences

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

Registrar
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

Course Title	Green Energy Technologies
Course Code	BTE403A
Department	Biotechnology
Faculty	Faculty of Life and Allied Health Sciences

1. Course Summary

This course has been designed with the objective to acquaint the students with alternative energy sources briefly touching upon all the green energy technologies available. The course deals with detailed knowledge of use of bioresources including agricultural and municipal waste valorisation, recent developments and future prospects.
Students will be able to acquire knowledge about the scientific and technological advances in biofuel technology and its role in sustainable development.

2. Course Size and Credits:

Number of Credits	3
Total Hours of Classroom Interaction	45
Number of laboratory Hours	0
Number of Semester Weeks	16
Department Responsible	Biotechnology
Course Marks	100
Pass Requirement	As per university regulations
Attendance Requirement	As per university regulations

Teaching, Learning and Assessment

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO 1. Explain the use, advantages and disadvantages use of enzymes, microorganisms, plants and organic wastes to produce biofuels.

CO2. Understand the role of biotechnology in the production of biofuels .

CO3. Critically assess the possibility of implementation of carbon neutral technologies for alternative fuels and their contribution to national energy security and development

4. Course Contents

Theory

Unit 1. Renewable energy source: Hydropower, geothermal power, solar power, wind power – Biofuel -Biomass - Feed stocks (agricultural crops, bioenergy crops, agricultural waste residues, wood residues, waste streams)

UNIT 2. Fuel technology and bioconversion History: Definition of biofuel, applications of biofuel (transport, direct electricity generation, home use and energy content of biofuel) - Bioconversion of lignocellulosics, cellulose saccharification, pretreatment technologies (air separation process, mechanical size reduction, autohydrolysis) - Pulping and bleaching – Enzymatic deinking.

UNIT 3. Biogas: biogas plant, feed stock materials, biogas production, factors affecting methane formation - Role of methanogens – Biohydrogen production - Oxygen sensitivity

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences

problems in hydrogenenases

UNIT 4: Bio ethanol and butanol: advantages of ethanol over fossil fuels, production of ethanol from cellulosic materials, ethanol recovery - Biobutanol production, energy content and effects on fuel economy - Octane rating, air fuel ratio, specific energy, viscosity, heat of vaporization -Butanol fuel mixtures

UNIT 5. Biodiesel Production of biodiesel, oil extraction from algae by chemical solvents, enzymatic, expeller press - Osmotic shock and ultrasonic assisted extraction - Applications of biodiesel, environmental benefits and concerns

5. CO-PO PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	1	-	-	3	-	-	1	2	3	-	1	3	3	2
CO-2	3	2	-	-	3	-	-	3	2	3	-	1	3	3	2
CO-3	3	3	-	-	3	-	-	1	2	3	-	1	3	3	2
		3: High Influence, 2: Moderate Influence, 1: Low Influence													

6. Course Teaching and Learning Methods:

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		36
Demonstrations		03
1. Demonstration using Videos	02	
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		02
1. Case Study Presentation	01	
2. Guest Lecture	01	
3. Industry / Field Visit		
4. Brainstorming Sessions		
5. Group Discussions		
6. Discussing Possible Innovations		
Term Test and Written Examination		**04**
Total Duration in Hours		**45**

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

Registrar
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

7. Method of Assessment

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 (60% Weightage)			SEE (40% Weightage)
	SC1 (Term Tests) 30%	SC2 (Innovative assignment) 10%	SC3 (Written Assignment) 20%	50 Marks
	(25 + 25 Marks)	10 Marks	40 Marks	
CO-1	X	X		X
CO-2	X	X		X
CO-3	X	X	X	X

8. Achieving Course Learning Outcome

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	--
5	Problem Solving Skills	Assignment, Examination
6	Practical Skills	--
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. Alain A. Vertès, Nasib Qureshi, Hans P. Blaschek, Hideaki Yukawa(eds)(2010) Biomass to Biofuels: Strategies for Global Industries.Print ISBN:9780470513125 |Online ISBN:9780470750025 |DOI:10.1002/9780470750025 John Wiley & Sons, Ltd
2. Twidell., J & Weir., T.(2006)Renewable energy resources, Taylor & Francis 2nd Edition.

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bengaluru - 560 054

Course Title	Internship
Course Code	BTM401A
Department	Biotechnology
Faculty	Faculty of Life and Allied Health Sciences

1. Course Summary

The aim of this course is to enable students to experience a working environment in a Biopharmaceutical or Life Science organization.

The students visit various departments of an organization and observe the activities in the units as Research & Development, Manufacturing and Production, clean rooms and other relevant units and relate to underlying theoretical and practical concepts. Students are also required to understand the principles and processes practiced in the downstream and upstream processing involved in the production of any Biomolecule. They will also undergo a training program in the respective industry.

