MAR IVANIOS COLLEGE
(AUTONOMOUS)

Affiliated with the University Kerala

Thiruvananthapuram

Kerala

SCHEME AND SYLLABUS FOR THE
FOUR YEAR UNDERGRADUATE PROGRAMME (FYUGP)

INTERDISCIPLINARY
BOTANY AND BIOTECHNOLOGY

(With effect from 2024 Admissions)

Approved by the Board of Studies in Biotechnology

LIST OF COURSES OFFERED BY THE DEPARTMENT OF BIOTECHNOLOGY

CONTENTS

SEMESTER WISE DISTRIBUTION

Course code	Course Title	Course category	Credit	Hour distribution per week		
				L	**T**	**P**
SEMESTER – I Academic Level 100-199						
MIUK1DSCBBT100.1	Biotechnology For Human Welfare	DSC	4	3		2
MIUK1MDCBBT100.1	Biotechnology and Skincare Sciences	MDC	3	3		
SEMESTER – II Academic Level 100-199						
MIUK2DSCBBT100.1	Fundamentals of Microbiology	DSC	4	3		2
MIUK2MDCBBT100.1	Innovations in Biotechnology	MDC	3	3		
SEMESTER – III Academic Level 200-299						
MIUK3DSCBBT200.1	Bioinstrumentation	DSC	4	3		2
MIUK3VACBBT100.1	IPR and Ethics in Biotechnology	VAC	3	3		
SEMESTER – IV Academic Level 200-299						

MIUK4DSCBBT200.1	Molecular Biology	DSC	4	3		2
MIUK4DSEBBT200.1	Immunology	DSE	4	3		2
MIUK4SECBBT200.1	Bio Fertilizers and Bio Pesticide Production	SEC	4	3		2
SEMESTER – V Academic Level 300-399						
MIUK5DSCBBT300.1	Recombinant DNA Technology	DSC	4	3		2
MIUK5DSEBBT300.1	Molecular diagnostics	DSE	4	3		2
MIUK5SECBBT300.1	Entrepreneurship in Biotechnology	SEC	3	3		
SEMESTER – VI Academic Level 300-399						
MIUK6DSCBBT300.1	Industrial and Environmental Biotechnology	DSC	4	3		2
MIUK6DSCBBT302.1	Plant and Animal Biotechnology	DSC	4	3		2
MIUK6DSEBBT300.1	Forensic Science and Technology	DSE	4	4		
MIUK6DSEBBT302.1	Bioinformatics and Artificial Intelligence	DSE	4	4		
SEMESTER – VII Academic Level 400-499						
MIUK7DSCBBT400.1	Stem Cell and Tissue Engineering	DSC	4	3		2
MIUK7DSEBBT400.1	Genomics and Proteomics	DSE	4	4		
SEMESTER – VIII Academic Level 400-499						
MIUK8DSCBBT400.1	Research Methodology and Scientific Writing	DSC-ODL	4	4		
MIUK8DSCBBT402.1	General Virology	DSC-ODL	4	4		

PREAMBLE

National Education Policy (NEP 2020) envisions 'higher education as playing an extremely important role in promoting human as well as societal wellbeing and in developing India as envisioned in its Constitution - a democratic, just, socially conscious, cultured, and humane nation upholding liberty, equality, fraternity, and justice for all' (Section 9.1). NEP also expects higher education 'to develop good, thoughtful, well-rounded, and creative individuals, enabling an individual to study one or more specialized areas of interest at a deep level, and also develop character, ethical and Constitutional values, intellectual curiosity, scientific temper, creativity, spirit of service, and 21st century capabilities across a range of disciplines including sciences, social sciences, arts, humanities, languages, as well as professional, technical, and vocational subjects' (Section 9.1.1). Hence, more than the creation of greater opportunities for individual employment, higher education represents the key to more vibrant, socially engaged, cooperative communities and a happier, cohesive, cultured, productive, innovative, progressive, and prosperous nation. (Section 9.1.3). NEP also identifies some of the major problems currently faced by the higher education system in India (Section 9.2) and envisions a complete overhaul and re-energizing of the higher education system to overcome these challenges and thereby deliver high-quality higher education, with equity and inclusion (Section 9.3). One of the major changes which the policy proposes is moving towards a more multidisciplinary undergraduate education (Section 9.3(b)) which develops all capacities of human beings -intellectual, aesthetic, social, physical, emotional, and moral in an integrated manner (Section 11.3). In order to achieve this in its full potential, NEP visions the adjusting of the structure and lengths of degree programmes accordingly. "The undergraduate degree will be of either 3 or 4-year duration, with multiple exit options within this period, with appropriate certifications, e.g., a certificate after completing 1 year in a discipline or field including vocational and professional areas, or a diploma after 2 years of study, or a Bachelor 's degree after a 3-year programme. The 4-year multidisciplinary Bachelor's programme, however, shall be the preferred option since it allows the opportunity to experience the full range of holistic and multidisciplinary education in addition to a focus on the chosen major and minors as per the choices of the student." (Section 11.9)

In accordance with the NEP 2020, the UGC formulated a new student-centric "Curriculum
and Credit Framework for Undergraduate Programmes (CCFUP)" incorporating a flexible choice-based credit system, multidisciplinary approach, and multiple entry and exit options and establishing three Broad Pathways,

(a) 3-year UG Degree,

(b) 4-year UG Degree (Honours), and

(c) 4-year UG Degree (Honours) with Research)

Accordingly, the Kerala Higher Education Reforms Commission 2022, headed by Prof Shyam B. Menon, has recommended a comprehensive reform in the undergraduate

curriculum with the adoption of the 4-year undergraduate Programmes, which will bring undergraduate education in Kerala at par with the universities abroad. Consequently, Kerala State Curriculum Committee for Higher Education 2023 has been constituted, with Dr Suresh Das as Chairman, and they have proposed a model Kerala State Higher Education Curriculum framework for undergraduate education.

The University of Kerala has decided to introduce the Four Year Under Graduate Programmes (FYUGP) from the academic year 2024-2025 onwards in its teaching departments and all affiliated colleges, and has issued many draft documents and conducted college level awareness programmes about the same.

Mar Ivanios College, by virtue of its autonomy status, conferred in 2014 and extended in 2022, vide University Grants Commission (Conferment of Autonomous Status Upon Colleges and Measures for Maintenance of Standards in Autonomous Colleges) Regulations, 2023, has the power to review existing courses/programmes and, restructure, redesign and prescribe its own courses/programmes of study and syllabi and to formulate new courses/programmes within the nomenclature specified by UGC as per the Specification of Degrees 2014 as amended from time to time. Accordingly, the Board of Studies in Bitechnology of Mar Ivanios College (Autonomous) proposed the implementation of the FYUGP scheme with effect from 2024 admission onwards and prepared the scheme and syllabi through maf the meetings and discussions. The Academic Council of the college which met on 30th April have discussed the proposal and syllabi in detail and approved the same to be implemented from 2024 admission onwards, subject to the final directions of the University of Kerala. The salient features of the syllabus prepared and presented by the Board of Studies include the following:

The curriculum, designed based on the Outcome Based Education (OBE) approach, follows the Choice-Based Credit System (CBCS), allowing students to select courses from a prescribed list and requiring a specified number of credits to earn a degree. It adheres to the basic framework and minimum/maximum course and program credits set by the University of Kerala for the Four Year Undergraduate Programme (FYUGP), complying with the mandatory principles of the UoK-FYUGP Regulations, 2024.

The Bachelor of Science Honours program in Botany and Biotechnology, where students' journeys are not just about learning but about preparing them for impactful careers and groundbreaking research in the field. Throughout this program, students will be equipped with the knowledge, skills, and hands-on experience necessary to excel in both professional roles and research endeavors within the biotechnology sector. Our curriculum is designed to provide a strong foundation in fundamental biotechnological concepts while also delving into the latest innovations and advancements shaping the industry. As students progress through the program, they will gain practical experience with state-of-the-art laboratory techniques, data analysis methods, and scientific communication skills. This hands-on approach ensures that students are not only familiar with theoretical concepts but also adept at applying them in real-world settings.

\Moreover, our emphasis on interdisciplinary learning and integration of industry-relevant topics such as quality control and entrepreneurship development ensures that students are well-prepared to navigate the dynamic landscape of biotechnological careers. Whether students aspire to work in healthcare, agriculture, environmental conservation, or industrial biotechnology, our program equips them with the tools and knowledge to succeed. Furthermore, for those inclined towards research, our program offers opportunities to engage in meaningful research projects, collaborate with industry partners, and contribute to scientific advancements. Students will learn research methodology, scientific writing, and critical analysis skills that are essential for conducting impactful research studies. By the time students graduate from our program, they will not only have a solid foundation in biotechnology but also be ready to embark on rewarding careers or pursue further studies in research.

Adequate Discipline Specific Elective (DSE) specialisation courses will be provided in Molecular diagnostics and hence the students will be able to acquire 3 Year/4 Year (Honours) UG degree majoring in Botany and Biotechnology with specialisation in Molecular diagnostics.

Graduate Attributesand Programme Outcomes (POs)

The National Higher Education Qualification Framework (NHEQF) envisages that students on completion of a programme of study must possess and demonstrate the expected graduate profile/attributes acquired through one or more modes of learning. The graduate profile/attributes indicate the quality and feature or characteristics of the graduate of a programme of study, including learning outcomes relating to the disciplinary area(s) relating to the chosen field(s) of learning and generic learning outcomes that are expected to be acquired by a graduate on completion of the programme(s) of study. The graduate profile/attributes include capabilities that help widen the current knowledge base and skills, gain and apply new knowledge and skills, undertake future studies independently, perform well in a chosen career, and play a constructive role as a responsible citizen in the society. The graduate profile/attributes are acquired incrementally and describe a set of competencies that are transferable beyond the study of a particular subject/disciplinary area and programme contexts in which they have been developed. Graduate profile/attributes are fostered through meaningful learning experiences made available through the curriculum and learning experience, the total college/university experience, and a process of critical and reflective thinking. Mar Ivanios College (Autonomous) is fully committed to ensuring the attainment of the necessary graduation attributes by the students. The college has clearly defined its raison de'tre, the philosophy of its existence, through the Motto "Truth Shall Liberate You" (Veritas Vos Liberabit) which refers to the ultimate enlightenment which can emerge only at the intersection of sharp intellect, sound physique, strong mind, staunch ethics, and profound spirituality. This is further made explicit through its Vision, Mission and Goals and the same expect all students who graduate from the college to:

- Have inculcated "the values of truth and charity for the protection and promotion

of human dignity and of a cultural heritage, through teaching, research, and extension activities dedicated to society";

- Be co-creators of a vibrant academic community known for its innovation, intellectual rigour and social commitment;
- Be "intellectually trained, morally upright, socially committed, spiritually inspired and ecologically conscious young men and women who would be dedicated to working for the good of society, the nation and the world";
- Have acquired "global competencies and skills";
- Have inculcated a sense of harmony, equality and fraternity among youth, transcending religious, linguistic, regional or sectional diversities; and
- Have developed "scientific temper, humanism and the spirit of inquiry and reform".

The Programme Outcomes (POs) for the FYUGP programmes across all streams and pathways, based on the above core philosophy, and in consonance with the National Higher Education Qualifications Framework (NHEQF) are given below:

Programme Outcomes (PSO)

By the end of the Four-Year Under-Graduate Programme, students will:

PO 1	Demonstrate the acquisition of all necessary knowledge and skills within their disciplinary/ multi-disciplinary areas of learning. **These include the acquisition of:** • **comprehensive knowledge and coherent understanding of their chosen disciplinary/ interdisciplinary areas of study, their linkages with related fields, and the awareness of current trends in their chosen area of study;** • **essential knowledge for skilled work in chosen field(s), including self-employment and entrepreneurship skills;** • **proficiency in specialized areas within chosen fields of study, encompassing diverse practical skills applicable to different situations within those fields;** • **the ability to apply learned knowledge to novel situations, solve problems, and relate concepts to real-world scenarios rather than just memorizing curriculum content.**
PO 2	**Acquire problem-solving, critical thinking, analytical reasoning skills and demonstrate creativity in their thought processes** by demonstrating the ability to: • solve different kinds of problems in familiar and non-familiar contexts

	both within and outside their disciplinary/ multidisciplinary areas of learning; • apply analytic thought to a body of knowledge, including the analysis and evaluation of policies, and practices, as well as evidence, arguments, claims, and beliefs; • analyse and synthesize data from a variety of sources and draw valid conclusions and support them with evidence and examples. • the ability to plan, execute and report the results of an experiment or investigation; • adhere to scientific temper and ethics in their thought process; • adopt innovative, imaginative, lateral thinking, interpersonal skills and emotional intelligence; and • incubate entrepreneurial and start-up ideas.
PO 3	**Develop a profound environmental dedication by fostering ecological awareness and engaging in actions that promote sustainable development** by achieving the ability to • recognize environmental and sustainability issues, and participate in actions to promote sustainable development as well as mitigate the effects of environmental degradation, climate change, and pollution; • contribute to effective waste management, conservation of biological diversity, management of biological resources and biodiversity, forest and wildlife conservation, sustainable development and living, and the preservation of life in all forms. • participate in community-engaged services/ developmental activities and thus exemplify the ideals of community engagement and service learning and deep social commitment.
PO 4	**Accomplish perfect communication, teamwork, and leadership skills, particularly in academic and professional settings, while demonstrating nuance and attention to etiquette in all communicative contexts.** This will enable them to: • listen carefully, and read texts and research documents, and present complex information with clarity and precision to different audiences; • express thoughts and ideas and communicate effectively through speech and writing using appropriate media; • communicate using language which is respectful of gender and minority orientations; • act together as a group or a team in the interests of a common cause and working efficiently as a member of a team; • inspire the team with a vision to achieve a stated goal, and use management skills to guide the team in the right direction.

PO5	**Acquire the necessary skills, including 'learning to learn' skills, and foster innovative ideas to improve competence and employability, keeping pace with the evolving global landscape and technological advancements** by demonstrating the ability to: • pursue learning activities throughout life, through self-paced and self-directed learning aimed at personal development, meeting economic, social, and cultural objectives, and adapting to changing trades and demands of the workplace, including adapting to the changes in work processes in the context of the fourth industrial revolution, through knowledge/ skill development/reskilling; • work independently, identify appropriate resources required for further learning; • acquire organizational and time management skills to set self-defined goals and targets with timelines; • be a proactive life-long learner. • use ICT in a variety of learning and work situations; • access, evaluate, and use a variety of relevant information sources, and use appropriate software for analysis of data; • navigate cyberspaces by following appropriate ethical principles and cyber etiquette. • use cutting edge AI tools with equal commitment to efficiency and ethics. • think 'out of the box' and generate solutions to complex problems in unfamiliar contexts;
PO6	**Develop research-related skills including the ability to conceptualize research hypotheses/projects and adopt suitable tools and methodologies for analysis** with: • a keen sense of observation, inquiry, and capability for asking relevant/ appropriate research questions; • the ability to problematize, synthesize, and articulate issues and design research proposals; • the ability to define problems, formulate appropriate and relevant research questions, formulate hypotheses, test hypotheses using quantitative and qualitative data, establish hypotheses, make inferences based on the analysis and interpretation of data, and predict cause-and effect relationships; • the capacity to develop appropriate methodology and tools for data collection; • the appropriate use of statistical and other analytical tools and techniques;

	• the ability to plan, execute and report the results of an experiment or investigation; • the ability to acquire the understanding of basic research ethics and skills in practicing/doing ethics in the field/ in personal research work, regardless of the funding authority or the field of study
PO7	**Assimilate a sound value system, a sense of autonomy, multicultural competence, social commitment, and the spirit of inclusivity and empathy by imbibing the spirit and the holistic ethos of the 'Multi-Dimensional Ivanian' (MDI) approach.** This will enable them to: • embrace and practice constitutional, humanistic, ethical, and moral values in life, including universal human values of integrity, truth, righteous conduct, peace, love, nonviolence, scientific temper, citizenship values; • identify ethical issues related to work, follow ethical practices and be objective, unbiased, and truthful actions in all aspects of work, including avoiding unethical behaviour such as fabrication, falsification or misrepresentation of data, or committing plagiarism, and adhering to intellectual property rights; • exercise responsibility and demonstrate accountability in applying knowledge and/or skills in work and/or learning contexts appropriate for the level of the qualification, including ensuring safety and security at workplaces; • practice responsible global citizenship required for responding to contemporary global challenges, enabling learners to become aware of and understand global issues and to become active promoters of more peaceful, tolerant, inclusive, secure, and sustainable societies; • effectively engage in a multicultural group/society and interact respectfully with diverse groups; • identify with or understand the perspective, experiences, or points of view and emotions of another individual or group. • demonstrate gender sensitivity and adopt a gender-neutral approach, as also empathy for the less advantaged and the differently-abled including those with learning disabilities; • demonstrate proficiency in arts/ sports/ games, physical, mental and emotional fitness, entrepreneurial /organizational /pubic speaking/environmental/ community-oriented areas by actively participating in the wide range of co-curricular activities that are available to the students of Mar Ivanios College.

Programme Specific Outcomes (PSO)

PSO 1: Deep Understanding of Biotechnological Principles: Graduates will demonstrate a comprehensive knowledge and understanding of fundamental principles and concepts in biotechnolology including genetics, molecular biology, biochemistry, and microbiology.
PSO 2: Advanced Laboratory Skills: Graduates will possess advanced laboratory skills, including proficiency in molecular techniques, cell culture, bioinformatics, and bioprocessing, enabling them to conduct experiments, analyze data, and interpret results effectively.
PSO 3: Application of Biotechnological Solutions: Graduates will be able to apply biotechnological solutions to address real-world challenges in areas such as healthcare (e.g., disease diagnosis, drug development), agriculture (e.g., crop improvement, biofertilizers), environment (e.g., bioremediation, waste management), and industry (e.g., biopharmaceutical production, biofuel development).
PSO 4: Critical Thinking and Problem-Solving: Graduates will demonstrate critical thinking, analytical reasoning, and problem-solving skills, allowing them to assess complex biotechnological problems, propose innovative solutions, and make informed decisions based on scientific evidence.
PSO 5: Effective Communication and Collaboration: Graduates will effectively communicate scientific concepts, experimental findings, and research outcomes through written reports, oral presentations, and scientific publications. They will also demonstrate the ability to collaborate with multidisciplinary teams, engage in scientific discussions, and contribute to collaborative research projects.
PSO 6: Ethical and Professional Conduct: Graduates will adhere to ethical and professional standards in biotechnological research and practice, demonstrating integrity, respect for intellectual property rights, awareness of safety protocols, and responsibility towards societal and environmental impacts of biotechnology.

