SHRI GURU RAM RAI UNIVERSITY

[Estd. by Govt. of Uttarakhand, vide Shri Guru Ram Rai University Act no. 03 of 2017 & recognized by UGC u/s (2f) of UGC Act 1956]

SYLLABUS FOR

M. Sc. Biotechnology

(One Year Course- Semester System)

National Education Policy-2020

School of Basic and Applied Sciences

(Effective from Academic Session 2025-2026 Onward)

VISION AND MISSION- DEPARTMENT OF BIOTECHNOLOGY

Vision

1. To be producing technical manpower through excellence in research and development, teaching, learning and training, with concern for worldwide environment and human society.
2. To provide well and quality education in the field of Life Sciences and Applied Sciences with proper training and practical expertise responsive to the needs of present and future century so that students excel and enhance in their professional life.

Mission

1. Providing friendly learning ambience to develop competence in diversified areas to create excellence in industrial, educational, research and technical areas.
2. Provide an efficient educational environment where students and research scholars can realize their full potential in their chosen disciplinary subjects and attain quality education to face the challenges of the future.
3. Establish networks collaborations and linkages with industries and academic institutes to produce ethically and morally strong workforce contributing to the development of knowledge economy.
4. Harness the skills of the students and assist them to excel in their professional life by providing lifelong learning skills, sound theoretical knowledge, practical experience and all-round development with the help of well qualified and experienced faculty. Inculcate moral and ethical values for character building.

CURRICULUM

MASTER OF SCIENCE- BIOTECHNOLOGY POSTGRADUATE ONE YEAR DEGREE PROGRAMME (2025-26 Onward)

1. Nomenclature:

There will be full time Master's Degree Programme named as M.Sc. in Biotechnology which will be written as M.Sc. Biotechnology. The duration of this programme shall be of one year (one full academic year) which shall be divided in to two semesters. Each semester will be of six months. Actual teaching in each semester is required minimum of 90 days. The examination for first semester will normally be held in the month of December and for the second semester in the month of May or as convenient to the University.

2. The Medium of Instruction:

The medium of Instruction will be English.

3. The Medium of Examination:

The medium of examination will be English.

4. Eligibility to apply for Admission:

No candidate shall be eligible for admission to **One Year** Full Time M.Sc. Biotechnology unless he/she has successfully completed a four years Under Graduate Degree either Honors or Honors with Research (with any Biological/Applied science subjects/Agriculture sciences/Medical sciences/Biotechnology/Microbiology/Zoology/Botany) with prescribed number of Credits through the Examinations conducted by a University/Autonomous Institution or possesses such qualifications as recognized by the University. Further a candidate holding four years Bachelor Degree (either Honors or Honors with Research) in any biological science discipline from a recognized University without credit system shall also be eligible. The maximum age of a candidate for taking admission in the programme and the gap between the last Degree/Diploma courses shall be as per the norms as prescribed by the university from time to time.

5. Selection Procedure for Admission: A candidate willing to seek admission to M.Sc. Biotechnology will have to appear in Written Entrance Test conducted by the University or on behalf of the University and followed by the counselling as per University norms. The selection for admission will be made on merit basis or as per University norms.

6. Semesters:

(a) An academic year shall consist of two semesters:

Odd Semester (I Semester) : generally July to November/December

Even Semester (II Semester): generally December to January to May/ June

The academic calendar for each semester shall be notified well before the commencement of the semester by the Dean, School of Basic and Applied Sciences.

(b) A semester shall normally extend over a period of 15 weeks. Each week shall have 30 hours of instruction including lab/ field work as applicable.

7. Credits:

(a) Credit defines the quantum of contents/ syllabus prescribed for a course and determines the number of hours of instruction required per week. Thus credits shall be assigned on the basis of the number of lectures/ tutorials / laboratory work/ project work and other forms of learning required to complete the course contents in a 15 week schedule.

