MGM UNIVERSITY, AURANGABAD

INSTITUTE OF BIOSCIENCES AND TECHNOLOGY

CHOICE-BASED CREDIT SYSTEM(CBCS) SEMESTER PATTERN

Faculty of Basic and Applied SciencesGraduate (UG) Program

Biotechnology - CURRICULUM

W.e.f. **Academic Year 2023-24**

B.Sc., B. Sc. (Hons.), B. Sc. (Hons.) with Research of Biotechnology

SEMESTER (I,II)

Prepared By
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Submitted By
Dr. S. V. Maske

Approved By
Board of Studies

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

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

Programs offered at IBT

Undergraduate Programmes	Postgraduate Programmes	PhD Programmes	PG Diploma Programmes	Certificate Programmes
B.Sc. Biotechnology Honours / Honours with Research	M.Sc. Biotechnology	Ph.D. Biotechnology		
B.Sc. Microbiology Honours/ Honours with Research	M.Sc.Microbiology/Virology	Ph.D. Microbiology		
B.Sc. Bioinformatics Honours / Honours with Research	M.Sc. Bioinformatics	Ph.D. Bioinformatics		
B.Sc. Food Technology and Processing Honours / Honours with Research	M.Sc. Food Technology	Ph.D.Food Technology & Processing		
B.Sc. Food nutrition and Ditetics Honours / Honours with Research	M.Sc. Plant Breeding and Molecular Genetics	Ph.D.Plant Breeding & Molecular Genetics		
B. Tech. Biomedical Engineering		Ph.D. Plant Biotechnology		
B. Tech. Biotechnology				
B. Tech. Food Processing and Technology				

Name of Program – B.Sc. (Hons) Biotechnology

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 / MHT-CET / PERA CET / JEE (Main) Paper-I and should obtain non zero score in MGMU-CET / MHT-CET/ PERA CET/ JEE (Main) Paper-I . However, preference shall be given to the candidate obtaining non-zero positive score in MGMU-CET over the candidates who obtained non-zero score in MHT-CET / PERA CET.

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/ MHT-CET/ PERA CET/ JEE (Main) Paper-I and should obtain non-zero score in MGMU-CET/ MHT-CET/ PERA CET/ 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/ MHT-CET/ PERA CET

Name of Faculty: Basic and Applied Sciences
Name of the College/Institute/Department/School: Institute of Bioscience and Technology
Name of the Programme: B.Sc./B.Sc. Hons. /B.Sc. Hons with Research
Programme Type (UG/PG): **UG**
Duration: 04 Years (08 Semesters)

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	SCB42MML101	Bacterial Biological Diversity	Lecture	3	3	-	60	40	100	-	16	40
MM	SCB42MML102	Bioinstrumentation	Lecture	2	2	-	30	20	50	-	8	20
IKS	SCB42IKL101	Zoology and Botany in India	Lecture	2	2	-	30	20	50	-	8	20
AEC	MGM54AEL104	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	MGM21VEL101	Environmental Studies	Lecture	2	2	4	30	20	50	-	8	20
VSC	SCB42VSP101	BT Lab I	Practical	2		4	30	20	50	-	8	20
SEC	SCB42SEP101	Explorations in Biotechnology –I	Practical	2		2	30	20	50	-	8	20
MM	SCB42MMP101	Bio-Skills Lab Factory-I	Practical	1	-	4	30	20	50	-	8	20
CC	MGM82CCP107	Cultural Activities	Practical	2		-	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

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	SCB42 MML103	Biomolecules and Bioenergetics	Lecture	2	2		30	20	50	-	8	20
MM	SCB42 MML104	Biology: Concept, Connections, Investigation and applications	Lecture	3	3	-	60	40	100	-	16	40
MI		Minor Course	Lecture	2	2	-	30	20	50	-	8	20
AEC	MGM54 AEL102	Functional English	Lecture	2	2	-	30	20	50	-	8	20
OE		Open Elective III	Lecture	2	2	-	30	20	50	-	8	20
OE		Open Elective IV	Lecture	2	2	-	30	20	50	-	8	20
VEC	MGM56 VEL102	Constitution of India	Lecture	2	2	-	30	20	50	-	8	20
VSC	SCB42V SP102	BT Lab II	Practical	2		4	30	20	50	-	8	20
SEC	SCB42S EP102	Explorations in Biotechnology –II	Practical	2		4	30	20	50	-	8	20
MM	SCB42 MMP102	Bio-Skills Lab Factory-II	Practical	1	-	2	30	20	50	-	8	20
CC	MGM82 CCP103	Sports	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

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	SCB42MML201	Genome maintenance and regulation	Lecture	2	2	-	30	20	50	-	08	20
MM	SCB42MML202	Fermentation Technology	Lecture	3	3	-	60	40	100	-	16	40
MM	SCB42MML203	Principles of Developmental Biology	Lecture	2	2	-	30	20	50	-	08	20
OE		**Open Elective V**	Lecture	2	2	-	30	20	50	-	08	20
MI		Minor Course	Lecture	3	3	-	60	40	100	-	16	40
AEC	**MGM54AEL103**	**Functional Hindi**	Lecture	2	2	-	30	20	50	-	08	20
MI		Minor Course	Practical	1	-	2	30	20	50	-	08	20
VSC	SCB42VSP201	Applied BT Lab-I	Practical	2	-	4	30	20	50	-	08	20
MM	SCB42MMP201	Microbial Technology Lab.	Practical	1	-	2	30	20	50	-	08	20
FP	SCB42FPJ201	Field Project	Project	2	-	4	30	20	50	-	08	20
CC	**MGM82CCP201**	**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

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	SCB42MML204	Molecular Immunology	Lecture	2	2	-	30	20	50	-	08	20
MM	SCB42MML205	Gene Technologies	Lecture	3	3	-	60	40	100	-	16	40
MM	SCB42MML206	Enzyme Engineering	Lecture	2	2	-	30	20	50	-	08	20
OE		**Open Elective VI**	Lecture	2	2	-	30	20	50	-	08	20
MI		Annexture I	Lecture	3	3	-	60	40	100	-	16	40
AEC	**MGM54AEL203**	**Communication Skills**	Lecture	2	2	-	30	20	50	-	08	20
SEC	SCB42SEP201	Applied BT Lab-II	Practical	2		4	30	20	50	-	08	20
MI		Minor Course	Practical	1	-	2	30	20	50	-	08	20
MM	SCB42MMP202	Advances in Microbial Technology	Practical	1	-	2	30	20	50	-	08	20
CEP	SCB42CEJ201	Community Engagement Program	Project	2	-	4	30	20	50	-	08	20
CC	**MGM73CCP105**	**Fine Arts**	Practical	2	-	4	30	20	50	-	08	20
MM	SCB42MML204	Molecular Immunology	Lecture	2	2	-	30	20	50	-	08	20
MM	SCB42MML205	Gene Technologies	Lecture	3	3	-	60	40	100	-	16	40
Total				27	19	16	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

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	SCB42MML301	Bioprocessing: Cell Culture & Scale up	Lecture	2	2	-	30	20	50		8	20
MM	SCB42MML302	System Biology	Lecture	3	3	-	60	40	100		16	40
MM	SCB42MML303	Biomanufacturing process science & Experiment Designing	Lecture	2	2	-	30	20	50		8	20
ME	SCB42MEL201	Phyton	Lecture	3	3	-	60	40	100		16	40
MI		Minor Course	Lecture	3	3	-	60	40	100		16	40
VSC	SCB42VSP301	Environment Biotechnology	Practical	2		4	30	20	50		8	20
MI		Minor Course	Practical	1	-	2	30	20	50		8	20
VSC	SCB42VSP302	Mini Project	Practical	2	-	4	30	20	50		8	20
MM	SCB42MMP301	Introduction to Bio manufacturing Lab	Practical	1	-	2	30	20	50		8	20
FP	SCB42FPJ301	Field project community engagement	Project	2		4	30	20	50		8	20
ME	SCB42MEP201	Phyton lab	Practical	1	-	2	30	20	50		8	20
Total				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 5.5 Award of UG degree in major and minor (44+44+44)=132 credits 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	SCB42MML304	Synthetic Biology	Lecture	2	2	-	30	20	50	-	8	20
MM	SCB42MML305	RNA Technology	Lecture	3	3	-	60	40	100	-	16	40
MM	SCB42MML306	Design Biomanufacturing, facilities, critical utilities, process & equipment	Lecture	3	3	-	60	40	100	-	16	40
ME	SCB42MEL202	Genome Editing	Lecture	3	3	-	60	40	100	-	16	40
MI		Minor Course	Lecture	3	3	-	30	20	50	-	8	20
MI		Minor Course	Practical	2		2	30	20	50	-	8	20
OJT	SCB42JTP301	On Job Training	Training	4		8	60	40	100	-	16	40
MM	SCB42MMP302	Biological Lab.	Practical	1	-	2	30	20	50	-	8	20
MM	SCB42MMP303	Mini Project	Practical	1	-	2	30	20	50	-	8	20
ME	SCB42MEP202	Data analysis and statistics	Practical	1	-	2	30	20	50	-	8	20
Total				**23**	**14**	**16**	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

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	SCB42MML401	Exponential Biotechnologies-2 (Biosensors, 3D Bio-printing)	Lecture	3	3		60	40	100		16	40
MM	SCB42MML402	Biotechnology Application (Bio fertilizer, Bio pesticide, Bio insecticides and plant Tissue culture)	Lecture	3	3		60	40	100		16	40
MM	SCB42MML403	Excitable cells: the foundation of neurosciences	Lecture	3	3		60	40	100		16	40
MM	SCB42MML404	Introduction to Bioengineering	Lecture	2	2		30	20	50		8	20
MM	SCB42MEL301	Introduction of R – programming	Lecture	3	3		60	40	100		16	40
RM	SCB42RML401	Research methodology–I	Lecture	3	3		60	40	100		16	40
RM	SCB42RMP401	Research methodology–II	Practical	1	-	2	30	20	50		8	20
ME	SCB42MEP301	R –programming lab	Practical	1	-	2	30	20	50		8	20
MM	SCB42MMP401	Bio industrial Lab.	Practical	1	-	2	30	20	50		8	20
MM	SCB42MMP402	Excitable Lab.	Practical	1	-	2	30	20	50		8	20
MM	SCB42MMP403	Major Project	Practical	1	-	2	30	20	50		8	20
Total				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