PSO 7: Graduates will analyse complex botanical problems, evaluate evidence, and formulate well-reasoned conclusions while upholding integrity and professionalism, acquiring plant knowledge for human health and wellness, addressing environmental challenges through sustainable practices, and demonstrating proficiency in plant practices.

Course and Credit Structure of FYUGP

The pathway preferably followed by the department will be interdisciplinary

INTERDISCIPLINARY MAJOR STRUCTURE FOR DOUBLE MAIN (CORE AND VOCATIONAL PROGRAMMES).

INTERDISCIPLINARY DOUBLE MAJOR STRUCTURE									
SEM	**DSC (Credit 4)**	**DSE (Credit 4)**	**AEC (Credit 3)**	**SEC (Credit 3)**	**MDC (Credit 3)**	**VAC (Credit 3)**	**Internship (credit-2)/ Project/ Additional Courses (credit-12)**	**Total courses**	**Total credits**
I	A-1 B-1 C-1		AEC (Eng)-1 AEC(OL)-2		MDC-1			6	21
II	A-2 B-2 C-2		AEC (Eng)-3 AEC(OL)-4		MDC-2			6	21
III	A-3 B-3 C-3	DSE A -1			MDC (Kerala Studies)-3	VAC-1		6	22
IV	A-4 B-4	DSE B-2		SEC-1		VAC-2 VAC-3	Internship	6	23
V	A-5 A-6 B-5	DSE B-3 DSE A-4		SEC-2				6	23
VI	A-7 B-6 B-7	DSE A-5 DSE B -6		SEC-3				6	23
Total		6	4	3	3	3	1*	36	133
EXIT OPTION AVAILABLE AND STUDENTS WILL BE AWARDED UG DEGREE WITH A MAJOR IN A and B									
VII	A-8 B-8 A/B-A/B A/B	DSE -7 A/B						6	24
VIII	MOOC courses A -9 B -9						Research Project/ Internship /Project or 03 courses -12C	2+1**/3***	20

Total		7	4	3	3	3	1*+1**/ 3***	44+1* + 1**/3***	177

A – Major Discipline ,B – Major Discipline,C – Complementary
* - Mandatory Internship at the end of Semester 4

** - Research Project/ Internship /Project as part of Honours with Research
*** - Additional courses of 4 credits each.
Cr - Credits

- **Research group project for students exiting after UG 3 years:** Students who propose to exit after 3 Year UG programme can do a group project with an extra two credits to obtain research experience in discipline-specific areas of the program. The BoS can decide the number of students for the group and the evaluation criteria.

- Students will be able to take other pathways permissible under **University of Kerala Four Year Under Graduate Programmes (UoK-FYUGP) Regulations, 2024,** subject to the availability of courses/ faculty/infrastructure of the college.

- The Board of Studies shall prepare and publish a list of online courses at different levels before the commencement of classes in the respective semester offered in various online educational platforms recognised by the academic council of the college, which can be opted by the students for acquiring additional credits.

Course Participation/Attendance-

1. A student shall be permitted to register for the end-semester evaluation of a specific course to acquire the credits only if the student has completed 75% of the prescribed classroom activities in physical, online, or blended modes, as stipulated by the BoS, including any makeup activities as specified by the faculty of that particular course.
2. The reasons/cases of permissible authorised leave shall be specified by the college, with the approval of the Academic Council, ratified by the Governing Body.
3. The condonation facility shall be availed as per the existing University/college norms.

Assessment and Evaluation

1. The assessment of a course shall combine a Continuous Comprehensive Assessment (CCA) and an End Semester Evaluation (ESE).
2. For courses without practical/lab modules, 30% weightage shall be given for CCA and the remaining 70% of the weight shall be for the ESE.

3. CCA will have two sub-components: Formative Assessment (FA) and Summative Assessment (SA).
4. The CCA subcomponents will be given marks as per the following proportions:
    - Discipline specific summative assessment - 15% of the total
    - Course attendance (Formative) - 5 % of the total.
    - Discipline specific formative assessment - 10% of the total.
5. The details of summative and formative assessment criteria, including that of attendance, will be specified by each course coordinator at the beginning of the semester, with the approval of the respective Head of the Department/BoS Chairperson and the Principal, and will be published on the college website.
6. For courses with practical/lab modules, 40% weightage shall be given for CCA and the remaining 60% of the weight shall be for the ESE.
7. In such cases specified in the item above, the CCA subcomponents will be given marks as per the following proportions:
    - Discipline specific summative assessment - 10% of the total
    - Course attendance (Formative) - 5 % of the total
    - Discipline specific formative assessment - 15% of the total.
    - Summative Assessment (Practical Record, Practical test, skill, etc). -10% of the total.

8. The Course Coordinator shall be responsible for evaluating all the components of CCA for the course in question. Any grievances regarding the same shall be submitted to the Course Coordinator within 5 days of the publication of the same on the department notice board or official class group. If the grievance is not settled at the Course Coordinator level, the student is free to appeal to the Head of the Department, within the next 3 days, who will discuss the same in the Department Level Monitoring Committee (DLMC). If still needed, students can further appeal to the College Level Monitoring Committee (CLMC) or in essential situations the University Level Monitoring Committee (ULMC) in a time period as specified by these bodies.
9. Regarding evaluation, one credit will be evaluated for 20 marks in a semester; thus, a 4-credit course will be evaluated for 80 marks, and 3-credit courses for 60 marks. However, any changes to this if brought by the University will be followed.
10. The duration of the end semester examination of a course with 4 credits will be 2 hours and the same for a course with 3 credits may be 1.5 hours/2 hours.

Mark Distribution Table

Course	Credit		Marks		Lecture			Practical		
	Lecture	**Practical**	**Lecture**	**Practical**	**CCA (30%)**		**ESE (70%)**	**CCA (40%)**		**ESE (60%)**
					SA (50%)	**FA (50%)**		**SA (50%)**	**FA (50%)**	

4 credit courses	4	0	80	0	12	12	56	0	0	0
	3	1	60	20	9	9	42	4	4	12
	2	2	40	40	6	6	28	8	8	24
	1	3	20	60	3	3	14	12	12	36
	0	4	0	80	0	0	0	16	16	48
	Credits		**Marks**		**Lecture**			**Practical**		
3 credit courses	**Lecture**	**Practical**	**Lecture**	**Practical**	**CCA (30%)**		**ESE (70%)**	**CCA (40%)**		**ESE (60%)**
					SA (50%)	**FA (50%)**		**SA (50%)**	**FA (50%)**	
	3	0	60	0	9	9	42	0	0	0
	2	1	40	20	6	6	28	4	4	12
	1	2	20	40	3	3	14	8	8	24
	0	3	0	60	0	0	0	12	12	36

Letter Grades and Grade Point

1. A mark system is followed to evaluate each question. For each course in the semester, letter grades and grade points are introduced in a 10-point indirect grading system as per the guidelines given below.
2. The Semester Grade Point Average (SGPA) is computed from the grades to measure the student's performance in a given semester. The SGPA is based on the current term's grades, while the Cumulative Grade Point Average (CGPA) is based on the grades in all courses taken after joining the programme of study.
3. The weighted grade point will be mentioned in the student's final grade cards, issued by the college, based on the marks obtained.
4. **The grades and grade points will be given as per the following format:**

Letter Grade	**Grade Point**	**Percentage of marks (X) (CCA + ESE together)**	**Class**
O (Outstanding)	10	$X \geq 95\%$	FIRST CLASS WITH DISTINCTION
A+ (Excellent)	9	$85\% \leq X < 95\%$	
A (Very Good)	8	$75\% \leq X < 85\%$	
B+ (Good)	7	$65\% \leq X < 75\%$	FIRST CLASS
B (Above Average)	6	$55\% \leq X < 65\%$	

C (Average)	5	$45\% \leq X < 55\%$	SECOND CLASS
P* (*Pass*)	4	$35\% \leq X < 45\%$	THIRD CLASS
F (Fail)	0	X< 35%	FAIL
Ab (Absent)	0		FAIL

- For a course PASS, separate minimum of 35% is needed for CCA and ESE.
- Less than 35% in either ESE or CCA is FAIL.

Computation of SGPA and CGPA

SGPA (Semester Grade Point Average) and CGPA (cumulative Grade Point Average) will be computed as follows:

1. The SGPA is the ratio of the sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student in the semester. That is,

$$S_j = \frac{\sum(C_{ij} \times G_{ij})}{\sum C_{ij}}$$

where S_j is the SGPA in the jthsemester,

C_{ij} is the number of credits for the ith course in the jthsemester, and

G_{ij} is the the grade point scored by the student in the ith course in the jthsemester.

2. The CGPA is also calculated in the same manner considering all the courses undergone by a student over all the semesters of a programme. That is,

$$CGPA = \frac{\sum(C_i \times S_i)}{\sum C_i}$$

where $S_i$is the SGPA in the ithsemester and

$\sum C_i$ is the total number of credits in the ith semester.

3. The SGPA and CGPA shall be rounded to 2 decimal points and reported in the transcripts.
4. **Requirement for the successful completion of a Semester:**

   SGPA of 4 or above and a PASS in all the courses, that is, a minimum total of 35% mark in each course (CCA + ESE), with a separate minimum of 35% mark for both CCA and ESE. Appropriate and permissible rules for rounding off numbers may be adopted as per decisions of the Academic Council.

Dr. Lini N
Chairman
BoS (Biotechnology)
Mar Ivanios College
(Autonomous),
Thiruvananthapuram

Thiruvananthapuram
19-05-2024

Mar Ivanios College (Autonomous)

Discipline	BIOTECHNOLOGY				
Course Code	MIUK1DSCBBT100.1				
Course Title	BIOTECHNOLOGY FOR HUMAN WELFARE				
Type of Course	**DSC**				
Semester	1				
Academic Level	100-199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours	-	2 hours	5
Pre-requisites	Students should have a basic understanding of Biology and Chemistry.				
Course Summary	This course is designed to provide students with a comprehensive understanding of biotechnological principles and applications in various sectors including agriculture, food, environment, medicine, and forensics. The course aims to develop students' theoretical knowledge, practical skills, critical thinking, and ethical awareness in the field of Biotechnology.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I		**Introduction to Biotechnology**	**10**
	1.	Introduction to the historical perspectives of Biotechnology and its evolutions as a scientific discipline. Exploring the Spectrum of Biotechnology: White, Green, Blue, and Red Biotechnology.	

	2.	Scope of Biotechnology - Commercial potential of biotechnology in various sectors such as healthcare, agriculture, and industry. Global Trends in Biotechnology.	
	3.	Major Biotechnology institutes and companies in India.	
II	**Agricultural, Food and Environmental Biotechnology**		**10**
	4.	Transgenic plants (Bt cotton, Golden rice).	
	5.	Innovations in food processing (e.g., Cheese, Beer). Functional foods, nutraceuticals, and dietary supplements.	
	6.	Biofuels, Sewage & Effluent Treatment.	
	7.	Precision Agriculture: Data-driven farming, IoT sensors and drone technology for resource optimization.	
III	**Biotechnology in Medical and Forensics Sciences**		**15**
	8.	Medical Biotechnology: Gene cloning and therapeutic applications. Production of safer and more affordable medicines. Transgenic animals in medicine (e.g., Enviropig, spider-goat). Human genome project and personalized medicine.	
	9.	Introduction to Forensic Biotechnology: Role in solving crimes and establishing identities. DNA fingerprinting and genetic analysis techniques. Paternity testing and theft investigations	
IV	**Labs, Ethics, and Regulatory Framework**		**10**
	10.	General introduction and use of the types of labs associated with Biotechnology (General lab, microbial culture lab, plant tissue culture lab, Animal tissue culture lab, Biosafety lab). Good Laboratory Guidelines.	
	11.	Ethical considerations in biotechnological research and applications.	
V	**Practicum (15 weeks session- 2 hr per week)**		**30**
	12.	1. Introducing the various labs in [General lab, microbial culture lab, plant tissue culture lab, Animal tissue culture lab	

		Biotechnology] 2. Familiarizing various instruments 3. Case studies on genetically modified (GM) crops and their impact on agriculture and food security. 4. Research institute or industrial visit.	

References:

1. Introduction to Genetic Engineering & Biotechnology, Nair, A.J., Infinity Science Press, USA.
2. Biotechnology Expanding Horizons, B.D. Singh, MedTech Science Press.
3. Principles of gene manipulation, 6th ed, S.B. Primrose& R.M. Twyman & R.W. Old, Blackwell pub.
4. Gene Cloning & DNA Analysis: An introduction, 8th ed, T.A. Brown, Wiley Blackwell pub
5. Advanced Biotechnology, R.C. Dubey, S. Chand Publication
6. Plant Biotechnology: The genetic manipulation of plants, 2ndedAdrian Slater, Nigel Scott & Mark Fowler, Oxford pub.
7. Biotechnology, U. Satyanarayana & U. Chakrapani, Books & Allied Pub PVT.LTD
8. Introduction to Biotechnology & Genetic Engineering, Nair, AJ, Johns & Bartlett Pub, Boston USA.
9. Industrial Microbiology, 2nd ed, L.E.J.R. Casida, New Age International Pub.
10. Principles and techniques of Biochemistry & Molecular Biology, 7th ed, Edited by Keith Wilson & John Walker, Cambridge University Press.

Course Outcomes

No.	Upon completion of the course, the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Understand the historical evolution and classical concepts of biotechnology, including its modern advancements	**U**	**PSO 1**
CO-2	Evaluate the commercial potential and global trends of biotechnology, focusing on its scope in India and major institutes and companies in the field.	**U, E**	**PSO 2, 4**
CO-3	Analyse the applications of biotechnology in the	**U, Ap**	**PSO 2, 3**

	Agricultural, Food, and Environmental sectors, including transgenic plants, innovations in food processing, and biofuel production.		
CO-4	Explore the role of biotechnology in Medical and Forensic Sciences, covering gene cloning, therapeutic applications, transgenic animals, and forensic techniques like DNA fingerprinting.	**U,**	**PSO 1, 6**
CO-5	Familiarize with laboratory practices, ethical considerations in biotechnological research, and regulatory frameworks governing the field.	**U, Ap**	**PSO 2, 6**
CO-6	Gain hands-on experience through practical sessions introducing various biotechnology labs. case studies on genetically modified crops. visits to research institutes or industries in the biotech sector.	**Ap**	**PSO 2, 3, 5**

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: Credits: 4:0:0 (Lecture: Tutorial: Practical)

CO No.	**PO/PSO**	**Cognitive Level**	**Knowledge Category**	**Lecture (L)/Tutorial (T)**	**Practical (P)**
CO-1	PO 1 PSO 1	U	F	L	
CO-2	PO 1, 8 PSO 2, 4	U, E	F, C	L	
CO-3	PO 1,8 PSO 2, 3	U, Ap	C	L	
CO-4	PO 1, 5, 6, 13 PSO 1, 6	U,	C	L	
CO-5	PO 1 PSO 2, 6	U, Ap	C	L	
CO-6	PO 1, 2, 3, 7 PSO 2, 3, 5	Ap	P		P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs:

CO's	Programme Specific Outcomes (PSO)					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	3	-	-	-	-	-
CO2	-	2	-	2	-	-

CO3	-	3	3	-	-	-
CO4	3	-	-	-	-	3
CO5	-	2	-	-	-	3
CO6	-	3	3	-	2	-
Average	**3**	**2.25**	**3**	**2**	**2**	**3**

CO's	Programme Outcomes						
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**
CO1	1	-	-	-	-	-	-
CO2	1	-	-	-	-	-	-
CO3	1	-	-	-	-	-	-
CO4	1	-	-	-	2	2	-
CO5	1	-	-	-	-	-	-
CO6	1	3	2	-	-	-	3
Average	**1**	**3**	**3**	**0**	**2**	**2**	**3**

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓
CO 3	✓			✓
CO 4		✓		✓
CO 5		✓		✓
CO 6		✓	✓	✓

Mar Ivanios College (Autonomous)

Discipline	BIOTECHNOLOGY				
Course Code	MIUK1MDCBBT100.1				
Course Title	BIOTECHNOLOGY AND SKINCARE SCIENCES				
Type of Course	**MDC**				
Semester	1				
Academic Level	100-199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours	-	-	3
Pre-requisites	Students should have a basic understanding of Biology and Chemistry.				
Course Summary	This course explores the intersection of biotechnology and cosmetology, focusing on the scientific principles behind skincare, haircare, and cosmetic products				

Detailed Syllabus:

Module	Unit	Content	Hrs
I		**Introduction to Biotechnology in Cosmetology**	**10**
	13.	Introduction to Biotechnology	
	14.	Biotechnology in Cosmetology	
	15.	Overview of cosmetology and beauty industry trends Biotechnological advancements shaping the cosmetic market.	
II		**Biotechnological Ingredients in Cosmetics**	**10**

	16.	Natural vs. Synthetic Ingredients: Understanding the sources and benefits of biotechnological ingredients.	
	17.	Bioactive Compounds in Cosmetics: Exploring antioxidants, peptides, and enzymes used in skincare products.	
III	**Biotechnological Techniques in Cosmetics Development**		**15**
	18.	Microbial Fermentation in Cosmetics: Production of active ingredients through fermentation processes.	
	19.	Genetic Modification for Cosmetic Purposes: Genetically engineered ingredients and their role in skincare.	
	20.	Nanotechnology in Cosmetics: Nanoparticles and their applications in improving product efficacy.	
IV	**Biotechnology in Skincare and Dermatology**		**10**
	21.	Anti-ageing technologies	
	22.	Acne treatment innovations: microbiome-based therapies	
	23.	Skin whitening and pigmentation control: enzyme inhibitors	
	24.	Regulatory aspects and safety assessment of cosmeceuticals	
	Activity		
	25.	Case studies of successful biotech-based cosmetic companies Career paths in cosmetic science and product development Industry Visit	

References:

11. Barton, S., Eastham, A., Isom, A., Mclaverty, D. (Eds.). (2020). Discovering Cosmetic Science. Royal Society of Chemistry.
12. Wu, W., Zhang, H. H., Welsh, M. J., Kaufman, P. B. (2003). Gene Biotechnology (2nd ed.). Taylor & Francis Inc.
13. Sakamoto, K., Lochhead, R., Maibac, H. I. (2017). Cosmetic Science and Technology: Theoretical Principles and Applications. Elsevier Science Publishing Co Inc International Concepts.
14. Advanced Biotechnology, R.C. Dubey, S. Chand Publication

Course Outcomes

No.	Upon completion of the course, the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Understand the fundamental principles of biotechnology and its applications in the cosmetology industry.	**U**	**PSO 1**
CO-2	Differentiate between natural and synthetic biotechnological ingredients, and assess their benefits and sources in cosmetic formulations.	**U, E**	**PSO 2, 4**
CO-3	Analyze the role of bioactive compounds, such as antioxidants, peptides, and enzymes, in the development of effective skincare products.	**U, Ap**	**PSO 2, 3**
CO-4	Explore biotechnological techniques, including microbial fermentation, genetic modification, and nanotechnology, used in the production and enhancement of cosmetic products.	**U,An**	**PSO 1, 6**
CO-5	Evaluate advanced biotechnological solutions for skincare and dermatology, focusing on anti-aging technologies, acne treatments, and skin pigmentation control.	**U, Ap**	**PSO 2, 6**
CO-6	Assess the regulatory aspects and safety considerations of biotechnological cosmeceuticals, and identify potential career paths in cosmetic science and product development.	**Ap**	**PSO 2, 3, 5**

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: Credits: 4:0:0 (Lecture: Tutorial: Practical)

CO No.	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/Tutorial (T)	Practical (P)
CO-1	PO 1 PSO 1	U	F	L	
CO-2	PO 1, 5 PSO 2, 4	U, E	F, C	L	
CO-3	PO 1,5 PSO 2, 3	U, Ap	C	L	
CO-4	PO 1, 2, PSO 1, 6	U,	C	L	
CO-5	PO 1,2 PSO 2, 6	U, Ap	C	L	
CO-6	PO 1, 2, 3 PSO 2, 3, 5	Ap	P	L	

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs:

CO's	Programme Specific Outcomes (PSO)					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	3	-	-	-	-	-
CO2	-	2	-	2	-	-
CO3	-	3	3	-	-	-
CO4	3	-	-	-	-	3
CO5	-	2	-	-	-	3
CO6	-	3	3	-	2	-
Average	**3**	**2.25**	**3**	**2**	**2**	**3**

CO's	Programme Outcomes						
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**
CO1	1	-	-	-	-	-	-
CO2	1	-	-	-	3	-	-
CO3	1	-	-	-	2	-	-
CO4	1	1	-	-	2	2	-
CO5	1	2	-	-	-	-	-
CO6	1	2	2	-	-	-	3
Average	**1**	**2.5**	**2**	**0**	**2**	**2**	**3**

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics: Quiz / Assignment/ Quiz/ Discussion / Seminar

- Midterm Exam
- Programming Assignments

- Final Exam

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓
CO 3	✓			✓
CO 4		✓		✓
CO 5		✓		✓
CO 6		✓	✓	✓

Mar Ivanios College (Autonomous)

Discipline	BIOTECHNOLOGY				
Course Code	MIUK2DSCBBT100.1				
Course Title	FUNDAMENTALS OF MICROBIOLOGY				
Type of Course	**DSC**				
Semester	II				
Academic Level	100-199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours	-	2 hours	5
Pre-requisites	Biology background				
Course Summary	This course provides a comprehensive overview of the microbial world, including its historical background, systematic classification, principles of microbial control, and methods of microbial identification and manipulation. Students will explore the diversity of microorganisms, learn about their structure, physiology, nutritional requirements, and growth factors, and gain insights into the practical applications of microbial control in various industries and healthcare settings.				

Detailed Syllabus:

Module	Unit	Content	Hrs.
I	**Overview of key events and discoveries in microbial history.**		**12**
	1	Discovery of the microbial world: Establishment of the theory of biogenesis, Contributions of Anton von Leeuwenhoek, Louis Pasteur, Robert Koch	
	2	Introduction to the Prokaryotic world, Eukaryotic microorganisms, acellular microorganisms (Viruses, Viroids, Prions)	
	3	Principles of microbial systematics: Taxonomy, phylogeny, and molecular classification methods, identification of bacteria (16srRNA gene sequencing)	
	4	Introduction to systems of classification: Binomial Nomenclature,	

		Whittaker's Five Kingdom classification system, Comparative analysis, and utility of different classification systems	
II	**Principles of microbial control**		**9**
	5	General principles: Control by killing, inhibition and removal.	
	6	Physical methods of microbial control: heat (dry and moist), high pressure, filtration, desiccation, osmotic pressure, radiation	
	7	Chemical methods of microbial control: levels of disinfectants and their mode of action.	
III	**Microbial growth and identification**		**12**
	8	Ultrastructure of bacteria: Cell wall (Gram positive & Gram negative) and internal organization.	
	9	Motility in bacteria – structure of flagella, types of flagella, sporulation	
	10	Nutrition in bacteria: Nutritional classification in bacteria	
	11	Culture media: Types, components & classification of media	
	12	Bacterial growth curve, measurement of bacterial growth, factors affecting growth of microbes, batch, fed-batch, continuous culture Bacterial culture methods: Pure culture techniques	
	13	Staining: Staining techniques, types of staining-simple, Grams, spore. Dyes and stains: Definition, acidic basic dyes and leucocompounds. Mechanism of staining. Types of staining: simple and differential staining	
IV	**Beneficial Microbes**		**12**
	14	Agricultural Applications bio fertilizer (*Rhizobium), Bio pesticides (Trichoderma)*	
	15	Food & Industrial Uses: *Lactobacillus* (Dairy products), *Saccharomyces* (Bread, Beer, Wine), *Aspergillus (*Citric acid), *Corynebacterium glutamicum (*Glutamic Acid)	
	16	Environmental Impact Biogeochemical cycles *Nitrobacteria (*nitrogen cycle), bioremediation (*Pseudomonas sp.)*	
	17	Medicinal Importance: Antimicrobial drugs, antibiotics (Penicillium *sp.)*	
	18	Extremophiles & their biotechnological applications – Thermophiles, Acidophiles, Halophiles and Alkaliphiles, Methanogenic bacteria.	
V	**Practicum**		**30**
	1	Sampling and Quantification of Microorganisms Techniques for sampling microorganisms from air, soil, and water sources. Quantification methods such as colony counting and turbidity measurements.	

	2	Isolation Techniques: Streak Plate Method, Spread Plate Method, Pour Plate Method, Serial Dilution.	
	3	Identification of Microorganisms: Simple Staining: Staining procedure using basic dyes to visualize bacterial morphology. Differential Staining: Techniques like Gram staining and acid-fast staining for differentiating between bacterial types. Capsule Staining: Method for staining bacterial capsules. Spore Staining: Procedure for staining bacterial spores. Motility Testing: Techniques to assess bacterial motility	
	4	Observation of Morphology: Microscopic observation of bacterial morphology, including shape, arrangement, and size. Identification of bacterial colonies grown from isolation techniques. Group activity: Isolate and identify various microorganisms in the environment	

References:

1. A Textbook of Microbiology - P. Chakraborthy, New central Book agency Pvt. Ltd, Calcutta
2. Modern concept of Microbiology – D D Kumar, S Kumar; Vikas Publishing House Pvt. Ltd. New Delhi
3. Introduction to Genetic Engineering & Biotechnology- A. J. Nair; Jones & Bartlett Publishers, Boston, USA.
4. Introduction to Microbiology- J Heritage, E G V Evans, R A Killington; Cambridge University Press.
5. Microbiology (9th Ed) - Prescott L. M., Harley, J. P., and Klein D. A. Mc Graw Hill, New York
6. Principles of Biotechnology – A. J. Nair Laxmi Publications New Delhi
7. Advances in Microbiology – J P Tewari, T N Lakhanpal, I Singh, R Gupta and B P Chanola; A P H Publishing Corporation, New Delhi.
8. Microbiology: Principles and Explorations – Jacquelyn G. Black. Prentice Hall, New Jersey.
9. Microbiology- P D Sharma; Rastogi Publications, Meerut.
10. Holt J. S., Krieg N. R., Sneath, P.H.A. and Williams S. T. 1994. Bergey s Manual of Determinative bacteriology. (9th ed).Williams & Wilkins, Baltimore.
11. Brock Biology of Microorganisms (15th Edition). Michael T. Madigan, Kelly S. Bender, Daniel H. Buckley, W. Matthew Sattley, David A. Stahl. NY : Pearson, [2018]
12. Microbiology: An Introduction, 12th Edition, Gerard J. Tortora, Berdell R. Funke, and Christine L. Case. Pearson, [2016]

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Summarize key events in microbial history, including the theory of biogenesis and contributions by Leeuwenhoek, Pasteur, and Koch.	**U**	**PSO-1 PSO-2**
CO-2	Differentiate between prokaryotic, eukaryotic, and acellular microorganisms, including viruses, viroids, and prions, understanding their roles and characteristics.	**R, U, A**	**PSO-1 PSO-2**
CO- 3	Explore microbial systematics, including taxonomy, phylogeny, and classification methods like binomial nomenclature, Whittaker's Five Kingdom system, and Carl Woese's Three Domain system.	**E**	**PSO-1**
CO-4	Understand principles of microbial control, such as killing, inhibiting, and removing microorganisms, and their applications in various industries and healthcare.	**U,An**	**PSO-1 PSO-4**
CO-5	Study physical methods of microbial control like heat treatment, low-temperature control, and high-pressure techniques, alongside chemical methods and disinfectant application.	**Apl**	**PSO-2**
CO-6	Investigate microbial growth factors, nutritional requirements, culture media types, and practical techniques for identification through staining, morphology observation, and isolation methods in a laboratory setting.	**C**	**PSO-4**

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: Credits: 4:0:0 (Lecture:Tutorial:Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/Tutorial (T)	Practical (P)
1	**CO 1**	PO-1 PSO-1,4	U	C	T	
2	**CO2**	PO-1 PSO 1,3	R	F	T	
3	**CO3**	PO-1 PSO-1,3	An	F,C	T	

4	**CO4**	PO-1,2,5,6 PSO-1,3,4	An	F,C	T	
5	**CO5**	PO-1 PSO-1,2,6	F,P	C,P		P
6	**CO6**	PO-1,2,5,7 PSO-1,2	F,P	C,P,M		P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs: Mapping of COs with PSOs and POs:

CO's	Programme Specific Outcomes					
	PSO 1	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	**PSO 6**
CO 1	2	-		2	0	0
CO 2	2	-	3	-	-	0
CO 3	2	-	3	-	-	0
CO 4	2	-	3	2	-	-
CO 5	2	3	-	-	-	2
CO 6	2	3	-	-	-	-
AVERAGE	**2**	**3**	**3**	**2**	**0**	**2**

CO's	Programme Outcomes						
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**
CO1	2	-	-	-	-	-	-
CO2	2	-	-	-	-	-	-
CO3	2	-	-	-	-	-	-
CO4	2	2	-	-	2	2	-
CO5	2	-	-	-	-	-	-
CO6	3	1	-	-	2	-	2
Weighted Average	**2.16**	**1.5**	**0**	**0**	**2**	**2**	**2**

Correlation Levels:

Level	**Correlation**
-	Nil

1	Slightly / Low
2	Moderate / Medium

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓
CO 3	✓			✓
CO 4		✓		✓
CO 5		✓		✓
CO 6		✓		✓

Mar Ivanios College (Autonomous)

Discipline	BIOTECHNOLOGY				
Course Code	MIUK2MDCBBT100.1				
Course Title	INNOVATIONS IN BIOTECHNOLOGY				
Type of Course	**MDC**				
Semester	II				
Academic Level	100-199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	3	3 hours	-		
Pre-requisites	Fundamental understanding of Biology and Chemistry.				
Course Summary	This course introduces bio innovations and major industries in biotechnology, including genetic engineering, synthetic biology, bioenergy, protein engineering, VR & AR, 3-D bioprinting, biosensors, microbiome manipulation, lab-grown organs, and personalized therapies.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I	**Introduction and Concepts**		**10**
	1.	Introduction: Basics and Importance of Bio Innovations.	
	2.	Innovative concepts in research and development.	
	3.	Major industries in Biotechnology.	
II	**Major areas of Innovation**		**10**
	4.	Innovations in Genetic Engineering: CRISPR-Cas9, Prime editing, Multiplex Genome Editing.	
	5.	Synthetic Biology: Biosensors and Bioactuators, Cell-free Bioprocessing.	
	6.	Bioenergy: Biofuel production, Biomass conversion technologies	
	7.	Protein Engineering: computational protein design, protein engineering for biomaterials, Enzyme engineering and	

		Biocatalysis	
	8.	Introduction to system Biology	
III	**Advanced Technologies in Biotechnology**		**10**
	9.	Virtual and augmented reality (VR & AR) applications.	
	10.	3-D Bioprinting.	
IV	**Cutting-edge Innovations**		
	11.	Biosensors for diagnostics.	**15**
	12.	Microbiome Manipulation Techniques.	
	13.	Lab-Grown Organs and Tissue Engineering.	
	14.	Living Medicines and personalized therapies.	

Reference

1. Jordan New, James F. (Year). Innovation, Commercialization, and Start-Ups in Life Sciences (1st ed.). Jordan Biotechnology.
2. Siler, Stephen. (Year). Biotechnology: A Guide To Scientific Approach And Technological Innovation (1st ed.). [Include any relevant publisher information if available].
3. Hockfield, Susan. (Year). The Age of Living Machines: How Biology Will Build the Next Technology Revolution.

Course Outcomes

No.	Upon completion of the course, the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Demonstrate understanding of the basics and importance of bio innovations in biotechnology, including their impact on research and development.	**R, U**	**PSO1**
CO-2	Analyse and apply innovative concepts in biotechnological research, such as CRISPR-Cas9, Prime editing, and Multiplex Genome Editing, to address specific challenges..	**U, Apl**	**PSO4**
CO-3	Identify major industries in biotechnology and assess their contributions to technological advancements and economic growth.	**An**	**PSO3**

CO-4	Develop skills in utilizing advanced biotechnological tools and techniques, such as virtual and augmented reality (VR & AR) applications and 3-D bioprinting, for research and development purposes.	**Apl**	**PSO6**
CO-5	Investigate cutting-edge innovations in biotechnology, such as biosensors for diagnostics, microbiome manipulation techniques, lab-grown organs and tissue engineering, and living medicines for personalized therapies.	**U, An**	**PSO2, 5**
CO-6	Demonstrate ethical awareness and responsibility in biotechnological practices, including considerations of biosafety and bioethics.	**E**	**PSO3**

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create
Note: 1 or 2 COs/module

Name of the Course: Credits: 4:0:0 (Lecture: Tutorial:Practical)

CO	**PO/PSO**	**Cognitive Level**	**Knowledge Category**	**Lecture (L)/Tutorial (T)**	**Practical (P)**
CO1	PO 1, 2, 3 PSO1	R, U	C	L	
CO2	PO 1,4, 5, 9 PSO4	U, Apl	P	L	
CO3	PO 1,6, 7 PSO3	An	F	L	
CO4	PO 1, 8, 10 PSO6	Apl	P	L	
CO5	PO 1,2, 3, 4 PSO2, 5	U, An	C	L	
CO6	PO 1 PSO3	E	C	L	

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs:

CO's	Programme Specific Outcomes (PSO)					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**

CO1	3	-	-	2	-	-
CO2	-	-	3	-	-	1
CO3	2	3	-	-	1	-
CO4	-	-	2	2	-	-
CO5	2	-	-	-	3	2
CO6	-	-	-	-	-	3
Average	**2.3**	**3**	**2.5**	**2**	**2**	**2**

CO's	Programme Outcomes						
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**
CO1	3	2	1	-	-	-	-
CO2	1	-	-	3	2	-	-
CO3	1	-	-	-	-	2	1
CO4	2	-	-	-	-	-	-
CO5	1	3	2	-	-	-	-
CO6	1	-	-	-	-	-	-
Average	**1.5**	**2.5**	**1.5**	**3**	**2**	**2**	**1**

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓
CO 3	✓			✓
CO		✓	✓	✓

4				
CO 5		✓	✓	✓
CO 6		✓		✓

Mar Ivanios College (Autonomous)

Discipline	**BIOTECHNOLOGY**				
Course Code	MIUK3DSCBBT200.1				
Course Title	BIOINSTRUMENTATION				
Type of Course	**DSC**				
Semester	III				
Academic Level	200-299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours	-	2 hours	5
Pre-requisites	Basic knowledge about the analytical instruments used in Biotechnology.				
Course Summary	This course will provide information about the analytical techniques in the field of Biotechnology and make the students understand the basic principles of Bioanalytical instruments				

Detailed Syllabus

Module	Unit	Content	Hrs
I		**Basic instruments**	**15**
	1	pH meter, Buffer of biological importance,.	
	2	Centrifuge- Preparative, Analytical and Ultra,	
	3	Laminar Air Flow, Autoclave, Hot Air Oven and Incubator	
II		**Spectroscopic Techniques**	**15**
	4	Spectroscopic Techniques: Colorimeter, Ultraviolet and visible, Infrared	
	5	Mass Spectroscopy, MALDI-TOF, NMR, X-ray crystallography	
III		**Chromatographic and Electrophoresis Techniques**	**15**
	6	Chromatographic Techniques: Paper, Thin Layer, Column, HPLC and GC.	
	7	Electrophoresis Techniques: Starch Gel, AGE, PAGE, 2-DE and isoelectric focussing, immune electrophoresis	

IV	**Microscopy**		**15**
	8	Principle of Microscopy, Various types of Microscopy - Simple, phase contrast, fluorescence and electron microscopy (TEM and SEM)	
	9	Modern developments in Microscopy-Confocal microscopy, AFM	
		Practicum	30
VI		1. pH Meter – Use of pH Meter, Familiarization of the instrument and Preparation of Phosphate buffers and determination of pH. 2. Spectrophotometer – Familiarization of the working of the instrument, Quantitative estimation of Sugars by Dinitrosalysilic acid and Proteins by Lowry's Method 3. Development of absorption spectra of chlorophyll or any other biological sample 4. Electrophoresis – Demonstration of PAGE and Agarose Gel Electrophoresis	