(b) 1 Credit = 1 hour of lecture for theory and 1 Credit = 3 hour of laboratory for practical and dissertation.

(c) Motivate students with industrial visit, educational trip, seminar/conference during semesters (not mandatory).

8. Roll Numbers and Enrolment Numbers:

The University shall allot a Roll Number to the students after payment realization, thorough scrutiny / verification of the required documents for the course. After the completion of the admission procedure the enrolment number for the students shall be allotted by the University at the entry point which shall remain same for the entire period of study in the University.

9. The Credit Based Course Structure: Master of Science (Biotechnology)- One Year Programme- As per NEP 2020 and Choice Based Credit System (CBCS)

One year Master's Program in Biotechnology shall be based on the choice based credit system or as per NEP 2020 in which credit defines the quantum of content/ syllabus prescribed for a course system and determines the number of hours of instruction per week.
The student shall be eligible for admission to one year Master's Degree Program in Biotechnology after he/she has successfully completed a four years undergraduate degree (either Honors or Honors with Research) or earned prescribed number of credits through the examinations conducted by University as equivalent to an undergraduate four year degree program (either Honors or Honors with Research). Students of B. Tech in Biotechnology will be applicable for two year master program.
Core courses prescribed for every Semester shall be mandatory for all students registered for the one year Master's Program in Biotechnology and shall carry minimum 40 credits (for one year program). There shall be Elective courses offered in semester I and shall carry a minimum of 10 credits and 10 credits shall be covered by two core paper both are consider as course paper with 20 credits. A self-study course would comprise of maximum 06 credits of which minimum 03 credits shall be mandatory which shall not be included while calculating grades. The student may choose self-study course either only in one of the two semesters (I/II). The self study course shall be based on advanced topics.
The dissertation is a semester long core course of 20 credits and is mandatory for every student. The dissertation would be allotted in the beginning of III Semester and candidate would submit the thesis/report during IV Semester examination. The dissertation may be in the form of a field based research work/ project work/ practical training. The students may complete the dissertation work in the department/ other research institutes/ industries/ hospitals etc.
The 1- Year Masters Programme will have the following components:

1) Core course (C): Minimum 10 credits
2) Elective course (E): Minimum 10 credits (Core+ Elective= Course papers)
3) Mojor Research/ Dissertation 20
4) Self study course: Maximum 06 credits (one minimum 03 credits shall be mandatory but not to be included while calculating grades).

10. Student Advisor:

Every student shall have a teacher of the Department as his/her Student Advisor. All teachers of the department shall function as Student Advisors and will have more or less equal number of students with them. The Student Advisor will advise the students in choosing Elective courses and offer all possible student support services.

11. Attendance:

a. The teacher handling a course shall be responsible for maintaining a record of attendance of students who have registered for the course.
b. All teachers shall intimate the Head of the Department at least seven calendar days before the last instruction day in the semester, the particulars of all students who have less than 75% attendance in one or more courses.
c. A candidate who has less than 75% attendance shall not be permitted to sit for the End-semester examination in the course in which the shortfall exists. However, it shall be open to the Dean/HOD to grant exemption to a candidate who has failed to obtain the prescribed 75% attendance for valid reasons on payment of prescribed fee and such exemptions shall not under any circumstances be granted for attendance below 60%.
d. A candidate who fails to put in least 75% attendance in I semester shall not be allowed to pursue the studies in II semester. Such candidates may apply to the Dean/HOD for re-registration in the I semester in the next academic session.

Note : Rest of the provisions will be as framed by the University.

12. Fee and Resource Generation

As per decision of the University.

13. Examination and Evaluation

(a) Evaluation will be done on a continuous basis. Three times during each semester. For The purpose of uniformity, there will be a uniform procedure of examination to be adopted by all teachers. There will be two Sessional tests (Three if any student are unable to attend any sessional test) and one End-semester examination.