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	SCB42MML405	Bioethics, Biosafety & IPR	Lecture	3	3	-	60	40	100		16	40
MM	SCB42MML406	Pharmaceutical Biotechnology	Lecture	3	3	-	60	40	100		16	40
MM	SCB42MML407	r-DNA technology	Lecture	3	3	-	60	40	100		16	40
MM	SCB42MML408	Genomics and proteomics	Lecture	2	2	-	30	20	50		8	20
ME	SCB42MEL302	Entrepreneurship and innovation	Lecture	3	3	-	60	40	100		16	40
OJT	SCB42JTP401	On Job Training	Training	4	-	8	60	40	100		16	40
ME	SCB42MEP302	Scale up Lab	Practical	1	-	2	30	20	50		8	20
MM	SCB42MMP404	Genomics and proteomics lab	Practical	1	-	2	30	20	50		8	20
MM	SCB42MMP405	RDT Lab	Practical	1	-	2	30	20	50		8	20
MM	SCB42MMP406	Seminar (research paper based)	Practical	1	-	2	30	20	50		8	20
Total				22	14	16	450	300	**750**		120	300

Note:

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

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Level 6.0 Four year UG Honours Degree in major and minor (44+44+44+44) = 176 credits

Level			First Year (Semester I)																			
	Course Type	Course code	Course Title	Type	Teaching period per week (Hrs /week)			Credits	Duration of Exam	Evaluation Scheme (Marks)							Minimum Passing (Marks)			
										Internal				External		Total	Internal	External		Total
					L	T	P			CA-I	MSE	CA-II	TW	ESE	PR		CA/MSE/TW	ESE	PR	
4.5	Core	BBMML101	Bacterial Biological Diversity	Theory	3			3		20	20	20	-	40	-	100		16		40
	Core	BBMML102	Bioinstrumentation	Theory	2		-	2		10	10	10	-	20	-	50		8	-	20
	IKS		Annexure I	Theory	2		-	2		10	10	10	-	20	-	50		8	-	20
	AEC		Communicative English I	Theory	2	-	-	2		10	10	10	-	20	-	50		8		20
	OE**	BBOEL103	Open Elective I	Theory	2		-	2		10	10	10	-	20	-	50		8		20
	OE	BBOEL104	Open Elective II	Theory	2		-	2		10	10	10	-	20	-	50		8		20
	VEC		Annexure I	Theory	2	-	-	2		10	10	10	-	20	-	50		8		20
	VSC*	BBVSP105	BT Lab I	Practical			4	2					30		20	50			8	20
	SEC*	BBSEP106	Explorations in Biotechnology –I	Practical			4	2					30		20	50			8	20
	Core	BBMMP107	Bio-Skills Lab Factory-I	Practical	-	-	2	1			-		30	-	20	50			8	20
	CC		Annexure I	Practical		-	4	2			-		30	-	20	50			8	20
	Total (L-T-P) Hrs / week = 29				**15**		**14**	**22**												

BBMML101 BACTERIAL BIOLOGICAL DIVERSITY 3+0

University: MGM University, Aurangabad **Faculty:** Basic and applied sciences

Institute: Institute of Biosciences and Tech. **Degree:** B.Sc. (Hons/Hons. with research) Biotechnology

Course Unit Code: BBMML101 **Course Unit Title:** Bacterial Biological Diversity

Credits allocated: 3+0(Theory) **Level of Study:** UG

Mode of delivery, planned learning activities and teaching method: Lecture 3hrs / weekly

Recommended Year /Semester: Biotechnology, Year 1/ Semester I

Course Objectives:

1. To study the Basic concepts of microbiology & microorganisms.
2. To understand the characters of prokaryotic and Eukaryotic microorganisms for conventional
3. and molecular characterization using modern methods.
4. Knowledge of cellular organization, life cycle and economic importance of bacteria

Course Outcomes:

By the conclusion of this course, the students –

1. Have developed a good knowledge of the development of the discipline of Microbiology andthe contributions made by prominent scientists in this field.
2. Have developed a very good understanding of the characteristics of different types of microorganisms, methods to organize/classify these into and basic tools to study these in the laboratory.
3. Are able to explain the useful and harmful activities of the microorganisms.
4. Are able to perform basic experiments to grow and study microorganisms in the laboratory.

Detailed Syllabus:

Unit 1 Prokaryotic and Eukaryotic cell (Lectures 07)

Prokaryotic and Eukaryotic cell differential account, Binomial nomenclature concept, Whittekar's five kingdom system, Carl woeses three kingdomsystem, Baltiomore classification.

Unit 2 General characters, Bacterial cell – organization and structure (Lectures 11)

General characters of Bacteria, Fungi, algae, actinomycetes, mycoplasma, rickettsia, archaea, protozoa. Morphology of acellular microorganisms (Viruses, Viroids, Prions)

Cell size, shape and arrangement, glycocalyx, capsule, flagella, endoflagella, fimbriae and pili. Difference between gram positive and gram-negative cell walls, Cell membrane, Ribosomes, mesosomes, chromosome, plasmids and endospore: structure and stages of sporulation. Archaebacterial cell wall and acid fast bacterial cell wall,

Unit 3 Methods of studying microorganism (Lectures 11)

Methods of studying microorganism; Staining techniques: simple staining, Gram staining and acid-fast staining. Sterilization techniques (physical & chemical sterilization). Culture media & conditions for microbial growth. Growth curve of bacteria. Pure culture isolation: Streaking, serial dilution and plating methods. Maintenance and preservation of pure cultures.

Unit4 Identification and Bacterial diversity (Lectures 08)

Classification of bacteria according to the Bergey's Manual of Systematic Bacteriology. Numerical taxonomy. Modern methods of studying bacterial diversity.

Unit 5 Role of microbes (Lectures 08)

Role of microorganisms in different fields as agriculture, human health, industry, food processing.

Reference Books and Text Books

1. Prescott, M.J., Harley, J.P. and Klein, D.A. Microbiology. 5th Edition WCB Mc Graw Hill,New York, (2002).
2. Tortora, G.J., Funke, B.R. and Case, C.L. Microbiology: An Introduction. Pearson Education,Singapore, (2004).
3. Alcomo, I.E. Fundamentals of Microbiology. VI Edition, Jones and Bartlett Publishers.Sudbury. Massachusetts, (2001).
4. Black J.G. Microbiology-Principles and Explorations. John Wiley & Sons Inc. New York, (2002).
5. Pelczar, MJ Chan ECS and Krieg NR, Microbiology McGraw-Hill.
6. Willey, Sherwood, Woolverton. Prescott, Harley, and Klein's Microbiology McGraw-Hill publication
7. Tortora, Funke, Case. Microbiology. Pearson Benjamin Cummings.
8. Jacquelyn G. Black. Microbiology Principles and Explorations. John Wiley & Sons, Inc.
9. Madigan, Martinko, Bender, Buckley, Stahl. Brock Biology of Microorganisms. Pearson 10.

BBMML102 **Bioinstrumentation** **2+0**

University: MGM University, Aurangabad

Faculty: Basic and applied science

Institute: Institute of Biosciences and Tech.

Degree: B.Sc Hons Biotechnology

Course Unit Code: BBMML102

Course Unit Title: Bioinstrumentation

Credits allocated: 2+0(Theory)

Level of Study: UG

Mode of delivery, planned learning activities and teaching method: Lecture 2hrs / weekly

Recommended Year /Semester: Biotechnology, Year 1/ Semester I

Course Objective

1. Students will develop a conceptual understanding of connections between physics and biology.
2. Students will be able to explain the behavior and interactions between, matter and energy at both the atomic and molecular levels by different atomic models.
3. Students will gain an understanding of interpreting spectra and will be able to explain how spectroscopic methods are used for quantitative analysis of biomolecules.

Course Outcome

Upon successful completion of this subject student should be able to acquire a deep knowledge in:

1. Students will be able to handle various equipment's used in biochemical analysis and troubleshoot them.
2. Students will be able develop competence in handing various chromatographic techniques and apply them in isolating and characterizing different biological molecules.
3. Understanding the applications of centrifugation and chromatography in biological investigations.
4. Discuss the applications of biophysics and principle involved in bioinstruments
5. Describe the methodology involved in biotechniques
6. Describe the applications of bioinstruments
7. Demonstrate knowledge and practical skills of using instruments in biology and medical

Detail Syllabus

Unit 1 General Biophysical methods (7 lectures)

Measurement of pH, Radioactive labeling & counting, Separation & Identification of Materials - concept of Chromatography (Partition Chromatography, Paper Chromatography, Adsorption Chromatography, TLC, GLC, Ion Exchange Chromatography, Gel Chromatography, HPLC, Affinity Chromatography); Electrophoresis (Gel Electrophoresis, Paper Electrophoresis).

Unit 2 Centrifugation (7 lectures)

Basic Principle of Centrifugation, Instrumentation of Ultracentrifuge (Preparative, Analytical), Factors affecting Sedimentation velocity, Standard Sedimentation Coefficient, Centrifugationof associating systems, Rate-Zonal centrifugation, sedimentation equilibrium Centrifugation.

Unit 3 Microscopy and Crystallography (7 lectures)

Light microscopy, Bright & Dark Field microscopy, Fluorescence microscopy, PhaseContrast microscopy, TEM, SEM. X-Ray Crystallography – X-ray diffraction, Bragg equation, Reciprocal lattice, Miller indices & Unit cell, Concept of different crystal structure, determination of crystal structure[concept of rotating crystal method, powder method].

Unit 4 Spectroscopy (09 lectures)

Spectroscopy: Raman Spectroscopy – What is Raman effect, Quantum mechanical reason of Raman effect, Basic concept of pure Rotational & Vibrational, Raman spectra of simple molecular (linear molecules).NMR Spectroscopy- Basic principle of NMR Spectroscopy, Absorption spectroscopy- simple theory of the absorption of light by molecules, Beer-lambert law, Instrumentation for measuring the absorbance of visible light, factor affecting the absorption properties a chromophore.

REFERENCES

1) Biophysical Chemistry 2020 by Nath and Upadhya.

2) Practical biochemistry principles and techniques by Wilson and Walker.

3) Instrumental methods of chemical analysis by Chatwal and Anand.

4) Lab Manual in Biochemistry by J. Jayaraman

5) Chromatography: Concepts and Contrasts- 1988 James Miller, John Wiley and Sons, Inc.

6) Analytical Biochemistry by Holme.

7) Spectroscopy by B.P. Straughan and S. Walker

8) Introduction to HPLC by R.J. Hamilton and P.A. Sewell

9) A Biologists Guide to Principles and Techniques of Practical Biochemistry. 1975 by Williams, B.L. and Wilson, K.

10) Spectroscopy. Volume 1. Edited by B.B. Straughan and S. Walker. Chapman and Hall Ltd.

11)Chromatography: Concepts and Contrasts- 1988 by James Miller. John Wiley and Sons. Inc., New York. 7. Analytical Biochemistry by Holme.

12)Introduction to High Performance Liquid Chromatography by R. J. Hamilton and P. A. Sewell.

13) Spectroscopy by B.P. Straughan and S. Walker.

14) Practical aspects of Gas Chromatography and Mass Spectrometry 1984 by Gordon M. Message, John Wiley and Sons, New York.

