MGM University

Vision

- To ensure sustainable human development which encourages self-reliant and self-content society.
- To promote activities related to community services, social welfare and also Indian heritage and culture.
- To inculcate the culture of non-violence and truthfulness through vipassanna meditation and Gandhian Philosophy.
- To develop the culture of simple living and high thinking

Mission

- To impart state of art education and technical expertise to students and give necessary training to teachers to create self-reliant society for future.
- To encourage students to participate in Indian and International activities in sports, literature, etc. so that future generation becomes base for free and liberal society
- To educate students in areas like Management, Finance, Human relations to inculcate philosophy of simple living and high thinking value of simple economic society.
- To inculcate culture of non-violence and truthfulness through Vipassana.

  To sustain activities of Indian culture (viz. classical dance, music and fine arts) through establishing institutes like Mahagami, Naturopathy, etc.

विद्यापीठ गीत

अत्त दिप भव भव प्रदिप भव,

स्वरूप रूप भव हो

ज्ञान सब्ब विज्ञान सब्ब भव ,

सब्ब दिप भव हो

अत्ताहि अत्त नो नाथो ,

अत्ताहि अत्त नो गति

अत्त मार्गपर अप्रमादसे है तुझे चलना

सब्ब का कल्याण हो ,

वो कार्यकुशल करना

सब्ब का उत्तम मंगल , पथप्रदर्शक हो

अत्त दिप भव भव प्रदिप भव ,

स्वरूप रूप भव हो

ज्ञान सब्ब विज्ञान सब्ब भव ,

सब्ब दिप भव हो

बुद्धमं शरनं गच्छामि :

धम्मं शरनं गच्छामि :

संघं शरनं गच्छामि :

Institute Of Biosciences And Technology (IBT) at a Glance

We are contributor in Medical and Advances in Agriculture sciences by studying living systems and organisms for development and research purpose. We shape our student for their bright future in thin field by proving knowledge and best practical facilities.

The Mahatma Gandhi Mission's Institute of Biosciences and Technology is promoted by Mahatma Gandhi Mission (MGM) Trust. The Mahatma Gandhi Mission Trust was founded with a vision to address the educational, health and other social needs of the public since 1983. MGM visualized the density of the field of life science resources and possible careers which will be helpful in the area of research. Through this keen interest MGM established the department of Biotechnology and Bioinformatics in 2001-2002.

Then in the year 2002-2003, with the affiliation of Dr. Babasaheb Ambedkar Marathwada University, the course of M.Sc. Biotechnology was started – a very large ambition and a great milestone in the area of Biotechnology. In the year 2004-05 MGM's IBT launched a course of B.Sc. Agricultural Biotechnology under the affiliation of Marathwada Krishi Vidyapeeth, Parbhani. With the launch of this course the department of biotechnology and Bioinformatics became the crowning glories of Marathwada region.

A tiny seedling turned into a huge tree with multiple branches. In the year 2005-2006 MGM's IBT visualized the importance informatics. Consistent with the attitude to excel in the field of biotechnology, the course of M.Sc. Bioinformatics was launched under the affiliation of Dr. Babasaheb Ambedkar Marathwada University, Aurangabad, in 2005-2006.

Now MGM's IBT is well established in the field of research focusing on the areas of Biotechnology and Bioinformatics with well-equipped R&D laboratory encouraging and supporting extensive research.

Vision

"To achieve academic excellence through research, teaching and training in biosciences disciplines which will eventually serve and benefits the society"

Mission

- To generate necessary and intellectually qualified biological work force.
- Strive to provide services and solutions through biologic knowledge forecasting the welfare and benefit of the society

Department of Bioinformatics

The Bachelor of Science (B.Sc.) in Bioinformatics degree program started in the year 2005 and is approved by the University Grants Commission (UGC), New Delhi and offers Choice Based Credit System education. In addition to core courses, students can opt for discipline specific elective subjects, open elective subjects from different institutes of the University. In addition, this program is uniquely designed to increase the employability and to prepare students to work in a Multi-disciplinary work environment. The program offers Major degree in Bioinformatics and is open to students opting for minor specializations as per their interests. Pedagogies concentrating on student's active participation are extensively used in the teaching-learning process.

Name of Program – B.Sc. (Bioinformatics) Hons / Hons. With Research

Duration – Four Years

Eligibility –

1. Maharashtra State Candidate.

(i) The Candidate should be an Indian National and having domicile of Maharashtra state and/or born in Maharashtra state.

(ii) Passed HSC or its equivalent examination with Physics and Mathematics as compulsory subjects along with one of the Chemistry or Biotechnology or Biology or Technical Vocational subject or Computer Science or Information Technology or Informatics Practices or Agriculture or Engineering Graphics or Business Studies, and obtained at least 45% marks (at least 40% marks, in case of Backward class categories and Persons with Disability candidates belonging to Maharashtra State only) in the above subjects taken together and the candidate should have appeared in MGMU-CET 2022/ MHT-CET 2022/ PERA CET 2022/ JEE (Main) Paper-I 2022 and should obtain non zero score in MGMU-CET 2022/ MHT-CET 2022/ PERA CET 2022/ JEE (Main) Paper-I 2022. However, preference shall be given to the candidate obtaining non-zero positive score in MGMU-CET 2022 over the candidates who obtained non-zero score in MHT-CET 2022/ PERA CET 2022.

OR

(ii)Passed Diploma in Engineering and Technology and obtained at least 45% marks (at least 40% marks, in case of Backward class categories and Persons with Disability candidates belonging to Maharashtra State only).

2. All India Candidates –

(i) The Candidate should be an Indian National.

(ii) Passed HSC or its equivalent examination with Physics and Mathematics as compulsory subjects along with one of the Chemistry or Biotechnology or Biology or Technical Vocational subject or Computer Science or Information Technology or Informatics Practices or Agriculture

or Engineering Graphics or Business Studies , and obtained at least 45% marks (at least 40% marks, in case of Backward class categories and Persons with Disability candidates belonging to Maharashtra State only) in the above subjects taken together and candidate should have appeared in MGMU-CET 2022/ MHT-CET 2022/ PERA CET 2022/ JEE (Main) Paper-I 2022 and should obtain non-zero score in MGMU-CET 2022/ MHT-CET 2022/ PERA CET 2022/ JEE (Main) Paper-I 2022. However, preference shall be given to the candidate obtaining non-zero positive score in JEE Mains Paper-I over the candidates who obtained non-zero score in MGMU-CET 2022/ MHT-CET 2022/ PERA CET 2022.

OR

(ii) Passed Diploma in Engineering and Technology and obtained at least 45% marks (at least 40% marks, in case of Backward class categories and Persons with Disability candidates belonging to Maharashtra State only)

Name of Faculty: Basic and Applied Sciences

Name of the College/Institute/Department/School: Institute of Biosciences and Technology

Name of the Programme: B.Sc. (Hon) Bioinformatics

Programme Type (UG/PG): UG

Duration: 4 years

First Year- Semester I												
Course Category	**Course Code**	**Course Title**	**Nature of Course**	**No. of Credits**	**Teaching (Contact hrs/ week)**		**Evaluation Scheme (Marks)**			**Minimum Passing (Marks)**		
					L	**P**	**Internal**	**External**	**Total**	**Internal**	**External**	**Total**
MM	BIO42MML 101	Physics I- Mechanics and Relativity	Lecture	2	2	-	30	20	50		8	2
MM	BIO42MML 102	C Programming & computer organization	Lecture	3	3		60	40	100		16	40
IKS	BIO42IKL101	Preservation and documentation of manuscripts	Lecture	2	2	-	30	20	50		8	20
AEC	MGM54AEL 104	Functional Marathi	Lecture	2	2	-	30	20	50		8	20
OE		Open Elective I	Lecture	2	2	-	30	20	50		8	20
OE		Open Elective II	Lecture	2	2	-	30	20	50		8	20
VEC	MGM21VEL 101	Environmental Studies	Lecture	2	2	-	30	20	50		8	20
VSC	BIO42VSP101	Bioinformatics Lab	Practical	2		4	30	20	50		8	20
SEC	BIO42SEP101	Programming Lab	Practical	2		4	30	20	50		8	20
MM	BIO42 MMP101	Foundations of Bioinformatics-I	Practical	1	-	2	30	20	50		8	20
CC	MGM62CCP 101	Cultural Activities	Practical	2		4	30	20	50		8	20
Total				**22**	**15**	**14**	360	240	600		96	240

Note:

Nature of Course : L- Lecture, P-Practical, S-Seminar, J-Project, I-Internship, D-Dissertation,

Course Category: MM-Major Mandatory, ME-Major Elective, MI-Minor, OE-Generic / Open electives, VSC-Vocational skill course, SEC-Skill Enhancement course, AEC-Ability Enhancement course, IKS-Indian Knowledge system, VEC-Value Education course, OJT-On Job Training / Internship / Apprenticeship, FP-Field project, CEP-Community engagement and service, CC-Co – curricular course, RM-Research methodology, RP-Research project