2. Course Size and Credits:

Number of Credits	3
Credit Structure (Lecture: Practical)	0:3
Total Hours of classroom Interaction	0
Number of laboratory hours	96
Number of Weeks in a Semester	16
Department Responsible	Biotechnology
Total Course Marks	100
Pass Requirement	As per the University Regulations
Attendance Requirement	As per the University Regulations

Teaching, Learning and Assessment

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO1. Discuss the organizational vision, mission, core values and structure relating to its products

CO2. Discuss the functional areas, and operational activities of various sectors of Biopharmaceutical industries

CO3. Summarize SWOT analysis, GLP and GMP of the organization

CO4. Explain the regulatory measures for new biomolecule production and launching

CO5. Prepare internship report as per prescribed format

4. Course Contents

Theory

1. Study the profile, Vision and Mission, Product range of the organisation
2. Study organisational structure of the selected organisation in relation to the product development
3. Conduct a detailed SWOT analysis of the organization

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore

M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

3. Elsa Cooper (2016) Bioresource Technology: Concepts, Design and Applications ISBN-13-9781682862261, ISBN-10-1682862267 Publisher:Syrawood Publishing House.

b. Recommended Reading

1. Luque, R., Camp, J., Hand book of biofuel production processes and technologies, Woodhead publishing ltd., 1st Edition, 2011.

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

4. Study Functional areas and Operational activities of various sectors of Biopharmaceutical industries
5. Select a particular function in the department and study the process in detail including the various stakeholders involved
6. Identify good laboratory practices and good manufacturing practices in the sectors
7. Regulatory bodies and regulations involved in production and launching of a biomolecule
8. Prepare and present internship report in the prescribed format.

5. CO-PO PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	2	2	-	-	-	-	2	2	-	-	-	2	2	2	3
CO-2	2	2	-	-	-	-	2	3	1	1	-	2	2	2	3
CO-3	2	-	2	-	3	-	-	3	1	1	-	2	2	2	3
CO-4	2	-	2	-	3	-	-	3	2	-	-	2	2	2	3
CO-5	-	-	2	-	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 interaction		06
Industry Internship		90
Field work/Training	50	
Report Writing	20	
Presentation preparations	10	
Evaluation of Report and Presentations	10	
Total Duration in Hours		96

7. Method of Assessment

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 (60% Weightage)	SEE (40% Weightage)
	60 Marks	40 Marks
CO-1	X	
CO-2	X	
CO-3	X	
CO-4	X	
CO-5		X

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Component - 1: 60% weight - Presentation and Viva-voce
Component - 2: 40% weight - Internship Report

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 Outcome

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	Internship
2.	Understanding	Internship
3.	Critical Skills	Internship
4.	Analytical Skills	Internship
5.	Problem Solving Skills	Internship
6.	Practical Skills	Internship
7.	Group Work	Internship
8.	Self-Learning	Internship Report
9.	Written Communication Skills	Internship Report, Logbook/Internship Diary
10.	Verbal Communication Skills	Presentation
11.	Presentation Skills	Presentation
12.	Behavioral Skills	Interaction with employees of the organization
13.	Information Management	Internship Report
14.	Personal Management	Internship
15.	Leadership Skills	

9. Course Resources

a. Essential Reading

1. Organization website
2. Organisation documents
3. Study on the Industry sectors

b. Websites

1. https://www.nseindia.com/

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

RAMAIAH UNIVERSITY OF APPLIED SCIENCES

M. S. Ramaiah University of Applied Sciences

Course Specifications

of

B.Sc. (Hons. with Research) in Biotechnology

Programme Code: 018

SEMESTER 8

Department of Biotechnology
Faculty of Life and Allied Health Sciences
M S Ramaiah University of Applied Sciences

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

Registrar
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Course Title	Research Project
Course Code	BTP401A
Programme	B.Sc. Biotechnology
Department	Biotechnology
Faculty	Life and Allied Health Sciences

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	21
Credit Structure (Lecture: Practical)	0:21
Total Hours of classroom Interaction	0
Number of laboratory hours	672
Number of Weeks in a Semester	16
Department Responsible	Biotechnology
Total Course Marks	400
Pass Requirement	As per the University Regulations
Attendance Requirement	As per the University Regulations

Teaching, Learning and Assessment

3. Course Outcomes

After undergoing this course students will be able to:

CO1. Identify and define a research question in the domain of Biotechnology/Life Sciences
CO2. Formulate a hypothesis to address the research question
CO3. Propose methodology to test the hypothesis
CO4. Analyse the data collected through experiments
CO5. Prepare a project report as per the specified guidelines
CO6. Presentation of research findings in an appropriate forum

4. Course Contents

The Research Project will cover the following:

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

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

5. CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	3	-	-	3	-	2	1	3	3	2	2	3	3	3
CO-2	2	3	-	-	3	-	2	1	3	3	2	2	3	3	3
CO-3	2	3	3	-	3	-	2	1	2	3	2	2	3	3	3
CO-4	2	3	-	3	3	-	2	1	2	2	2	2	3	3	3
CO-5	-	-	-	-	3	3	2	1	2	1	2	-	3	3	3
CO-6	-	-	-	-	3	3	2	1	2	1	2	-	3	3	3
		3: High Influence, 2: Moderate Influence, 1: Low Influence													

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours
1. Defining Problem, Aim, Objective & Methodology in concurrence with academic and industrial guide	20
2. Literature Review	40
3. Plan, design and execution of experiments	302
4. Data collection, Analysis and Interpretation	90
5. Discussion with supervisor	20
6. Propose solution / Design / Model etc	90
7. Demonstration, Presentation and Technical	60
8. Report presentation	50
Total Duration in Hours	**672**

7. Method of Assessment

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.