(b) Sessional tests (of one to two hours duration) may employ one or more assessment tools such as objective tests, assignments, paper presentation, laboratory work, etc suitable to the course. This requires an element of openness. The students are to be informed in advance about the nature of assessment. It will be obligatory for the Students to attend the both Sessional tests, failing which they will not be allowed to appear in the concerned semester examination. The Sessional test as part of the continuous internal assessment shall be conducted and evaluated by the teacher offering the course.

A Student cannot repeat Sessional Tests (without permission from HOD). However, if for any compulsive reason the student could not attend the test, the prerogative of arranging a special test lies with the teacher with the approval of the Head of the Department. In case of students who could not attend any of the Sessional tests due to medical reason or under extraordinary circumstances, a separate test shall be conducted before the concerned semester examinations by the concerned faculty member after the approval of the Head of the Department and the Dean concerned.

(c) The Sessional tests will carry 40% of total marks for the course. The marks of the two Sessional Tests shall be taken into account for the computation of Grades.

(d) There shall be a written End Semester Examination which shall be of 2/3 hours duration carrying 60% of total Marks assigned for the course, covering the entire syllabus prescribed for the course.

(e) The End Semester practical examinations (field tour report, project report and Training report) shall normally be held before the theory examination/or as per convenience by the Department . The internal faculty shall associate themselves with the examination process.

(f) Valuation of Dissertation and Viva- voce: Dissertation / project report shall be evaluated jointly by internal and one external examiner.

OUTCOME BASED EDUCATION

Programme outcome (POs)
The Student will be able to:

PO 1	Acquire knowledge and enhance their fundamentals pertaining to basic and applied fields of biotechnology and allied sciences including microbiology, computer application, biostatistics etc.
PO2	Exhibit technical skills to apply modern tools, techniques (bio-analytical, IT, biostatistics) and identify the utility and application in scientific studies.
PO3	Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal and environmental considerations.
PO4	Exhibit ability to design and conduct laboratory-based experiments and inculcate research aptitude and critical thinking ability to analyze and interpret data.
PO5	To identify entrepreneurship potential of biotechnological process and products, impact on environment and society, along with associated ethical issues.
PO6	Enhance their presentation, communication and writing skills through trainings, seminars, research writing, report writing.
PO7	Environment and Sustainability: Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.
PO8	Demonstrate an ability to identify the potential of biotechnology (basic and applied) to recognize and propose/ design/derive a solution to complex problem. Attain eligibility and competency pursue career in research, various industries, entrepreneurship and inculcate lifelong learning ability.
PO9	Effective Writing: Got Skill for Write up in scientific literature and other social media platform related to life science.
PO10	Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.
PO11	Social Interaction and Ethics: Elicit views of others, mediate disagreements and help reach conclusions in group. Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them settings conclusions in group settings.
PO12	Interdisciplinary approach and Practical learning: Analyse the relationships among animals, plants, microbe sand Industry. Perform proceduresas per laboratory standards in the areas of Applies Sciences, Life Sciences, Biotechnology, Biochemistry, Bioinformatics, Genomics, industrial biotechnology and fermentation technology.

Program Specific Outcome (PSOs)

PSO 1	Demonstrate proficiency in theoretical as well as practical knowledge in the field of biotechnology and allied sciences (molecular & cell biology, biochemistry, bioinformatics, RDT, plant & animal science environmental biotechnology, immunology, IPR, Genomics, microbiology, Computer application, biostatistics & others).
PSO2	Exhibit potential to design and conduct experiments, analyze and interpret data in different field of biotechnology along with inculcation of research-oriented learning.
PSO3	Identify the potential and application of biotechnology and scientific knowledge to design / derive a solution of problem pertaining to environment conservation, health, agriculture, society and industry considering associated ethical issues.
PSO4	Ability to analyze prevailing career opportunities to pursue a career in research, industries, other organizations, setup start-ups.

Eligibility for admission:

Any candidate who has passed the B. Sc. with Biological Science subject with not less than 45%- marks in aggregate is eligible for admission, However, SC/ST, OBC and other eligible communities shall be given relaxation as per University rules.