Level 4.5 Award of UG certificate with 40 credits and an additional 4-credits core NSQF course / internship OR continue with major and minor

First Year- Semester II												
Course Category	**Course Code**	**Course Title**	**Nature of Course**	**No. of Credits**	**Teaching (Contact hrs/ week)**		**Evaluation Scheme (Marks)**			**Minimum Passing (Marks)**		
					L	**P**	**Internal**	**External**	**Total**	**Internal**	**External**	**Total**
MM	BIO42MML 103	C++ Programming	Lecture	2	2		30	20	50		8	20
MM	BIO42MML 104	Data structures and Algorithms	Lecture	3	3	-	60	40	100		16	40
MI		Minor Course	Lecture	2	2	-	30	20	50		8	20
AEC	MGM54AEL 101	Communicative English	Lecture	2	2	-	30	20	50		8	20
OE		Open Elective I	Lecture	2	2	-	30	20	50		8	20
OE		Open Elective II	Lecture	2	2	-	30	20	50		8	20
VEC	MGM56VEL 102	Constitution of India	Lecture	2	2	-	30	20	50		8	20
VSC	BIO42VSP10	Bioinformatic Lab II	Practical	2		4	30	20	50		8	20
SEC	BIO42SEP102	Bioinformatics Exploration I	Practical	2		4	30	20	50		8	20
MM	BIO42 MMP102	Foundations of Bioinformatics-II	Practical	1	-	2	30	20	50		8	20
CC	MGM82CCP 103	Sports	Practical	2		4	30	20	50		8	20
Total				**22**	**15**	**14**						

Note:

Nature of Course : L- Lecture, P-Practical, S-Seminar, J-Project, I-Internship, D-Dissertation,

Course Category: MM-Major Mandatory, ME-Major Elective, MI-Minor, OE-Generic / Open electives, VSC-Vocational skill course, SEC-Skill Enhancement course, AEC-Ability Enhancement course, IKS-Indian Knowledge system, VEC-Value Education course, OJT-On Job Training / Internship / Apprenticeship, FP-Field project, CEP-Community engagement and service, CC-Co – curricular course, RM-Research methodology, RP-Research project

Level 4.5 Award of UG certificate with 40 credits and an additional 4-credits core NSQF course / internship OR continue with major and minor

Second Year- Semester III												
Course Category	**Course Code**	**Course Title**	**Nature of Course**	**No. of Credits**	**Teaching (Contact hrs/ week)**		**Evaluation Scheme (Marks)**			**Minimum Passing (Marks)**		
					L	**P**	**Internal**	**External**	**Total**	**Internal**	**External**	**Total**
MM	BIO42MML 201	Molecular Biology of cell	Lecture	2	2		30	20	50	-	08	20
MM	BIO42MML 202	Mathematical Techniques for Bioinformatics-III	Lecture	3	3	-	60	40	100	-	16	40
MM	BIO42MML 203	Fundamental of Bioinformatics	Lecture	2	2	-	30	20	50	-	08	20
OE		Open Elective V	Lecture	2	2	-	30	20	50	-	08	20
MI		Annexture I	Lecture	3	3	-	60	40	100	-	16	40
AEC	MGM54AEL 103	Functional Hindi	Lecture	2	2	-	30	20	50	-	08	20
MI		Minor Course	Practical	1		2	30	20	50	-	08	20
VSC	BIO42VSP201	Applied BI Lab I	Practical	2		4	30	20	50	-	08	20
MM	BIO42MMP 201	Bioinformatics tools in Molecular Biology	Practical	1		2	30	20	50	-	08	20
FP	BIO42FPJ201	Field Project	Project	2	-	4	30	20	50	-	08	20
CC	MGM82CCP 201	Health and Wellness	Practical	2		4	30	20	50	-	08	20
Total				**22**	**14**	**16**	**390**	**260**	**650**	-	**104**	**260**

Note:

Nature of Course : L- Lecture, P-Practical, S-Seminar, J-Project, I-Internship, D-Dissertation,

Course Category: MM-Major Mandatory, ME-Major Elective, MI-Minor, OE-Generic / Open electives, VSC-Vocational skill course, SEC-Skill Enhancement course, AEC-Ability Enhancement course, IKS-Indian Knowledge system, VEC-Value Education course, OJT-On Job Training / Internship / Apprenticeship, FP-Field project, CEP-Community engagement and service, CC-Co – curricular course, RM-Research methodology, RP-Research project

Level 4.5 Award of UG certificate with 40 credits and an additional 4-credits core NSQF course / internship OR continue with major and minor

Second Year- Semester IV												
Course Category	**Course Code**	**Course Title**	**Nature of Course**	**No. of Credits**	**Teaching (Contact Hrs/ week)**		**Evaluation Scheme (Marks)**			**Minimum Passing (Marks)**		
					L	**P**	**Internal**	**External**	**Total**	**Internal**	**External**	**Total**
MM	BIO42MML 204	Genetics of Life	Lecture	2	2	-	30	20	50	-	08	20
MM	BIO42MML 205	Computational Molecular Biology	Lecture	3	3	-	60	40	100	-	16	40
MM	BIO42MML 206	Structural Bioinformatics	Lecture	2	2	-	30	20	50	-	08	20
OE		Open Elective VI	Lecture	2	2	-	30	20	50	-	08	20
MI		Annexure I	Lecture	3	3	-	60	40	100	-	16	40
AEC	MGM54AEL 203	Communication Skills	Lecture	2	2	-	30	20	50	-	08	20
SEC	BIO42SEP201	Applied BI Lab - II	Practical	2	-	4	30	20	50	-	08	20
MI		Minor Course	Practical	1	-	2	30	20	50	-	08	20
MM	BIO42MMP 202	Python and Structural Bioinformatics Lab	Practical	1	-	2	30	20	50	-	08	20
CEP	BIO42CEJ202	Community Engagement and Service (Mini project)	Project	2	-	4	30	20	50	-	08	20
CC	MGM73CCP 105	Fine Arts	Practical	2		4	30	20	50	-	08	20
Total				**22**	**14**	**16**	**390**	**260**	**650**		**104**	**260**

Note:

Nature of Course : L- Lecture, P-Practical, S-Seminar, J-Project, I-Internship, D-Dissertation,

Course Category: MM-Major Mandatory, ME-Major Elective, MI-Minor, OE-Generic / Open electives, VSC-Vocational skill course, SEC-Skill Enhancement course, AEC-Ability Enhancement course, IKS-Indian Knowledge system, VEC-Value Education course, OJT-On Job Training / Internship / Apprenticeship, FP-Field project, CEP-Community engagement and service, CC-Co – curricular course, RM-Research methodology, RP-Research project

Level 4.5 Award of UG certificate with 40 credits and an additional 4-credits core NSQF course / internship OR continue with major and minor

Third Year- Semester V												
Course Category	**Course Code**	**Course Title**	**Nature of Course**	**No. of Credits**	**Teaching (Contact hrs/ week)**		**Evaluation Scheme (Marks)**			**Minimum Passing (Marks)**		
					L	**P**	**Internal**	**External**	**Total**	**Internal**	**External**	**Total**
MM	BIO42MML301	System Biology	Lecture	2	2	-	30	20	50		8	20
MM	BIO42MML302	Algorithms in Bioinformatics	Lecture	3	3	-	60	40	100		16	40
MM	BIO42MML303	Database Management System	Lecture	2	2	-	30	20	50		8	20
ME	BIO42MEL201	Foundations of Machine learning and AI	Lecture	3	3	-	60	40	100		16	40
MI		Minor Course	Lecture	3	3	-	60	40	100		16	40
VSC	BIO42VSP302	Vocational Skill Course	Practical	2		4	30	20	50		8	20
MI		Minor Course	Practical	1	-	2	30	20	50		8	20
VSC	BIO42VSP30	Mini Project	Practical	2	-	4	30	20	50		8	20
MM	BIO42MMP301	DBMS Labs and Machine Learning Lab.	Practical	1	-	2	30	20	50		8	20
FP	BIO42FPJ301	Community Engagement and Service	Practical	2		4	30	20	50		8	20
ME	BIO42MEP201	Seminar (Research Paper based)	Practical	1	-	2	30	20	50		8	20
				22	**13**	**18**	420	280	**700**		112	280

Note:

Nature of Course : L- Lecture, P-Practical, S-Seminar, J-Project, I-Internship, D-Dissertation,

Course Category: MM-Major Mandatory, ME-Major Elective, MI-Minor, OE-Generic / Open electives, VSC-Vocational skill course, SEC-Skill Enhancement course, AEC-Ability Enhancement course, IKS-Indian Knowledge system, VEC-Value Education course, OJT-On Job Training / Internship / Apprenticeship, FP-Field project, CEP-Community engagement and service, CC-Co – curricular course, RM-Research methodology, RP-Research project

Level 4.5 Award of UG certificate with 40 credits and an additional 4-credits core NSQF course / internship OR continue with major and minor