There are two components for assessment in this course:

	Type of Assessment	
Course Outcome	Component-I (Synopsis, Interim and Final Presentation, Viva-voce, Demonstration) 240 Marks	Component-II (Project Report) 160 Marks
CO1.	X	X
CO2.	X	X
CO3.	X	X
CO4.	X	X
CO5.	X	X

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

Dean - Academic Affairs
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

Component - 1: 60% weight - Conduction of experiments, synopsis, interim presentation, viva voce and presentation will be evaluated for maximum of 240 marks

Component - 2: 40% weight - Submission of project report will be evaluated in the semester end examination for maximum of 160 marks. The assessment questions are set to test the learning outcomes. In each component certain learning outcomes are assessed. The above table illustrates the focus of learning outcome in each component assessed.

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	Project Work
2.	Understanding	Project Work\ Interaction with Supervisor
3.	Critical Skills	Project Work
4.	Analytical Skills	Project Work
5.	Problem Solving Skills	Project Work
6.	Practical Skills	Project Work
7.	Group Work	Project Work
8.	Self-Learning	Project Work
9.	Written Communication Skills	Project Report
10.	Verbal Communication Skills	Examination, Viva-Voce
11.	Presentation Skills	Presentation, Viva-Voce
12.	Behavioral Skills	Project Work
13.	Information Management	Project Report
14.	Personal Management	Project Work
15.	Leadership Skills	

9. Course Resources

a. Essential Reading

1. Gurumani, N., 2006, Research methodology for biological sciences, MJP Publishers.

b. Recommended Reading

1. Gurumani, N., 2010, Scientific Thesis Writing And Paper Presentation, 1st Edition, MJP Publishers.

c. Web resources

1. https://www.ncbi.nlm.nih.gov/pubmed
2. https://www.sciencedirect.com/
3. https://www.biomedcentral.com/
4. http://www.nature.com/
5. https://www.cell.com/

d. Other Electronic Resources

1. Journals related to the respective topics of research

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

RAMAIAH UNIVERSITY OF APPLIED SCIENCES

M. S. Ramaiah University of Applied Sciences

Course Specifications

of

B.Sc. (Hons.) in Biotechnology
Programme Code: 018

SEMESTER 8

Department of Biotechnology
Faculty of Life and Allied Health Sciences
M S Ramaiah University of Applied Sciences

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

Dean
Faculty of Life & Allied Health Sciences
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Course Title	Data management in Biotechnology
Course Code	BTC404A
Department	Biotechnology
Faculty	Life and Allied Health Sciences

1. Course Summary

This course introduces students to Microsoft Excel as a powerful tool for data a nalysis, visualization, and problem-solving. Students will learn to organize, analyze, and present data effectively. Emphasis will be placed on applications in the field of biotechnology, such as growth curves, enzyme kinetics, metabolite analysis, bioprocess data, and genomics.

2. Course Size and Credits:

Number of Credits	05
Credit Structure (Lecture: Practical)	3:2
Total Hours of classroom Interaction	45
Number of laboratory hours	60
Number of Weeks in a Semester	16
Department Responsible	Biotechnology
Total Course Marks	100
Pass Requirement	As per the University Regulations
Attendance Requirement	As per the University Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO-1. Import and clean data in excel
CO-2. Understand and use elementary excel syntax and functions
CO-3. Understand and use advanced excel syntax and functions
CO-4. Analyze experimental data using excel
CO-5. Visualize Biological Data using excel
CO-6. Perform biostatistical analyses using excel
CO-7. An introduction to genomics using excel

4. Course Contents

Theory

Unit I: Data Importation and cleaning in Biotechnology. Importing CSV/text files from sequencing, spectrophotometers, and lab instruments. Handling missing values, outliers, and duplicates. Standardizing data formats (units, nomenclature, date/time).

Unit II: Elementary Excel functions and syntax. Relative (A1), absolute (A1), and mixed (A$1, $A1) references, structure of formulae, Excel's order of operations. Arithmetic and aggregation tools such as SUM, AVERAGE, COUNT, ROUND, ROUNDUP, and ROUNDDOWN. Descriptive statistics like MIN, MAX, MEDIAN, MODE, STDEV.S, and VAR.S, logical functions like IF, AND, OR, and NOT.

Unit III: Advanced Excel functions and syntax. Lookup and reference tools such as VLOOKUP,

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

HLOOKUP, XLOOKUP, and INDEX with MATCH. LNested IF, IFS, and IFERROR for error handling. Text functions like LEFT, RIGHT, MID, LEN, TRIM, CONCAT, and TEXTJOIN.

Unit IV: Experimental Data Analysis. Growth curve data (OD600 readings vs. Time). Enzyme kinetics (Michaelis–Menten plots, Lineweaver–Burk transformation). Gene/protein expression datasets

Unit V: Visualization for Biological Data. Scatter plots with trendlines for kinetics. Heatmaps using conditional formatting (e.g., gene expression levels). Boxplots for comparing experimental groups. Power BI for creating interactive dashboards and visualizations of large-scale biological datasets.

Unit VI: Biostatistical Functions in Excel. Descriptive statistics (mean, median, SD, error bars). Correlation and regression analysis. t-tests and ANOVA with Excel's Data Analysis ToolPak.