15). Gel Chromatography by Tibor Kremmery. Wiley Publications.

16) Gel Electrophoresis of Proteins- A Practical Approach by Hanes.

BBVSP105 **BT Lab - I** **0+2**

University: MGM University, Aurangabad **Faculty:** Basic and applied science

Institute: Institute of Biosciences and Tech. **Degree: B.Sc Hons.** Biotechnology

Course Unit Code: BBVSJ105 **Course Unit Title:** Micro Project- I

Credits allocated: 0+2 (Practical) **Level of Study:** UG

Mode of delivery, planned learning activities and teaching method: Practical 4 hrs / weekly

Recommended Year /Semester: Biotechnology, Year I/ Semester I

Course Objective:

1. The purpose of the mini-project is to allow you to explore the breadth of research that is being performed within the college.

2. Identify, discuss and justify the technical aspects of the chosen project with a comprehensive and systematic approach.

Course outcome:

1. Students will be able to practice acquired knowledge within the chosen area of technology for project development.

2. Identify, discuss and justify the technical aspects of the chosen project with a comprehensive and systematic approach.

Thrust Area of Project:

1. Molecular biology,
2. Molecular breeding,
3. Molecular diagnostics,
4. Recombinant DNA technology,
5. Plant tissue culture & genetic transformation,
6. Genomics & proteomics,
7. Bioinformatics**.**
8. Fermentation Technology

BBSEP106 **Explorations in Biotechnology-I** **0+2**

University: MGM University, Aurangabad **Faculty:** Basic and applied sciences

Institute: Institute of Biosciences and Tech. Biotechnology **Degree**: B.Sc (Hons/Hons. with research).

Course Unit Code: BBSEP106 **Course Unit Title:** Biotechnology Exploration Program

Credits allocated: 0+2 **Level of Study:** UG

Mode of delivery, planned learning activities and teaching method: Practical 4 hrs / weekly

Recommended Year /Semester: Biotechnology, Year 1/ Semester I

Course Objectives

1. To unable students with different skills for preliminary needed skills for project designing and development
2. To aware student for understand market and their problem
3. To explore and aware the students for finding the solution on different problems

Course Outcomes

As an outcome of completing the course, students will able to

1. Explain the role bioscience scientist as a problem solver
2. Identify multi-disciplinary approach required in solving as biosciences problem
3. Build simple systems using biotechnology and bioinformatics
4. Analyses biosciences solutions from ethical perspectives.
5. Analyses biosciences solution from sustainability perspectives.
6. Use basics of science project management skills in doing projects.
7. Demonstrate data acquisition and analysis skills using a tool.

Practical's-

1. Sterilization: principles & operations –
    - Autoclave
    - Hot Air Oven
    - Laminar Air Flow
2. Principles & operations of Incubators & Shaker,

3. Principles & operations of centrifuge
4. Principles & operations of Colorimeter Spectrophotometer.
5. To determine the PH of the given sample using PH paper or Universal Indicator.
6. Survey of Cell Types: Structure and Function
7. Preparation of Microbial media (bacteria, yeast, mold, algae, protozoa)
8. Preparation of dilute solutions by serial dilution from- (Soil, Air &; Water)
9. Methods of Isolation of bacteria from different sources.
10. To Perform Simple Staining.
11. Differential Staining: Gram Staining
12. To study the Species Diversity
13. Collection of different seeds and classification**.**
14. Thin layer chromatography
15. Paper Chromatography of Sugars /lipids
16. Blood group analysis.
17. Estimation of ascorbic acid
18. Water analysis.
19. Hays test for bilirubin
20. Heat coagulation Albumin and Globulin
21. Enzyme activity of serum alkaline phosphatase
22. Isolation of Rhizobium from root nodules and its confirmation
23. Isolation of Azotobacter from soil on N2 free medium

BBMMP107 **Bio-Skills Lab Factory-I** **0+1**

University: MGM University, Aurangabad **Faculty:** Basic and applied science

Institute: Institute of Biosciences and Tech. **Degree:** B.Sc Hons. Biotechnology

Course Unit Code: BBMMP107 **Course Unit Title:** Bio-skills Lab Factory-I

Credits allocated: 0+1 **Level of Study:** UG

Mode of delivery, planned learning activities and teaching method: Practical 2 hrs / weekly

Recommended Year /Semester: Biotechnology, Year 1/ Semester I

Course Objectives:

1. To explore students with hands on laboratory techniques
2. To unable students for different skills sets
3. To acquire students Lab etiquettes
4. Applying principles of lab safety.
5. Keeping accurate records with sufficient information to reproduce what was done.
6. Preparing aqueous solutions of varying composition.
7. Applying core principles of cell and molecular biology.
8. Applying core principle of centrifugation and spectrophotometry.
9. Preparing microbiological media and applying aseptic technique in the culturing of microorganisms.
10. Oral and written communication, maintaining a professional work ethic, and working well with others.

Course Outcomes

1. Examine and apply the fundamentals of cellular and molecular biology concepts to biotechnology research and its practical applications.
2. Develop and maintain laboratory records according to standard scientific and industrial guidelines.

3. Employ mathematical skills and knowledge of chemistry to accurately prepare an aqueous solution with the desired chemical concentrations and pH.

Practical's:

1. Qualitative analysis of the carbohydrates.
2. Qualitative analysis of the protein by biuret method.
3. Qualitative analysis of the RNA by Orcinol method
4. Qualitative analysis of the DNA by Diphenylamine method
5. To estimate protein by using Lowry's method.
6. Determination of saponification value of oil or fat.
7. To isolate potato starch.
8. To isolate cholesterol and lectin from egg yolk.
9. Qualitative analysis of starch.
10. To Perform the Sudan IV Test for Lipids.
11. Identifying solutes and determining their concentration (spectrophotometer)
12. Solubility of lipid in polar and non-polar solvent
13. Separation of amino acids by paper chromatography.
14. Acid base titrations
15. To identify lipids in a given sample by TLC.
16. Mitosis: Cell Division
17. Meiosis
18. Study of structure of any Prokaryotic and Eukaryotic cell.
19 Isolation of chloroplast from cauliflower/ spinach.
20 To separate mixture of lipid by using thin layer chromatography.
21. Separate bromophenol blue and xylene by using agarose gel electrophosis
22. Separation of serum protein by agarose gel electrophosis

Reference

1. Biotechnology: A laboratory Skills Course, J. Kirk Brown 2011 (ISBN-13: 978-0-9832396-0-4)
2. Methods in Biotechnology, SB Hong, MB Rashid, LZ Santiago-Vazquez 2017 (ISBN-13: 978-1-119-15678-9)
3. Quantitative Analysis in Chemistry by Vogel (link is external)
4. Practical Chemistry for BSc I, II & III year students O.P Pandey, D.N Bajpai, S. Giri
5. Advanced practical physical chemistry by Yadav

First Year II Semester

Level		First Year (Semester II)																				
	Course Type	Course code	Course Title	Type	Teaching period per week			Credit	Duration of Exam	Evaluation Scheme							Minimum Passing			
										Internal				External		Total	Internal	External		Total
					L	T	P			CA-I	MSE	CA-II	TW	ESE	PR		CA/MSE/ TW	ESE	PR	
4.5	Core	BBMML108	Biomolecules and Bioenergetics	Theory	2			2		10	10	10	-	20	-	50		8		20
	Core	BBMML109	Biology: Concept, Connections, Investigation and applications	Theory	3		-	3		20	20	20	-	40	-	100		16		40
	MIN	BBMIL110	Annexure I	Theory	2		-	2		10	10	10	-	20	-	50		8		20
	AEC		Communicative English II	Theory	2	-	-	2		10	10	10	-	20	-	50		8		20
	OE**	BBOEL111	Open Elective I	Theory	2		-	2		10	10	10	-	20	-	50		8		20
	OE	BBOEL112	Open Elective II	Theory	2		-	2		10	10	10	-	20	-	50		8		20
	VEC		Annexure I	Theory	2	-	-	2		10	10	10	-	20	-	50		8		20
	VSC*	BBVSP113	BT Lab II	Practical			4	2					30	20	50				8	20
	SEC*	BBSEP114	Explorations in Biotechnology –II	Practical			4	2					30	20	50				8	20
	Core	BBMMP115	Bio-Skills Lab Factory-I	Practical	-	-	2	1			-		30	-	20	50			8	20
	CC		Annexure I	Practical	-	-	4	2			-		30	-	20	50			8	20
	Total (L-T-P) Hrs / week = 29				**15**		**14**	**22**												

BBMML108 Biomolecules and Bioenergetics 2+0

University: MGM University, Aurangabad
Faculty: Basic and applied sciences
Institute: Institute of Biosciences and Tech.
Degree: B.Sc. (Hons/Hons. with research) Biotechnology **Course Unit Code:** BBMML108
Course Unit Title: Biomolecules and Bioenergetics **Credits allocated:** 2+0(Theory)
Level of Study: UG
Mode of delivery, planned learning activities and teaching method: Lecture 2hrs / weekly
Recommended Year /Semester: Biotechnology, Year 1/ Semester II

Course Objectives:

1. Develop in students the ability to apply the knowledge and skills they have acquired to thesolution of specific theoretical and applied problems in biochemistry.
2. Objectives of studying Biomolecules and Bioenergetics that is, to analyse, appreciate, understand the basic concepts of chemical reactions that occur in living systems, which enable them to understand the various perspectives of applied sciences that benefit the mankind.

Course outcomes:

1. Demonstrate knowledge and understanding of the molecular machinery of living cells; demonstrate knowledge and understanding of the principles that govern the structures of
2. macromolecules and their participation in molecular recognition; demonstrate knowledge and understanding of the principles and basic mechanisms of
3. metabolic control and molecular signalling; use basic laboratory skills and apparatus to obtain reproducible data from biochemical experiments

Detailed Syllabus:

Unit I: Biomolecules and Bioenergetics: (Lecture : 7)

The cellular basis of life. Major classes of biomolecules. Role of water in design of biomolecules. Thermodynamics –First law of thermodynamics, second law of thermodynamics, Gibbs free energy, endergonic & exergonic reactions. Standard state free energy changes-DG, DG0 and DG'0, Relationship between equilibrium constant and DG'o, Feasibility of reactions. ATP-Structure, properties and energy currency of the cell, Importance of Coupled reactions, High energy

compounds, Introduction to Metabolism - Catabolism, anabolism, catabolic, anabolic and amphibolic pathways.