Third Year- Semester VI												
Course Category	**Course Code**	**Course Title**	**Nature of Course**	**No. of Credits**	**Teaching (Contact hrs/ week)**		**Evaluation Scheme (Marks)**			**Minimum Passing (Marks)**		
					L	**P**	**Internal**	**External**	**Total**	**Internal**	**External**	**Total**
MM	BIO42MML304	Biological Data analysis-I	Lecture	2	2		30	20	50		8	20
MM	BIO42MML305	Genomics and Proteomics	Lecture	3	3		60	40	100		16	40
MM	BIO42MML306	Statistical methods in Bioinformatics and Statistical Inference	Lecture	3	3		60	40	100		16	40
ME	BIO42MEL20	Metabolomics	Lecture	3	3		60	40	100		16	40
MI		Minor Course	Lecture	2	3		30	20	50		8	20
MI		Minor Course	Practical	1		2	30	20	50		8	20
OJT	BIO42JTP301	On Job Training/Internship/Apprenticeship	Training	4		8	60	40	100		16	40
MM	BIO42MMP302	Genomics, Proteomics and Metabolomics Lab.	Practical	1		2	30	20	50		8	20
MM	BIO42MMP302	Mini project	Practical	1		2	30	20	50		8	20
ME	BIO42MEP202	Data analysis and statistics	Practical	1		2	30	20	50		8	20
				22	**14**	**16**	450	300	**750**		120	300

Note:
Nature of Course : L- Lecture, P-Practical, S-Seminar, J-Project, I-Internship, D-Dissertation,

Course Category: MM-Major Mandatory, ME-Major Elective, MI-Minor, OE-Generic / Open electives, VSC-Vocational skill course, SEC-Skill Enhancement course, AEC-Ability Enhancement course, IKS-Indian Knowledge system, VEC-Value Education course, OJT-On Job Training / Internship / Apprenticeship, FP-Field project, CEP-Community engagement and service, CC-Co – curricular course, RM-Research methodology, RP-Research project

Level 4.5 Award of UG certificate with 40 credits and an additional 4-credits core NSQF course / internship OR continue with major and minor

Fourth Year- Semester VII												
Course Category	**Course Code**	**Course Title**	**Nature of Course**	**No. of Credits**	**Teaching (Contact hrs/ week)**		**Evaluation Scheme (Marks)**			**Minimum Passing (Marks)**		
					L	**P**	**Internal**	**External**	**Total**	**Internal**	**External**	**Total**
MM	BIO42MML401	Biological Data analysis-II	Lecture	3	3		60	40	100		16	40
MM	BIO42MML402	Medical Informatics	Lecture	3	3		60	40	100		16	40
MM	FPT42MML403	Agriculture Informatics	Lecture	3	3		60	40	100		16	40
MM	BIO42MML404	Biosafety, IPR and Bioethics	Lecture	2	2		30	20	50		8	20
ME	BIO42MEL301	Agriculture & Medical Informatics	Lecture	3	3		60	40	100		16	40
RM	BIO42RML401	Research Methodology	Lecture	3	3		60	40	100		16	40
RM	BIO42RMP401	Research Methodology	Practical	1		2	30	20	50		8	20
ME	BIO42MEP301	R Programming	Practical	1		2	30	20	50		8	20
MM	BIO42MMP401	Biological Data analysis Lab.	Practical	1		2	30	20	50		8	20
MM	BIO42MMP402	Major Project	Practical	1		2	30	20	50		8	20
MM	BIO42MMP403	Deep Learning with Python	Practical	1		2	30	20	50		8	20
				22	**17**	**10**	480	320	**800**		128	320

Note:

Nature of Course : L- Lecture, P-Practical, S-Seminar, J-Project, I-Internship, D-Dissertation,

Course Category: MM-Major Mandatory, ME-Major Elective, MI-Minor, OE-Generic / Open electives, VSC-Vocational skill course, SEC-Skill Enhancement course, AEC-Ability Enhancement course, IKS-Indian Knowledge system, VEC-Value Education course, OJT-On Job Training / Internship / Apprenticeship, FP-Field project, CEP-Community engagement and service, CC-Co – curricular course, RM-Research methodology, RP-Research project

Level 4.5 Award of UG certificate with 40 credits and an additional 4-credits core NSQF course / internship OR continue with major and minor

Fourth Year- Semester VIII												
Course Category	**Course Code**	**Course Title**	**Nature of Course**	**No. of Credits**	**Teaching (Contact hrs/ week)**		**Evaluation Scheme (Marks)**			**Minimum Passing (Marks)**		
					L	**P**	**Internal**	**External**	**Total**	**Internal**	**External**	**Total**
MM	BIO42MML405	Chemistry-II	Lecture	3	3		60	40	100		16	40
MM	BIO42MML406	Biology: Concept, Connections, Investigation and applications	Lecture	3	3		60	40	100		16	40
MM	BIO42MML407	Physics II-Electricity and Magnetism	Lecture	3	3		60	40	100		16	40
MM	BIO42MML408	Entrepreneurship Bioinformatics	Lecture	2	2		30	20	50		8	20
ME	BIO42MEL302	Science of organisms	Lecture	3	3		60	40	100		16	40
OJT	BIO42JTP401	On Job Training/Internship/Apprenticeship	Training	4		8	60	40	100		16	40
ME	BIO42MEP302	Software Design Labs	Practical	1		2	30	20	50		8	20
MM	BIO42MMP404	Practical Based on Research Methodology	Practical	1		2	30	20	50		8	20
MM	BIO42MMP405	Big Idea	Practical	1		2	30	20	50		8	20
MM	BIO42MMP406	Programming Labs	Practical	1		2	30	20	50		8	20
				22	**14**	**16**	450	300	**750**		120	300

Note:

Nature of Course : L- Lecture, P-Practical, S-Seminar, J-Project, I-Internship, D-Dissertation,

Course Category: MM-Major Mandatory, ME-Major Elective, MI-Minor, OE-Generic / Open electives, VSC-Vocational skill course, SEC-Skill Enhancement course, AEC-Ability Enhancement course, IKS-Indian Knowledge system, VEC-Value Education course, OJT-On Job Training / Internship / Apprenticeship, FP-Field project, CEP-Community engagement and service, CC-Co – curricular course, RM-Research methodology, RP-Research project

Level 4.5 Award of UG certificate with 40 credits and an additional 4-credits core NSQF course / internship OR continue with major and minor

Syllabus
Semester-III

Course code: BIO42MML201 Course name: Molecular Biology of Cell Course category: Major mandatory
Credits: 2 **Teaching scheme:** L-3 **Evaluation scheme:** CA–30, ESE–20
Exam Duration: 01 Hrs
Pre-requisites: The student should have basic knowledge of biological and applied sciences and
successfully completed 1st year of degree program.the processes of cell Division and cell cycle,
Course Objectives:
1. To describe structural dynamics of cell and its organelles,
2. the processes of cell Division and cell cycle,
Course Outcomes: At the end of the course, the students will be able to -
CO1: After successful completion of this course student will be able to describe structural dynamics of the cell and its organelles.
CO2: Students will understand Cell Division and Cell Cycle with its regulation.
Students will understand biosynthetic mechanisms and processes of Biomolecules.
CO3: Students will understand different structural models of Bio membrane and transport mechanism across it.
CO4: Students will gain understanding of folding and modification of Biomolecules, prions and diseases associated with it.

Contents –

Unit	Content	Teaching hours
1	**Title of 1 -** Discovery of cell and Cell Theory; Comparison between plant and animal cells, Chemical components and dynamics of prokaryotic & eukaryotic cells. Cell wall, Plasma membrane; Modification of plasma membrane, Mitochondria, Chloroplast, Endoplasmic Reticulum, Golgi complex, Lysosome, Ribosome and Nucleus. Cell Division and Cell Cycle: Mitosis, Meiosis, and Cytokinesis, protein kinases and Cyclin-Cdk complex dependent regulation of cell cycle, programmed cell death.	10
2	**Title of 2 -** Abiotic formation of carbohydrates, amino acids, organic acids, purines, pyrimidines,formation of nucleosides and nucleotides, Polymerization of nucleotides, polymerization of amino acids to Polypeptides and Proteins. Formation of 3D structure of DNA, Formation of nucleoproteins.	05
3	**Title of 3 -** Langmuir ‘s lipid monolayer, Gorter and Grendel ‘s lipid bilayer, Davson and Danielle ‘slipped bilayer plus protein sheet, Overton ‘s lipid nature of membrane, Robertson ‘s Unit membrane, Singer and Nicolson ‘s fluid mosaic. Membrane Transport: Passive transport: simple diffusion, facilitated diffusion-transporters (uniporters and co transporters) and channel proteins. Active transport: Pumps, Group Translocation and Electrochemical Gradients	10

4	**Title of 4 -** Model organisms (e. g. Chlamydomonas Reinhardtian and Plasmodium falciparum) to study of flagella, chloroplast formation and photosynthesis, novel organisms and complex life cycles. Scope and application of CRISPR/Cas9 system in bacteria and yeast, two hybrids in fungi.	05

Text Books: 1.Molecular Biology of the Cell by Bruce Alberts, Alexander Johnson, Julian Lewis, David Morgan, Martin Raff, Keith Roberts, and Peter Walter - Publisher: Garland Science - Edition: 6th - Year: 2014
2. The Cell: A Molecular Approach by Geoffrey M. Cooper - Publisher: Sinauer Associates,Inc. - Edition: 7th - Year: 2019
Reference Books: 1. Cell Biology: A Short Course by Stephen R. Bolsover, Jeremy S. Hyams, Elizabeth A. Shephard, and Hugh A. White - Publisher: John Wiley & Sons - Edition: 3rd -
2. Molecular Biology: Principles of Genome Function by Nancy Craig, Rachel Green, Carol Greider, Gisela Storz, and Cynthia Wolberger - Publisher: Oxford University Press - Edition: 2nd - Year: 2014
Online Resources: 1. NPTEL / SWAYAM lectures.