Duration of the Programme: 1 Year

STUDY & EVALUATION SCHEME
Choice Based Credit System /ECS/NEP 2020
Master of Science- Biotechnology

First Semester

S. No.	Course Category	Couse Code	Course Name	Periods				Evaluation scheme		Subject Total
				L	T	P	C	Sessional (Internal)	External (ESE)	
Theory										
1	Core	MBTMC 101	Recombinant DNA Technology & Genomics	3	0	0	3	40	60	100
2	Core	MBTMC 102	Bioinformatics, Legal Biotechnology & Bio Business Management	3	0	0	3	40	60	100
3	Elective	MBTME 104	Food and Beverages Biotechnology	3	0	0	3	40	60	100
		MBTME 105	Research Methodology: Tools & Techniques	3	0	0	3	40	60	100
		MBTME 106	Chemical Sciences & Biomaterials	3	0	0	3	40	60	100
4	Elective	MBTME 107	Pharmaceutical Biotechnology & Drug Designing	3	0	0	3	40	60	100
		MBTME 108	Plant Biotechnology	3	0	0	3	40	60	100
		MBTME 109	Advanced Bioinformatics	3	0	0	3	40	60	100
5	Self Study (Any one)	MBTMS 111	Bio – Entrepreneurship	3	0	0	3	40	60	100
6		MBTMS 112	IPR, Patenting & Bioethics	3	0	0	3	40	60	100
7		MBTMS 113	Biomedical Technology	3	0	0	3	40	60	100
8		MBTMS 114	Genomics and Proteomics	3	0	0	3	40	60	100
Practical										

1	Core	MBTML 103	Lab Course 1 based on course MBTMC 301 & MBTMC 302	0	0	4	4	40	60	100
2	Core	MBTML 110	Lab Course 2 based on course MBTME 104/105/106 & MBTME 107/108/109	0	0	4	4	40	60	100
			Total	15	0	8	20+3*	280	420	600+100*

L – Lecture, T – Tutorial, P – Practical, C – Credit

*A self-study course would comprise of maximum 06 credits of which minimum 03 credits shall be mandatory which shall not be included while calculating grades.

Second Semester

S. No.	Course Category	Couse Code	Course Name	Periods				Evaluation scheme		Subject Total
				L	T	P	C	Sessional (Internal)	External (ESE)	
1	Research	MBTMR 201	Dissertation	0	0	0	20	120	480	600
2	*Self Study Any one	MBTMS 202	Enzyme Technology	3	0	0	3	40	60	100
3		MBTMS 203	Molecular Virology & Infections	3	0	0	3	40	60	100
4		MBTMS 204	Basics of Forensic Science	3	0	0	3	40	60	100
5		MBTMS 205	Agriculture Biotechnology	3	0	0	3	40	60	100
			Total	6	0	4	20	180	420	600

L – Lecture, T – Tutorial, P – Practical, C – Credit

*Self Study= Student can take either in I Semester or II Semester (Not mandatory in II semester)

Dissertation Marks Distribution= 300 Marks for project submission and 300 Marks for Internal (120 Marks) + External (180 Marks) for project presentations.

Examination Scheme:

Components	Ist internal Assignment/Presentation-I	IInd Internal Written/Attendance/ Presentation-II	External (ESE)
Weightage (%) Theory	20 Marks	20 Marks	60 Marks
Practical	20 Marks	20 Marks	60 Marks
Weightage (%) Dissertation	60 Marks	60 Marks	480 Marks

Course code	**: MBTMC 101**			
Course Name	**: Recombination DNA Technology & Genomics**			
Semester /Year	**: I**			
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. This course offer students to learn about molecular basis tools and technology used in genetic engineering, modern molecular diagnosis methods.
2. Demonstrate the study working principle of various instrument utilized in RDT.
3. To identify the ethical values related to transgenic and recombinant DNA technology.
4. To develop team effort practices within students with experiments of recombinant DNA technology in the field of modern biomedical science, agriculture.