References:

1. Introductory Practical Biochemistry – S. K. Sawhney and Randhir Singh. Narosa Publishing House
2. Principles of Applied Biomedical Instrumentation- Gedder A and L. E. Balsar,John Wiley and Sons.
3. Modern Experimental Biochemistry 2nd Edition- Boyer, Rodney F.Benjamin and Cummins
4. A Textbook of Biophysics- R N Roy, New central Book Agency Pvt. Ltd, Calcutta.
5. Biophysics- S.Thiruvia Raj , Saras Publications , Tamilnadu.
6. Biophysics, Volkenstein, M.V
7. Biochemistry., Voet,D&Voet, J.G

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Understand the principles, working, and applications of essential laboratory instruments such as pH meters, centrifuges (preparative, analytical, and ultra), laminar air flow cabinets, autoclaves, hot air ovens, and incubators, and their importance in biotechnological research and applications.	**U, An**	**PO-1,2,6 PSO-1,2**

CO-2	Grasp the theoretical principles, operational techniques, and applications of spectroscopic methods, including colourimetry, ultraviolet-visible (UV-Vis) spectroscopy, MALDI-TOF.	**U, C**	**PO-1,2,6 PSO-1,2**
CO-3	Comprehend the principles, methodologies, and applications of various chromatographic and electrophoretic techniques.	**U,An**	**PO-1,2,6 PSO-1,2**
CO-4	Explore the principles, functioning, and applications of different types of microscopies to study cellular and molecular structures.	**U,An**	**PO-1,2,6 PSO-1,2**
CO-5	Understand the principles, functioning, and applications of fluorescence and radiation based techniques	**U,An**	**PO-1,2,6 PSO-1,2**
CO-6	Develop practical skills and conceptual understanding through laboratory exercises	**U, Ap**	**PO-1,2,5,6 PSO-1,2,3**

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: Credits: 3:0:2 (Lecture:Tutorial: Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/Tutorial (T)	Practical (P)
1	**CO1**	PO-1,2,6 PSO-1,2,3,4	U, An	F,C,P	T	
2	**CO2**	PO-1,2,6 PSO-1,2,3,4	U, An	F,C,P	T	
3	**CO3**	PO-1,2,6 PSO-1,2,3,4	U, An	F,C,P	T	
4	**CO4**	PO-1,2,6 PSO-1,2,3,4	U, An	F,C,P	T	
5	**CO5**	PO-1,2,6 PSO-1,2,3,4	U, An	F,C,P	T	
6	**CO6**	PO- 1,2,5,6 PSO-1,2,3,4	U, Ap	P,M		P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

CO's	Programme Specific Outcomes (PSO)					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	3	1	1	1	-	-

CO2	3	1	1	1	-	-
CO3	3	1	1	1	-	-
CO4	3	1	1	1	-	-
CO5	3	1	1	1	-	-
CO6	3	3	2	2	-	-
Average	**3**	**1.33**	**1.17**	**1.17**	**-**	**-**

CO's	Programme Outcomes						
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**
CO1	2	2	-	-	-	1	-
CO2	2	2	-	-	-	1	-
CO3	2	2	-	-	-	1	-
CO4	2	2	-	-	-	1	-
CO5	2	2					
CO6	2	2					
Average	**2**	**2**	**-**	**-**	**-**	**1**	-

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓
CO	✓			✓

3				
CO 4		✓	✓	✓
CO 5		✓	✓	✓
CO 6		✓		✓

Mar Ivanios College (Autonomous)

Discipline	BIOTECHNOLOGY				
Course Code	MIUK3VACBBT100.1				
Course Title	IPR AND ETHICS IN BIOTECHNOLOGY				
Type of Course	**VAC**				
Semester	III				
Academic Level	200 – 299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	3	3 hours	-	0 hours	3
Pre-requisites	Class twelve plus two pass				
Course Summary	Understand different types of intellectual property rights in general and protection of products derived from biotechnology research and issues related to application and obtaining patent.				

Detailed Syllabus

Module	Unit	Content	Hrs
I		**Introduction To Intellectual Property Rights**	**9**
	1.	Importance of IPR, protection of biotechnological inventions, History of world intellectual property rights organization (WIPO), GATT, WTO and TRIPS	
II		**Types of IPR**	**12**
	2.	IPR types: patents, copyrights and related rights,trade-marks, design rights, geographical indications	
III		**Patent system& Patent filing**	12
	3.	Patents-kind of inventions protected by patent- patentable and non-patentable – patenting life – legal– patent databases.	

	4	The different layers of international patent system-national, regional and international options. - country-wise patent searches (USPTO, EPO, India) .	
	5	Process and product patent, double patent - patents of addition. Legal requirements for patents- Granting of patents - Rights of a patent ,exclusive right.	
	6.	Patent application process: Types of patent applications ,Drafting of a patent	
IV	**Bioethics**		**12**
	7.	Ethics of Science and Ethical issues in research taking the case of GM crops and stem cell.	

References:

1. PatentinginBiotechnology-PartI,R.StephenCrespi,Tibtech,Vol.9,117-122,1991.
2. IPR, Biosafety and Bioethics (2013), by DeepaGoel, ShominiParashar
3. Intellectual Property Rights and the Law, Gogia Law Agency, by Dr. G.B. Reddy
4. Law relating to Intellectual Property, Universal Law Publishing Co, by Dr.B.L.Wadehra
5. IPR by P. Narayanan 4. Law of Intellectual Property, Asian Law House, Dr.S.R. Myneni.

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Understand different types of intellectual property rights in general and protection of products derived from biotechnology research and issues related to application and obtaining patents	**R, U**	**PSO-1,6**
CO-2	Understand why India has adopted an IPR Policy and be familiar with broad outline of patent regulations.	**U, An**	**PSO-1,6**
CO-3	Learn the process of filing a patent	**U, Ap**	**PSO-1,3,6**
CO-4	Identify the ethical issues in science and research in biotechnology	**U, An**	**PSO-1,6**

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: Credits: 3:0:2 (Lecture:Tutorial:Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/Tutorial (T)	Practical (P)
1	**CO-1**	PO-1,2 PSO-1,6	R, U	F,C	L	
2	**CO-2**	PO-1,2 PSO-1,6	U, An	F,C	L	
3	**CO-3**	PO-1,6 PSO-1,3,6	U, Ap	F,P	L	
4	**CO-4**	PO-1,2,6,7 PSO-1,6	U, An	C,M	L	

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs:

CO's	Programme Specific Outcomes (PSO)					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	3	-	-	-	-	3
CO2	3	-	-	-	-	3
CO3	3	-	-	-	-	3
CO4	3	-	-	-	-	3
Average	**3**	**0**	**0**	**0**	**0**	**3**

CO's	Programme Outcomes						
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**
CO1	1	2	-	-	2	3	-
CO2	1	1	-	-	-	-	-
CO3	1		-	-	-	2	-
CO4	2	2	-	-	-	2	2
Weighted Average	**1.25**	**1.25**	**0**	**0**	**2**	**2.3**	**2**

Correlation Levels:

Level	Correlation
-	Nil

1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓
CO 3	✓			✓
CO 4		✓		✓

Mar Ivanios College (Autonomous)

Discipline	BIOTECHNOLOGY				
Course Code	MIUK4DSCBBT200.1				
Course Title	MOLECULAR BIOLOGY				
Type of Course	**DSC**				
Semester	IV				
Academic Level	200 – 299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours	-	2 hours	5
Pre-requisites	Students should have a foundational understanding of biology, including cell structure and genetics. Familiarity with basic laboratory techniques such as pipetting, dilution calculations, and safety protocols is recommended.				
Course Summary	This Core Course imparts an essential foundation for understanding of mechanisms and regulations of gene expression at the molecular level. Understanding the molecular basis of life is very important to apply manipulation strategies in future for genetic engineering and genome editing.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I		**Molecular basis of life**	**10**
	1.	History and significant discoveries in molecular biology, Classic experiments demonstrating DNA as the genetic material.	
	2.	Central Dogma of Molecular Biology, Structure of DNA.	
	3.	Eukaryotic chromosomes - Molecular organization, Nucleosomes.	
	4.	Replication of DNA (Prokaryotic and Eukaryotic), Enzymes of DNA replication.	
II		**Gene expression I**	**10**
	5.	Transcription (Prokaryotic and Eukaryotic).	
	6.	RNA Polymerase, promoter, transcription factors.	

	7.	Types of RNA - mRNA, tRNA, rRNA, snRNA and miRNA.	
	8.	Post-transcriptional modification of mRNA in eukaryotes - Capping, Tailing and Splicing mechanisms).	
III	**Gene expression II**		**10**
	9.	Organisation of Prokaryotic and Eukaryotic genes - Split genes, Introns & Exons, Reading frame, Enhancers and Silencers.	
	10.	Genetic code - Properties of genetic code, Codons, Codon assignment, Redundancy and Wobble theory.	
	11.	Translation - Mechanism of translation in Prokaryotic and Eukaryotic mRNA.	
	12.	Post-translational modification of proteins.	
IV	**Gene regulation**		**15**
	13.	Prokaryotic gene regulation, Operon (*lac* and *trp* operon).	
	14.	Eukaryotic gene regulation - Levels of control of gene expression.	
	15.	Regulation of RNA processing - mRNA degradation and protein degradation control.	
	16.	RNA interference.	
V	**Practicum**		**30**
	17.	1. Familiarisation of instruments and equipment used in molecular biology laboratory. 2. Preparation of solutions and buffers for DNA isolation. 3. Isolation of Genomic DNA from a suitable source - Bacteria, Plant or Animal tissue. 4. Examination of the purity of DNA by agarose gel electrophoresis. 5. Quantification of DNA by UV-spectrophotometer. 6. Isolation and purification of plasmid DNA. 7. Agarose gel analysis of plasmid DNA. 8. Extraction of Protein and RNA from plant samples. 9. Visit a molecular biology laboratory within the entire course tenure.	

References:

1. Lewin, B. (2012). Genes XI (11th ed.). Jones and Bartlett Inc. USA.
2. Watson, J. D., Baker, T. A., Bell, S. P., Gann, A., Levine, M., & Losick, R. (2008). Molecular Biology of the Gene (6th ed.). Cold Spring Harbour Lab. Press, Pearson Pub.
3. Weaver, R. (2011). Molecular Biology (5th ed.). McGraw Hill Science. USA.

4. Pal, J. K., & Ghaskadbi, S. (2009). Fundamentals of Molecular Biology. Oxford University Press.
5. Tropp, B. E. (2011). Molecular Biology: Genes to Proteins (4th ed.). Jones & Bartlett Learning, USA.
6. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments (6th ed.). John Wiley & Sons Inc.
7. Brown, T. A. (Year). Essential Molecular Biology - A Practical Approach. Oxford University Press.
8. Lewin, B. (Year). Gene VIII. Offord University Press.

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Demonstrate a comprehensive understanding of the historical milestones and significant discoveries in molecular biology, including classic experiments illustrating DNA as the genetic material.	**R, U, An**	**PSO 1**
CO-2	Explain the Central Dogma of Molecular Biology and describe the structure of DNA, highlighting differences between prokaryotic and eukaryotic chromosomes and the molecular organization of eukaryotic DNA.	**R, U, An**	**PSO 1, 3**
C0-3	Analyze the process of DNA replication in both prokaryotic and eukaryotic cells, including the enzymes involved in DNA replication.	**U, An**	**PSO 1, 4**
C0-4	Describe transcription processes in prokaryotic and eukaryotic cells, including the roles of RNA Polymerase, promoters, and transcription factors, and discuss the types of RNA and their post-transcriptional modifications.	**U**	**PSO 1, 4**
CO-5	Evaluate the organization of genes in prokaryotic and eukaryotic genomes, the genetic code properties, translation mechanisms, and post-translational modifications of proteins.	**U, E, An**	**PSO 1, 4**
CO-6	Learn practical skills	**E, U, Ap**	**PSO 1, 3, 6**

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: Credits: 3:0:2 (Lecture:Tutorial:Practical)

CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/Tutorial (T)	Practical (P)
CO-1	PO 1, 5 PSO 1	R, U, An	F	L	
CO-2	PO 1, 3 PSO 1, 3	R, U, An	F, C	L	
CO-3	PO 1, 2 PSO 1, 4	U, An	F, C	L	
CO-4	PO 1, 5 PSO 1, 4	U	C	L	
CO-5	PO 1, 2, 4 PSO 1, 4	U, E, An	F, C	L	
CO-6	PO 1, 3, 4, 5 PSO 1, 3, 6	E, U, Ap	F, C, P		P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs:

CO's	Programme Specific Outcomes (PSO)					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	1	-	-	-	-	-
CO2	2	-	-	-	-	-
CO3	1	-	-	2	-	-
CO4	1	-	-	2	-	-
CO5	1	-	-	2	-	-
CO6	2	-	2	-	-	2
Average	**1.3**	**0**	**2**	**2**	**0**	**2**

CO's	Programme Outcomes						
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**
CO1	1	-	-	-	2	-	-
CO2	1	-	2	-	-	-	-
CO3	1	2	-	-	-	-	-
CO4	1	-	-	-	2	-	-
CO5	1	1	-	2	-	-	-
CO6	1	-	3	2	1	-	-
Weighted Average	**1**	**1.5**	**2.5**	**2**	**2.5**	**0**	**0**

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓
CO 3	✓			✓
CO 4		✓		✓
CO 5		✓		✓
CO 6		✓	✓	✓

Mar Ivanios College (Autonomous)

Discipline	BIOTECHNOLOGY				
Course Code	MIUK4DSEBBT200.1				
Course Title	IMMUNOLOGY				
Type of Course	**DSE**				
Semester	IV				
Academic Level	200 – 299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours	-	2 hours	5
Pre-requisites	Class twelve pass with biology background				
Course Summary	This elective paper will give a basic awareness to the students on immunesystem, immunology and immunology related techniques. Training in this course will create an interest in immunology and is essential for further studies in Biotechnology.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I		**Introduction to immunology**	**10**
	1	Historical perspective of immunology, innate and specific or acquired immunity,Haematopoiesis	
	2	Immune system and immunity, innate and specific or acquired immunity,	
	3	Haematopoiesis	
	4	The Human Immune System - organs, tissues and cells involved in immunity Different barriers, phagocytosis, pattern recognition receptors, signaling, cytokines and chemokines, Inflammatory response. Functions of complement system, components of complement, complement activation	

II		**Humoral immune response**	**10**
	5	Humoral immunity–Antigen capture and presentation to lymphocytes, B cell activation and proliferation	
	6	Factors that influence immunogenicity, adjuvants, haptens, epitopes	
	7	Basic structure of antibodies, Immunoglobulin fine structure, antibody mediated effector functions, antibody classes and biological activities, monoclonal antibodies, strength of antigen-antibody interactions: affinity, avidity	
III		**Cell mediated immune response**	**10**
	8	Cell mediated immunity –T cell receptor: structure, function, General properties of effector T cells,.	
	9	Antibody-Dependent Cell-mediated Cytotoxicity.	
	1	Major Histocompatibility complex and antigen presentation: MHC restriction	
	1	Antigen presentation and T cell activation	
IV		**Vaccines & therapeutics**	**5**
	1	Brief account on Vaccines and toxoids (Attenuated, Killed, PurifiedMacromolecules, PeptideVaccines,SubunitVaccines,DNAVaccines,EdibleVaccines). Antibody engineering and therapeutics	
V		**Irregularities in immune response**	**10**
	1	Hypersensitivity and its types	
	1	Autoimmunity and autoimmune diseases: Hashimoto's thyroiditis; Myasthenia gravis; Rheumatoid Arthritis, Pernicious anemia, Systemic lupus erythematosus (SLE).	
	1	Basics of tumor immunology	
VI		**Practicum**	**30**
	1	1. Identification of blood cells through microscopy 2. Total count of RBC 3. Total count of WBC 4. Differential count of WBC 5. Separation of immune cells from lymphoid organs of lab animals / blood. 6. Blood grouping – Determination of blood groups 7. Neutralization and complement fixation reaction	

References:

1. An Introduction to Immunology – C V Rao, Narosa Publishing House, New

Delhi
2. Basics of Biotechnology- A J Nair; Laxmi Publications, New Delhi
3. Immunology – Joshi, Osama; AgroBotanica, New Delhi
4. Immunology – R A Goldsby, T J Kindt, B A Osborne, Janis Kuby; W H Freeman & Company, New York
5. Instant Notes in Immunology – P M Abbas, A H Lichtman, M W Fanger; Viva Books Pvt.Ltd, New Delhi.
6. Introduction to Genetic Engineering & Biotechnology- A. J. Nair; Jones & Bartlett Publishers, Boston,USA.
7. Principle Cellular and Molecular Immunology- Jonathan M Austyn 7 Kathryn J Wood; Oxford, New York

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Understand the basics of immune system and immunity	**R, U**	**PSO-1,2,3,4**
CO-2	Analyse the structure of immunoglobulin gene and its types.	**U, An**	**PSO-1,2,3,4**
C0-3	Understand monoclonal antibodies and its applications	**R, U, Ap**	**PSO-1,2,3,4**
C0-4	Analyse tools and techniques based on antigen antibody interaction	**U, An**	**PSO-1,2,3,4**
CO-5	Understand the principle behind various types of vaccines and apply this knowledge to develop vaccines	**R, U, E,C**	**PSO-1,2,3,4**
CO-6	Analyse the dysregulation of immune mechanisms during hypersensitivity states or autoimmune conditions	**An, E**	**PSO-1,2,3,4**
CO-7	Learn the basics of tumor immunology	**U**	**PSO-1,2,3,4**
CO-8	Identification and enumeration of immune cells.	**U,Ap,E**	**PSO-1,2,3,4**

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: Credits: 3:0:2 (Lecture:Tutorial:Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/Tutorial (T)	Practical (P)

1	**CO-1**	PO-1 PSO-1,2,3,4	R, U	F, C	L	
2	**CO-2**	PO-1 PSO-1,2,3,4	U, An	F, C	L	
3	**C0-3**	PO-1,2,5 PSO-1,2,3,4	R, U, Ap	F,C	L	
4	**C0-4**	PO-1,2,5 PSO-1,2,3,4	U, An	P		P
5	**CO-5**	PO-1,2,5,6 PSO-1,2,3,4	R, U, E,C	F,C	L	
6	**CO-6**	PO-1,2, PSO-1,2,3,4	An, E	F, C	L	
7	**CO-7**	PO-1,2, PSO-1,2,3,4	U	F,C	L	
8	**CO-8**	PSO-1,2,5	U,Ap,E			