Syllabus
Semester-III

Course code: BIO42MML202 Course name: Mathematical Techniques for Bioinformatics III
Course category: Major mandatory
Credits: 3 **Teaching scheme:** L-3 **Evaluation scheme:** CA–60, ESE–40
Exam Duration: 02 Hrs
Pre-requisites: The student should have basic knowledge of biological and applied sciences and successfully completed the 1st year of the degree program.
Course Objectives:
1. Develop proficiency in mathematical tools and techniques essential for bioinformatics analysis.
2. Understand the theoretical foundations of mathematical algorithms applied in bioinformatics.
Course Outcomes: At the end of the course, the students will be able to -
CO1: Gain practical skills in utilizing mathematical algorithms for sequence analysis and molecular modeling in bioinformatics.
CO2: Apply mathematical techniques to decipher patterns and structures in genomic, proteomic, and metabolomic data.
CO3: Demonstrate proficiency in statistical methods for analyzing high-throughput biological data sets.
CO4: Develop the ability to design and implement novel mathematical approaches for solving specific bioinformatics challenges.

Contents –

Unit	Content	Teaching hours
1	**Title of 1 -** Sets, Types of Sets, Subsets, Complement of Sets, union and Intersection of Sets, Difference of Sets, Dem organ's Law, Cartesian product of Sets. Basics of Probability, Permutation and combination. Measure of central tendency and dispersion: Mean, median, mode, range, standard deviation, variance.	09
2	**Title of 2 -** Types, Karl-Pearson 's correlation, Spearman 's Rank correlation, Regression equation and fitting. Probability Distribution: Basics of Binomial, Poisson and Normal distributions and their application in biology. Random Variable; Discrete and Continuous Probability Distribution, Probability mass function, probability Density function, Mathematical Expectation.	09
3	**Title of 3 -** Types of Matrices, Addition of matrices, Subtraction of matrices and Product of matrices. Properties of Matrix Multiplication. Transpose of Matrix, Symmetric and Skew-symmetric Matrices, Inverse of Matrix.	09
4	**Title of 4 -** trigonometric ratios, Inverse trigonometric functions. Binomial theorem. Sequences and series AP, GP, HP, Logarithmic and Exponential Series. Basics of Functions and Limits, Elementary Differentiation and Integration Fourier transform, Laplace transform and another standard transform.	09

5	**Title of 4 -** Distance between two points, section formula, Locus of points. Equation of lines, Circle, Ellipse, Parabola, Hyperbola Vector: Addition, subtraction, dot product, cross product, scalar triple product, Vector differentiation and vector integration, gradient, divergence, curl of a vector, equation of normal	09

Text Books: 1."Introduction to Bioinformatics" by Arthur M. Lesk. Publisher: Oxford University Press. Edition: 4th. Year of Publication: 2017.
2. "Bioinformatics Algorithms: An Active Learning Approach" by Phillip Compeau and Pavel Pevzner. Publisher: Active Learning Publishers. Edition: 2nd. Year of Publication: 2019.
Reference Books: 1. "Bioinformatics: Sequence and Genome Analysis" by David W. Mount. Publisher: Cold Spring Harbor Laboratory Press. Edition: 2nd. Year of Publication: 2004.
2. "Biological Data Analysis: Using R" by Øivind Nilsen. Publisher: Wiley. Edition: 1st. Year of Publication: 2018.
Online Resources: 1. NPTEL / SWAYAM lectures.

Syllabus
Semester-III

Course code: BIO42MML203 Course name: Fundamental of Bioinformatics
Course category: Major mandatory
Credits: 2 **Teaching scheme:** L-2 **Evaluation scheme:** CA–30, ESE–20
Exam Duration: 01 Hrs
Pre-requisites: Registration of a student in various courses in consultation with the respective course teacher and Adviser and acceptance by the principal. The approved courses must be mentioned in the roster form
Course Objectives:
1. Understanding Fundamental Concepts: To comprehend the basic principles and theories underlying bioinformatics, including algorithms, data structures, and computational methodologies.
2. Proficiency in Tools and Techniques: To develop proficiency in utilizing bioinformatics tools and techniques for data analysis, sequence alignment, and molecular modeling.
Course Outcomes: At the end of the course, the students will be able to -
CO1: Ability to Perform Sequence Analysis: Students will be able to perform sequence analysis tasks such as sequence alignment, similarity searching, and motif discovery using bioinformatics tools and databases
CO2: Understanding of Genomic Data Analysis: Students will demonstrate an understanding of genomic data analysis techniques, including gene prediction, genome annotation, and comparative genomics.
CO3: Proficiency in Structural Bioinformatics: Students will acquire proficiency in structural bioinformatics by analyzing protein structures, predicting protein folding, and modeling protein-ligand interactions
CO4: Application of Machine Learning: Students will apply machine learning algorithms and statistical methods to analyze biological data, including gene expression data and protein-protein interactions.
Contents –

Unit	Content	Teaching hours
1	**Title of 1 -** Introduction to Bioinformatics, History of Bioinformatics, Scope and application of bioinformatics, Data generation of large-scale data from Molecular biology data (Through NMR Spectroscopy, X- RAY diffraction, Microarray, Genome sequencing, Protein sequencing, Gel electrophoresis), Internet, www	10
2	**Title of 2 -** Biological data, Nature of Biological data, Bioinformatics Resources – NCBI, EBI, SIB, Biological databases, Types of databases, Protein sequence database- PIR, Uniprot, Swissport, Structural database- PDB, NDB, Nucleic acid Sequence database- GenBank, EMBL, DDBJ, Introduction to Biological information Search engine, distributions and their application in biology. Random Variable; Discrete and Continuous Probability Distribution, Probability mass function, probability Density function, Mathematical Expectation	10

3	**Title of 3** Concept of sequence alignment, Types of sequence alignment- Pairwise sequence alignment, multiple sequence alignment, Methods of sequence alignment- LOCAL & GLOBAL alignment sequence similarity search tool – BLAST, FASTA, Clustal-w, Clustal omega Matrices – PAM &BLOSUM	05
4	**Title of 4 -** Introduction to Protein, Amino acid, Levels of Proteins, Protein structure, Secondary structure prediction – chou- fasman method, GOR method ,3 D structure prediction, molecular modelling methods – Homology, Threading (fold recognition) , Ab- initio.	05

Text Books: "Bioinformatics Algorithms: An Active Learning Approach" by Phillip Compeau and Pavel Pevzner. Publisher: Active Learning Publishers. Edition: 2nd. Year of Publication: 2019.
2. "Bioinformatics For Dummies" by Jean-Michel Claverie and Cedric Notredame. Publisher: For Dummies. Edition: 2nd. Year of Publication: 2020
Reference Books: 1. "Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins" by Andreas D. Baxevanis and B. F. Francis Ouellette. Publisher: Wiley. Edition: 3rd. Year of Publication: 2005.
2. "Biological Sequence Analysis: Probabilistic Models of Proteins and Nucleic Acids" by Richard Durbin, Sean R. Eddy, Anders Krogh, and Graeme Mitchison. Publisher: Cambridge University Press. Edition: 1st. Year of Publication: 1998.
Online Resources: 1. NPTEL / SWAYAM lectures.