Unit II: Amino acids, peptides, Sugars and polysaccharides (Lecture : 7)

Types of amino acids and their chemistry, derivatives of amino acids and their biological role. Introduction to biologically important peptides. Basic chemistry of sugars, optical activity. Disaccharides, trisaccharides and polysaccharides- their distribution and biologicalrole. Carbohydrate Metabolism:Glycolysis and its regulation, TCA cycle, amphibolic & amp; anaplerotic reactions. Electron Transport chain, Oxidative phosphorylation

Unit III: Nucleosides, nucleotides and nucleic acids (Lecture : 8)

Structures and chemistry, DNA structures and their importance, different types of RNA. Unusual DNA structures, other functions of nucleotides.Amino Acid/ Nucleic Acid Metabolism: Biodegradation of amino acids – deamination,transamination, decarboxylation, urea cycle including its regulation. Biosynthesis of amino acids, Disorders of amino acid metabolism (phenylketonuria, alkaptonuria, Biologically active amines Recycling of Purineand Pyrimidine nucleotides by salvage pathways. Lesch-Nyhan syndrome

Unit IV: Lipids and Vitamins (Lecture : 8)

Various classes of lipids and their distribution, storage lipids, structural lipids in membranes, lipids as signals, Lipid Metabolism: Beta – oxidations of saturated & unsaturated fatty acids. Ketone bodies,production during starving and diabetes Biosynthesis of fatty acids Acetyl-CoA carboxylase reaction, Fatty acid synthase complex, biosynthesis of palmitate, energetics, Regulation of fatty acid biosynthesis.

Reference:

1. Lehninger, Nelson and Cox, Principles of Biochemistry, 4th Edition, W.H.Freeman Company, 2004.
2. Fundamentals of Biochemistry, Upgrade Edition, Wiley, 2002.
3. LubertStryer, Biochemistry, 4th Edition, W.H. Freeman

BBMML109 Biology: Concepts, Connections, Investigation and Applications 3+0

University: MGM University, Aurangabad Faculty: Basic and applied sciences

Institute: Institute of Biosciences and Tech.

Course Unit Code: BBMML109 **Credits allocated:** 3+0(Theory)

Degree: B.Sc. (Hons/Hons. with research). Biotechnology

Course Unit Title: Biology: Concepts, Connections, Investigation and Applications

Level of Study: UG

Mode of delivery, planned learning activities and teaching method: Lecture 3 hrs / weekly

Recommended Year /Semester: Biotechnology, Year 1/ Semester II

Course Objectives:

To familiarize students with the biology concept. structure of genetic material, organization of genes, genetic code and mechanisms involved in the expression of genetic material in final functional form.

Course outcome Students will acquire knowledge about biology concept

Detail Syllabus:

UNIT 1 Eukaryotic and prokaryotic cell (Lecture 11)

Eukaryotic and prokaryotic cell, organelle structure and functions, Integrated cellular functions, Apoptosis and natural cell death.

Brief account on plant and animal cells. Viruses – structure and features, types of viruses Building blocks of cell

CARBOHYDRATES- nomenclature, structure and functions, monosaccharides, disaccharides, polysaccharides, homo polysaccharides, hetero polysaccharides, Glycoproteins

LIPIDS- Classification and functions; Fatty Acids- even-odd, saturated and unsaturated, length, nomenclature, TAGs, Phospholipids, Steroids, lipoprotein, Cholesterol; Amphipathic lipids, Soaps and detergents.

UNIT 2 Nucleic Acid (Lecture 7)

NUCLEIC ACID- Nucleotides, structure and nomenclature, DNA structure, different forms of DNA, measurement units. Denaturation, Tm value, melting point and renaturation.

Structure of RNA and its types, role of different RNA, Ribozymes.

UNIT 3 PROTEINS- functions & its chemical nature (Lecture 9)

PROTEINS- functions chemical nature; Amino acid structure and properties, peptide bond, Levels of protein structure- primary, secondary (alpha helix and beta structures), tertiary and quaternary

structure. Other bonds in protein structure, examples. Properties of proteins and their Classification, Protein denaturation, Determination of protein structure, Isolation and purification of proteins.

UNIT 4 Enzymes (Lecture 9)

ENZYMES- Historical events in discovery, nomenclature and classification, properties, Enzyme activity, Factors affecting enzyme activity like concerntration of substrate or enzyme or product, temperature, pH, Active centre of enzymes, Enzyme inhibition, Coenzymes, Enzyme action.

UNIT 5 Techniques in RDT (Lecture 9)

TECHNIQUES in RDT- DNA isolation, RNA isolation, Protein isolation, gel electrophoresis,

Reference's; -

1. Biology: Concepts and Investigations, Mariëlle Hoefnagels , 2, illustrated
2. Biology: Concepts and Applications 10th Edition by Cecie Starr, Christine Evers, Lisa Starr
3. Biology: Concepts and Applications, Cecie Starr, Christine Evers, Lisa Star
4. Biology Concepts and Investigations, Mariëlle Hoefnagels: McGraw-Hill Europe
5. Campbell Biology: Concepts & Connections by Martha R. Taylor, Eric J. Simon, Jean L. Dickey, Kelly A. Hogan, Jane B. Reece
6. Biology by Peter Raven, George Johnson, Kenneth Mason, Jonathan Losos , Susan Singe

BBMIL110 Microbial Physiology and Metabolism **2+0**

University: MGM University, Aurangabad **Faculty:** Basic and applied sciences

Institute: Institute of Biosciences and Tech. Biotechnology **Degree:** B.Sc. (Hons/Hons. with research).

Course Unit Code: BBMIL110 **Course Unit Title:** Microbial Physiology and Metabolism

Credits allocated: 2+0(Theory) **Level of Study:** UG

Mode of delivery, planned learning activities and teaching method: Lecture 2 hrs / weekly

Recommended Year /Semester: Biotechnology, Year 1/ Semester II

Course Objectives:

1. Microbial Physiology is an intensive course with the goal of integrating biochemistry and genetics to enhance the understanding of the microbial cell and the robust and diverse nature of life.
2. This fundamental paper discusses the importance of microorganisms
3. The course throws light on types of microorganisms in and around humans.

Course Outcomes:

By studying this syllabus students are able to:

1. At the end of the course, the student has understanding on the metabolism and mechanism of microbial life
2. Microbial physiology and metabolism provides information on sources of energy and its utilization by microorganisms

Detail Syllabus

Unit I: Microbial Growth and Effect of Environment on Microbial Growth (Lecture 8)

Definitions of growth, measurement of microbial growth, Batch culture, Continuous culture, generation time and specific growth rate, synchronous growth, diauxicgrowth curve Microbial growth in response to environment –Temperature (psychrophiles, mesophiles, thermophiles, extremophiles, thermodurics, psychrotrophs), pH (acidophiles, alkaliphiles), solute and water activity (halophiles, xerophiles, osmophilic), Oxygen (aerobic, anaerobic, microaerophilic, facultative aerobe, facultative anaerobe), barophilic. Microbial growth in response to nutrition and energy – Autotroph/Phototroph, heterotrophy, Chemolithoautotroph, Chemolithoheterotroph, Chemoheterotroph, Chemolithotroph, photolithoautotroph, Photoorganoheterotroph.

Unit II: Nutrient uptake and Transport (Lecture 8)

Passive and facilitated diffusion Primary and secondary active transport, concept of uniport, symport and antiport, Group translocation.

Unit III: Chemo heterotrophic Metabolism – Aerobic Respiration (Lecture 7)

Concept of aerobic respiration. EMP, ED, Pentose phosphate pathway, TCA cycle, Electron transport chain: components of respiratory chain, comparison of mitochondrial and bacterial ETC, uncouplers and inhibitors

Unit IV: Chemoheterotrophic Metabolism- Anaerobic respiration and fermentation (Lecture 7)

Anaerobic respiration with special reference to dissimilatory nitrate reduction (Denitrification; nitrate /nitrite and nitrate/ammonia respiration; fermentative nitrate reduction) Fermentation - Alcohol fermentation. Lactate fermentation (homofermentative and heterofermentative pathways). Introductionto phototrophic metabolism: an Overview - groups of phototrophic microorganisms, anoxygenic vs. oxygenic photosynthesis with reference to photosynthesis in green bacteria, purple bacteria and cyanobacteria.

Suggested Reading:

1. Madigan MT, and Martinko JM (2014). Brock Biology of Microorganisms. 14th edition. Prentice Hall International Inc.
2. Moat AG and Foster JW. (2002). Microbial Physiology. 4th edition. John Wiley &Sons
3. Reddy SR and Reddy SM. (2005). Microbial Physiology. Scientific Publishers India

   Gottschalk G. (1986). Bacterial Metabolism. 2nd edition. Springer Verlag

4. Madigan MT, and Martinko JM (2014). Brock Biology of Microorganisms. 14th edition.
5. Moat AG and Foster JW. (2002). Microbial Physiology. 4th edition. John Wiley&Sons
6. Moat AG and Foster JW. (2002). Microbial Physiology. 4th edition. John Wiley &Sons
7. Reddy SR and Reddy SM. (2005). Microbial Physiology. Scientific Publishers India
8. Gottschalk G. (1986). Bacterial Metabolism. 2nd edition. Springer Verlag.
9. Stanier RY, Ingrahm JI, Wheelis ML and Painter PR. (1987). General Microbiology.5thedition, McMillan Press.
10. Willey JM, Sherwood LM, and Woolverton CJ. (2013). Prescott's Microbiology.9thedition. McGraw Hill Higher Education

BBVSP113 **BT Lab - II** **0+2**

University: MGM University, Aurangabad **Faculty:** Basic and applied sciences

Institute: Institute of Biosciences and Tech. Biotechnology (UG) **Degree:** B.Sc. (Hons/Hons with research).

Course Unit Code: BBVSJ113 **Course Unit Title:** Micro Project

Credits allocated: 0+2(Practical's) **Level of Study:** UG

Mode of delivery, planned learning activities and teaching method: Practical 4 hrs / weekly

Recommended Year /Semester: Biotechnology, Year I/ Semester II

Course Objective:

1. The purpose of the mini-project is to allow you to explore the breadth of research that is being performed within the college.
2. Identify, discuss and justify the technical aspects of the chosen project with a comprehensive and systematic approach.

Course outcome:

1. Students will be able to practice acquired knowledge within the chosen area of technology for project development.
2. Identify, discuss and justify the technical aspects of the chosen project with a comprehensive and systematic approach.