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs:

CO's	Programme Specific Outcomes (PSO)					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	3	-	3	-	-	-
CO2	3	-	3	-	-	-
CO3	3	-	3	-	-	-
CO4	3	3	3	1	-	
CO5	3	3	3	1	-	
CO6	3	-	3	1	-	-
CO7	3	-	3	1	-	-
C08	3	3	3	1	-	-
Average	**3**	**3**	**3**	**1**		

CO's	Programme Outcomes						
	PO	**PO**	**PO**	**PO**	**PO**	**PO**	**PO**

	1	2	3	4	5	6	7
CO1	2	-	-	-	-	-	-
CO2	2	-	-	-	-	-	-
CO3	2	-	-	-	-	-	-
CO4	2	2	-	-	2	2	-
CO5	2	-	-	-	-	-	-
CO6	3	1	-	-	2	-	2
Average	**2.16**	**1.5**	**0**	**0**	**2**	**2**	**2**

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓
CO 3	✓			✓
CO 4		✓		✓
CO 5		✓		✓
CO 6		✓		✓
CO 7		✓		✓
CO 8		✓	✓	✓

Mar Ivanios College (Autonomous)

Discipline	BIOTECHNOLOGY				
Course Code	MIUK4SECBBT200.1				
Course Title	BIO FERTILIZERS AND BIO PESTICIDE PRODUCTION				
Type of Course	**SEC**				
Semester	IV				
Academic Level	200-299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours	-	2 hours	5
Pre-requisites	Students should have a basic understanding of biology and microbiology concepts. Familiarity with laboratory techniques such as media preparation, microbial isolation, and staining methods is recommended, not essential. Knowledge of agricultural practices and sustainability concepts would also benefit students undertaking this course.				
Course Summary	The course provides a comprehensive understanding of biofertilizers, mycorrhizal biofertilizers, biopesticides, and mass production techniques, covering their definitions, classifications, mechanisms of action, and field application methods. Students gain practical knowledge and skills in utilizing microorganisms for sustainable agriculture practices, including the preparation, application, and management of bio-based agricultural inputs.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I		**Introduction to Biofertilizers**	**10**
	1.	Introduction, history, concept, and scope of biofertilizers in India.	
	2.	Classification of biofertilizers and microorganisms used: bacterial, fungal, and algal biofertilizers.	
	3.	Symbiotic and nonsymbiotic microorganisms, mechanism of	

		nodulation, nitrogen fixation.	
	4.	Importance, types, and characteristic features of ecto and endo mycorrhiza.	
	5.	Mechanism of phosphorus solubilisation, uptake of phosphates by roots.	
	6.	Consortium-based inoculums and their significance.	
II	**Biopesticides**		**10**
	7.	Definition, concept, history, scope, and importance of biopesticides.	
	8.	Classification: botanicals, bacterial, fungal, and viral-based biopesticides	
	9.	Mechanism of action of *Bacillus thuringiensis* and *Trichoderma viridae* as biocontrol agents	
III	**Mass Production Techniques**		**15**
	10.	Media types, preparation for mass production of biofertilizers and biopesticides. Isolation methods: streak plate, spread plate, and pour plate techniques.	
	11.	Purification and identification of microorganisms used as biofertilizers and biopesticides. Mass production and packing techniques.	
IV	**Field Application Methods**		**10**
	12.	Preparation of carrier-based inoculum using carriers like sphagnum, peat, and vermiculite. Dosage standardization for field application methods.	
	13.	Techniques for seed treatment, foliar application, root dressing, soil application. Storage, and maintenance of inoculum for effective field applications.	
V	**Practicum**		**30**
	14.	1. Preparation of Nutrient agar, YEMA, and PDA media 2. Isolation of Rhizobium from root nodules 3. Isolation of Azatobacter from soil samples 4. Isolation of Trichoderma 5. Gram staining of bacteria 6. VAM root staining 7. Raising of legume seedlings with Rhizobium treatment 8. Visit a commercial biocontrol unit and Krishi seva Kendra. 9. Activity: Prepare a biofertilizer	

References:

1. Hyma, P. (2017). Biofertilizers: Commercial production technology and quality control.

2. Kaniyan, S., Kumar, K., & Govinda Rajan, K. (2010). Biofertilizers technology.
3. Sharma, A. K. (2017). Biofertilizers for sustainable agriculture.
4. Singh, D. (2021). Advances in plant biopesticides. Springer India.
5. Singh, R., Jindal, V., & Dhaliwal, G. S. (2013). A textbook of integrated pest management.

Course Outcomes

No.	Upon completion of the course, the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Describe the essential components and preparation techniques of a biofertilizer.	**R, U**	**PSO 1**
CO-2	Explain the role of microorganisms in biofertilizers and their symbiotic relationships with plants.	**R. U**	**PSO 1, 4**
CO-3	Demonstrate proficiency in media preparation for mass production of biofertilizers, including nutrient agar, YEMA, and PDA.	**U, Ap**	**PSO 2, 4**
CO-4	Apply isolation techniques (e.g., streak plate, spread plate) effectively to isolate target microorganisms for biofertilizer production.	**U, AP**	**PSO 2, 4**
CO-5	Standardize dosage for field application methods based on recommended guidelines and research findings.	**U, Ap**	**PSO 1,3**
CO-6	Analyse and troubleshoot challenges that may arise during the preparation, mass production, or application of biofertilizers.	**E, An**	**PSO 4,3,2**

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: Credits: 4:0:0 (Lecture: Tutorial: Practical)

CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/Tutorial (T)	Practical (P)
CO-1	PO 1,2 PSO 1	R, U	C	L	
CO-2	PO 1, 3 PSO 1, 4	R. U	F	L	
CO-3	PO 1, 2 PSO 2, 4	U, Ap	F, P	L	
CO-4	PO 1, 2	U, AP	F, P	L	

	PSO 2, 4				
CO-5	PO 1, 2 PSO 1,3	U, Ap	P	L	P
CO-6	PO 1, 2,3 PSO 4,3,2	E, An	F, P	L	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs:

CO's	Programme Specific Outcomes (PSO)					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	1	-	-	-	-	-
CO2	1	-	-	1	-	-
CO3	-	2	-	2	-	-
CO4	-	2	-	2	-	-
CO5	2	-	2	-	-	-
CO6		2	2	2	-	-
Average	**1.3**	**2**	**2**	**1.75**	**0**	**0**

CO's	Programme Outcomes						
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**
CO1	1	2	-	-	-	-	-
CO2	1	-	1	-	-	-	-
CO3	1	2	-	-	-	-	-
CO4	1	3	-	-	-	-	-
CO5	1	-	-	-	-	-	-
CO6	1	2	3	-	-	-	-
Average	**1**	**2.3**	**2**	**0**	**0**	**0**	**2**

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium

3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓
CO 3	✓			✓
CO 4	✓	✓		✓
CO 5	✓	✓		✓
CO 6	✓	✓		✓
CO 6	✓	✓	✓	✓

Mar Ivanios College (Autonomous)

Discipline	BIOTECHNOLOGY				
Course Code	MIUK5DSCBBT300.1				
Course Title	RECOMBINANT DNA TECHNOLOGY				
Type of Course	**DSC**				
Semester	V				
Academic Level	300 – 399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours		2	5
Pre-requisites	DSC Molecular Biology-level 1V				
Course Summary	The students will have a basic understanding on steps involved in constructing a recombinant DNA molecule. They will get a basic knowledge about the special features of various enzymes and vectors used in recombinant DNA technology. Students may come to know about the tools and techniques in gene identification and gene expression analysis				

Detailed Syllabus:

Module	Unit	Content	Hrs
I		**Introduction to gene cloning and its applications**	**15**
	1.	Tools of recombinant DNA technology	
	2.	Restriction endonucleases, classification and general characteristics of RE, other enzymes used in the recombinant DNA technique- DNA ligase, alkaline phosphatase, Polynucleotide kinase, Terminal transferase, Taq polymerase	
	3.	Adaptors, linkers	
II		**Vectors, the vehicle for cloning**	**15**
	4.	Special features needed for a vector,	

		Various types of cloning vectors Plasmid cloning vectors- pBR322, Expression vectors- the pUC series.	
	5.	Bacteriophage cloning vectors – λ phage cloning vectors, M13 phage based vector. Combination vectors- Phagemid and Cosmid vectors.	
	6.	**Artificial Chromosomes:** Yeast artificial chromosome vectors (YACs), Bacterial artificial chromosome vectors (BACs),	
	7.	Application for YAC and BAC in genome sequencing. Shuttle vectors for animals and plants, mammalian vectors	
III	**Construction of recombinant DNA and methods of gene transfer**		**15**
	8.	Construction of recombinant DNA, host cells, competent cells, bacterial transformation, screening methods of transformed cells	
	9.	DNA libraries: genomic DNA libraries and cDNA libraries- applications.	
	10.	Various methods of genetic transformation in eukaryotes- Direct gene transfer and vector-mediated gene transfer. Screening methods of transformed cells and organisms.	
IV	**Tools and techniques in Gene identification and gene expression analysis**		**15**
	11.	Molecular hybridization techniques for genome analysis: RFLP, AFLP, RAPD, Southern hybridization	
	12.	Nucleic acid sequencing: Principle and applications, Genome sequencing methods, Human genome project– a brief account.	
	13.	Gene expression analysis – Northern hybridization and microarrays Practicum and activity based on theory	
	Practicum		
	14.	Plasmid DNA extraction	
	15.	Restriction digestion	
	16.		

References:

1. Animal cell culture - John R W Master; Oxford University Press

2. Culture of animal cells A manual of basic technique, R Ian Freshney; Wiley- Liss Publication, New York.
3. Basics of Biotechnology- A. J. Nair; Laxmi Publications, New Delhi.
4. Introduction to Biotechnology & Genetic Engineering, Jones & Bartlett Publishers, Boston.
5. Modern concept of Biotechnology- H D Kumar; Vikas Publishing House, Pvt. Ltd., New Delhi.
6. Introduction to Genetic Engineering & Biotechnology- Nair, A. J., Jones & Bartlett Publishers, Boston,USA.
7. Biotechnology B D Singh Kalyani Publishers, New Delhi.
8. Microbiology (7th Ed) - Prescott L. M., Harley, J. P., and Klein D. A. Mc Graw Hill, New York

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Understand the enzymes and vectors used in recombinant DNA technology	**R, U**	**PSO-1**
CO-2	To compare various vector types plasmid, bacteriophage, hybrid vectors	**U, An**	**PSO-1,4**
CO-3	To describe the steps involved in recombinant DNA construction and competent cell preparation	**R, U**	**PSO-1,3**
CO-4	To compare the various gene transfer methods	**U, An**	**PSO-1,3**
CO-5	Explain the tools and techniques in gene identification and gene expression	**R, U**	**PSO-1**
CO-6	Prepare the reagents for rDNA experiments	**An, Ap**	**PSO-1,2,3,5**
CO - 7	To isolate, digest and estimate plasmid DNA	**U, E**	**PSO-1,2,3,5**
CO-8	To prepare competent cell and transform to host cell	**U, Ap**	**PSO-1,2,3,5**

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: Credits: 3:0:2 (Lecture:Tutorial:Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/Tutorial (T)	Practical (P)
1	**CO-1**	PO-1 PSO-1	R, U	F, C	L	

2	**CO-2**	PO-1,2 PSO-1,4	U, Ap	C, P	L	
3	**CO-3**	PO-1,2,6 PSO-1,3	U, An	F,C	L	
4	**CO-4**	PO-1 PSO-1,3	An,Ap	P	L	
5	**CO-5**	PO-1,2 PSO-1	R,U	F,C	L	
6	**CO-6**	PO-1,5,6 PSO-1,2,3,5	An,Ap	C, P		P
7	**CO -7**	PO-1,5,6 PSO-1,2,3,5	An,Ap	C, P		P
8	**CO-8**	PO-1,2,5,6 PSO-1,2,3,5	An,Ap	C, P		P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

CO's	Programme Specific Outcomes (PSO)					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	3	-	-	-	-	-
CO2	3	-	-	1	-	-
CO3	3	-	1	-	-	-
CO4	3	-	1	-	-	-
CO5	3	-	-	-	-	-
CO6	3	3	1	-	1	-
CO7	3	3	1	-	1	-
CO8	3	3	1	-	1	-
Average	**3**	**1.13**	**0.625**	**0.125**	**0.375**	**-**

CO's	Programme Outcomes						
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**
CO1	2	-	-	-	-	-	-
CO2	2	2	-	-	-	-	-
CO3	2	2	-	-	-	2	-
CO4	2	-	-	-	-	-	-

CO5	2	2	-	-	-	-	-
CO6	2	-	-	-	2	2	-
C07	3	-	-	-	2	2	-
C08	3	2	-	-	2	3	-
Weighted Average	**2.25**	**2**	**0**	**0**	**2**	**2.25**	

correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓
CO 3	✓			✓
CO 4	✓	✓		✓
CO 5	✓	✓	✓	✓
CO 6	✓	✓	✓	✓

Mar Ivanios College (Autonomous)

Discipline	**BIOTECHNOLOGY**				
Course Code	MIUK5DSEBBT300.1				
Course Title	MOLECULAR DIAGNOSTICS				
Type of Course	**DSE**				
Semester	V				
Academic Level	300-399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours	-	2 hours	5
Pre-requisites	Students should have a basic understanding of biology and biochemistry, including knowledge of cell structure and molecular biology concepts. Familiarity with laboratory procedures such as Polymerase Chain Reaction (PCR), gel electrophoresis, and immunodiagnostics will be beneficial for effective participation in the course activities and practical demonstrations.				
Course Summary	The course covers a comprehensive range of diagnostic techniques in Biotechnology and Healthcare, including immunological diagnostics, molecular assays, protein analysis, and advanced instrumentation. Students will gain hands-on experience in applying these techniques for disease detection, genetic analysis, biomarker identification, and precision diagnostics.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I		**Introduction to molecular diagnosis**	**10**
	26	History and overview of the diagnostics techniques	
	27	Methods for DNA/RNA extraction	
	28	Quality assessment of nucleic acids	
II		**Techniques involved in Molecular Diagnostics**	**10**
	29	Nucleic acid amplification techniques Principles of PCR and its variations	
	30	Real-time PCR and its application	

	31	Amplified Ribosomal DNA Restriction analysis (ARDRA) and application	
	32	Hybridization techniques: Fluorescence In-Situ Hybridization (FISH) and its clinical utility	
III	**Diagnostic Biomarkers**		**10**
	33	Definition and types of biomarkers	
	34	Genomic and proteomics biomarker	
	35	Biomarker Detection using Mass Spectrometry (MS)	
	36	Western blotting and its role in protein identification	
	37	Elisa and its application	
IV	**Advanced Diagnostic Technologies (Brief Overview and Applications)**		**15**
	38	Multiplex PCR for simultaneous detection of multiple targets	
	39	Next Generation Sequencing (NGS) methods for genetic analysis	
	40	Molecular barcoding techniques and their utility in sample tracking	
	41	Microarray technology: gene expression analysis and mutation detection	
	42	CRISPR technology: gene editing and diagnostics applications.	
V	**PRACTICUM**		**30**
	43	Practices. ·By virtual lab/hands-on 1. Perform/demonstrate RFLP/AFLP and its analysis. 2. A kit-based detection of a microbial infection (Widal test/RPR/ASO) 3. Immunoblotting 4. Perform any one immunodiagnostic test (Typhoid, Malaria, Dengue) 5. PCR 6. Real-time PCR	

References

1. Buckingham, L. (n.d.). Molecular diagnostics: Fundamentals, methods and clinical applications. F.A. Davis Company. ISBN 9780803626775.
2. Patrinos, G. P., & Ansorge, W. (Eds.). (2009). Molecular diagnostics (2nd ed.). Academic Press.
3. Brooks, G. F., Carroll, K. C., Butel, J. S., & Morse, S. A. (2007). Jawetz, Melnick and Adelberg's Medical Microbiology (24th ed.). McGraw Hill Publication.
4. Goering, R., Dockrell, H., Zuckerman, M., & Wakelin, D. (2007). Mims' Medical Microbiology (4th ed.). Elsevier.
5. Willey, J. M., Sherwood, L. M., & Woolverton, C. J. (2008). Prescott, Harley and Klein's Microbiology (7th ed.). McGraw Hill Higher Education.