Unit VII: Genomics using excel. Managing gene expression datasets, organizing sequencing output, and handling variant tables. Lookup functions to map gene IDs to annotations. AVERAGE, STDEV.S, and CORREL to analyze gene expression patterns. Pivot tables and conditional formatting to identify trends such as upregulated or downregulated genes across experimental conditions. Scatter plots and heat maps to summarize and present genomic data.

Practical

1. Import and clean sequencing CSV files by handling missing values, duplicates, and standardizing units.
2. Practice relative, absolute, and mixed references while applying basic arithmetic functions like SUM and AVERAGE on spectrophotometer data.
3. Use descriptive statistics (MIN, MAX, STDEV.S, VAR.S) and logical functions (IF, AND, OR, NOT) to analyze enzyme assay outputs.
4. Apply lookup functions (VLOOKUP, XLOOKUP, INDEX–MATCH) and text functions (TRIM, CONCAT, TEXTJOIN) on gene annotation datasets.
5. Analyze bacterial growth curve data in Excel by plotting OD600 vs. time and fitting trendlines.
6. Create enzyme kinetics plots (Michaelis–Menten and Lineweaver–Burk) from absorbance/time data and interpret results.
7. Perform statistical tests (t-test, ANOVA, regression) using Excel's Data Analysis ToolPak on protein expression data.
8. Manage gene expression tables with pivot tables and conditional formatting to highlight upregulated/downregulated genes, followed by scatter plot and heatmap visualizations.

5. CO-PO PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	2	2	3	3	1	1	1	2	1	2	1	2	2	2	2
CO-2	2	2	2	3	1	1	1	1	1	1	1	2	2	2	2
CO-3	3	3	3	3	2	2	2	2	2	2	1	2	3	3	2
CO-4	2	2	2	3	2	3	1	1	2	3	1	2	2	2	2
CO-5	2	3	2	3	2	2	1	2	3	3	1	2	2	3	3
CO-6	3	2	3	3	1	1	1	2	1	2	1	2	3	3	3
CO-7	2	2	2	3	1	1	2	1	1	1	1	2	3	3	3
		3: High Influence, 2: Moderate Influence, 1: Low Influence													

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		45
Demonstrations		31
1.Demonstration using Videos	9	
2. Demonstration using Physical Models / Systems	2	
3. Demonstration on a Computer	20	
Numeracy		0
1. Solving Numerical Problems	00	
Practical Work		56
1. Course Laboratory	56	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		10
1. Case Study Presentation	02	
2. Guest Lecture	02	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	02	
5. Group Discussions	02	
6. Discussing Possible Innovations	02	
Term Tests, Laboratory Examination/Written Examination, Presentations		4+4
Total Duration in		**105**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the UG Programme (B.Sc. / B.Com/ BBA). The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2, SC3 or SC4), COs are assessed as illustrated in the following Table.

Focus of Course Learning Outcomes in each component assessed				
	CE (60% Weightage)			SEE (40% Weightage)
	SC1 Term Tests 30 %	SC2 Assignments 10%	SC3 Assignments 20%	
	25 + 25 Marks	10 Marks	40 Marks	50 Marks
CO-1	X	X		X
CO-2	X			X
CO-3	X		X	X

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

CO-4		X	X	X
CO-5		X		X
CO-6	X		X	X
CO-7		X	X	X

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

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

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	Face to face lectures
2.	Understanding	Face to face lectures, group discussions
3.	Critical Skills	Excel coding assignments
6.	Practical Skills	Excel coding assignments
7.	Group Work	Course work, practice, assignment, group discussion
8.	Self-Learning	Course work, practice, assignment, group discussion
9.	Written Communication Skills	–
10.	Verbal Communication Skills	–
11.	Presentation Skills	--
12.	Behavioral Skills	Course work, practice, assignment, group discussion, presentation practice.
13.	Information Management	Excel coding assignments
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

a. Essential Reading

1. Winston, W. L. (2016). *Microsoft Excel Data Analysis and Business Modeling* (5th ed.). Redmond, WA: Microsoft Press.
2. Neufert, A., & Bunse-Gerstner, A. (2019). *Excel 2019 for Scientists* (2nd ed.). Cham: Springer.

b. Recommended Reading

1. Walkenbach, J. (2015). Excel 2016 Bible. Hoboken, NJ: John Wiley & Sons.
2. Excel 2019 for Biological and Life Sciences Statistics: A Guide to Solving Practical Problems. Springer.

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

Registrar (Academics)
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

Course Title	Food Biotechnology and Nutraceuticals
Course Code	BTC405A
Department	Biotechnology
Faculty	Faculty of Life and Allied Health Sciences

1. Course Summary

The course on Food Biotechnology and Nutraceuticals aims to provide students with a comprehensive understanding of the application of biotechnology in food production, processing, preservation, and quality enhancement, along with insights into the development and use of functional foods and nutraceuticals.

It is designed to equip students with knowledge of microbial, enzymatic, and molecular tools applied in food biotechnology, while also emphasizing the role of bioactive compounds in promoting health and preventing disease. The course seeks to bridge fundamental scientific principles with industrial applications, regulatory perspectives, and emerging trends in the field, preparing students for research, innovation, and careers in food and health-related industries.