Syllabus
Semester-III

Course code: BIO42VSP201	**Course name: Applied BI Lab I**
Course category: Vocational skill course	
Credits: 2 **Teaching scheme:** P-4	**Evaluation scheme:** CA–30, ESE–20
Exam Duration: 02 Hrs	
Pre-requisites: The student should have basic knowledge of biological and applied sciences and successfully completed 1st year of degree program.	
Course Objectives: 1. Advanced Data Analysis Skills: Develop advanced skills in analyzing biological data using bioinformatics tools and techniques.	
2. Integration of Omics Data: Learn to integrate and analyze data from various omics disciplines such as genomics, transcriptomics, proteomics, and metabolomics.	
Course Outcomes: At the end of the course, the students will be able to –	
PO1: . Proficiency in Bioinformatics Tools: Students will be proficient in using a variety of bioinformatics tools and databases for analyzing biological data.	
PO2: Integration of Multi-Omics Data: Students will be able to integrate and analyze multi-omics data to gain insights into biological processes and systems.	
PO3: Algorithm Development Skills: Students will have the ability to develop, implement, and optimize algorithms for bioinformatics analysis tasks.	
PO4: Application of Machine Learning: Students will be capable of applying machine learning techniques to classify, cluster, and predict biological data.	
Contents –	

Unit	Title of the Experiment
1	Introduction to GenBank
2	Introduction to BLAST (Basic Local Alignment Search Tool)
3	Local Sequence Alignment
4	Global Sequence Alignment
5	Sequence alignment using FASTA
6	Multiple sequence alignment using CLUSTAL OMEGA
7	Phylogeny among organisms
8	PAM scoring matrix (Point Accepted Mutation)
9	BLOSUM scoring matrix (Block substitution Matrix)
10	Identification of Introns and Exons using GenScan
11	Gene relationship analysis using GRAIL
12	Nucleotide sequence analysis using PipMaker
13	Sequence translation and reading frame identification using Geneboy

14	Restriction site identification using Nebcutter
15	Restriction site identification using Webcutter
16	Reference Frame of nucleotide
17	ORF reader of nucleotide
18	NCBI PRIMER for nucleotide
19	Introduction to FASTQ format
20	Introduction to SRA

Reference Book / Hand Books/ Lab Manual
1. Applied Bioinformatics: An Introduction by Selzer Paul Maria.
BIOINFORMATICS: PRINCIPLES AND APPLICATIONS by Zhumur Ghosh, Bibekanand Mallick.

Syllabus
Semester-III

Course code: BIO42MMP201 Course name: Bioinformatics tools in Molecular Biology
Course category: Major Mandatory
Credits: 1 **Teaching scheme:** P-3 **Evaluation scheme:** CA–30, ESE–20
Exam Duration: 02 Hrs
Pre-requisites: The student should have basic knowledge of biological and applied sciences and successfully completed 1st year of degree program.
Course Objectives: 1. Understanding Bioinformatics Tools: To introduce students to various bioinformatics tools commonly used in molecular biology research, including sequence analysis tools, structural bioinformatics tools, and genome analysis software.
2. Hands-on Experience: Provide students with hands-on experience in using bioinformatics tools to analyze molecular biology data, including DNA and protein sequences, molecular structures, and genomic datasets.
Course Outcomes: At the end of the course, the students will be able to –
PO1: . Proficiency in Bioinformatics Tools: Students will be proficient in using a variety of bioinformatics tools and software packages relevant to molecular biology research.
PO2: Ability to Analyze Molecular Data: Students will be able to analyze molecular biology data using bioinformatics tools, including DNA and protein sequences, molecular structures, and genomic datasets.
PO3: Competence in Sequence Analysis: Students will be competent in performing basic and advanced sequence analysis tasks, such as sequence alignment, motif discovery, phylogenetic analysis, and gene prediction.
PO4: Understanding of Structural Bioinformatics: Students will understand the principles and techniques of structural bioinformatics and be able to analyze biomolecular structures using computational tools.
Contents –

Unit	Title of the Experiment
1	Introduction to Galaxy
2	Importing FASTQ file to galaxy
3	Introduction to file format SAM and BAM
4	Introduction to file format gtf and gff
5	Introduction to BCF/BCF
6	FASTQC for checking sequence quality
7	MULTIQC for compiling FASTQC results
8	TRIMMOMATICS for sequence trimming
9	Mapping of target genome with reference genome
10	Transcriptome reconstruction of target genome

11	Transcriptome assembly of target genome
12	Analysis of the differential gene expression
13	Count the number of reads per transcript
14	Perform differential gene expression testing
15	Protein structure Visualization
16	Ribosomal RNA fragments filtering for microbiome
17	Interlace forward and reverse reads for microbiome
18	Extraction of the community profile for microbiome
19	Extract the community structure in microbiome
20	Analyzing an isolated metatranscriptome

Reference Book / Hand Books/ Lab Manual
Galaxy Training (Lab Manual)

Syllabus
Semester-III

Course code: BIO42FPJ201	**Course name:** Field Project	**Course category:** Field Project
Credits: 2 **Teaching scheme:** P-3		**Evaluation scheme:** CA–30, ESE–20
Exam Duration: 02 Hrs		
Pre-requisites: The student should have basic knowledge of biological and applied sciences and successfully completed 1st year of degree program.		
Course Objectives:		
1. It allows the students to demonstrate his or her capabilities while working independently. It shows the students ability to apply desired skills such as doing research.		
2. The objective of field study is to observe and interpret the subject of study in its natural environment. It is used in the field of study of humans and health care professions.		
Course Outcomes: At the end of the course, the students will be able to –		
PO1: Students will be able to practice acquired knowledge within the chosen area of technology for project development.		
PO2: Identify, discuss and justify the technical aspects of the chosen project with a comprehensive and systematic approach.		

Contents –

Unit	Content
1	**Ideas of project:** Defining project ideas is crucial for setting realistic expectations and laying out a clear vision or a project life cycle. Project-based learning not only provides opportunities for students to collaborate or drive their own learning, but it also teaches them skills such as problem solving, and helps to develop additional skills integral to their future, such as critical thinking and time management.
2	**Literature survey:** A literature review establishes familiarity with and understanding of current research in a particular field before carrying out a new investigation. Conducting a literature review should enable you to find out what research has already been done and identify what is unknown within your topic.
3	**Performance:** Performance measurement during a project is to know how things are going so that we can have early warning of problems that might get in the way of achieving project objectives and so that we can manage expectations. The criteria of it as given below.
4	**Implementation:** Follows closely the design, uses appropriate techniques with skill and understanding to produce a good solution.

5	**Evaluation:** Clearly relates to the problem. Shows a good understanding and appreciation of the solution. Objectives of what has been done.
6	**5. Project Log:** a. The individual student's effort and commitment. b. The quality of the work produced by the individual student. c. The student's integration and co-operation with the rest of the group. d. The completeness of the logbook & time to time signature of guide Objective: To elaborate the procedure for Guiding Student projects Responsibility:

PROCEDURE

Unit	Activities	Responsibilities
1	PG students are decide on their team members for their semester project with their proposed project domain and title	Project head PG students
2	Director shall allocate the project guide based on their area of expertise (not more than 3 batches to a guide)	Director
3	Ensuring that students have regular discussion meetings with their project guides	Project guide Project head
4	Synopsis preparation and submission	Project head
5	Verification of student project log book	Project guide Project head
6	Approval of PPT: Abstract, existing, proposed system. 30% of proposed work. 80% of proposed work. 100% of proposed work.	Project guide
7	Preparation and submission of progress report during project	Students

		Project head
8	Preparing list for Redo students (insufficient content plagiarism, poor presentation, genuine absentees.	Project head
9	Submission of hard copy of project report	Project head
10	Evaluation of project report	External examiner
11	Organizing final project viva-voce	Project heads
12	Ensuring that if a candidate fails to submit the project report on or before the specified deadline , he/she is deemed to have failed in the project work and shall re –enroll for the same	Project head Project guide Director

Syllabus

Semester-IV

Course code: BIO42MML204
Course name: Genetics of life **Course category:** Major mandatory
Credits: 2 **Teaching scheme:** L-2 **Evaluation scheme:** CA–30, ESE–20
Exam Duration: 01 Hrs
Pre-requisites: The student should have basic knowledge of biological and applied sciences and
successfully completed 1st year of degree program.the processes of cell Division and cell cycle,
Course Objectives:
1. To describe types, structures, chemistry & functions of nucleic acids (DNA and RNA).
2. To describe processes like DNA replication, repair, recombination, and transcription.
3. To provide knowledge of gene regulation, RNA processing and translation in bacteria & eukaryotes.
Course Outcomes: At the end of the course, the students will be able to -
CO1: After successful completion of this course student will be able to describe structures and chemistry of nucleic acids (DNA and RNA).
CO2: Students will understand functions and relative stability of nucleic acids. They will also understand various types of DNA and RNA.
CO3: Students will understand interactions of nucleic acids with proteins.
CO4: Students will describe processes like DNA replication, repair, recombination, and transcription.
CO5: Students will have preparatory knowledge of gene regulation, RNA processing and translation in bacteria & eukaryotes.