Course Outcomes

No.	Upon completion of the course, the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Demonstrate an understanding of the historical	**U, An, Ap**	**PSO 1, 3**

	development and various techniques involved in molecular diagnostics, including DNA/RNA extraction and quality assessment of nucleic acids.		
CO-2	Explain the principles and applications of nucleic acid amplification techniques, such as PCR and its variations, Real-time PCR, and ARDRA, for molecular diagnosis.	**An, Ap**	**PSO 1, 2**
CO-3	Identify different types of diagnostic biomarkers, including genomic and proteomic biomarkers, and describe their detection using Mass Spectrometry, Western blotting, and ELISA techniques.	**An, Ap**	**PSO 1, 2**
CO-4	Analyze advanced diagnostic technologies like multiplex PCR, Next Generation Sequencing (NGS), molecular barcoding, microarray technology, and CRISPR technology for gene editing and diagnostics.	**E, Ap**	**PSO 1, 4**
CO-5	Apply theoretical knowledge in practical settings by performing and analyzing techniques like RFLP/AFLP, kit-based microbial infection detection, immunoblotting, immunodiagnostic tests (e.g., Typhoid, Malaria, Dengue), PCR, and Real-time PCR in a virtual lab or hands-on environment.	**E, An**	**PSO 1, 3, 4**
CO-6	Evaluate the clinical relevance and utility of hybridization techniques like Fluorescence In-Situ Hybridization (FISH) and their role in molecular diagnostics.	**E**	**PSO 1, 4, 5**

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: Credits: 4:0:0 (Lecture:Tutorial:Practical)

CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/Tutorial (T)	Practical (P)
CO-1	PO 1, 8 PSO 1, 3	U, An, Ap	F, C, P, M	L	
CO-2	PO 1, 2, 4 PSO 1, 2	An, Ap	C	L	
CO-3	PO 1, 2, 5 PSO 1, 2	An, Ap	C, P	L	
CO-4	PO 1, 3, 6 PSO 1, 4	E, Ap	C	L	
CO-5	PO 1, 3, 6 PSO 1, 3, 4	E, An	C, F	L	
CO-6	PO 1, 4, 6 PSO 1, 4, 5	E	C		P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs:

CO's	Programme Specific Outcomes (PSO)					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	1	-	2	-	-	-
CO2	2	2	-	-	-	-
CO3	2	2	-	-	-	-
CO4	1	-	-	2	-	-
CO5	1	-	2	1	-	-
CO6	1	-	-	2	1	-
Average	**1.3**	**1**	**2**	**2.5**	**1**	**0**

CO's	Programme Outcomes						
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**
CO1	2	-	-	-	-	-	-
CO2	1	2	-	2	-	-	-
CO3	1	2	-	-	1	-	-
CO4	2	-	2	-	-	2	-
CO5	1	-	2	-	-	2	-
CO6	1	-	-	2	2	-	-
Weighted Average	**1.3**	**2**	**2**	**2**	**1.5**	**2**	**0**

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓

CO 2	✓			✓
CO 3	✓			✓
CO 4	✓	✓		✓
CO 5	✓	✓		✓
CO 6	✓	✓	✓	✓

Mar Ivanios College (Autonomous)

Discipline	BIOTECHNOLOGY				
Course Code	MIUK5SECBBT300.1				
Course Title	ENTREPRENEURSHIP IN BIOTECHNOLOGY				
Type of Course	**SEC**				
Semester	V				
Academic Level	300-399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	3	3 hours	-		
Pre-requisites	Students should have a basic understanding of Biology and Chemistry.				
Course Summary	This course is designed to provide students with a comprehensive understanding of biotechnological principles and applications in various sectors including agriculture, food, environment, medicine, and forensics. The course aims to develop students' theoretical knowledge, practical skills, critical thinking, and ethical awareness in the field of Biotechnology.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I	**Introduction to Entrepreneurship**		**10**
	1.	Introduction to Bio-entrepreneurship, Needs and Importance of Entrepreneurship, Qualities and functions of Entrepreneurs.	
	2.	Types of bio-industries, Strategy, and operations of bio-sector firms.	
	3.	Promotion of entrepreneurship, Factors and influencing entrepreneurship, Features of a successful Entrepreneurship.	
II	**Creating an Enterprise**		**10**

	4.	Forms of Business Organization, Project Identification, Selection of the product, Project formulation, Assessment of project feasibility.	
	5.	Challenges in the marketing of Bio business - market conditions & segments; developing distribution channels, the nature, analysis, and management of customer needs.	
III	**Buisiness Plan**		**10**
	6.	Business plan preparation including statutory and legal requirements and business feasibility study.	
	7.	Financial management issues of procurement of capital and management of costs.	
IV	**Marketing and Management**		**15**
	8.	Marketing Concepts, Marketing Process Marketing mix - Marketing environment.	
	9.	Concept of a Product - Product mix decisions, Brand Decision New Product Development - Development – Sources of novel Bioproduct idea & Development.	
	10.	Marketing Research and the importance of the survey, Physical Distribution and Stock Management.	
	11.	Selection of a market for international business and Institutional support for exports.	
V	**Activity**		**15**
	12.	Project Report on a selected bioproduct should be prepared and submitted.	

References

1. Holt, D. H. (Year). Entrepreneurship: New Venture Creation.
2. Kaplan, J. M. (Year). Patterns of Entrepreneurship.
3. Gupta, C. B., & Khanka, S. S. (Year). Entrepreneurship and Small Business Management. Sultan Chand & Sons.
4. Onetti, A., & Zucchella, A. (Eds.). (2018). Business Modeling for Life Science and Biotech Companies: Creating Value and Competitive Advantage with the Milestone Bridge (1st ed.). Routledge Studies in Innovation, Organizations and Technology. CRC Press, Taylor and Francis Group. ISBN: 9781138616905.
5. Shimasaki, C. D. (2014). Biotechnology Entrepreneurship: Starting, Managing, and Leading Biotech Companies. Amsterdam: Elsevier. Academic Press.
6. Jordan, J. F. (Ed.). (2014). Innovation, Commercialization, and Start-Ups in Life Sciences (1st ed.). CRC Press, Taylor and Francis Group. ISBN: 9781482210125.
7. Desai, V. (Year). The Dynamics of Entrepreneurial Development and Management (6th ed.). New Delhi: Himalaya Pub. House. ISBN: 9350244543.

8. Adams, D. J., Sparrow, J. C., & Bloxham, Scion. (2008). Enterprise for Life Scientists: Developing Innovation and Entrepreneurship in the Biosciences. ISBN: 1904842364.

Course Outcomes

No.	Upon completion of the course, the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Understand the fundamentals of bio-entrepreneurship, including the needs and importance of entrepreneurship, the qualities and functions of entrepreneurs, and the types, strategies, and operations of bio-industries.	**An**	**PO 1, 6, PSO 1, 4**
CO-2	Analyze the process of creating an enterprise, including forms of business organization, project identification, product selection, project formulation, and assessment of project feasibility.	**An, U**	**PO 1,2,3, PSO 1, 3, 4**
CO-3	Develop skills in business plan preparation, including understanding statutory and legal requirements, conducting business feasibility studies, and addressing financial management issues such as capital procurement and cost management.	**E**	**PO 2, 3, 5 PSO 1, 4**
CO-4	Explore marketing concepts and processes specific to the bio-business sector, including market analysis, customer needs management, product mix decisions, brand decisions, new product development, marketing research, physical distribution, stock management, and selection of international markets with institutional support for exports.	**C**	**PO 1,2,3, PSO 1, 4, 5**
CO-5	Apply theoretical knowledge and practical skills by preparing a comprehensive project report on a selected bioproduct, demonstrating an understanding of the entire bio-entrepreneurship process. (Activity-based)	**C**	**PO 1, 2, 3 PSO 3, 5**
CO-6	Understand the fundamentals of bio-entrepreneurship, including the needs and importance of entrepreneurship, the qualities and functions of entrepreneurs, and the types, strategies, and operations of bio-industries.	**U**	**PO 1, 2 PSO 1**

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: Credits: 4:0:0 (Lecture: Tutorial: Practical)

CO No.	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/Tutorial (T)	Practical (P)
CO-1	PO 1, 6, 8 PSO 1, 4	An	C, F	L	
CO-2	PO 11, 12, 14 PSO 1, 3, 4	An, U	C, P	L	
CO-3	PO 2, 3, 5, 9 PSO 1, 4	E	P	L	
CO-4	PO 10, 11, 14 PSO 1, 4, 5	C	P, M	L	
CO-5	PO 1, 2, 3 PSO 3, 5	C	P, M	L	
CO-6	PO 1, 2 PSO 1	U	C	L	

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs:

CO's	Programme Specific Outcomes (PSO)					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	1	-	-	2	-	-
CO2	1	-	2	2	-	-
CO3	1	-	-	2	-	-
CO4	1	2	1	2	1	-
CO5	1	2	2	-	2	-
CO6	1	2	-	-	-	-
Average	**1**	**2**	**1.66**	**2**	**1.5**	**0**

CO's	Programme Outcomes						
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**
CO1	1	-	-	-	-	1	-
CO2	1	2	1	-	-	-	-
CO3	-	2	2	-	1	-	-
CO4	-	-	-	-	-	-	-
CO5	1	1	1	-	-	-	-
CO6	1	1	-	-	-	-	-
Average	**1**	**1.3**	**1.5**	**0**	**1**	**1**	**0**

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓
CO 3	✓			✓
CO 4	✓	✓		✓
CO 5	✓			✓
CO 6	✓			✓
CO 6	✓	✓	✓	✓

Mar Ivanios College (Autonomous)

Discipline	BIOTECHNOLOGY				
Course Code	MIUK6DSCBBT300.1				
Course Title	INDUSTRIAL AND ENVIRONMENTAL BIOTECHNOLOGY				
Type of Course	**DSC**				
Semester	VI				
Academic Level	300 – 399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours		2	5
Pre-requisites	Biotechnology and Human Welfare paper basics				
Course Summary	The objective of this course is to give a basic knowledge in the industrial fermentation process and bioreactors.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I		**Waste management and Bioenergy**	**15**
	1.	Biotechnological approaches to waste treatment and recycling.	
	2.	Water quality assessment methods	
	3.	Biofuel production from renewable resources (bioethanol, biodiesel, biogas).	
II		**Bioremediation**	**15**
	4.	Bioremediation	
	5.	Microbial degradation of pollutants and xenobiotics.	
	6.	Phytoremediation and its applications in environmental cleanup.	
	7.	Watre act and Environmental protection act	
III		**Basic principles of Industrial Biotechnology**	**15**
	8.	Industrially important microbes, its screening, selection and identification.	

	9.	Maintenance and preservation of industrially important microbial cultures.	
	10.	Strain Improvement, Basic concepts of fermentation	
	11.	Design of fermenter. Types of fermenters and applications	
IV	**Commercial Production of Microbial products**		**15**
	12.	Bioprocess products and applications; Microbial production of Organic acids (Lactic acid, citric acid), Amino acids (Glutamic acid and Lysine).	
	13.	Fermentation by microbes for food additives: dairy products (Cheese, Yogurt), beverages (Beer, Wine) and antibiotics (Streptomycin, Penicillin)	
	Practical		
	14.	1. Demonstrate the preparation of ethyl alcohol from glucose using yeast fermentation, followed by the separation of ethanol through distillation. 2. Perform a growth curve analysis of bacteria or yeast cultures in nutrient broth, illustrating microbial growth phases. 3. Isolate and identify microorganisms from spoiled food samples, employing microscopy and biochemical tests for characterization. 4. Isolate lactic acid bacteria from curd/milk and demonstrate lactose fermentation by these organisms. 5. Set up and operate a laboratory fermentor, showcasing its basic features, purpose, and applications in bioprocess engineering. 6. Conduct enzyme activity assays for amylase, protease, and lipase to determine their catalytic efficiency. 7. Immobilize cells or enzymes in calcium alginate beads, demonstrating the technique's utility in biotechnological applications. 8. Perform microbiological assessments of drinking water from various sources, including well water, river water, supplied water, and packaged drinking water. 9. Isolate microbes from different environmental sources,	

		such as air, soil, lab surfaces, and water bodies, using appropriate sampling and isolation techniques. 10. Evaluate the organic load in aquatic systems and factory effluents by determining biochemical oxygen demand (BOD) and chemical oxygen demand (COD) levels.	

References:

1. Environmental Biotechnology - Alan Scragg; Longman, England
2. Biotechnology fundamentals and applications – Purohit & Mathur; Agrobotanica, India
3. Biotechnology – B D Singh; Kalyani Publishers, New Delhi
4. Biological waste water treatment 2nd Edition- Grady C P L
5. Industrial Microbiology – A H Patel, Panima Publishing House New Delhi.
6. Fermentation technology – Whittaker

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Demonstrate biotechnological approaches for waste treatment and recycling, emphasizing sustainability.	**U,An**	**PSO-1,3,4,6**
CO-2	Apply water quality assessment methods to evaluate the environmental impact of waste management practices.	**U, E**	**PSO-1,4**
C0-3	Produce biofuels like bioethanol, biodiesel, and biogas from renewable resources, contributing to green energy initiatives.	**E, Ap**	**PSO-1,3,4,6**
C0-4	Utilize bioremediation techniques for the removal of pollutants and xenobiotics from contaminated environments.	**U, An**	**PSO-1,3,4**
CO-5	Implement phytoremediation methods for environmental cleanup, showcasing the potential of plants in remediation processes.	**U, Ap**	**PSO-1,2,4**
CO-6	Apply knowledge of the Water Act and Environmental Protection Act in waste management strategies, ensuring compliance with environmental regulations.	**E, C**	**PSO-1,2,3,4**

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: Credits: 3:0:2 (Lecture:Tutorial:Practical)

CO No.	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/Tutorial (T)	Practical (P)
1	PO-1,3 PSO-1,3,4,6	U,An	F,C	L	
2	PO-1,2,3 PSO-1,4	U, E	F,C	L	
3	PO-1,2,3,6 PSO-1,3,4,6	E, Ap	F,C	L	
4	PO-1,2,3,6 PSO-1,3,4	U, An	F,C	L	
5	PO-1,2,5,6 PSO-1,2,4	U, Ap	C,P		P
6	PO-1,2,5,6 PSO-1,2,3,4	E, C	P,M		P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs

CO's	Programme Specific Outcomes (PSO)					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	3	-	3	3	-	3
CO2	3	0	-	1	0	0
CO3	3	0	3	3	0	3
CO4	3	0	3	3	-	-
CO5	3	3	-	1	-	-
CO6	3	3	3	3	-	-
Average	**3**	**2.25**	**2**	**2.33**	**0.16**	**1**

CO's	Programme Outcomes						
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**
CO1	3	-	3	-	-	-	-

CO2	2	2	2	-	-	-	-
CO3	2	2	3	-	-	2	-
CO4	1	2	-	-	2	2	-
CO5	2	2	-	-	2	2	-
CO6	2	2	-	-	2	2	-
Weighted Average	**2**	**2**	**2.66**	**0**	**2**	**2**	**0**

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓
CO 3	✓			✓
CO 4	✓	✓		✓
CO 5	✓	✓	✓	✓
CO 6	✓	✓	✓	✓
CO 6	✓	✓	✓	✓

Mar Ivanios College (Autonomous)

Discipline	BIOTECHNOLOGY				
Course Code	MIUK6DSCBBT302.1				
Course Title	PLANT AND ANIMAL BIOTECHNOLOGY				
Type of Course	**DSC**				
Semester	VI				
Academic Level	300-399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours	-	2 hours	5
Pre-requisites	Students should have a basic understanding of Biology and Cell Structure. Familiarity with laboratory techniques such as aseptic techniques, media preparation, and basic microbiological practices is recommended.				
Course Summary	The course in Plant and Animal Biotechnology provides a comprehensive understanding of advanced techniques such as Plant Tissue Culture, Transgenesis, and Molecular Markers, as well as Animal Tissue Culture methods and Gene Therapy concepts. Students will gain practical skills in media preparation, culture establishment, and data analysis, preparing them for roles in Biotechnology Research and Development.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I	**Plant tissue culture techniques & secondary metabolites production**		**10**
	1.	Basic principles of plant tissue culture, totipotency Nutrient requirements for culture media Roles of plant hormones in tissue culture	
	2.	Sterilization techniques. Establishment of cultures – Callus culture and its applications. Cell suspension culture techniques. Micropropagation for rapid multiplication callus culture.	
	3.	Somatic embryogenesis and its significance Synthetic seed production and protoplast culture	

		Somatic hybridization for genetic manipulation.	
	4.	Cryopreservation	
	5.	Plant secondary metabolites - Concept and their importance	
II	**Transgenesis and Molecular markers**		**10**
	6.	Plant transformation technology- Agrobacterium-mediated Gene transfer (Ti plasmid), Hairy Root Features of Ri Plasmid.	
	7.	Role of transgenic plants in producing valuable products,Examples of transgenic plants used as bioreactors. Mechanisms of herbicide resistance in plants, Bacillus thuringiensis (Bt) toxin and its role in insect resistance Glyphosate-resistant plants and their agricultural implications	
	8.	Molecular markers - RAPD, RFLP and DNA Fingerprinting - Principles and Applications	
III	**Animal tissue culture techniques**		**15**
	9.	Essential reagents for animal cell culture. Composition and preparation of cell culture media. Culture of Mammalian Cells, Tissues, and Organs.	
	10.	Primary Culture, Secondary Culture, Cell Lines	
	11.	Cell Viability and Cytotoxicity Tests	
	12.	Transfection methods (calcium phosphate precipitation, electroporation, Microinjection) and applications	
IV	**Transgenic Animals & Gene Therapy**		**10**
	13.	Concept of transgenic animals – Merits and demerits	
	14.	Role of transgenic animals in producing vaccines, diagnostics, hormones, and other recombinant DNA products.	
	15.	Principles and techniques of gene therapy.	
	16.	Ethical issues in animal biotechnology	
V	**Practicum**		**30**
	17.	1. Preparation of plant tissue culture medium, and sterilization, Preparation of stock solutions of nutrients for MS Media. 2. Surface sterilization of plant materials for inoculation (implantation in the medium) 3. Development of callus cultures and its sub-culturing 4. Organogenesis- shoot regeneration, root regeneration, somatic embryogenesis 5. Micropropagation of potato/tomato/ - Demonstration 6. Production of artificial seeds (encapsulation method) 7. Animal tissue culture – maintenance of established cell lines. 8. Animal tissue culture – virus cultivation.	

		9. Estimation of cell viability by dye exclusion (Trypan blue). 10. ELISA – Demonstration	

Reference

6. De, K. K. (1997). *Plant Tissue Culture*. New Central Book Agency.
7. Satyanarayana, U. (1997). *Biotechnology*.
8. Bajaj, Y. P. S., & Reinhard, A. (2001). *Plant Cell, Tissue and Organ Culture: Applied and Fundamental Aspects*.
9. Razdan, M. K. (2003). *Introduction to Plant Tissue Culture*. Science Publishers.
10. Dubey, R. C., & Gupta, S. (2014). *A Textbook of Biotechnology*. Chand Publishing.
11. Gupta, P. K. (1994). *Elements of Biotechnology*. Rastogi Publications.
12. Marshak, D. R., Gardner, R. L., & Gottlieb, D. (2001). *Stem Cell Biology*. Cold Spring Harbour Laboratory Press, New York.
13. Ranga, M. M. (2006). *Animal Biotechnology*. Agrobios (India).