- **Thrust Area**
  1. Molecular biology,
  2. Molecular breeding,
  3. Molecular diagnostics,
  4. Recombinant DNA technology,
  5. Plant tissue culture & genetic transformation,
  6. Genomics & proteomics,
  7. Bioinformatics
  8. Fermentation Technology

BBSEP114 **Explorations in Biotechnology-II** **0+2**

University: MGM University, Aurangabad **Faculty:** Basic and applied science

Institute: Institute of Biosciences and Tech. **Degree:**B.Sc (Hons/ Hons. With research) Biotechnology (UG)

Course Unit Code: BBSEP114 **Course Unit Title:** Explorations in Biotechnology -I

Credits allocated: 0+2(Practical) **Level of Study:** UG

Total Hours:

Mode of delivery, planned learning activities and teaching method: Practical 4hrs / weekly

Recommended Year /Semester: Biotechnology, Year 1/ Semester II

Course Objectives

1. To unable students with different skills for preliminary needed skills for project designing and development
2. To aware student for understand market and their problem
3. To explore and aware the students for finding the solution on different problems

Course Outcomes

1. As an outcome of completing the course, students will able to
2. Explain the role bioscience scientist as a problem solver
3. Identify multi-disciplinary approach required in solving as biosciences problem
4. Build simple systems using biotechnology and bioinformatics
5. Analyses biosciences solutions from ethical perspectives
6. Analyses biosciences solution from sustainability perspectives
7. Use basics of science project management skills in doing projects
8. Demonstrate data acquisition and analysis skills using a tool

PRACTICALS-

1. To prepare the different culture media for growing micro-organisms to learn the methods for mainting bacteria.
2. Isolation of Azatobacter from soil.
3. To study minimal inhibitory concentration
4. Isolation of micro- organisms from water.
5. Isolation of micro- organisms from air.
6. Isolation of human micro flora.
7. To observe the epidermal cell from onion.
8. To observe the stomatal cell from leaves.
9. Preparation of blood smear and differential staining of blood cell.
10. Observation & germination of Pollen Grains by Hanging drop technique.
11. To study the growth curve.
12. Biochemical characterization of micro-organisms (IMVIC) test.
13. To study the susceptibility of a pathogen to range ofantibiotics.
14. Microbial examination of milk.
15. To extract alpha amylase from Bacillus Spp.
16. Biomass separation by centrifuge & filtration.
17. Extraction of caffeine from tea powder.
18. To study the HPLC.
19. To indentify lipid in given sample by thin layered chromatography.
20. Separation of amino acid using Paper Chromatography.
21. Extraction of protein from cereals.
22. To recover protein from solution by salting out & dialysis.
23. Separation & identification of protein by SDS PAGE.
24. To study mutation induced by uv light in bacteria.
25. To study the Photo repair or dark repair in bacteria
26. Isolation of plant cellular DNA

27. Quantitative analysis of DNA
28. Isolation of RNA from plant.
29. Isolation of genomic DNA.
30. To study PCR Technique.

BBMMP115 **Bio-skills Lab Factory-II** **0+1**

University: MGM University, Aurangabad **Faculty: Basic and applied sciences**

Institute: Institute of Biosciences and Tech. **Degree:** B.Sc. Hons**.** Biotechnology (UG)

Course Unit Code: BBMMP115 **Course Unit Title:** Bio-skills Lab Factory

Credits allocated: 0+1(Practical) **Level of Study:** UG

Mode of delivery, planned learning activities and teaching method: Practical 2Hrs / weekly

Recommended Year /Semester: Biotechnology, Year 1/ Semester II

Course Objectives:

To explore students with hands on laboratory techniques

To unable students for different skills sets

To acquire students Lab etiquettes

Applying principles of lab safety.

Keeping accurate records with sufficient information to reproduce what was done.

Preparing aqueous solutions of varying composition.

Applying core principles of cell and molecular biology.

Applying core principles of centrifugation and spectrophotometry.

Preparing microbiological media and applying aseptic technique in the culturing of microorganisms.

Oral and written communication, maintaining a professional work ethic, and working well with others.

Course Outcomes

1. Examine and apply the fundamentals of cellular and molecular biology concepts to biotechnology research and its practical applications.
2. Develop and maintain laboratory records according to standard scientific and industrial guidelines.

3. Employ mathematical skills and knowledge of chemistry to accurately prepare an aqueous solution with the desired chemical concentrations and ph.

PRCTICALS -

1) Visualization of chromosome in meiotic stage.
2) Isolation of mitochondria from cauliflower.
3) To study the lipid solubility of membrane.
4) Effect of detergent on erythrocyte membrane.
5) Study of osmosis in blood cell.
6) Isolation of casein from milk.
7) Simple staining of bacteria.
8) Negative staining of bacteria
9) Gram staining of bacteria
10) Bacterial cell wall staning.
11) Acid – fast staining of bacteria.
12) Capsule staining.
13) Estimation of protein by Lowery.
14) Estimation of protein by Biuret method.
15) Estimation of RNA by Orcinol method.
16) Estimation of amino acid by Ninhydrin method.
17) Enzyme activity of serum alkaline phosphatase.
18) Gel Electrophoresis.
19) Estimation of amount of DNA present in given unknown solution by Diphenylamine.
20) To study Antigen-Antibody .
21) Assay in ELISA(Enzyme link immunoassay)

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	SCB42MML201	Genome maintenance and regulation	Lecture	2	2	-	30	20	50	-	08	20
MM	SCB42MML202	Fermentation Technology	Lecture	3	3	-	60	40	100	-	16	40
MM	SCB42MML203	Principles of Developmental Biology	Lecture	2	2	-	30	20	50	-	08	20
OE		**Open Elective V**	Lecture	2	2	-	30	20	50	-	08	20
MI		Minor Course	Lecture	3	3	-	60	40	100	-	16	40
AEC	**MGM54AEL103**	**Functional Hindi**	Lecture	2	2	-	30	20	50	-	08	20
MI		Minor Course	Practical	1	-	2	30	20	50	-	08	20
VSC	SCB42VSP201	Applied BT Lab-I	Practical	2	-	4	30	20	50	-	08	20
MM	SCB42MMP201	Microbial Technology Lab.	Practical	1	-	2	30	20	50	-	08	20
FP	SCB42FPJ201	Field Project	Project	2	-	4	30	20	50	-	08	20
CC	**MGM82CCP201**	**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

Syllabus

Semester-III

Course code: SCB42MML201 **Course category:** Major Mandatory	**Course name:** Genome maintenance and regulation
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 first year of the Degree Program.	
Course Objectives:	
1. This course instills sufficient knowledge in all of the areas of Nucleic acids and Molecular Biology.	
2. They should be aware of replication, transcription, and translation in prokaryotes and eukaryotes .	
3. They must know the concepts of genes, gene expression, and regulations, Concept of molecular biology and its application in genomics,	
4. Student must understand genomics and to provide a knowledge base that enables the student to move on and master advanced topics in genomics successfully.	
5. This course instills sufficient knowledge in all of the areas of Nucleic acids and Molecular Biology.	
Course Outcome:	
CO1: The concept of Nucleic acids and their chemistry.	
CO2: Knowledge of Molecular biology, replication, transcription, and translation.	
CO3: The concepts of genes, gene expression, and regulations.	
CO4: Concepts of gene and genomics.	
CO5: Techniques and Applications of Genomics.	

Contents –

Unit	Content	Teaching hours
1	**Nucleic acids and Introduction to Molecular Biology** Structure and functions of Nucleosides, Nucleotides, and Types of Nucleic acids: DNA & RNA, their importance, Introduction to Molecular Biology, Central dogma of molecular biology, DNA Replication: Experimental evidence and enzymes of replication (Prokaryotes and Eukaryotes), Replication fork and its significance	7
2	**Gene and Gene Expression** Definition of Gene and functions of the gene, Process of transcription in Prokaryotes and Eukaryotes, Factors affecting transcription process of translation in Prokaryotes and Eukaryotes, Factors affecting translation	8

3	**Gene Regulation** Introduction to gene regulation levels, Evidence and experimental design/methodologies of gene regulation concept of gene regulation models in bacteria (operon models of lac, trp, and ara) Control of lysis and lysogeny in λ phage, Role and significance of genetic analysis	7
4	**Introduction to Genome and Genomics** Definition of Genome, Genome organization in Prokaryotes and Eukaryotes**,** Genomes of model organisms (E. coli, Yeast, Arabidopsis thaliana, C. elegans, drosophila melanogaster, laboratory mouse, Zebra fish, Human)**,** History and functions of Genomics Human-Genome Project and Scientific achievements. Principles, Techniques, and Applications of Genomics	8

Text Books:

1. Pelczar M. J.Jr. Chan E.C.S., Kreig. Microbiology 5th edition Tata McGraw Hill. (2006)
2. Prescott and Dunn's Industrial Microbiology", edited by Reed, G., 4th edition, 1982.
3. Prescott, L.M, Harley, J.P, Klein, D.A.; 1st Edition. Microbiology McGraw Hill. (2007).

Reference Books:

1. Arnold L. Demain & Julian E. Davis. Industrial Microbiology & Biotechnology, ASM Press. (2004).
2. Coulson, J.M. and J.F. Richardson; 6th Edition, Chemical Engineering Elsevier. Mc Graw Hill Publication. (1999).
3. Emt.el-Mansi & CFA. Bryce Fermentation Microbiology & Biotechnology, Taylor & Francis Ltd. (2004).
4. Stanbury, P.F., A. Whitaker & S.J. Hall. Principles of fermentation technology Oxford Press. (1997).
5. Industrial microbiology", by Miller B. M., and W. Litsky, 1976 Mc Graw-hill, New York

Course code: SCB42MML202	**Course name:** Fermentation Technology
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 first year of the Degree Program.	
Course Objectives:	
1. This course mainly focuses on the process of fermentation and technology applied	
2. They should know the microbes and their kinetics	
3. They must know the concepts of fermentation and fermenter (Bioreactor),	
4. The design and industrial applications of Bioreactor	
5. Student must understand the products of fermentation, their purification methods, and applications.	
Course Outcome:	
CO1: Microbes are involved in the process of fermentation.	
CO2: Isolation and applications of microbes in industries.	
CO3: Principle, Design of bioreactor and its applications.	
CO4: Maintenance of fermenter, sensors, and control measurements.	
CO5: Purification techniques of fermented products.	

Contents –

Unit	Content	Teaching hours
1	**Gene and Gene Expression** Definition of Gene and functions of the gene, Process of transcription in Prokaryotes and Eukaryotes, Factors affecting transcription process of translation in Prokaryotes and Eukaryotes, Factors affecting translation	9
2	**Isolation of industrially important microorganisms** Isolation, preservation, and improvement of industrially important microorganisms. Media for industrial fermentations, media formulation. Development of inoculum for industrial fermentation	9
3	**Design of Fermenter** Types of fermenters and basic functions of fermenters. Design of fermenter for microbial and animal cell culture. Alternative vessel design, common measurements, and control systems. Sensors-Solutions	9

	to common problems in fermentation, anaerobic fermentation	
4	**Maintenance of fermentation** Control of fermentation – requirements for control, design of a fermentation control system, Sensors and controllers. Control of incubation, aeration, and agitation. Software and computers in fermentation technology, control, and supervision of the fermentation process.	9
5	**Purification of fermentation products** Introduction to recovery and purification of fermentation products. Removal of microbial cells and other solid materials, foam separation. Filtration theory, use of filter aids- batch filters and continuous filters. Centrifugation-Cell aggregation and flocculation. Cell disruptions, physical. Chemical, mechanical, liquid-liquid extraction Solvent recovery, two-phase aqueous extraction, supercritical fluid extraction.	9

Text Book:

1. Pelczar M. J.Jr. Chan E.C.S., Kreig. Microbiology 5th edition Tata McGraw Hill. (2006)
2. "Prescott and Dunn's Industrial Microbiology", edited by Reed, G., 4th edition, 1982.
3. Prescott, L.M, Harley, J.P, Klein, D.A.; 1st Edition. Microbiology McGraw Hill. (2007).