Contents –

Unit	Content	Teaching hours
1	**Origin of life on Earth**: Historical background of origin of life on earth Charles Darwin theory of evolution. Birth of Genetics.	10
2	**History of Genetics :** Pre- Mendelian genetic concepts: Preformation, Epigenesis, Inheritance of acquired characters and Mutation theory. Heredity and Environment: Concepts of Phenotype, Genotype, Heredity, variation, Pure lines.	05
3	**Mendelian Genetics:**	10

	Law of Segregation: Monohybrid cross, Back cross and Test cross, Problems related. Law of Independent Assortment: Dihybrid cross in pea plant, Trihybrid cross, Back cross and Test cross, Problems related. Forked line method for genetic problems	
4	**Genetic verses Environmental effects** Multiple Alleles: Definition, ABO blood groups and Rh factor in Human, Genetic Problems related. Gene Interactions Deviations from Mendelism: Incomplete inheritance and Codominance. Epistasis - Dominant Ex.: Fruit color in Cucurbitapepo, Recessive - Ex.: Coat color in Mice falciparum) to study of flagella, chloroplast formation and photosynthesis, novel organisms and complex life cycles. Scope and application of CRISPR/Cas9 system in bacteria and yeast, two hybrids in fungi.	05

Text Books:

1. "Genetics: Analysis and Principles" by Robert J. Brooker
2. "Principles of Genetics" by D. Peter Snustad and Michael J. Simmons
3. "Introduction to Genetic Analysis" by Anthony J.F. Griffiths, Susan R. Wessler, Richard C. Lewontin, Sean B. Carroll
4. "Human Genetics: Concepts and Applications" by Ricki Lewis
5. "Genetics: From Genes to Genomes" by Leland H. Hartwell, Michael L. Goldberg, Janice Fischer, Leroy Hood, and Charles F. Aquadro
6. "Genetics Essentials: Concepts and Connections" by Benjamin A. Pierce

Reference Books:

1. Genetics, Third edition by Monroe W. Strickberger First Indian Impression 2006.
2. Principles of Genetics, Eighth edition, Gardner, Simmons and Snustad.2001.
3. Molecular Genetics An introductory Narrative. Second edition, by Gunther S. Stent and Richard Calendar –University of California Berkley 1986 first Indian edition and reprint 2004.
4. Principles of Genetics, Temin Baltimore. Genetics By Wintergreen.
5. "Genetics: A Conceptual Approach" by Benjamin A. Pierce
6. "Genetics and Analysis of Quantitative Traits" by Michael Lynch and Bruce Walsh
7. "Molecular Biology of the Cell" by Bruce Alberts, Alexander Johnson, Julian Lewis, David Morgan, Martin Raff, Keith Roberts, and Peter Walter
8. "Genetics: From Genes to Genomes" by Leroy Hood, Michael Goldberg, and Ann Reynolds

Online Resources: 1. NPTEL / SWAYAM lectures.

Syllabus
Semester-IV

Course code: BIO42MML205	**Course name:Computational Molecular Biology**
Course category: Major mandatory	
Credits: 3 **Teaching scheme:** L-3	**Evaluation scheme:** CA–60, ESE–40
Exam Duration: 02 Hrs	
Pre-requisites:	
The student should have basic knowledge of biological and applied sciences and successfully completed 1st year of degree program.	
Course Objectives:	
1. Introduction to Computational Techniques: Provide students with a foundational understanding of computational methods and algorithms used in molecular biology research.	
2. Understanding Biological Data: Familiarize students with various types of biological data, including DNA sequences, protein sequences, gene expression data, and structural information, and how computational methods are applied to analyze and interpret these data.	
3. Programming Proficiency: Develop students' programming skills, particularly in languages commonly used in computational molecular biology such as Python, R, or Perl, enabling them to implement algorithms and analyze biological datasets.	
4.Bioinformatics Tools and Resources: Introduce students to bioinformatics tools, databases, and resources available for molecular biology research, such as BLAST, UCSC Genome Browser, and Protein Data Bank, and teach them how to effectively utilize these tools for data analysis and interpretation.	
5.Integration of Multi-Omics Data: Enable students to integrate and analyze data from multiple omics disciplines (genomics, transcriptomics, proteomics, metabolomics) to uncover complex biological relationships and mechanisms.	
6.Advanced Computational Methods: Explore advanced computational techniques used in molecular biology research, including sequence alignment, motif discovery, phylogenetic analysis, gene prediction, protein structure prediction, and molecular dynamics simulations.	
7.Problem-Solving Skills: Cultivate students' ability to apply computational methods and tools to solve real-world biological problems and research questions, fostering critical thinking and analytical reasoning.	
8. Ethical and Legal Considerations: Discuss ethical and legal issues related to computational molecular biology research, such as data privacy, intellectual property rights, and responsible conduct of research.	
Course Outcomes:	
CO1. Proficiency in Computational Methods: Students will gain proficiency in using computational methods and algorithms for analyzing biological data, including sequence analysis, structural analysis, and functional annotation.	
CO2.Programming Competence: Students will develop competence in programming languages and tools relevant to computational molecular biology, allowing them to write scripts, analyze datasets, and visualize results.	

CO3. Effective Utilization of Bioinformatics Tools: Students will be able to effectively utilize bioinformatics tools, databases, and resources for data retrieval, analysis, and interpretation in molecular biology research.
CO4. Integration and Analysis of Biological Data: Students will be able to integrate and analyze multi-omics data to uncover biological insights, patterns, and relationships relevant to molecular biology research questions.
CO5. Application of Advanced Computational Techniques: Students will be capable of applying advanced computational techniques, such as sequence alignment algorithms, phylogenetic inference methods, and molecular modeling approaches, to address complex biological problems.
CO6. Critical Thinking and Problem-Solving Skills: Students will develop critical thinking skills and problem-solving abilities, enabling them to evaluate computational methods, interpret results, and propose novel solutions to molecular biology challenges.
CO7.Communication Skills: Students will be able to effectively communicate their findings, analyses, and interpretations to both scientific and non-scientific audiences through written reports, oral presentations, and visualizations.
CO8.Ethical Awareness: Students will gain an understanding of ethical considerations and legal frameworks relevant to computational molecular biology research, and demonstrate awareness of responsible conduct of research principles.

Contents –

Unit	Content	Teaching hours
1	**Molecular Techniques** PCR Techniques- Principle of polymerase chain reaction (PCR) - Components of PCR reaction and optimization of PCR -Gene specific primer and degenerate primer – Inverse PCR, Hot-start PCR, Loop mediated PCR -, Reverse transcription PCR and Real time PCR. Chemistry of primer synthesis. Hybridization methods-Probes – Labelling of probes- Radioactive and non-radioactive probes - Detection techniques, Southern hybridization, Northern hybridization, Western blotting DNA Sequencing methods-Sanger‘s method of DNA sequencing – Manual and automated methods. Pyrosequencing – massively parallel 454-sequencing, Illumina sequencing, SOLiD sequencing, single molecule sequencing. Protein Sequencing methods-Electrophoresis of protein – native and denaturing conditions, capillary and gel electrophoresis, 2D gel electrophoresis, ELISA, yeast hybrid system – one hybrid system – two hybrid system, phage display.	09
2	**Molecular tools for Gene Cloning** Restriction enzymes – Introduction and types with examples, methylation sensitivity of restriction enzymes Dam, Dcm and CpGmethylases, star	09

	activity of restriction enzymes, . modifying enzymes, DNA and RNA polymerases, reverse transcriptase, terminal transferase, DNA/RNA modifying enzymes-methylases-CpGmethylase (M.Sss I), dam methylase, M.EcoR I. Introduction to cloning vectors, plasmid biology, plasmid vectors (high copy and low copy), phage biology, phage vectors, cosmid vectors, phasmid vectors, BAC vectors and YAC vectors, yeast vectors. Construction of Gene Libraries-Construction of cDNA library- construction subtractive cDNA library – construction of genomic DNA library – BAC library – YAC library.	
3	**Cloning Techniques:** RFLP, DNA fingerprinting and foot printing, chromosome walking, marker techniques Gene cloning strategies, cloning in bacteria other than E Coli, Cloning in Saccharomyces cerevisiae and other fungi, Gene transfer to animal cells, Genetic manipulation of animal Cloning after restriction digestion - blunt and cohesive end ligation – creation of restriction sites by PCR- cloning using linkers and adapters - cloning after homopolymer tailing. Cloning Technologies Strategies for cloning PCR products – TA cloning -TOPO-TA cloning- Ligation free cloning. Bio Brick cloning, Restriction Enzyme Cloning, Gateway recombination cloning, Topo cloning / TA, Gibson Assembly, Type II S Assembly, Global Gate/Moc, Ligation independent cloning, Peast mediated cloning & oligonucleotide stitching, PCR cloning, Seamless cloning, Recombinational cloning, Gateway cloning, Infusion cloning, BI/ multi-cistronic Cloning.	09
4	**Expression methods & Synthetic Biology** Basics of Gene expression – hybridization techniques, Northern blot analysis, Primer extension, S1 mapping, RNAase protection assays, Reporter assays), Nucleic acid microarrays. Gene expression in bacteria and Yeast, expression in insects and insect cells, expression in mammalian cells, expression in plants – characterization of recombinant proteins, stabilization of proteins; Phage display, Yeast Two- and three Hybrid system..	09
5	**Advance Gene Technologies & RNA Engineering** Genome-Editing Technologies: Principles and Applications, RNA Interference: Biology, Mechanism, and Applications, Genome editing with engineered zinc finger nucleases, CRISPR-Cas: biology, mechanisms and relevance, TALEN Genome-Editing System, Meganucleases, Introduction-- Amplify aptamer-encoding DNA, SELEX I: Building a Library-Purify aptamer- encoding DNA, SELEX II: Selecting RNA with target functionality-Prepare RNA by IVT, SELEX III: Technical advances & problem-solving--Purify RNA and run affinity column, Characterizing aptamers--RNA to DNA by RT-PCR, Introduction to porphyrins: chemistry	09