Course Outcomes

No.	Upon completion of the course, the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Demonstrate proficiency in plant tissue culture techniques, including media preparation, sterilization methods, and culture establishment, for applications such as micropropagation, somatic embryogenesis, synthetic seed production, and somatic hybridization.	**R, U, Ap**	**PSO 1, 3**
CO-2	Analyse and evaluate transgenesis technologies in plants, including Agrobacterium-mediated gene transfer and the use of molecular markers (RAPD, RFLP, DNA fingerprinting), and assess their implications in plant biotechnology.	**An, Ap**	**PSO1, 4**
CO-3	Apply animal tissue culture techniques effectively, including cell culture media preparation, cultivation of mammalian cells and tissues, cell viability testing, and cryopreservation methods.	**U, Ap**	**PSO 2, 3**
CO-4	Critically assess the production and applications of recombinant DNA products in medicine using transgenic animals, and analyse the ethical considerations surrounding animal biotechnology, including gene therapy and in vitro fertilization (IVF).	**E, An**	**PSO 4, 6**
CO-5	Develop critical thinking and analytical skills to evaluate scientific research in plant and animal	**U, An**	**PSO 1, 4, 3**

	biotechnology, interpret experimental data, and apply theoretical knowledge to real-world scenarios.		
CO-6	Demonstrate effective communication skills through written reports, presentations, and discussions, articulating complex scientific concepts, presenting research findings, and engaging in scholarly discourse related to plant and animal biotechnology.	**E, C, An**	**PSO 1, 4, 3**

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: Credits: 4:0:0 (Lecture:Tutorial:Practical)

CO	**PO/PSO**	**Cognitive Level**	**Knowledge Category**	**Lecture (L)/Tutorial (T)**	**Practical (P)**
CO-1	PO 1,2 PSO 1,3	R, U, Ap	C, F, P	L	
CO-2	PO 1 PSO1,4	An, Ap	F, P	L	
CO-3	PO 1, 2 PSO 2, 3	U, Ap	F, P	L	
CO-4	PO 1, 4 PSO 4, 6	E, An	F,	L	
CO-5	PO 1, 4 PSO 1,4,3	U, An	C, F	L	
CO-6	PO 1, 3,5 PSO 1,4,3	E, C, An	M	L	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs:

CO's	Programme Specific Outcomes (PSO)					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	-	2	2	-	-	-
CO2	1	-	-	2	-	-
CO3	-	1	2	-	-	-
CO4	-	-	-	2	-	2
CO5	1	-	2	2	-	
CO6	1	-	-	-	2	1
Average	**1**	**1.5**	**2**	**2**	**2**	**1.5**

CO's	Programme Outcomes						
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**
CO1	1	2	-	-	-	-	-
CO2	1	-	-	-	-	-	-
CO3	1	2	-	-	-	-	-
CO4	1	-	-	3	-	-	-
CO5	1	-	-	3	-	-	-
CO6	1	-	1	-	2	-	-
Weighted Average	**1**	**2**	**1**	**3**	**2**	**0**	**0**

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

-
- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓
CO 3	✓			✓
CO 4	✓	✓		✓
CO 5	✓	✓	✓	✓
CO 6	✓	✓	✓	✓

Mar Ivanios College (Autonomous)

Discipline	BIOTECHNOLOGY				
Course Code	MIUK6DSEBBT300.1				
Course Title	FORENSIC SCIENCE AND TECHNOLOGY				
Type of Course	**DSE**				
Semester	VI				
Academic Level	300-399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	4 hours	-		
Pre-requisites	Students should have a basic understanding of Biology and Chemistry.				
Course Summary	This course is designed to provide students with a comprehensive understanding of biotechnological principles and applications in various sectors including agriculture, food, environment, medicine, and forensics. The course aims to develop students' theoretical knowledge, practical skills, critical thinking, and ethical awareness in the field of Biotechnology.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I		**Introduction to Biotechnology**	**15**
	1.	History and Development of Forensic Science, Scope of Forensic Science	
	2.	Organization of Forensic Science Laboratories, Branches of Forensic Science, Principles of Forensic Science	
	3.	Legal Standards: Frye Case and Daubert Standard Ethics in Forensic Sciences	
II		**Analysis of Toxicity and Chemical Evidence**	**15**
	4.	Toxicity Analysis of: Insecticides & Pesticides,Tranquillizers & Sedatives,Hypnotics & Stimulants, Narcotics and Opiates	
	5.	Chemical Evidence for Explosives	
	6.	Identification of: Plant and Metallic Poisons	
	7.	Identification of:Common Poisons from Viscera, Tissues, and	

		Body Fluids	
III	**Techniques in Forensic Investigation**		**15**
	8.	Blood Group Determination from Blood Stains	
	9.	Detection and Analysis of: Seminal Fluid and Other Body Fluids,Red Cell Enzymes, Serum Proteins of Forensic Significance	
IV			**15**
	10.	Lie Detection Techniques: Polygraphy,Narcoanalysis,Voice Sampling Forensic Analysis of Fingerprints	
	11.	Overview of Cybercrimes: Hacking,Spamming,Phishing,Stalking	

References:

1. A Handbook of Forensic Medicine and Toxicology: Question Answer Format with Illustrations by
2. Dr. Madona Joseph and Dr. Harpreet Kaur
3. 2. The Essentials of Forensic Medicine and Toxicology by K.S. Narayan Reddy, O.P. Murty
4. 3. Textbook of Forensic Medicine and Toxicology by Anil Aggrawal
5. 4. Parikhs textbook of medical jurisprudence forensic medicine and toxicology for classrooms and
6. courtrooms by Subrahmanyam B.V.
7. Cyber Forensics by Dejey and Murugan

Course Outcomes

No.	Upon completion of the course, the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Understand the historical and organizational aspects of forensic science, including legal standards and ethical considerations.	**U**	**PSO 1**
CO-2	Analyze the toxicity of various substances and identify chemical evidence related to explosives, poisons, and common toxins.	**U, An**	**PSO 2, 4**
CO-3	Demonstrate proficiency in identifying and analyzing poisons from biological samples such as viscera, tissues, and body fluids.	**U, Ap**	**PSO 2, 3**
CO-4	Apply techniques for determining blood groups and analyzing forensic significance of body fluids and enzymes.	**U,Ap**	**PSO 1, 6**
CO-5	Utilize lie detection techniques and perform forensic analysis of fingerprints.	**U, Ap**	**PSO 2, 6**
CO-6	Gain awareness of cybercrimes and their overview, including hacking, spamming, phishing, and stalking.	**U.E**	**PSO 2, 3, 5**

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: Credits: 4:0:0 (Lecture: Tutorial: Practical)

CO No.	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/Tutorial (T)	Practical (P)
CO-1	PO 1 PSO 1	U	F	L	
CO-2	PO 1, 7 PSO 2, 4	U, An	F, C	L	
CO-3	PO 1,7 PSO 2, 3	U, Ap	C	L	
CO-4	PO 1, 5, 6, PSO 1, 6	U,Ap	P	L	
CO-5	PO 1 PSO 2, 6	U, Ap	P	L	
CO-6	PO 1, 2, 3, 7 PSO 2, 3, 5	U.E	P	L	

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs:

CO's	Programme Specific Outcomes (PSO)					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	3	-	-	-	-	-
CO2	-	2	-	2	-	-
CO3	-	3	3	-	-	-
CO4	3	-	-	-	-	3
CO5	-	2	-	-	-	3
CO6	-	3	3	-	2	-
Average	**3**	**2.25**	**3**	**2**	**2**	**3**

CO's	Programme Outcomes						
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**
CO1	1	-	-	-	-	-	-
CO2	1	-	-	-	-	-	3
CO3	1	-	-	-	-	-	2
CO4	1	-	-	-	2	2	-
CO5	1	-	-	-	-	-	-
CO6	1	3	2	-	-	-	-

Weighted Average	**1**	**3**	**3**	**0**	**2**	**2**	**2.5**

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓
CO 3	✓			✓
CO 4	✓	✓		✓
CO 5	✓	✓		✓
CO 6	✓	✓		✓

Mar Ivanios College (Autonomous)

Discipline	BIOTECHNOLOGY				
Course Code	MIUK6DSEBBT302.1				
Course Title	BIOINFORMATICS AND ARTIFICIAL INTELLIGENCE				
Type of Course	**DSE**				
Semester	VI				
Academic Level	300-399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	4 hours	-		
Pre-requisites	Basic computer and biology knowledge				
Course Summary	This course will provide an understanding of the various computational techniques with Artificial Intelligence. How to analyze biological data with the use of sequence information. The course will cover the steps involved in Evolutionary analysis and practical implications of AI in health care industry.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I	**Outline of Bioinformatics and AI**		**15**
	1.	Introduction and Applications of Bioinformatics.	
	2.	Classification of biological databases, Biological data formats.	
	3.	Introduction to single letter code of amino acids, Symbols used in nucleotides. Data retrieval from Entrez and SRS.	
	4.	Artificial Intelligence (AI) Introduction: Definition, Challenges and Applications. Role of AI in bioinformatics.	
II	Sequence allignment		**15**
	5.	Outline and Uses of sequence alignment. Similar sequence search using FASTA and BLAST programs in the database.	
	6.	Pairwise sequence alignment and Multiple sequence alignment.	

		Local and Global alignment (Smith-Waterman and Needleman-Wunsch algorithm).	
	7.	Substitution matrices, Scoring matrices - PAM, BLOSUM and Dot plot.	
	8.	Statistics of alignment score and evaluation.	
III	**Phylogenetic analysis**		**15**
	9.	Overview of Tree analysis. Cladistics, Phenetics and Distances. Various tree types.	
	10.	Overview of Bootstrapping. Tools – Clustal Omega, PHYLIP and Mega.	
	11.	Problems and errors in phylogenetic reconstruction.	
	12.	Overview of AI in Phylogenetic analysis.	
IV	**Artificial intelligence in health care**		**15**
	13.	Practice and implications of AI in Healthcare industry.	
	14.	Algorithms for Bioinformatics prediction: HMM and Neural Network.	
	15.	Case study: AI in computational sequence analysis.	

References:

1. S.C. Rastogi et al. Bioinformatics: Methods and Applications: (Genomics, Proteomics and Drug Discovery) Kindle Edition.
2. Stuart Russel and Peter Norvig, "Artificial Intelligence- A Modern Approach", Prentice Hall, 1995.
3. Andreas D. Baxevanis and B.F. Francis Ouellette. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins. ISBN: 978-0-471-47878-2.
4. George F Luger, "Artificial Intelligence", Pearson Education, 4th Edition, 2001

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	To do the sequence analysis and phylogenetic prediction with their own knowledge.	**Ap**	**PSO-1,2,4**
CO-2	Also capable to search the protein/gene sequence and structural information from the any biological databases.	**U**	**PSO-1,2,4**
C0-3	Helps to ensure the comparative sequence analysis without any error	**E**	**PSO-1,2,4**

C0-4	To analyze and interpret the biological data through Artificial Intelligence	**An**	**PSO-1,2,4**

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: Credits: 3:0:2 (Lecture:Tutorial:Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/Tutorial (T)	Practical (P)
1	**CO-1**	PSO-1,2,4	Ap	C,P,M		
2	**CO-2**	PSO-1,2,4	U	C,P		
3	**C0-3**	PSO-1,2,4	E	C,P		
4	**C0-4**	PSO-1,2,4	An	P,M		

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

CO's	Programme Specific Outcomes (PSO)					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	3	3	-	3	-	-
CO2	3	3	-	3	-	-
CO3	3	3	-	3	-	-
CO4	3	3	-	3	-	-
Average	**3**	**3**	**-**	**3**	**-**	**-**

CO's	Programme Outcomes						
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**
CO1	3	3	1	3	1	1	3
CO2	3	3	1	3	1	1	3
CO3	3	3	1	3	1	1	3
CO4	3	3	1	3	1	1	3
Average	**3**	**3**	**1**	**3**	**1**	**1**	**3**

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam
-

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓
CO 3	✓			✓
CO 4	✓	✓		✓

Mar Ivanios College (Autonomous)

Discipline	BIOTECHNOLOGY				
Course Code	MIUK7DSCBBT400.1				
Course Title	STEM CELL AND TISSUE ENGINEERING				
Type of Course	**DSC**				
Semester	**VII**				
Academic Level	400-499				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours	-	2 hours	5
Pre-requisites	Students should have a basic understanding of cell biology and genetics. Familiarity with molecular biology techniques and tissue culture methods is advantageous but not required.				
Course Summary	This course covers fundamental stem cell biology concepts such as history, types, properties, and niches. It explores stem cell differentiation mechanisms, therapeutic applications in regenerative medicine and disease modelling, tissue engineering principles, clinical applications, ethical considerations, and regulatory frameworks. The practicum includes visiting a tissue engineering facility.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I		**Introduction to stem cell biology**	**10**
	1.	Introduction to stem cells: history, definitions, and significance	
	2.	Types of stem cells: embryonic, adult, induced pluripotent stem cells	
	3.	Stem cell properties: self-renewal, potency, plasticity	
	4.	Stem cell niches and microenvironment	
II		**Stem Cell Differentiation and Therapeutic Applications**	**10**
	5.	Mechanisms of stem cell differentiation	
	6.	Factors influencing stem cell fate: signalling pathways,	

		epigenetics	
	7.	Applications of stem cells in regenerative medicine	
	8.	Stem cells in disease modelling and drug discovery	
III	**Tissue Engineering Principles and Techniques**		**15**
	9.	Principles of tissue engineering: scaffolds, cells, growth factors	
	10.	Biomaterials in tissue engineering: Polymers, Ceramics, Composites	
	11.	Scaffold design and fabrication techniques	
	12.	Cell seeding, growth factors, and bioreactors	
IV	**Clinical Applications and Ethical Considerations**		**10**
	13.	Clinical applications of stem cells and tissue engineering	
	14.	Case studies: stem cell therapies for specific diseases	
	15.	Ethical considerations in stem cell research and therapy	
	16.	Regulatory frameworks and guidelines	
V	**PRACTICUM**		**30**
	17.	Visit a commercial unit or Laboratory practising Tissue Engineering Basic islation and characterization of stem cells	

References:

1. Lanza, R., & Atala, A. (2020). Essentials of Stem Cell Biology (3rd ed.). Academic Press.
2. Deb, K. K., & Totey, S. M. (2009). Stem Cells: Basics and Applications (Reprint ed.). Tata McGraw-Hill Education.
3. Stachowiak, M. K., & Tzanakaki, E. (Eds.). (Year). Stem Cells: From Mechanisms to Technologies. World Scientific Publishers.
4. Lanza, R., et al. (Year). Principles of Tissue Engineering (4th ed.). Academic Press.
5. Carlson, B. M. (Year). Stem Cell Anthology: From Stem Cell Biology, Tissue Engineering, Cloning, Regenerative Medicine and Biology. Academic Press.
6. Calegari, F., & Waskow, C. (Eds.). (Year). Stem Cells: From Basic Research to Therapy, Volume I (1st ed.). CRC Press.

Course Outcomes

No.	Upon completion of the course, the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Understand the historical background, definitions, and significance of stem cells.	**R**	**PSO 1, 3**
CO-2	Differentiate between various types of stem cells, including embryonic, adult, and induced pluripotent	**U, E**	**PSO 1, 3**

	stem cells.		
CO-3	Describe the properties of stem cells, such as self-renewal, potency, and plasticity.	**An**	**PSO 1, 4**
CO-4	Explain the role of stem cell niches and microenvironments in regulating stem cell behavior.	**Apl**	**PSO 1, 2, 3**
CO-5	Analyze the mechanisms involved in stem cell differentiation.	**U,E**	**PSO 1, 6**
CO-6	Evaluate the factors that influence stem cell fate, including signaling pathways and epigenetics.	**Ap**	**PSO 1, 3**

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: Credits: 4:0:0 (Lecture:Tutorial:Practical)

CO	**PO/PSO**	**Cognitive Level**	**Knowledge Category**	**Lecture (L)/Tutorial (T)**	**Practical (P)**
CO-1	PO 1 PSO 1, 3	R	F	L	
CO-2	PO 1, 3 PSO 1, 3	U, E	C	L	
CO-3	PO 1, 4 PSO 1, 4	U, An	C	L	
CO-4	PO 1, 3 PSO 1, 2, 3	Ap	C, P	L	
CO-5	PO 1, 4 PSO 1, 6	U, E	C	L	
CO-6	PO 1, 5, 6 PSO 1, 3	Ap, An	C, P	L	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs:

CO's	Programme Specific Outcomes (PSO)					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	1	-	2	-	-	-
CO2	1	-	1	-	-	-
CO3	1	-	-	2	-	-
CO4	1	1	2	-	-	-
CO5	1	-	-	-	-	1
CO6	1	-	2	-	-	-

Average	**1**	**1**	**1.75**	**2**	**0**	**1**

CO's	Programme Outcomes						
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**
CO1	1	-	-	-	-	-	-
CO2	1	-	1	-	-	-	-
CO3	1	-	-	1	-	-	-
CO4	1	-	2	-	-	-	-
CO5	1	-	-	2	-	-	-
CO6	1	-	-	-	1	1	-
Average	**1**	**0**	**1.5**	**1.5**	**1**	**1**	**0**

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓
CO 3	✓			✓
CO 4	✓	✓		✓
CO	✓	✓		✓

5				
CO 6	✓	✓		✓
CO 6	✓	✓	✓	✓

Mar Ivanios College (Autonomous)

Discipline	BIOTECHNOLOGY				
Course Code	MIUK7DSEBBT400.1				
Course Title	GENOMICS AND PROTEOMICS				
Type of Course	**DSE**				
Semester	V11				
Academic Level	400 – 499				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	4 hours	-	hours	
Pre-requisites	Prerequisites for this course include a basic understanding of DNA structure, gene expression, and protein function, as well as familiarity with bioinformatics tools for data analysis. Additionally, hands-on experience with molecular techniques and laboratory skills will be beneficial for the practical sessions.				
Course Summary	This course provides an in-depth exploration of genomics, proteomics, and bioinformatics, covering topics such as DNA sequencing methods, protein structure analysis, and data management tools. Students will gain practical skills in molecular techniques, bioinformatics analysis, and protein characterization through hands-on laboratory sessions.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I		**Introduction to Genomics**	**15**
	1.	DNA sequencing methods: manual & automated: Maxam & Gilbert and Sangers method. Pyrosequencing, Genome Sequencing: Shotgun & Hierarchical (clone contig) methods.	
	2.	Computer tools for sequencing projects: Genome sequence assembly software.	
II		**Managing and Distributing Genome Data**	**15**

	3.	Managing and Distributing Genome Data: Web-based servers and software for genome analysis: ENSEMBL, VISTA, UCSC Genome Browser, NCBI genome.	
	4.	Selected Model Organisms' Genomes and Databases.	
III	**Introduction to Protein structure and chemical properties of Proteins**		**15**
	5.	Physical interactions that determine the properties of proteins.	
	6.	Short-range interactions, electrostatic forces, Van der Waals interactions, hydrogen bonds, and hydrophobic interactions.	
IV	**Introduction to Proteomics**		**15**
	7.	Introduction to Proteomics, Analysis of Proteomes. 2D-PAGE. Sample preparation, solubilization, reduction, resolution. Reproducibility of 2D-PAGE.	
	8.	Mass spectrometry-based methods for protein identification. De novo sequencing using mass spectrometric data.	
V	**Activity**		
	9.	1. Use of SNP databases at NCBI and other sites 2. Use of OMIM database 3. Detection of Open Reading Frames using ORF Finder 4. Proteomics 2D PAGE database 5. Softwares for Protein localization.	