Reference Book :

1. Arnold L. Demain & Julian E. Davis. Industrial Microbiology & Biotechnology, ASM Press. (2004).
2. Coulson, J.M. and J.F. Richardson; 6th Edition, Chemical Engineering Elsevier. Mc Graw Hill Publication. (1999).
3. Emt.el-Mansi & CFA. Bryce Fermentation Microbiology & Biotechnology, Taylor & Francis Ltd. (2004).
4. Stanbury, P.F., A. Whitaker & S.J. Hall. Principles of fermentation technology Oxford Press. (1997).
5. "Prescott and Dunn's Industrial microbiology", edited by Reed, G., 4th edition, 1982.

Course code: SCB42MML203 **Course name:** Principles of Developmental Biology **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 first year of the Degree Program.
Course Objectives: At the end of the course, the students will be able to –
1. It will introduce students to the molecular and cellular mechanisms that underlie the early development of organisms
2. This course is good preparation for students in the biological field who will be required to take an embryology course for their professional degree
3. The focus will be on the genes and proteins involved in controlling the behavior of cells in the processes of differentiation, morphogenesis, and growth, Developmental mechanisms.
4. Processes will be examined in genetic model organisms such as the fruit fly (*D. melanogaster*) and the worm (*C. elegans*) as well as in vertebrates such as the frog (*X. laevis*), chicken, mouse, and humans
5. Describe the main signalling pathways that play important roles in development.
Course Outcome:
CO1: Name, describe, and order the main stages of development common to most multicellular organisms.
CO2: Describe the main anatomical changes that occur during development.
CO3: Identify the cellular behaviors that lead to morphological change during development.
CO4: Describe the hierarchy of gene activation that occurs in early Drosophila development.
CO5: Understand how gene activation plays a role in differentiation and development.

Contents –

Unit	Content	Teaching hours
1	**Concepts of development** Potency, commitment, specification, induction, competence, determination, and differentiation; morphogenetic gradients; Cell fate and cell lineages; stem cells; genomic equivalence and the cytoplasmic determinants; imprinting; Mutants and transgenic in the analysis of development.	6
2	**Gametogenesis, fertilization, and early development** Production of gametes, cell surface molecules in sperm-egg recognition in animals; embryo sac development and double fertilization in plants; zygote	8

	formation, cleavage, blastula formation, embryonic fields, gastrulation, and formation of germ layers in animals; embryogenesis, establishment of symmetry in plants; seed formation and germination. Differentiation of sex, structure, function, and cellular interactions in mammalian testis and ovary, mechanism of ovulation and fertilization, early embryonic development, implantation, and placentation	
3	**Morphogenesis and organogenesis** Animals: Cell aggregation and differentiation in *Dictyostelium*; axes and pattern formation in *Drosophila*, amphibia, and chick; organogenesis – vulva formation in *Caenorhabditiselegans;* eye lens induction, limb development and regeneration in vertebrates; differentiation of neurons, post-embryonic development-larval formation, metamorphosis; environmental regulation of normal development; sex determination **Plants:** Organization of shoot and root apical meristem; shoot and root development; leaf development and phyllotaxy; transition to flowering, floral meristems, and floral development in *Arabidopsis* and *Antirrhinum.*	8
4	**Programmed cell death, aging, and senescence** Adaptive radiation: Reptiles: Turtle, Tortoise, Chameleon, Phrynosoma, Wall lizard, Rat Snake, Sea Snake, Crocodile or Gharial; Mammals: Duck-billed Platypus, Kangaroo, Bottlenose dolphin, Blue whale, Sea Cow	8

Text Book: 1. Principal of Development – 1998 Lewis Wolpert

2. Experimental Developmental Biology – 2012 4 edition R.M Twyam

3. Developmental Biology, Eighth Edition" by Scott F Gilbert

4. Jones, R. B. (2020). *Cellular and Molecular Biology of Development.* Springer.

Reference Book :

1. Neuroscience: Exploring the Brain by Barry W. Connors. Amazon Pub. 2015 (4th edition).

2. Clinical Neuroscience by Kelly Lambert & Craig Kinsley. Worth Pub. Inc. 2005.

3. Plant Physiology by 2008 Lincoln Taiz, Eduardo Zeiger

4. Guyton & Hall Textbook of Medical Physiology 12th Ed. Elsevier Pub. 2011.

5. Mechanisms in Plant Development by Ottoline Leyser& Stephen Day. 2008 Amazon Pub.

Course code: SCB42VSP201 **Course name:** Applied BT 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 the first year of the Degree Program.
Course Objectives:
1. The purpose of a applied BT Lab project is to allow you to explore the breadth of research that is being performed within the college
2. Identify, discuss, and justify the technical aspects of the chosen project with a comprehensive & systematic approach.
3. Optimize the production of a recombinant protein or metabolite in a bioreactor system by varying parameters such as temperature, pH, and nutrient concentration.
4. Analyze the impact of these variables on product yield and purity, Design a bioremediation strategy to degrade pollutants in soil or water samples,
5. Provide opportunities for students to develop proficiency in laboratory techniques commonly used in biotechnology.
Lab Outcome: At the end of the course, the students will be able to understand.
LO1: Design a cloning experiment where students clone a gene of interest into a plasmid vector and analyze gene expression using techniques like PCR, gel electrophoresis, and gene expression assays.
LO2: Design a bioremediation strategy to degrade pollutants in soil or water samples. Students can isolate and characterize microbial strains with pollutant-degrading capabilities and assess their efficacy in laboratory-scale project.
LO3: Develop a prototype for a biomedical device or diagnostic tool. Students can design and build a biosensor for detecting biomolecules, create a tissue engineering scaffold, or engineer a genetically modified organism for therapeutic purposes.
LO4: Understand the principles of bioprocess engineering, fermentation kinetics, and bioreactor operation.
LO5: Isolate and characterize microbial strains from diverse environments (e.g., soil, water, extreme habitats) and screen them for antimicrobial, anticancer, or enzyme-producing activities using bioassays and high-throughput screening techniques.

Contents –

List of Practical:

Sr. No.	Title of the Experiment
1	**DNA Extraction from Plant or Animal Tissue**: Basic technique introducing students to DNA isolation.
2	**PCR Amplification of a Gene**: Applied technique for amplifying a specific gene, useful in various research and diagnostic applications.
3	**Gel Electrophoresis of PCR Products**: Basic technique for visualizing DNA fragments, crucial in molecular biology analyses.
4	**Enzyme Assays**: Basic technique to study enzyme kinetics, with applications in pharmaceuticals, agriculture, and biotechnology
5	**Yeast Fermentation**: Applied technique demonstrating the production of ethanol, a process relevant in brewing and biofuel industries.
6	**Bacterial Fermentation:** Applied technique showcasing the production of various compounds like organic acids or antibiotics, crucial in biotechnology and pharmaceuticals
7	**Plasmid Isolation and Transformation:** Basic technique for DNA manipulation, with applications in genetic engineering and biotechnology.
8	**Cell Culture Techniques:** Applied technique for growing mammalian cells, essential in biomedical research and pharmaceutical development.
9	**RNA Extraction and RT-PCR**: Applied technique for analyzing gene expression levels, important in molecular biology and medical diagnostics.
10	**Gene Knockdown Using RNA Interference (RNAi)**: Applied technique for studying gene function and potential therapeutic applications.
11	**Zebrafish Developmental Biology**: Basic and applied technique studying vertebrate development, with applications in biomedical research and drug discovery.
12	**Drosophila Genetics**: Basic and applied technique studying inheritance patterns and gene function, essential in genetics research.
13	**CRISPR-Cas9 Genome Editing**: Cutting-edge technique for precise genome engineering, with vast applications in biotechnology, medicine, and agriculture.
14	**Fermentation Kinetics Analysis**: Applied technique for studying the kinetics of fermentation processes, important in optimizing industrial fermentation.
15	**Stem Cell Differentiation Assays**: Applied technique for studying the differentiation potential of stem cells, crucial in regenerative medicine and drug discovery.

Reference Book / Hand Books/ Lab Manual
1. Dubey RC and Maheshwari DK (2004) Practical Microbiology, 1st edition, S. Chand and Co., Delhi.
2. Benson, H. J. (1985). Microbiological Applications: A Laboratory Manual in

General Microbiology.
3. D.K. Maheshwari. (2002). Practical Microbiology. S. Chand Publishing
4. Harley, J. P. and Prescott L. M. (2002) Laboratory Exercises in Microbiology, 5th edition, The McGraw-Hill Co., New York
5. Benson H. (2001) Microbiological Applications Lab Manual, 8 th edition, The McGrawHill Companies, New York
6. Aneja K.R. (1996) Experiments in Microbiology, 3rd edition, WishwaPrakashan, New

Course code: SCB42MMP201 **Course name:** Microbial Technology 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 the first year of the Degree Program.
Course Objectives:
1. Isolate and purify microbial strains from various environmental sources, employing selective and differential media, biochemical tests, and molecular identification techniques such as PCR and DNA sequencing
2. Develop proficiency in a range of microbiological techniques including aseptic handling, isolation, culturing, and characterization of microorganisms using microscopy, staining methods, and biochemical assays
3. Gain insights into the role of microorganisms in industrial processes such as fermentation, enzyme production, biofuel synthesis, and bioremediation
4. Develop skills in data acquisition, analysis, and interpretation of experimental results obtained from microbial cultures, biochemical assays, and molecular techniques
5. Induce microbial cultures to produce enzymes of industrial importance and optimize fermentation parameters for maximum enzyme yield and stability.
Lab Outcome: At the end of the course, the students will be able to understand.
LO1: Students should be able to identify different microbial species, understand their metabolic pathways, and appreciate their physiological adaptations to diverse environments.
LO2: Perform aseptic techniques for handling microbial cultures, including streak plating, spread plating, and pour plating, with a high degree of accuracy and precision.
LO3: Master microscopy skills to visualize and identify microbial morphologies, cell structures, and cellular arrangements using light microscopy and staining method
LO4:. Design and execute fermentation experiments to cultivate microbial cultures under controlled conditions, optimizing parameters such as temperature, pH, oxygenation, nutrient supplementation, and agitation.
LO5: Scale-up fermentation processes from laboratory-scale to pilot-scale bioreactors, considering factors such as reactor design, mass transfer, mixing efficiency, and heat transfer for efficient production.