	& biology--, Aptamer applications in biology & technology--Aptamer binding assay, Aptamers as therapeutics Introduction--Start-up biomaterials engineering, Introduction to biomaterials; cartilage composition- Initiate cell culture	

Text Books:

1. "Bioinformatics Algorithms: An Active Learning Approach" by Phillip Compeau and Pavel Pevzner.
2. "Biological Sequence Analysis: Probabilistic Models of Proteins and Nucleic Acids" by Richard Durbin, Sean R. Eddy, Anders Krogh, and Graeme Mitchison
3. "Introduction to Computational Biology: Maps, Sequences and Genomes" by Michael S. Waterman
4. "Computational Biology: A Practical Introduction to BioData Processing and Analysis with Linux, MySQL, and R" by Röbbe Wünschiers
5. "Genome-Scale Algorithm Design: Biological Sequence Analysis in the Era of High-Throughput Sequencing" by Veli Mäkinen, Djamal Belazzougui, Fabio Cunial, and Alexandru Tomescu
6. "Computational Molecular Evolution" by Ziheng Yang

Reference Books:

1. Alberts B, Bray D, Johnson A et al. (1997) Essential Cell Biology. London: Garland Publishing. Darwin C (1859) On the Origin of Species. London: Murray.
2. Graur D & Li W-H (1999) Fundamentals of Molecular Evolution, 2nd edn. Sunderland, MA: Sinauer Associates.
3. Madigan MT, Martinko JM & Parker J (2000) Brock's Biology of Microorganisms, 9th edn. Englewood Cliffs, NJ: Prentice Hall.
4. Alberts B, Bray D, Johnson A et al. (1997) Essential Cell Biology. London: Garland Publishing. Darwin C (1859) On the Origin of Species. London: Murray.
5. "Molecular Modeling of Proteins" by Andreas Kukol
6. "Biological Data Mining" by Jake Y. Chen and Stefano Lonardi

Online Resources: 1. NPTEL / SWAYAM lectures.

Syllabus
Semester-IV

Course code: BIO42MML206	**Course name: Structural Bioinformatics**
Course category: Major mandatory	
Credits: 2 **Teaching scheme:** L-2	**Evaluation scheme:** CA–30, ESE–20
Exam Duration: 01 Hrs	
Pre-requisites: The student should have basic knowledge of biological and applied sciences and successfully completed the 1st year of the degree program.	
Course Objectives:	
1. Introduction to Structural Bioinformatics: To introduce students to the field of structural bioinformatics, including the principles and techniques used to analyze biomolecular structures.	
2. Understanding Biomolecular Structures: To provide students with a fundamental understanding of biomolecular structures, including proteins, nucleic acids, and complexes, and their importance in biological function.	
3.Computational Methods for Structure Prediction: To familiarize students with computational methods used for predicting biomolecular structures, including protein structure prediction, RNA/DNA structure prediction, and structure-based drug design.	
4.Structure Analysis Techniques: To teach students various techniques for analyzing biomolecular structures, such as molecular visualization, structural alignment, and geometric analysis.	
5.Protein-Ligand Interactions: To explore the principles of protein-ligand interactions and teach students how to predict and analyze protein-ligand binding using computational methods.	
6.Molecular Docking and Virtual Screening: To introduce students to molecular docking algorithms and virtual screening techniques used for drug discovery and design.	
7.Structural Bioinformatics Databases and Tools: To familiarize students with structural bioinformatics databases and software tools commonly used for structure analysis, visualization, and modeling.	
8.Applications of Structural Bioinformatics: To illustrate the applications of structural bioinformatics in various fields, including drug discovery, protein engineering, and molecular biology research.	
Course Outcomes: At the end of the course, the students will be able to -	
CO1: Understanding of Biomolecular Structures: Students will gain a thorough understanding of biomolecular structures, including their components, organization, and biological functions.	
CO2: Proficiency in Computational Methods: Students will develop proficiency in using computational methods for predicting, analyzing, and modeling biomolecular structures.	
CO3: Skills in Structural Analysis: Students will acquire skills in structural analysis techniques, including molecular visualization, structural alignment, and geometric analysis, to interpret biomolecular structures.	
CO4:Knowledge of Protein-Ligand Interactions: Students will learn about the principles of protein-ligand interactions and gain the ability to predict and analyze protein-ligand binding using computational methods.	

CO5:Competence in Molecular Docking and Virtual Screening: Students will become competent in using molecular docking algorithms and virtual screening techniques for drug discovery and design applications.
CO6:Familiarity with Structural Bioinformatics Tools: Students will become familiar with structural bioinformatics databases and software tools, enabling them to effectively utilize these resources for structure analysis and modeling.
CO7:Critical Thinking and Problem-Solving Skills: Students will develop critical thinking and problem-solving skills by applying structural bioinformatics methods to address research questions and practical challenges in molecular biology and drug discovery.
CO8: Integration of Structural Bioinformatics Knowledge: Students will be able to integrate their knowledge of structural bioinformatics with other disciplines, such as biochemistry, molecular biology, and computational biology, to advance research and innovation in the field.

Contents –

Unit	Content	Teaching hours
1	**Introduction to Bioinformatics:** Introduction to Bioinformatics, History of Bioinformatics, Scope and application of bioinformatics, Data generation of large scale data from Molecular biology data (Through NMR Spectroscopy, X- RAY diffraction, Microarray, Genome sequencing, Protein sequencing ,Gel electrophoresis) , Internet, www	09
2	**Databases and Resources:** Biological data, Nature of Biological data, Bioinformatics Resources – NCBI, EBI,SIB, Biological databases, Types of databases, Protein sequence database- PIR , Uniprot ,Swissprot, Structural database- PDB,NDB , Nucleic acid Sequence database- GenBank, EMBL,DDBJ, Introduction to Biological information Search engine,	09
3	**Sequence Alignment:** Concept of sequence alignment, Types of sequence alignment- Pairwise sequence alignment, multiple sequence alignment, Methods of sequence alignment- LOCAL & GLOBALalignment sequence similarity search tool – BLAST, FASTA, Clustal-w, Clustal omega Matrices – PAM &BLOSUM	09
4	**Protein and Protein structure Prediction:** Introduction to Protein, Amino acid, Levels of Proteins, Protein structure, Secondary structure prediction – chou- fasman method, GOR method ,3 D	09

	structure prediction, molecular modelling methods – Homology, Threading (fold recognition) , Ab- initio.	

Text Books:

1. "Introduction to Protein Structure" by Carl Branden and John Tooze
2. "Principles of Protein Structure" by G.E. Schulz and R.H. Schirmer
3. "Bioinformatics Algorithms: An Active Learning Approach" by Phillip Compeau and Pavel Pevzner
4. "Introduction to Structural Biology" by Narayanaswamy Srinivasan
5. "Molecular Modeling: Principles and Applications" by Andrew Leach
6. "Protein Structure Prediction: Methods and Protocols" edited by David Webster
7. "Structural Bioinformatics" by Philip E. Bourne and Helge Weissig

Reference Books:

1. Bioinformatics and functional genomics by Pevsner J, 2nd edition, Wiley
2. David W Mount Bioinformatics – Sequence and genome analysis 2nd edition
3. Introduction to Bioinformatics (Atwood, T.K. and parry smith, D.J)
4. Essential Bioinformatics -Jin Xiong
5. "Computational Methods in Structural Bioinformatics" edited by G. Ellis Bell and John M. Archibald
6. "Protein Structure: Determination, Analysis, and Applications for Drug Discovery" edited by Daniel John Rigden
7. "Structural Bioinformatics: An Algorithmic Approach" by Roland L. Dunbrack Jr

Online Resources: 1. NPTEL / SWAYAM lectures.

Syllabus
Semester-IV

Course code: BIO42SEP201	**Course name:Applied BI Lab II**
Course category: Skill Enhancement course	
Credits: 2 **Teaching scheme:** P-3	**Evaluation scheme:** CA–30, ESE–20
Exam Duration: 02 Hrs	
Pre-requisites:	
The student should have basic knowledge of biological and applied sciences and successfully completed the 1st year of the degree program..	
Course Objectives:	
1. Advanced Data Analysis Skills: Develop advanced skills in analyzing complex biological datasets using state-of-the-art bioinformatics tools and algorithms.	
2. Integration of Multi-Omics Data: Learn to integrate and analyze data from various omics disciplines such as genomics, transcriptomics, proteomics, and metabolomics to gain comprehensive insights into biological systems.	
3. Algorithm Implementation and Optimization: Gain proficiency in implementing, customizing, and optimizing bioinformatics algorithms for tasks such as sequence analysis, network analysis, and structural prediction.	
4. Machine Learning Applications: Understand and apply machine learning techniques to biological data analysis, including classification, clustering, regression, and feature selection.	
5. Structural Bioinformatics and Molecular Modeling: Explore advanced methods for predicting and analyzing biomolecular structures, including protein-ligand interactions, molecular docking, and molecular dynamics simulations.	
6. Network Analysis and Systems Biology: Learn advanced network analysis techniques to study biological networks such as gene regulatory networks, protein-protein interaction networks, and metabolic pathways.	
7.High-Throughput Data Visualization: Develop skills in visualizing and interpreting high-throughput biological data using advanced visualization tools and techniques.	
8. Advanced Research Projects: Undertake advanced research projects or case studies in bioinformatics, focusing on real-world biological problems and applying advanced computational methods to address them.	
Course Outcomes:	
PO1. Proficiency in Advanced Bioinformatics Tools: Students will demonstrate proficiency in using advanced bioinformatics tools and software packages for analyzing complex biological datasets.	
PO2.Integration and Analysis of Multi-Omics Data: Students will be able to integrate and analyze multi-omics data to uncover complex biological relationships and mechanisms.	
PO3. Advanced Algorithm Development Skills: Students will develop advanced algorithm development skills, including the ability to customize and optimize bioinformatics algorithms for specific analysis tasks.	