2. Course Size and Credits:

Number of Credits	5
Total Hours of Classroom Interaction	45
Number of laboratory Hours	60
Number of Semester Weeks	16
Department Responsible	Biotechnology
Course Marks	100
Pass Requirement	As per university regulations
Attendance Requirement	As per university regulations

Teaching, Learning and Assessment

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO1. Explain the principles, scope, and historical development of food biotechnology.
CO2. Apply molecular and genetic tools such as rDNA technology, GMOs, and CRISPR to analyze and evaluate their applications in food biotechnology
CO3. Evaluate food safety systems, regulatory aspects, and emerging technologies in food processing.
CO4. Demonstrate the ability to analyze and apply microbial and enzymatic methods for food product development
CO5. Assess the role of functional foods and nutraceuticals in promoting human health. CO6.Perform standard microbiological, biochemical, and molecular techniques to isolate, analyze, and characterize food-associated microorganisms and bioactive compounds.
CO7. Apply fermentation, enzyme technology, and antioxidant assays to evaluate functional properties of foods and gain experiential knowledge through industry exposure.

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

4. Course Contents

Theory

Unit 1: Introduction to Food Biotechnology, Food Biotechnology: Definition, scope, and historical development; comparison of traditional and modern approaches in food biotechnology; applications in food production, preservation, and processing; strategies for controlling microbiological quality and ensuring food safety; overview of food-borne illnesses and related diseases; role of microbial cultures in food fermentation, including their maintenance and strain improvement.

Unit 2: Genetically Modified Food, GM foods: Introduction and controversies related to GMOs; Ethical issues concerning GM foods; testing for GMOs; current regulatory guidelines governing the production, release, and movement of GMOs; labelling and traceability; trade related aspects; biosafety; risk assessment and risk management. Public perception of GM foods, IPR, GMO Act–2004; development of novel products and processes in plant- and animal-based food commodities; Recombinant DNA technology and molecular tools; Nutritional improvements via biotechnology (GM crops, biofortification); Gene editing (CRISPR-Cas9) in food improvement.

Unit 3: Food Quality and its Regulations, Analysis of food, major ingredients present in different product, Food additives colour, flavour, vitamins, Microbial safety of food products, Chemical safety of food products, heavy metal, fungal toxins, and pesticide/herbicide residues; overview of foodborne pathogens and spoilage microorganisms; modern detection technologies such as PCR, ELISA, and biosensors; approaches for shelf-life extension; Food safety management systems (ISO 22000, HACCP), Regulatory aspects: FSSAI, Codex, HACCP, GMP, GHP.

Unit 4: Production of Food Products, Production of organic acids (citric acid, vinegar, lactic acid); alcoholic beverages (beer, wine, and distilled alcoholic beverages such as whiskey, rum, vodka); Propagation of baker's yeasts; Microbial production of vitamins (B2 and B12); antibiotics (penicillin, streptomycin, tetracycline); enzymatic production of glucose, fructose, starch, SCP and mushrooms.

Unit 5: Functional Foods & Nutraceuticals, Definitions, scope, and classifications: functional foods, nutraceuticals, dietary supplements; Bioactive components: phytochemicals, antioxidants, peptides, omega fatty acids, fibers, probiotics and prebiotics; Manufacturing of nutraceuticals: (lycopene, isoflavonoids, glucosamine, phytosterols); Role of functional food and neutraceuticals in health and diseases.

Practical:

1. Good Laboratory Practices (GLP) in a food biotech lab
2. Isolation and enumeration of microorganisms from food samples
3. Microbial analysis of milk (MBRT test)
4. Production of probiotic cultures and viability testing
5. Enzyme assay: amylase activity from microbial cultures
6. Enzyme immobilization and activity testing
7. DNA extraction from plant/food samples
8. PCR amplification of target genes from food microbes
9. Fermentation of dairy products/acoholic breverages
10. Extraction and quantification of antioxidants from plant foods
11. Determination of antioxidants by DPPH method
12. Visit to Functional food/Nutraceuticals manufacturing industry

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

5. CO-PO PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	2	-	-	3	-	-	-	-	2	2	1	1	2	1
CO-2	3	3	2	-	3	-	-	-	-	2	2	3	3	2	2
CO-3	3-	3	2	-	3	-	-	2	1	2	2	3	1	3	3
CO-4	3	2	2	-	3	-	-	-		2	2	3	3	2	2
CO-5	3	3	2	-	3	-	-	-	-	3	2	3	3	3	3
CO-6	3	3	3	2	3	-	-	2	2	2	3	3	3	3	3
CO-7	3	3	3	2	2	-	-	2	-	3	3	3	3	3	3
3: High Influence, 2: Moderate Influence, 1: Low Influence															

6. Course Teaching and Learning Methods:

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		**30**
Demonstrations		03
1. Demonstration using Videos	02	
2. Demonstration using Physical Models / Systems	01	
3. Demonstration on a Computer		
Numeracy		
1. Solving Numerical Problems		
Practical Work		**50**
1. Course Laboratory	50	
2. Computer Laboratory		
3. Engineering Workshop / Course/Workshop / Kitchen		
4. Clinical Laboratory		
5. Hospital		
6. Model Studio		
Others		15
1. Case Study Presentation	1	
2. Guest Lecture	4	
3. Industry / Field Visit	8	
4. Brain Storming Sessions		
5. Group Discussions	01	
6. Discussing Possible Innovations	01	
Term Tests, Laboratory Examination/Written Examination, Presentations		7
Total Duration in Hours		**105**