Contents –

List of Practical:

Sr. No.	Title of the Experiment
1	Determination of substrate consumption rate in batch culture.
2	Determination of specific cell growth rate
3	Determination of yield coefficient of cell biomass on substrate.
4	Citric acid production in batch culture
5	Penicillin production, its recovery and its purification
6	Solid state fermentation of some microbial products
7	Alcoholic fermentation (demonstration – industrial scale)
8	Antibiotic production in bioreactor
9	Collection and identification of important bacterial/fungal strains of industrial importance
10	Production of alkaline phosphatase in lab scale Fermenter
11	Isolation and identification of pathogenic bacteria, fungi, protozoa, from clinical samples
12	Various agglutination reactors; widal test, Haemagglutination
13	Various precipitation techniques, Immunodiffusion, Immunoeletrophresis
14	ELISA test
15	Separation and characterization of serum and lymphocytes from blood
16	Isolation and characterization of bacteria from urine samples
17	Immobilization of microbial cells by calcium alginate gel entrapment
18	Microbial biomass production (SCP)
19	Development of PGPR inoculant, bio fertilizer inoculant and their application in pot experiment
20	Screening of antimicrobial product from higher plants

Reference Book / Hand Books/ Lab Manual
1. Dubey RC and Maheshwari DK (2004) Practical Microbiology, 1st edition, S. Chand and Co., Delhi.
2. Benson, H. J. (1985). Microbiological Applications: A Laboratory Manual in General Microbiology.
3. D.K. Maheshwari. (2002). Practical Microbiology. S. Chand Publishing

4. Harley, J. P. and Prescott L. M. (2002) Laboratory Exercises in Microbiology, 5th edition, The McGraw-Hill Co., New York
5. Benson H. (2001) Microbiological Applications Lab Manual, 8 th edition, The McGrawHill Companies, New York
6. Aneja K.R. (1996) Experiments in Microbiology, 3rd edition, WishwaPrakashan, New
7. Microbiological edition practical edition by Amita Jain.

Course code: SCB42FPJ201 **Course name:** Field Project **Course Category:** Field Project
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 the first year of the 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.
Lab Outcome: At the end of the course, the students will be able to understand.
LO1: Students will be able to practice acquired knowledge within the chosen area of technology for project development.
LO2: Students are capable to find out appropriate existing literature on specific area of research project.
LO3: Students are capable of set the precise research topic.
LO4: Students can set the objectives and hypotheses for the research project.
LO5: Students could be design and execute the research project.

Contents –

- **List of Practical:**

Sr. No.	Title of the Experiment
1	**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.
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	**Project Log:** 1. The individual student's effort and commitment. 2. The quality of the work produced by the individual student. 3. The student's integration and co-operation with the rest of the group. 4. The completeness of the logbook & time to time signature of guide
7.	**Thrust Area of Project:** Molecular biology, Molecular breeding, Molecular diagnostics, Recombinant DNA technology, Plant tissue culture & genetic transformation, Genomics & proteomics, Bioinformatics.

PROCEDURE

SN	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 (to 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%ofproposedwork.	Project guide
7	Preparation and submission of progress report during a 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

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	SCB42MML 204	Molecular Immunology	Lecture	2	2	-	30	20	50	-	8	20
MM	SCB42MML 205	Gene Technologies	Lecture	3	3	-	60	40	100	-	16	40
MM	SCB42MML 206	Enzyme Engineering	Lecture	2	2	-	30	20	50	-	8	20
OE		**Open Elective VI**	Lecture	2	2	-	30	20	50	-	8	20
MI		Annexture I	Lecture	3	3	-	60	40	100	-	16	40
AEC	**MGM54AEL203**	**Communication Skills**	Lecture	2	2	-	30	20	50	-	8	20
SEC	SCB42SEP201	Applied BT Lab-II	Practical	2		4	30	20	50	-	8	20
MI		Minor Course	Practical	1	-	2	30	20	50	-	8	20
MM	SCB42MMP 202	Advances in Microbial Technology	Practical	1	-	2	30	20	50	-	8	20
CEP	SCB42CEJ201	Community Engagement Program	Project	2	-	4	30	20	50	-	8	20
CC	**MGM73CCP 105**	**Fine Arts**	Practical	2	-	4	30	20	50	-	8	20
MM	SCB42MML 204	Molecular Immunology	Lecture	2	2	-	30	20	50	-	8	20
MM	SCB42MML 205	Gene Technologies	Lecture	3	3	-	60	40	100	-	16	40
Total				27	19	16	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 projec**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-IV

Course code: SCB42MML204	**Course name:** Molecular Immunology
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 first year of the Degree Program.	
Course Objectives:	
1. To acquire sound knowledge on basic concepts Immune cells and systems of the body	
2. To gain the knowledge about the immune defence types and their mode of action	
3. To study the concepts of molecular mechanism of cellular immunity	
4. To obtain the knowledge on cytokines and receptors of immune cells and system,	
5. To understand the interaction of antigen and antibody	
Course Outcome:	
CO1: Students able to understand the nature of immune cells, functions and immune system	
CO2: Students capable to define the immune defense mechanism of the body.	
CO3: Students capable to demonstrate the molecular mechanism of cellular immunity.	
CO4: Students able to explain the mode of function of cytokines and cell receptors.	
CO5: Students can described the interaction of antigen-antibody.	

Contents –

Unit	Content	Teaching hours
1	**Basic Concepts in Immunology** Overview of the Immune system, Types of immune cells, immune system, function of immune cells and Immune system. Macrophages, Phagocytosis, barrier to infection. Epitope, Paratope, Hapten, Adjuvant, Chemical basis of antigen specificity. Immunoglobulin family antibodies: Types of Immunoglobulin, structure of immunoglobulin. Infection and immunity: Antigen, Antibody, Allergen, Pathogen, Pathogenesis, Infection and immunity: Definitions - Antigen, Antibody, Allergen, Pathogen, Pathogenesis, Virulence, Toxins, Infection, Disease, Immune Response: Effector response and memory response.	7
2	**Types of Immunity** Types of Immunity and Their Functions: Innate immunity, The Function of Innate Immunity, Acquired immunity, Immunological Memory, Specificity,	7

	Ability to Distinguish Between Self and Non-Self, Active Immunity,The Function of Active Immunity,Passive Immunity, The Function of Passive Immunity	
3	**Cellular and molecular Immunology** Major histocompatibility complex, Antigen processing and presentation to T- lymphocytes. Antigen receptors and accessory molecules of T lymphocytes. Development of Lymphocytes. Activation of Lymphocytes B cell activation and antibody production. Immune memory response. Cytokines. Mechanism of cell mediated immune response. Immunological techniques.	8
4	**Antigen-Antibody Interactions** Mechanism of antigen antibody interaction, principle, methods and applications of precipitation and agglutination. Precipitation: Precipitation in Fluids, Precipitation in Gel (Radial Immunodiffusion & Doubl Immunodiffusion), Immunoprecipitation. Agglutination: Hemagglutination, Bacterial Agglutination, Passive Agglutination.	8

Text Book:

1. Basic Immunology: 2011 Functions and Disorders of the Immune System, A. K. Abbas, 6th Edition.
2. Cellular and Molecular Immunology,2008 A.K Abbas, A.k.Litcham,10th Edition.
3. Abbas, A. K., Lichtman, A. H., & Pillai, S. (2017). Cellular and Molecular Immunology. Elsevier
4. Janeway, C. A., Travers, P., Walport, M., & Shlomchik, M. J. (2001). *I*mmunobiology*: The Immune System in Health and Disease.* Garland Science.
5. Murphy, K., Weaver, C., & Janeway, C. (2016). *Janeway's Immunobiology.* Garland Science.

Reference Book :

1. Immunology Kuby, R.A. Goldsby, T.J. Kind 1997, 4 th Edition B.A. Osborne
2. Roitt I. Essential Immunology. 1995 10th Ed. Blackwell Science.
3. Fundamentals of Immunology Paul W.E. (Eds.) 1998 Raven press, New York.
4. Bernard, Davis B. Dulbecco, Eisen and Ginsberg.
5. Ananthanarayan and Paniker. 2007 Text book of microbiology. University press. 8 th Edition

Course code: SCB42MML205 **Course name:** Gene Technologies **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 first year of the Degree Program.
Course Objectives:
1. To acquire sound knowledge on basic concepts of gene techniques
2. To gain the knowledge about the gene sequence techniques
3. To study the molecular tools for gene manipulation
4. To obtain the knowledge of cloning techniques
5. To understand the gene expression methods.
Course Outcome: After completion of this course, student will be able to understand
CO1: Students able to understand the gene techniques.
CO2: Students capable to define the gene sequence techniques.
CO3: Students capable to demonstrate the molecular tools for gene manipulation.
CO4: Students able to explain the gene cloning techniques.
CO5: Students can described the gene expression methods.

Contents –

Unit	Content
1	**Molecular Techniques** PCR Techniques- Principle of polymerase chain reaction (PCR) - Components of PCR reaction and optimization of PCR , 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
2	**Gene Sequencing Techniques** DNA Sequencing methods- Sanger's method of DNA sequencing – Manual and automated methods. Pyrosequencing – massively parallel 454-sequencing, Illumina sequencingProtein 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.
3	**Molecular tools for Gene Cloning** Restriction enzymes – Introduction and types with examples, methylation sensitivity of restriction enzymes Dam, Dcm and CpG methylases, star 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.EcoRI.Ligases – Ecoli DNA ligase, T4 DNA ligase, T4 RNA ligase, polynucleotide kinase, phosphatases, DNA and RNA polymerases, reverse transcriptase, terminal transferase, DNAses- Exonuclease I, Exonucleases III, Mung Bean Nuclease. RNases-RNaseI, RNaseA, RNaseH, Topoisomerase.Introduction to cloning vectors,
4	**Gene Cloning Techniques** RFLP, DNA fingerprinting and footprinting, chromosome walking, 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**.**
5	**Gene Expression Method.** 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, Methods of Plant Transformation-Biology of Agrobacterium tumefaciens- plant transformation methods - stable and transient -Agrobacterium-mediated, biolistic, PEG/ liposome-mediated, electroporation, chloroplast transformation, protoplast transformation, site directed integration of transgene (zinc finger).

Text Book:
1. Genetics: A Conceptual approach. (1998) Pierce, B.A
2. Genetics: Analysis & Principles (2012)Professor Brooker R.G
3. Pierce, B. A. (2019). *Genetics: A Conceptual Approach.* W. H. Freeman.
4. Hartl, D. L., & Ruvolo, M. (2017). *Essential Genetics: A Genomic Perspective.* Jones & Bartlett Learning.
5. Simmons, M. J., & Snustad, D. P. (2016). *Genetics: Analysis and Principles.* Wiley.
Reference Book :
1. Brown, T. A. (2017). *Genomes 4.* Garland Science.
2. Reinhard, D. (2017). *Biotechnology for Beginners.* Academic Press
3.Watson, J. D., Baker, T. A., Bell, S. P., Gann, A., Levine, M., & Losick, R. (2014). *Molecular Biology of the Gene.* Pearson.
4. Pierce, B. A. (2019). *Genetics: A Conceptual Approach.* W. H. Freeman.
5. Primrose, S. B., & Twyman, R. M. (2006). *Principles of Gene Manipulation and Genomics.* Wiley-Blackwell.