Course Contents [Credit = 3]

Unit 1

Introduction to Recombinant DNA technology and applications. Cloning vector: Plasmids, Phages, cosmids, Yeast cloning vectors, Animal and plant viruses as vectors. BAC, PAC & YAC. Nucleic acid modifying enzymes. Restriction endonuclease. Isolation of nucleic acid from plant, animal & bacteria.

Unit 2

Basic steps of gene cloning: Construction of cDNA and genomic libraries. Selection of r DNA clones and their expression products, chromosome walking. Expression of cloned genes in heterologous host. Probe labeling and hybridization. Blotting techniques: Southern, Northern and Western blotting (Methodologies and applications)

Unit 3

DNA sequencing: chemical and enzymatic methods. PCR. Site directed mutagenesis. Ribonuclease protection assay, Gel retardation assay, DNA foot printing, DNA finger printing, DNA profiling.

Unit 4

Genomic analysis: Exon- intron trapping, S-1 mapping, RFLP, RAPD, AFLP. Transgenic Technology (Plant & Animals).

Unit 5

Gene therapy: Principles, strategies and ethics of gene therapy. Genomics. Human Genome Project-Strategy and implications.

Suggested Reading and Text Books

1. Gene cloning T.A Brown.
2. Molecular Biotechnology, Glick & Pasternak: Panima Publ. Corporation, 1994
3. Molecular biology & Biotechnology (3rd ed), Walker & Gingold: Panima Publ. Corporation,1999
4. Lewin: Genes, Vol. VII Oxford, 1998, Inded.
5. Straehan & Read: Human Molecular Genetics 1999, John Wiley & Sons Pte. Ltd.
6. Gene cloning, Glover: 1984
7. Recombinant DNA, Watson et al: 1983
8. Genetic Engineering Vol. 1-4, Villiamson (ed)
9. Genetic Engineering Vol. 1-7 Setton and Bolanden (ed)

Course Outcomes (COs): On completion of this course, the students will be:

CO	Description	Bloom's Taxonomy Level
CO1	**Remember** the different basic concepts of introduction to molecular tools used in RDT and applications, Restriction and modification system, hybridization techniques, Genetic engineering in animals, Random and site-directed mutagenesis and Genetic engineering in plants.	1 Remembering
CO2	**Understand** and remember the specific and basic concepts of basic principle components of molecular tools used in RDT and applications, Restriction and modification system, hybridization techniques, Genetic engineering in animals, Random and site-directed mutagenesis and Genetic engineering in plants. Develop understanding of various modern tools, instruments and RDT techniques and their utilization to solve the society and industry-related problems.	1,2 Remembering, Understanding
CO3	**Applying,** understanding and remembering the detailed processes, essential technique and features of molecular tools used in RDT and applications, Restriction and modification system, hybridization techniques, Genetic engineering in animals, Random and site-directed mutagenesis and Genetic engineering in plants. Apply the basic and advanced recombinant DNA techniques for higher studies, employment and advanced research in industrial and academic scale.	1,2,3 Remembering, Understanding, Demonstrating
CO4	**Analyzing,** applying, remembering and understanding the detailed study related to concepts of molecular tools used in RDT and applications, Restriction and modification system, hybridization techniques, Genetic engineering in animals, Random and site-directed mutagenesis and Genetic engineering in plants. Comprehend the range of molecular biology techniques for DNA or genome profiling, DNA sequencing/synthesis. Knowledge of the biological systems information and the explanation of the key concepts Omits technologies-genomics.	1,2,3,4 Remembering, Understanding, Applying, Analyzing
CO5	**Evaluating,** analyzing, applying, remembering, and understanding the principle, methods, properties and functions of molecular tools used in RDT and applications, Restriction and modification system, hybridization techniques, Genetic engineering in animals, Random and site-directed mutagenesis and Genetic engineering in plants. Demonstrate an understanding of transgenic technology and applications in health, agriculture and environment, along with associated social and environmental issues.	1,2,3,4,5 Remembering, Understanding, Applying, Analyzing, Evaluating
CO6	**Constructing (Creating),** Evaluating, Analyzing, demonstrating, remembering, and understanding the take part in molecular tools used in RDT and applications, Restriction and modification system, hybridization techniques, Genetic engineering in animals, Random and site-directed mutagenesis and Genetic engineering in plants. Acquire domain-specific knowledge and develop globally-relevant skills for academic and professional enhancement.	1,2,3,4,5,6 Remembering, Understanding, Applying, Analyzing, Evaluating Creating