PO4. Application of Machine Learning Techniques: Students will apply machine learning techniques to biological data analysis, demonstrating proficiency in classification, clustering, regression, and feature selection..
PO5. Expertise in Structural Bioinformatics: Students will demonstrate expertise in structural bioinformatics and molecular modeling techniques, including protein-ligand interactions, molecular docking, and molecular dynamics simulations.
PO6.Network Analysis Proficiency: Students will be proficient in analyzing and interpreting biological networks using advanced network analysis techniques.
PO7.Effective Visualization and Interpretation: Students will effectively visualize and interpret high-throughput biological data using advanced visualization tools and techniques, generating meaningful insights.
PO8.Advanced Research Skills: Students will demonstrate advanced research skills by successfully completing advanced research projects or case studies in bioinformatics, addressing real-world biological problems with innovative computational solutions.

Contents –

Sr. No.	Title of the Experiment
1	Introduction to Protein Data Bank
2	Introduction to Nucleotide Date Bank
3	Molecular visualization using RASMOL
4	Molecular visualization using PYMOL
5	RNA secondary structure prediction
6	Drawing chemical structure using Chemsketch
7	Drawing chemical structure using Chemdraw
8	Introduction to PDB file format
9	Introduction to other molecular file formats
10	Introduction to Cactus
11	Introduction to Openbabel
12	Introduction to Homology Modelling
13	Introduction to threading
14	Introduction Ab initio Modelling

15	Introduction to Docking
16	Introduction to Hex
17	ntroduction to Autodock
18	Introduction to ADME
19	Introduction to Molinspiration
20	Introduction to Swiss ADME

Reference Book / Hand Books/ Lab Manual

1. Essential Bioinformatics by Jin Xiong
2. Introduction To Bioinformatics by LESK
3. "Bioinformatics Algorithms: An Active Learning Approach" by Phillip Compeau and Pavel Pevzner
4. "Bioinformatics: Sequence and Genome Analysis" by David W. Mount
5. "Introduction to Computational Molecular Biology" by João Carlos Setubal and João Meidanis

Online Resources: 1. NPTEL / SWAYAM lectures.

Syllabus
Semester-IV

Course code: BIO42MMP202	**Course name: Python and Structural Bioinformatics Lab**
Course category: Major mandatory	
Credits: 1 **Teaching scheme:** P-2	**Evaluation scheme:** CA–30, ESE–20
Exam Duration: 02 Hrs	
Pre-requisites: The student should have basic knowledge of biological and applied sciences and successfully completed 1st year of degree program.	
Course Objectives:	
To define the structure and components of a Python program. To learn how to write loops and decision statements in Python. To learn how to write functions and pass arguments in Python. To learn how to do object oriented programming using python To learn how to do optimization modeling.	
Course Outcomes: At the end of the course, the students will be able to	
PO1.Student will be able to Understanding Bimolecular Structure	
PO2.Student will be able to Bioinformatics Tool	
PO3.Students will improve their Programming Proficiency	
PO4.Students will use Python to solve computational problems.	
PO5.Student will know python Libraries and Frameworks	

List of Practical:

Sr. No.	Title of the Experiment
1	Standard operating Procedure of laboratory (Compulsory practical)
2	To study basics of Macromolecules: DNA/RNA, Protein and there visualization
3	To study optimization methods like: -a) Linear programming b) Mixed integer programming c)Nonlinear programming d) Constraint programming
4	To study the use of spreadsheets for optimization modeling.
5	To study tree structured Parzen estimators.
6	To study model parameters and model hyperparameters with deep neural network.
7	To study population-based training (PBT) applied to neural networks.

8	To study the BOHB (Bayesian optimization and HyperBrand) algorithm.
9	To study the probability distribution using Python.
10	To study the sampling distribution of the proportion.
11	To study sampling distribution using the central limit theorem.
12	Python programs for all operators
13	Python programs for controlling statements
14	Python programs of file handling
15	Python programs for functions and modules
16	Python programs for exception handling
17	Python programs for Object oriented concepts
18	Python programs for web programming
19	Python programs for database

Reference Book / Hand Books/ Lab Manual
1. https://neptune.ai/blog/hyperparameter-tuning-in-python-complete-guide
2. https://www.riverlogic.com/blog/optimization-modeling-everything-you-need- To-know
3. https://stattrek.com/sampling/sampling-distribution.aspx?tutorial=AP Biological Modelling and Simulation: A survey Practical Models, Algorithms and Numerical Methods by Russell Schwartz.

Syllabus
Semester-IV

Course code: BIO42CEJ202	**Course name:Community Engagement Programme**
Course category: Community engagement and service	
Credits: 2 **Teaching scheme:** P-4	**Evaluation scheme:** CA–30, ESE–20
Exam Duration: 02 Hrs	
Pre-requisites: The student should have basic knowledge of biological and applied sciences and successfully completed 1st year of degree program.	
Course Objectives:	
1. Students will be able to practice acquired knowledge within the chosen area of technology for development,	
2. Identify, discuss and justify the technical aspects of the chosen project with a comprehensive and systematic approach,	
3. To search the appropriate existing literature on specific area of project	
4. To design and execute the research project	
5 To analyze, correlate, discuss and conclude the project.	
Course Outcomes: At the end of the course, the students will be able to -	
PO1: Students will be able to practice acquired knowledge within the chosen area of technology for project development.	
PO2: Students are capable to find out appropriate existing literature on specific area of research project.	
PO3: Students are capable of set the precise research topic.	
PO4: Students can set the objectives and hypotheses for the research project.	
PO5: Students could be design and execute the research project.	

List of Practical:

Sr. No.	Title of the Experiment
I	**Ideas of project:** Defining project ideas is crucial for setting realistic expectations and laying out a clear vision for a project life cycle. Project-based learning not only provides opportunities for students to collaborate or drive their own learning, but it also teaches them skills such as problem solving, and helps to develop additional skills integral to their future, such as critical thinking and time management.

II	**Literature survey:** A literature review establishes familiarity with and understanding of current research in a particular field before carrying out a new investigation. Conducting a literature review should enable you to find out what research has already been done and identify what is unknown within your topic.
III	**Performance:** Performance measurement during a project is to know how things are going so that we can have early warning of problems that might get in the way of achieving project objectives and so that we can manage expectations. The criteria of it as given below
IV	**Implementation:** Follows closely the design, uses appropriate techniques with skill and understanding to produce a good solution.
V	**Evaluation:** Clearly relates to the problem. Shows a good understanding and appreciation of the solution. Objectives of what has been done.
VI	**Project Log:** a. The individual student's effort and commitment. b. The quality of the work produced by the individual student. c. The student's integration and co-operation with the rest of the group. d. The completeness of the logbook; time to time signature of guide
VII	**Thrust Area of Project:** 1. Health Informatics 2. Agri Informatics 3. Exome Sequencing

	4. Chip Sequencing 5. DNA Barcording 6. Evolution analysis 7. Biological Data Science 8. Computational Neuroscience

PROCEDURE

Sr. No.	Activities	Responsibilities
1	UG students are deciding on their team members for their semester project with their proposed project domain And title	Project head, UG students
2	Director shall allocate the project guide based on their area Of expertise (tomorethan3batchestoaguide)	Director
3	Ensuring that students have regular discussion meetings with their project guides.	Project guide Project head
4	Synopsis preparation and submission	Project head
5	Verification of student project log book	Project guide Project head
6	Approval of PPT: Abstract, existing, proposed system. 30% of proposed work. 80% of proposed work. 100%ofproposedwork.	Project guide
7	Preparation and submission of progress report during project	Students Project head
8	Preparing list for Redo students (insufficient content, plagiarism, poor presentation, genuine absentees.	Project head
9	Submission of hard copy of project report	Project head

10	Evaluation of project report	External examiner
11	Organizing final project viva-voce	Project heads
12	Ensuring that if a candidate fails to submit the project report on or before the specified deadline , he/she is deemed to have failed inthe project work and shall re – enroll for the same	Project head Project guide Director