Course code: SCB42MML206	**Course name:** Enzyme Engineering
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 first year of the Degree Program.	
Course Objectives:	
1. To gain knowledge in characteristics of enzymes as biological catalysts	
2. To learn the classification of enzymes	
3. To understand the kinetics of enzymes	
4. To obtain the knowledge on activity and specific activity of enzymes	
5. To understand the applications of enzymes.	
Course Outcome: After completion of this course, student will be able to understand	
CO1: Students capable to explain the basic concepts of enzymes	
CO2: Students can describe the role of enzymes as biocatalyst	
CO3: Demonstrate a knowledge and understanding of the role of energy conversions in cell	
CO4: Demonstrate the development of practical/technical skills	
CO5: Correctly interpret the regulation of enzyme activity	

Contents –

Unit	Content
1	**Concept, Nomenclature and Classification of enzymes** General features: Enzymes, Coenzymes, Vitamin B-complex and their coenzyme forms, Cofactors, Example of enzymes and their cofactors; Systematic basis for enzyme nomenclature (Enzyme commission), EC number for enzymes, Common name and EC numbers of some enzymes; Classification of enzymes, Catalytic properties of enzymes (How enzymes operate?), Active site, Types of specificity, Enzyme-substrate complex, Lock and key model, Induced fit model; Catalytic strategies: Covalent catalyis, acid-base catalysis and Metal ion catalysis; Enzyme activity, specific activity, enzyme unit, Katal
2	**Kinetics of enzymes** Quantitative study of enzyme catalysis, Reaction rates, Affinity of enzymes for substrates, Affinty of inhibitors, Reaction mechanisms; Kinetics of enzyme catalyzed reactions: Leonor Michaelis and Maud Menten reaction, Michaelis constant (Km), V-max, Briggs and Haldane steady safe assumption, Significance of Km and Vmax, Turn

	over number (Kcat), Lineweaver-Burk plot, Effect of temperature and pH; Enzyme activity inhibition: Competitive, Non-competitive and Un-competitive inhibition
3	**Regulation of enzyme activity and Enzyme assay** Allosteric enzymes: Homotropic, Heterotropic; Regulation by reversble covalent modifcation; Feedback inhibitor; Isozymes; Zymogen; Ribozyme. Enzyme and isoenzyme measurement methods with two examples (fixed incubation and kinetic methods); Enzymes in immunoassay techniques, Methods for investigating the kinetics of Enzyme catalyzed reactions -Initial velocity studies, rapid-reaction techniques. Standardization and optimization methods.
4	**Applications of enzymes** Microbial enzymes, Industrially important microbial enzymes, Immobilization techniques: adsorption, covalent binding, cross linking, entrapment, encapsulation, Properties of immobilized enzymes to free enzymes. Enzyme utilization in Industry: Application in Food and Drink industries, Application in Artificial kidney machines, Application in other industries (pharmaceutical industry; washing powder manufacturing industries); Recombinant enzymes from bacteria and fungi

Text Book:

1. Lehninger, A. L., Nelson, D. L., & Cox, M. M. (2017). *Lehninger Principles of Biochemistry.* W. H. Freeman.
2. Berg, J. M., Tymoczko, J. L., & Gatto, G. J. (2018). *Stryer's Biochemistry.* W. H. Freeman.
3. Garrett, R., & Grisham, C. M. (2016). *Biochemistry.* Cengage Learning.
4. Voet, D., Voet, J. G., & Pratt, C. W. (2016). *Fundamentals of Biochemistry: Life at the Molecular Level.* Wiley.
5. Nelson, D. L., Cox, M. M., Lehninger, A. L., & Cox, M. M. (2022). *Lehninger Principles of Biochemistry.* W. H. Freeman.

Reference Book :

1. Life Sciences: Fundamentals and practice; part-1, fourth edition by Pranavkumar and Usha Mina
2. Fundamentals of Biochemistry by J.L. Jain 2003
3. Principles of Biochemistry , 8th Edition by Lehninger 2008
4. Industrial enzymes: Trends, scope and relevence 1998 by Anil K Sharma and Vikas Beniwal
5. Principles of Biochemistry, third edition by 2007 Voet and Voet

Course code: SCB42SEP201 **Course name:** Applied BT Lab-II **Course category: Major Mandatory.**
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 the first year of the Degree Program.
Course Objectives:
1. Gain practical skills in basic laboratory techniques commonly used in biotechnology, such as DNA extraction, PCR (Polymerase Chain Reaction), gel electrophoresis, protein purification, and cell culture.
2. Familiarize students with the use of advanced biotechnological instruments, including spectrophotometers, centrifuges, thermal cyclers, and chromatography systems.
3. Develop the ability to design and plan experiments, considering variables, controls, and troubleshooting strategies, to achieve reliable and reproducible results.
4. Understand and optimize bioprocess parameters for the production of bio-based products, such as fermentation conditions, growth media composition, and downstream processing.
5. Bridge theoretical knowledge with practical applications, allowing students to see the real-world implications and applications of biotechnological concepts.
Lab Outcome: After completion of this course, student will be able to understand
LO1: Student will be gain Perform fundamental biotechnological laboratory techniques with precision and accuracy, including DNA extraction, PCR, gel electrophoresis, and protein purification.
LO2: Operate and troubleshoot advanced biotechnological instruments, such as spectrophotometers, centrifuges, thermal cyclers, and chromatography systems, to obtain reliable data.
LO3: Formulate hypotheses, design experiments, and execute protocols to investigate specific biological questions or problems in the context of biotechnology.
LO4: Students can gain knowledge of Antibody assay.
LO5: Students can able to do enzyme assay.

Contents –

List of Practical:

Sr. No.	Title of the Experiment
1	Amylase enzyme assay
2	Acid Phosphatase enzyme assay

3	Demostration of Catalase enzyme assay
4	Urease enzyme assay
5	Demostration of antigen-antibody interaction techniques
6	Demostration of direct agglutination reaction
7	Purification of bovin serum immunoglobulin G (IgG) fractionation by ammonium sulphate precipitation
8	Rocket Immunoelectrophoresis
9	Enzyme linked immunosorbant assay
10	Antibody capture assay
11	Plasmid isolation
12	RNA Isolation
13	C-DNA synthesis
14	Covid detection by RT-PCR
15	Amplification of interest of gene using PCR method

Reference Book / Hand Books/ Lab Manual

1. Parija S.C. (2005) Text Book of Practical Microbiology, 1st edition, Ahuja Publishing House New Delhi.
2. Dubey RC and Maheshwari DK (2004) Practical Microbiology, 1st edition, S. Chand and Co., Delhi.
3. Harley, J. P. and Prescott L. M. (2002) Laboratory Exercises in Microbiology, 5th edition, The McGraw-Hill Co., New York
4. Benson H. (2001) Microbiological Applications Lab Manual, 8 th edition, The McGrawHill Companies, New York
5. Aneja K.R. (1996) Experiments in Microbiology, 3rd edition, WishwaPrakashan, New
6. Sambrook, J., & Russell, D. W. (2001). Molecular Cloning: A Laboratory Manual (3rd ed.).

Course code: SCB42MMP202 **Course name:** Advance in Microbial Technology **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 the first year of the Degree Program.
Course Objectives:
1. To gain the knowledge of various microorganism
2. To learn the various techniques,
3. To set the various activity
4.To understand isolation of microorganism
5. To study purification method.
Lab Outcome: After completion of this course, student will be able to understand
LO1: Students will be well familiar with microorganism.
LO2: Students will capable to isolate various microorganism.
LO3: Students can understand various activity.
LO4: Students could learn various techniques.
LO5: Students are capable to do diagnosis test.

Contents –

List of Practical:

Sr. No.	Title of the Experiment
1	Isolation of Micro flora from skin
2	Analysis of infectious microorganism in urine sample.
3	Isolation and analysis of microorganism in milk.
4	Estimation of urease activity
5	Estimation of Catalase activity
6	Estimation Oxidase activity
7	Diognosis of Thyphoid using Widal Test
8	Partial Purification of Immunoglobulin by ammonium sulphate Precipitation
9	Plasma & Serum blood cells separation from Whole Blood

10	Production of Citric acid From Aspergillus Niger
11	To know the ELISA Technique.
12	Wine production of by using grape juice
13	Isolation of microorganism by streak plate method
14	Isolation of microorganism by Spread plate method
15	Isolation of microorganism by zig zag method plate method
16	Charaterization of microbes by using macconkey media
17	Determine of nitrate reduction by bacteria
18	Determination of TDP of on microorganism
19	Determination of TDT of on microorganism
20	Germicidal effect of UV light on bacteria growth(UV survival curve)

Reference Book / Hand Books/ Lab Manual

1. Parija S.C. (2005) Text Book of Practical Microbiology, 1st edition, Ahuja Publishing House, New Delhi.
2. Dubey RC and Maheshwari DK (2004) Practical Microbiology, 1st edition, S. Chand and Co., Delhi.
3. Harley, J. P. and Prescott L. M. (2002) Laboratory Exercises in Microbiology, 5th edition, The McGraw-Hill Co., New York
4. Benson H. (2001) Microbiological Applications Lab Manual, 8 th edition, The McGrawHill Companies, New York
5. Aneja K.R. (1996) Experiments in Microbiology, 3rd edition, WishwaPrakashan, New

Course code: SCB42CEJ201	**Course name:** Community Engagement Program **Course category:** Community Engagement Project
Credits: 2 **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 the first year of the 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 analyse, correlate, discuss and conclude the project.	
Lab Outcome: After completion of this course, student will be able to understand	
LO1: Students will be able to practice acquired knowledge within the chosen area of technology for project development.	
LO2: Students are capable to find out appropriate existing literature on specific area of research project.	
LO3: Students are capable of set the precise research topic.	
LO4: Students can set the objectives and hypotheses for the research project.	
LO5: Students could be design and execute the research project.	

Contents –

List of Practical:

Sr. No.	Title of the Experiment
1	**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.
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	**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
7	**Thrust Area of Project:** 1. Molecular biology, 2. Molecular breeding, 3. Molecular diagnostics, 4. Recombinant DNA technology, 5. Plant tissue culture & genetic transformation, 6. Genomics & proteomics, 7. Bioinformatics. 9.FermentationTechnology

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 in the project work and shall re – enroll for the same	Project head Project guide Director