Mapping of COs with POs & PSOs

Course Outcomes	Program Outcomes(POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	3	2	2	2	2	2	3	2	2	2	3	2	3	2
CO2	3	2	2	2	3	3	3	2	3	2	2	3	3	3	2	2
CO3	2	2	2	2	2	2	2	3	3	2	2	2	2	2	2	2
CO4	2	2	2	2	2	2	2	2	2	1	3	2	2	2	2	2
CO5	3	2	2	2	2	2	2	2	3	2	2	2	2	2	2	2
CO6	2	2	2	2	2	2	2	2	2	3	3	2	2	2	3	3

3:High, 2:Medium, 1:Low

Course code	**: MBTMC 102**				
Course Name	**: Bioinformatics, Legal Biotechnology & Bio Business Management**				
Semester /Year	**: I**				
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. To provide scientific and computational knowledge related to various techniques associated with biotechnology.
2. To impart laboratory skills for handling analytical tools in industry and research institution.
3. To give the scientific knowledge regarding safety regulations for handling of instruments in the laboratory and industry.
4. To demonstrate the operating procedures associated with upstream and downstream process like chromatography, electrophoresis, centrifugation, etc.

Course Contents [Credit = 3]

Unit 1

Introduction to bioinformatics. Objectives, Application and Scopes, IT in biology, bioinformatics resources on NET, Internet, Word wide web, Web Browsers. Biological databases-Primary, secondary database, Bibliographic, GEN BANK, EMBL, DDBJ, SWISSPROT. Search engine- ENTREZ, SRS Web Server-NCBI, EBI.

Unit 2

Sequence alignment and applications: Local and Global alignment; Scoring Matrices; Homology and related concepts; Dot matrix; general gap, gap penalty. Dynamic Programming methods for global and local alignments; sequence similarity searching tools – FASTA, BLAST; Statistical and biological significance. Multiple Sequence alignment and applications.

Unit 3

Legal and IPR issues in Biotechnology, Intellectual Property Protection (IPP), Trade secret protection, licensing of bio-product, procedure for obtaining patent, characteristics of the disclosure for a biotechnology invention, marketing, a biotechnology invention, trade regulations.

Unit 4

Worldwide market scenario of biotechnology based business, Bio-business prospective in India. Management Process & organization, General analysis of Indian Bio-business, Project formulation and selection based on size, technological assessment, technical report, feasibility and commercial viability of project.

Unit 5

Total product cost, capital investment and profitability, manufacturing and cost estimation for biological products for R & D decision making. Marketing management and consumer behaviour, Marketing of pharmaceuticals and other bioproducts.

Suggested Reading and Text Books

1. Lesk: Introduction to Bioinformatics, Wiely Publication.
2. Primrose and Twyman: Principles of genomes and genomics.
3. ROM and Holmas EC: Molecular Evolution: a phylogenetic approach, Blackwell science.
4. Des Higgins and Willie Taylor: Bioinformatics: Sequences, structure and databanks, Oxford University Press. P. Narayan: Patent Law.
5. S. L Rao: Economic reforms and Indian markets.
6. Sharma, Munjal, Shankar: A Text Book of Bioinformatics, Rastogi Publication.
7. Bioinformatics: Methods and Applications Genimics Proteomics and Drug Discovery, S C Rastogi, N.
8. Mendiratta, P. Rastogi: Prentice Hall of India Private Ltd.
9. Manual of Industrial Microbiology and Biotechnology by A. L. Demain and N.A. Solomon.