References:

1. Krebs, J., Goldstein, E., & Kilpatrkk, S. (2018). *Lewin's Genes XII* (Cen'·co Publisher Services, Kristin Parker, Ed.). Burlington, MA: Jones & Bartlett Learning.

2. Liebler, D. C. (2002). *Introduction to Proteomics: Tools for the New Biology*. Totowa, NJ: Humana Press.

3. Campbell, A. M., & Heyer, L. J. (2003). *Discovering Genomics, Proteomics, and Bioinformatics*. San Francisco: Benjamin Cummings.

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Understand DNA sequencing methods, including Maxam & Gilbert, Sangers, and Pyrosequencing, as well as Shotgun & Hierarchical Genome Sequencing techniques.	R, U	PSO 1, 2

CO-2	Utilize computer tools for genome sequence assembly, including ENSEMBL, VISTA, UCSC Genome Browser, and NCBI genome analysis software.	Ap, An	PSO 1, 3
C0-3	Manage and distribute genome data effectively using web-based servers and software, and explore databases of selected model organisms' genomes.	Ap, Ev	PSO 1, 5
C0-4	Analyze physical interactions determining protein properties, including short-range interactions, electrostatic forces, Van der Waals forces, hydrogen bonds, and hydrophobic interactions.	U, An	PSO 1, 4
CO-5	Apply techniques in proteomics, such as 2D-PAGE for proteome analysis, sample preparation, solubilization, and mass spectrometry-based protein identification.	Ap, An	PSO 1, 2, 4
CO-6	Demonstrate practical skills in using bioinformatics tools and databases, including SNP databases, OMIM database, ORF Finder for detecting Open Reading Frames, and software for protein localization and analysis.	Ap, Ev	PSO 2, 6, 3

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: Credits: 3:0:2 (Lecture:Tutorial:Practical)

CO No.	**PO/PSO**	**Cognitive Level**	**Knowledge Category**	**Lecture (L)/Tutorial (T)**	**Practical (P)**
CO-1	PO 1 PSO 1, 2	R, U	F, C	L	
CO-2	PO 1, PSO 1, 3	Ap, An	F, C, P	L	
CO-3	PO 1 PSO 1, 5	Ap, E	P, C	L	
CO-4	PO 1, 2 PSO 1, 4	U, An	F, C, M	L	
CO-5	PO 1, 2, 4 PSO 1, 2, 4	Ap, An	C, P	L	
CO-6	PO 6, 7, PSO 2, 6, 3	Ap, E	P, M	L	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

CO's	Programme Specific Outcomes (PSO)					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	1	1	-	-	-	-

CO2	2	-	2	-	-	-
CO3	2	-	-	-	2	-
CO4	1	-	-	2	-	-
CO5	1	2	-	2	-	-
CO6	-	1	2	-	-	1
Average	**1.17**	**1**	**2**	**2**	**2**	**1**

CO's	Programme Outcomes						
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**
CO1	1	-	-	-	-	-	-
CO2	1	-	-	-	-	-	-
CO3	1	-	-	-	-	-	-
CO4	1	2	-	-	-	-	-
CO5	1	2	-	2	-	-	-
CO6	-	-	-	-	-	1	2
Weighted Average	**1**	**2**	**0**	**2**	**0**	**1**	**2**

Correlation Levels:

Level	**Correlation**
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓
CO 3	✓			✓
CO 4	✓	✓		✓
CO 5	✓	✓		✓
CO 6	✓	✓		✓
CO 6	✓	✓	✓	✓

Mar Ivanios College (Autonomous)

Discipline	BIOTECHNOLOGY				
Course Code	MIUK8DSCBBT400.1				
Course Title	RESEARCH METHODOLOGY AND SCIENTIFIC WRITING				
Type of Course	**DSC**				
Semester	VIII				
Academic Level	400-499				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	3	3 hours	-	-	3
Pre-requisites	Students should have a basic understanding of scientific principles and terminology, including familiarity with research terminology such as hypothesis, experimentation, and ethics. Proficiency in written communication and citation methods is recommended.				
Course Summary	Introduction to Research Methodology covers fundamental concepts such as types of research, research methods, and components of research like problem identification and hypothesis formulation. Additionally, students will gain insight into research ethics, plagiarism prevention, and various indices used in scientific communication.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I		**Introduction to Research Methodology**	**15**
	1.	Fundamental concepts of Research. Research- meaning, characteristics and objectives.	
	2.	Types of research. Different methods of Research: Experimental, Descriptive, Historical, Qualitative and Quantitative methods.	
II		**Components of research**	**15**
	3.	Identification, design and & formulation of the research problem. Hypothesis, Null Hypothesis & Alternative Hypothesis. Hypothesis Testing.	
III		**Scientific Writing and Manuscript Preparation**	**15**

	4.	Scientific communication- formats of writing research articles. Methods and styles of referencing.	
	5.	Research Ethics. Plagiarism. Impact factor and other indices of articles and journals	
	6.	Scientific communication, Communicating research findings to diverse audiences	
	7.	Proposal writing	
IV	**Activity**		
	8.	Write a Review	

Reference

1. Thomas, C. G. (2021). Research Methodology and Scientific Writing. Springer
2. https://dokumen.pub/research-methodology-and-scientific-writing-2nd-edition-3030648648-9783030648640-9783030648657.html

Course Outcome

No.	Upon completion of the course, the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Demonstrate a comprehensive understanding of fundamental research concepts, including the meaning, characteristics, and objectives of research, as well as the different types and methods such as experimental, descriptive, historical, qualitative, and quantitative methods.	U	PSO 1, 4
CO-2	Apply critical thinking skills to identify, design, and formulate research problems effectively, develop clear hypotheses (including null and alternative hypotheses), and employ hypothesis testing techniques to analyze data and draw meaningful conclusions.	Ap	PSO 3, 4
CO-3	Acquire proficiency in scientific writing and manuscript preparation, including knowledge of various formats for writing research articles, methods, and styles of referencing, and the ability to communicate complex ideas clearly and concisely.	Ap	PSO 5, 6
CO-4	Understand and adhere to research ethics principles, demonstrating awareness of issues related to plagiarism prevention, the responsible conduct of research, and the importance of maintaining integrity in all aspects of the research process.	U	PSO 1, 3

CO-5	Evaluate the impact factor and other indices used to assess the quality and relevance of articles and journals in scientific communication, and effectively communicate research findings to diverse audiences using appropriate strategies and techniques.	E	PSO 4, 5
CO-6	Apply theoretical knowledge and practical skills acquired throughout the module to complete a review paper, integrating research findings, critical analysis, and scholarly writing to produce a comprehensive and well-structured academic document.	Ap	PSO 2, 3

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: Credits: 4:0:0 (Lecture:Tutorial:Practical)

CO	**PO/PSO**	**Cognitive Level**	**Knowledge Category**	**Lecture (L)/Tutorial (T)**	**Practical (P)**
CO-1	PO 1, 3 PSO 1, 4	U	C	L	
CO-2	PO 2, 4 PSO 3, 4	Ap	P	L	
CO-3	PO 1, 6 PSO 5, 6	Ap	P	L	
CO-4	PO 1, 5 PSO 1, 3	U	F	L	
CO-5	PO 1, 6 PSO 4, 5	E	C	L	
CO-6	PO 2,4 PSO 2, 3	Ap	P	L	

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs:

CO's	Programme Specific Outcomes (PSO)					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	2	-	-	3	-	-
CO2	-	-	3	2	-	-
CO3	-	-	-	-	3	3
CO4	2	-	2	-	-	-
CO5	-	-	-	3	2	-
CO6	-	2	2	-	-	-

Average	**2**	**2**	**2.3**	**2.6**	**2.5**	**3**

CO's	Programme Outcomes						
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**
CO1	1	-	1	2	-	-	-
CO2	-	3	-	2	-	3	-
CO3	2	-	-	-	-	-	-
CO4	1	-	-	-	3	-	-
CO5	1	-	-	-	-	2	-
CO6	-	2	2	-	-	-	-
Weighted Average	**1.3**	**2.5**	**1.5**	**2**	**3**	**2.5**	**0**

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓
CO 3	✓			✓
CO 4		✓		✓

CO 5		✓		✓
CO 6		✓		✓

Mar Ivanios College (Autonomous)

Discipline	**BIOTECHNOLOGY**				
Course Code	MIUK8DSCBBT402.1				
Course Title	GENERAL VIROLOGY				
Type of Course	DSE				
Semester	V1				
Academic Level	400-499				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours	-	-	5
Pre-requisites	Students should have a basic understanding of biology, microbiology, and molecular biology concepts. Familiarity with cell structure, genetic principles, and laboratory techniques would be beneficial.				
Course Summary	The course on Virology explores the evolution, classification, morphology, and transmission of viruses, alongside methods for virus culture and disease management. Students gain a comprehensive understanding of viral biology and its implications in human health and biotechnological a pplications.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I		**History, nature & Properties of Virus**	**12**
	1.	History: History, origin & evolution of viruses.	
	2.	Nomenclature and classification of viruses: Guidelines for naming and classification, ICTV classification of viruses.	
	3.	Morphology and properties of viruses: morphology and structure, chemical composition. dsDNA virus- Adenovirus, Herpes. ssDNA virus- PARVO, Gemini. dsRNA virus – Retro virus. ssRNA Virus- Corona, Hepatitis.	
	4.	Virus culture methods: using whole organism, embryo & cell culture, phage culture.	
II		**Bacteriophage Diversity and Replication**	**10**
	5.	Diversity and Classification of Bacteriophages	

	6.	one-step multiplication curve, the lytic and lysogenic cycle of phage	
	7.	Early and late proteins in bacteriophage's replication cycle,	
III	**Viral Transmission, Viral disease & management**		**16**
	8.	Modes of Viral Transmission: Persistent, Non-persistent, Vertical, Horizontal	
	9.	Viral diseases of humans - Pneumotropic: Influenza, Adenoviral Infection, Rhinoviral Infection	
	10.	Dermotropic: Herpes Simplex, Chickenpox, Measles, Rubella	
	11.	Viscerotropic: Yellow Fever, Dengue Fever	
	12.	Neurotropic: Rabies, Polio, NIPAH	
	13.	Introduction to oncogenic viruses: Types of oncogenic DNA and RNA viruses, oncogenes and proto-oncogenes	
	14.	Prevention & Management of Viral Diseases: Antiviral Compounds Interferons and Their Mode of Action General Principles of Viral Vaccination	
IV	**Viral disease & management**		**10**
	15.	**Bio-safety principles:** Containment Facilities Maintenance and Handling of Laboratory Animals Criteria of Virological Laboratory	
	16.	**Applications of Virology** Viral Vectors and Cloning Phage Therapy Phage Display and Gene Therapy	
V	**Practicum**		
	17.	Virus identification	
	18.	Viral culture	

Course Outcomes

No.	Upon completion of the course, the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Understand the history, inception, and development of viruses, including their characteristics, nomenclature, and classification according to ICTV guidelines.	R, U	PSO 1
CO-2	Describe the morphology, physical and chemical properties of viruses, and explain virus culture methods.	R, U	PSO 1, 2
CO-3	Identify the diversity of bacteriophages and classify them based on their characteristics.	U	PSO 1
CO-4	Explain the one-step multiplication curve, lytic and lysogenic cycles of viruses, and discuss transcription regulation.	U, E	PSO 1, 4
C0-5	Analyze viral transmission modes, properties of viral genomes, and different replication strategies	U, An	PSO 1, 4

	employed by viruses.		
CO-6	Explore the relationship between viruses and cancer, including the types of oncogenic viruses and measures for viral prevention.	U	PSO 1, 6

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: Credits: 4:0:0 (Lecture:Tutorial:Practical)

CO No.	**PO/PSO**	**Cognitive Level**	**Knowledge Category**	**Lecture (L)/Tutorial (T)**	**Practical (P)**
CO-1	PO 1, 2 PSO 1	R, U	F, C	L	
CO-2	PO 1, 4 PSO 1, 2	R, U, An	F, C	L	
CO-3	PO 1,7 PSO 1	U	F, C	L	
CO-4	PO 1, 2 PSO 1, 4	U, E	F, C	L	
CO-5	PO 1, 3, 4 PSO 1, 4	U, An	F, C	L	
CO-6	PO 1, PSO 1, 6	U, Ap	F, C, P	L	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

CO's	Programme Specific Outcomes (PSO)					
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	2	-	-	-	-	-
CO2	1	1	-	-	-	-
CO3	2	-	-	-	-	-
CO4	2	-	-	2	-	-
CO5	1	-	-	1	-	-
CO6	1	-	-	-	-	2
Average	**1.5**	**1**	**0**	**1.5**	**0**	**2**

CO's	Programme Outcomes						
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**
CO1	2	-	2	-	-	-	-
CO2	2	-	-	2	-	-	-
CO3	2	-	-	-	-	-	2
CO4	1	2	-	-	-	-	-

CO5	1	-	2	2	-	-	-
CO6	1	-	-	-	-	-	-
Weighted Average	**1.5**	**2**	**2**	**2**	**0**	**0**	**2**

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓
CO 3	✓			✓
CO 4		✓		✓
CO 5		✓		✓
CO 6		✓		✓

BOARD OF STUDIES MEMBERS IN BIOTECHNOLOGY(2023-2026)

No.	Name	Designation/Office with phone no. and E-mail id	Category and Guidelines
1.	**(Chairman)** **Dr. Lini.N**	**Dr. Lini.N** Assistant professor Department of Biotechnology lini.n@mic.ac.in Ph.8129172238	Head of the Department concerned
2.	**Dr. Deepthy Alex**	**Dr. Deepthy Alex** Assistant professor Department of Biotechnology **deepthy.alex@mic.ac.in** Ph.9847172375	Faculty member of the Department
3.	**Dr. Santhi Krishnan**	**Dr. Santhi Krishnan** Guest faculty Department of Biotechnology Ph.9645240146 Email. santhi.krishnan@mic.ac.in	Special invitee to BoS
4.	**Dr. Preetha S. S.**	**Dr. Preetha S. S.** Assistant Professor Email: preetha.ss@mic.ac.in Phone : +91 8281915797	Subject expert Botany
5.	**Dr. Mary Sheeba A.**	**Dr. Mary Sheeba A.** Assistant Professor Email: mary.sheeba@mic.ac.in Phone : +91 9746512803	Subject expert Botany
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9.	**Dr Shiburaj Sugathan**	**Dr Shiburaj Sugathan** Professor Department of Botany University of Kerala Email. drshiburaj@gmail.com	Subject expert (special invitee)
10.	**Dr Raghul Subin**	**Dr Raghul Subin** Assistant Professor Department of Zoology Govt. College Kariavattom Email. raghulzubin@gmail.com	Subject expert (Special invitee)
11.	**Dr. Radhakrishnan E.K.**	**Dr.Radhakrishnan E.K.** Assistant Professor School of Biosciences Mahatma Gandhi University, PD Hills (PO) Kottayam, Kerala – 686 560 Email: radhakrishnanek@gmail.com Ph: 9847901149	Subject expert from outside the parent University nominated by the Academic Council

12.	**Dr. Bhavya B C**	**Dr. Bhavya B C** Assistant professor Department of Biotechnology Cochin University of Science and Technology,Cochi Email. bhavya@cusat.ac.in Ph. 8157025337	Subject expert from outside the parent University nominated by the Academic Council
13.	**Dr EA Siril**	**Dr EA Siril** Professor and Head Department of Botany University of Kerala Kariavattom Email: easiril@keralauniversity.ac.in	Expert nominated by the Vice-Chancellor
14.	**Dr. Santhosh R.S.**	**Dr. Santhosh R.S.** CEO, Phytocom Pharmaceuticals (P) Ltd. KRIBS-BIONEST KINFRA-HighTech Park Kochi E-mail:mail@phytocom.co.in Mob.:8281555274	Representative from industry nominated by the principal
15.	**Dr.Swapna Alex**	**Dr. Swapna Alex** Professor Department of Biotechnology College of Agriculture, Vellayani **Ph:**9847067220 Email: swapna.alex@kau.in	Representative from allied areas nominated by the principal

16.	**C. Padmakumar**	**C. Padmakumar** Special Officer Kerala Medical Technology Consortium Thiruvananthapuram Taluk, Kerala, India. Director The Kerala Life Sciences Parks private Limited Thiruvananthapuram, Kerala, India Email.chandrapadmakumar@gmail.com	Representative from corporate sector nominated by the principal
17.	**Dr. Roshin Elizabeth George**	**Dr. Roshin Elizabeth George** Research Director Biovent, KU-TBSC start-up Department of Biotechnology Karyavattom Thiruvananthapuram – 695581 E-mail: ifo@biovent.co.in Mob.: 9946793797	One member of the college alumni nominated by the principal.
18.	**Dr. Prakash.G. Williams**	**Dr. Prakash.G. Williams** Assistant Professor Department of Biotechnology Bishop Moore College,	Expert from outside the College nominated by the principal.
19.	**Dr. Jairani P S**	**Dr. Jairani P S** Assistant Professor & Head Department of Biotechnology Govt. College, Karyawattom Thiruvananthapuram E-mail: jairanips@gmail.com Mobile: 8547491638	Expert from outside the College nominated by the principal.
20.	**Dr. Sajeeb Khan A**	**Dr. Sajeeb Khan A**. Assistant Professor Department of Zoology University College Thiruvananthapuram – 695034 E-mail: khansajeeb@gmail.com Mobile: 9995566343	Expert from outside the College nominated by the principal.