Head
Department of Biotechnology
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

6. Method of Assessment

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 (60% Weightage)			SEE (40% Weightage)	
	SC1 (Term Tests) 30%	SC2 (Innovative + Lab assignment) 10%	SC3 (Written+ Lab Assignment) 20%	SEE (Theory) 25%	SEE (Lab) 15%
	(25 + 25 Marks)	10 Marks	20 Marks	50 Marks	30 Marks
CO-1	X	X		X	
CO-2	X	X		X	
CO-3	X		X	X	
CO-4			X	X	
CO-5				X	
CO-6		X	X		X
CO-7		X	X		X

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, Examination
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	--

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

Dean Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

8. Course Resources

a. Essential Reading

1. Zeuthen, P., Cheftel, J.C., Eriksson., Gormley, T.R., Linko, P and Paulus, K, Processing and Quality of Foods: Food Biotechnology: Avenues to healthy and nutritious products. Elsevier Applied Science.
2. Kalidas Shetty, Gopinathan Paliyath, Anthony Pametto, Robert E.Levin, Food Biotechnology, 2nd edition, Taylor & Francis.
3. Robert EC. 2006. Handbook of Nutraceuticals and Functional Foods. 2nd Ed. Wildman.
4. Shi J. (Ed.). 2006. Functional Food Ingredients and Nutraceuticals: Processing Technologies. CRC Press.
5. Webb GP. 2006. Dietary Supplements and Functional Foods. Blackwell Publ.

b. Recommended Reading

1. Introduction to food biotechnology by perry Johnson-Green (2018)
2. Neeser JR and German BJ. 2004. Bioprocesses and Biotechnology for Nutraceuticals. Chapman and Hall.
3. Tomar S.K. 2011. Functional Dairy Foods Concepts and Applications. Satish Serial Publishing House, Delhi.
4. Mingruo Guo. 2009. Functional food: principle and technology. CRC Press
5. .Woodhead publishing limited. New Delhi

c. Magazines and Journals

1. https://egyankosh.ac.in/bitstream/123456789/99619/1/Unit-1.pdf
2. FOOD SCIENCE and TECHNOLOGY-Magazine
3. Current Nutraceuticals
4. Journal of Nutraceuticals, Functional and Medical Foods

d. Websites

1. https://foodinsight.org/
2. http://www.nutraceuticalinstitute.com
3. http://www.nutraceuticalalliance.com

e. Other Electronic Resources

1. https://www.ncbi.nlm.nih.gov/pmc/articles

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

Course Title	Good Manufacturing Practices and Quality Control
Course Code	BTC406A
Department	Biotechnology
Faculty	Life and Allied Health Sciences

1. Course Summary

The course aims to provide students with a comprehensive understanding of the principles, regulations, and practices of Good Manufacturing Practices (GMP) and Quality Control (QC). It seeks to develop the knowledge and skills required to ensure the production of safe, effective, and high-quality products in pharmaceuticals, biotechnology, and food industries. Students will gain insight into regulatory frameworks, facility and process design, quality testing, documentation systems, and risk management approaches essential for maintaining global quality standards and regulatory compliance.

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 University Regulations
Attendance Requirement	As per University Regulations

Teaching, Learning and Assessment

3. Course Outcomes

After undergoing this course students will be able to:

CO 1. Explain the principles and importance of GMP in ensuring product quality and safety.
CO 2. Apply GMP principles to manufacturing workflows
CO 3. Implement validation protocols and ensure data integrity
CO 4. Integrate QA systems to ensure consistent product quality
CO 5. Conduct GMP audits and manage deviations effectively

4. Course Contents

Unit 1: Fundamentals of GMP and Regulatory Frameworks, Introduction to GMP: history, objectives, and importance, International GMP standards: WHO, US FDA, EU, PIC/S, ICH, Indian GMP regulations (Schedule M, FSSAI for food, AYUSH guidelines), GMP in different sectors: pharmaceuticals, food, cosmetics, nutraceuticals, Roles of regulatory bodies and compliance requirements

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Unit 2: GMP Requirements and Facility Design, Facility design and layout for GMP compliance, Equipment qualification (IQ, OQ, PQ, DQ); calibration and maintenance, Personnel hygiene, training, and gowning procedures, Raw material handling, storage, and traceability, Process controls and in-process checks, Environmental monitoring and contamination control

Unit 3: Documentation, Validation, and Data Integrity, Good Documentation Practices (GDP), Batch manufacturing records, SOPs, logbooks, Validation types: process, cleaning, analytical method validation, Calibration and qualification of instruments, Data integrity principles (ALCOA+) and audit trails, Electronic records and signatures (21 CFR Part 11 compliance)

Unit 4: Quality Control and Quality Assurance Systems, QC vs QA: roles and responsibilities, Sampling plans and statistical quality control, Physical, chemical, and microbiological testing of raw materials and finished products, Stability studies and shelf-life determination, Out-of-specification (OOS) and out-of-trend (OOT) investigations, Risk management in QC (ICH Q9)

Unit 5: Audits, Deviations, and Continuous Improvement, Internal and external audits: planning, execution, and follow-up, Self-inspection programs, Deviation management, CAPA (Corrective and Preventive Actions), Complaint handling and product recall procedures, Continuous improvement tools (Six Sigma, Lean principles), Case studies of GMP failures and product recalls, Future perspectives: automation, AI, and digitalization in GMP and QC

5. CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	2	3	3	2	-	-	3	2	2	2	2	3	3	2
CO-2	3	2	3	3	2	-	-	3	2	2	2	2	3	3	2
CO-3	3	2	3	3	2	-	-	3	2	2	2	2	3	3	2
CO-4	3	2	3	3	2	-	-	3	2	2	2	2	3	3	2
CO-5	3	2	3	3	2	-	-	3	2	2	2	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		30
Demonstrations		04
1. Demonstration using Videos	04	
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		

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

5. Hospital		
6. Model Studio		
Others		07
1. Case Study Presentation	03	
2. Guest Lecture		
3. Industry / Field Visit		
4. Brain Storming Sessions		
5. Group Discussions	03	
6. Discussing Possible Innovations	01	
Term Test and Written Examination		04
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 (60% Weightage)			SEE (40% Weightage)
	SC1 Term Tests 30 %	SC2 Assignments 15%	SC3 Assignments 15%	
	25 + 25 Marks	25 Marks	25 Marks	50 Marks
CO-1	X	X		X
CO-2	X	X		X
CO-3	X	X	X	X
CO-4	X		X	X
CO-5			X	X

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

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

8. Achieving Course Learning Outcomes

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

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	GroupWork	--
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. Willig, S.H., Stoker, J.R. & Tuckerman, M.M., 2017. Good Manufacturing Practices for Pharmaceuticals. 7th ed. New York: CRC Press.
2. Sharp, J., 2005. Good Pharmaceutical Manufacturing Practice: Rationale and Compliance. 2nd ed. London: CRC Press.
3. Vasconcellos, J. & Saraiva, J., 2018. Good Manufacturing Practices for the Food Industry. Boca Raton: CRC Press.
4. Cooney, C.L. & Kowalski, R., 2017. Bioprocessing: Principles and Applications for Biotechnology. 2nd ed. New York: Wiley.

b. Recommended Reading

1. Mortimore, S. & Wallace, C., 2013. HACCP: A Practical Approach. 3rd ed. New York: Springer.
2. Hui, Y.H. & Evranuz, E.Ö., 2015. Handbook of Food Safety Engineering. Chichester: Wiley-Blackwell.
3. Agalloco, J. & Carleton, F.J., 2008. Validation of Pharmaceutical Processes. 3rd ed. New York: Informa Healthcare.
4. Liu, D., 2019. Biopharmaceutical Manufacturing: Technology and Process Development. New York: Wiley.

c. Magazines and Journals

1. https://link.springer.com/journal/12247
2. https://www.sciencedirect.com/journal/journal-of-food-protection
3. https://www.sciencedirect.com/journal/regulatory-toxicology-and- pharmacology

d. Websites

1. Innovations in biotechnology: Recent advances and future directions
2. https://www.who.int/teams/health-product-and-policy-standards/quality-assurance/gmp
3. https://www.fda.gov/drugs/pharmaceutical-quality-resources/current-good-manufacturing-practices-cgmps

e. Other Electronic Resources

1. https://www.ijpsjournal.com/assetsbackoffice/uploads/article/A+Review+on+Quality+Assurance+and+Quality+Management+System+in+Pharmaceutical+Industry.pdf

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

Course Title	Group Project
Course Code	BTP402A
Department	Biotechnology
Faculty	Life and Allied Health Sciences

1. Course Summary

The aim of this course is to give students an experience of addressing a real time problem in Biotechnology. The students are expected to work in a team of not more than 4 members and are required to develop an appropriate solution by identifying a problem for which a better or new solution is required. The team need to propose a solution / develop a physical product and write a project report.

2. Course Size and Credits:

Number of credits	8
Total hours of class room interaction during the semester	0
Total number of hours for the team of 4 members	256
Number of semester weeks	16
Department responsible	Biotechnology
Course marks	Total Mark: 100 Component 1(CE): 60% Weight Presentation, Viva-voce, Demonstration Component 2(SEE): Project Report: 40% Weight
Pass requirement	As per University Regulations
Attendance requirement	As per University Regulations

Teaching, Learning and Assessment

3. Course Outcome (CO)

After undergoing this course students will be able to:

CO1. Identify and define a real time problem in Biotechnology or related Life Science

CO2. Identify appropriate methodology to solve the problem

CO3. Propose solutions to the problem identified

CO4. Prepare a project report as per the specified guidelines

CO5. Presentation of the research finding in an appropriate forum

4. Course Contents

1. Identifying a problem for which a better or new solution is required, through literature review or as defined by Biotechnology experts from Industry
2. Defining the scope of the problem followed by aim and objectives
3. Identifying the methodology to meet the objectives
4. Data collection, analysis and interpretation
5. Propose solution based on data analysis and interpretation (Can be a physical

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

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

Dean - Academics
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

product as well)

6. Preparing/ writing a project report and presentation in appropriate forum

5. CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	2	2	3	2	3	1	1	2	1	2	1	2	3	3	3
CO-2	2	2	2	3	3	1	1	1	1	1	1	2	3	3	3
CO-3	3	3	3	2	3	2	2	2	2	2	1	2	3	3	3
CO-4	2	2	2	2	2	3	1	1	2	3	1	2	2	2	2
CO-5	2	3	2	3	2	3	1	2	3	3	1	2	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
1. Defining Problem, Aim, Objective & Methodology in concurrence with academic and industrial guide	10
2. Literature Review	20
3. Plan, design and execution of experiments	100
4. Data collection, Analysis and Interpretation	40
5. Discussion with supervisor	10
6. Propose solution / Design / Model etc	26
7. Demonstration, Presentation and Technical	30
8. Report presentation	20
Total Duration in Hours	256

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.

There are two components for assessment in this course:

	Type of Assessment	
Course Outcome	Component-I (Synopsis, Interim and Final Presentation, Viva-voce, Demonstration) 60 Marks	Component-II (Project Report) 40 Marks
CO1.	X	X
CO2.	X	X
CO3.	X	X
CO4.	X	X
CO5.	X	X

Head
Department of Biotechnology
Ramaiah University of Applied Sciences
Bangalore - 560 054

Component - 1: 60% weight - Conduction of Laboratory exercises, presentation, viva voce and demonstration will be evaluated for maximum of 50 marks.

Component - 2: 40% weight - Submission of project report will be evaluated in the semester end examination for maximum of 50 marks. The assessment questions are set to test the learning outcomes. In each component certain learning outcomes are assessed. The above table illustrates the focus of learning outcome in each component assessed.

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	Project Work
2.	Understanding	Project Work\ Interaction with Supervisor
3.	Critical Skills	Project Work
4.	Analytical Skills	Project Work
5.	Problem Solving Skills	Project Work
6.	Practical Skills	Project Work
7.	Group Work	Project Work
8.	Self-Learning	Project Work
9.	Written Communication Skills	Project Report
10.	Verbal Communication Skills	Examination, Viva-Voce
11.	Presentation Skills	Presentation, Viva-Voce
12.	Behavioral Skills	Project Work
13.	Information Management	Project Report
14.	Personal Management	Project Work
15.	Leadership Skills	Team work

9. Course Resources

a. Essential Reading

1. Gurumani, N., 2006, *Research methodology for biological sciences*, MJP Publishers.

b. Recommended Reading

1. Gurumani, N., 2010, *Scientific Thesis Writing And Paper Presentation*, 1st Edition, MJP Publishers.

c. Magazines and Journals

1. Journals related to the respective topics of research

d. Websites

1. https://www.ncbi.nlm.nih.gov/pubmed
2. https://www.sciencedirect.com/
3. https://www.biomedcentral.com/
4. http://www.nature.com/
5. https://www.cell.com/

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

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

RAMAIAH UNIVERSITY OF APPLIED SCIENCES

University House
New BEL Road
MSR Nagar
Bangalore-560 054

T 080 4536 6666
F 080 4536 6677
E info@msruas.ac.in
W www.msruas.ac.in
www.ramaiah-india.org

Addendum

The programme matrix and curriculum for B.Sc. in Biotechnology, B.Sc. (Honours with Research) in Biotechnology, and B.Sc. (Honours) in Biotechnology, framed in accordance with NEP 2020, have been approved and revised in successive Academic Council Meetings (ACMs).

Approval and Revision History

I. 26th Academic Council Meeting (ACM) – 14th July 2022

1. The Programme Structure for B.Sc. (Honours) in Biotechnology was conceptualized, presented, and approved.
2. The course structures for the first and second semesters were approved.

II. 28th Academic Council Meeting (ACM) – 3rd April 2023

1. The course structures for the third and fourth semesters were approved.
2. A minor revision was approved for the first semester course, wherein **Biophysical Techniques and Instrumentation** was renamed **Biological Techniques and Instrumentation**, with advanced instrumentation shifted to the seventh semester based on stakeholder feedback.

III. 31st Academic Council Meeting (ACM) – 22nd March 2024

1. A minor revision and reordering of the third- and fourth-year programme matrix were approved based on BoS recommendations, including shifting **Medical Biotechnology** to the fifth semester, **Competitive Examination Training** in the sixth semester and **Internship** in the seventh semester. A new course, **Green Energy Technologies,** was introduced as Discipline-Specific Elective in the seventh semester.
2. The course structures for the fifth to eighth semesters were approved.

IV. 36th Academic Council Meeting (ACM) – 27th September 2025

The introduction of two four-year undergraduate degree tracks was discussed and approved with the eligibility criteria given below. For students opting to continue into the fourth year of the B.Sc. programme, eligibility for the respective degree track shall be determined as follows:

1. **B.Sc. (Honours with Research) in Biotechnology:** Students who have completed 132 credits at the end of the first three academic years and secured a minimum CGPA of 7.5/10 shall be eligible. Eligible students shall undertake an individual research project of 21 credits in the eighth semester.
2. **B.Sc. (Honours) in Biotechnology**: Students who have completed the required credits but do not meet the CGPA criterion shall be awarded the B.Sc. (Honours) in Biotechnology and shall undertake 13 credits of prescribed coursework along with an 8 credit group project in the eighth semester.

Shruti Mathur

Dr. Shruti Mathur
Head, Department of Biotechnology
Faculty of Life and Allied Health Sciences

Head
Department of Biotechnology
M S Ramaiah University of Applied Sciences
Bangalore - 560 054

Dr. Soma Chaki
Dean, Faculty of Life and Allied Health Sciences

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

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054