CO5	**Evaluating,** analyzing, applying, remembering, and understanding the principle, methods, properties and functions of bioinformatics, legal biotechnology & bio Business management: Introduction to bioinformatics, objectives, application and scopes, Sequence alignment and applications, legal and IPR issues in biotechnology, Worldwide market scenario of biotechnology based business and total product cost, capital investment and profitability, manufacturing and cost estimation for	1,2,3,4,5 Remembering, Understanding, Applying, Analyzing, Evaluating
CO6	**Constructing (Creating),** Evaluating, Analyzing, demonstrating, remembering, and understanding the take part in bioinformatics, legal biotechnology & bio Business management: Introduction to bioinformatics, objectives, application and scopes, Sequence alignment and applications, legal and IPR issues in biotechnology, Worldwide market scenario of biotechnology based business and total product cost, capital investment and profitability, manufacturing and	1,2,3,4,5,6 Remembering, Understanding, Applying, Analyzing, Evaluating Creating

Mapping of COs with POs & PSOs

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	3	3	2	2	2	3	2	2	2	3	2	3	2
CO2	3	2	2	2	3	3	3	2	3	2	2	3	3	3	2	2
CO3	2	2	2	2	2	2	2	3	3	2	2	2	2	2	2	2
CO4	3	2	2	2	3	2	2	2	2	1	3	2	2	2	2	2
CO5	3	2	2	2	2	2	2	2	3	2	2	2	2	2	2	2
CO6	2	2	2	2	2	2	2	2	2	3	3	2	2	2	3	3

3:High, 2:Medium, 1:Low

Course code : MBTML 103				
Course Name : Laboratory Course-I				
Semester /Year : I				
	L	**T**	**P**	**C**
	0	**0**	**4**	**4**

L - Lecture T – Tutorial P – Practical C – Credit

Course Contents [Credit = 4]

1. This course offer students to learn about molecular basis tools and technology used in genetic engineering, modern molecular diagnosis methods.
2. Demonstrate the study working principle of various instrument utilized in RDT.
3. To identify the ethical values related to transgenic and recombinant DNA technology.
4. To develop team effort practices within students with experiments of recombinant DNA technology in the field of modern biomedical science, agriculture.
5. To study about the molecular biology techniques, bio-informatics tools and databases for genomic sample collection, preparation and estimation.
6. To learn the about the methods of protein and genome estimation and separation.
7. To be expertise in running of programs, bio-informatics tools, software and instruments for the genomic data analysis.
8. To develop practical skill in handling of biological samples, pedigree chart, analysis of inheritance pattern.
9. To provide scientific and computational knowledge related to various techniques associated with biotechnology.
10. To impart laboratory skills for handling analytical tools in industry and research institution.
11. To give the scientific knowledge regarding safety regulations for handling of instruments in the laboratory and industry.
12. To demonstrate the operating procedures associated with upstream and downstream process like chromatography, electrophoresis, centrifugation, etc.

Course outcomes (COs):
Upon successful completion of the course a student will be able to

CO1	Interpret the test hypotheses; analyze the data of RDT by using modern molecular methods.
CO2	Develop laboratory skills for academic and professional enhancement
CO3	Apply the basic and advanced recombinant DNA techniques experiments applicable in scientific research and different industries.
CO4	Demonstrate the experimental techniques related to recombinant DNA molecule and expression of recombinant DNA. Demonstrate the scientific knowledge regarding safety regulations for handling of scientific instruments and radioisotopes and other hazardous chemicals in the laboratory.
CO5	Development of experimental and operating knowledge regarding various tools and techniques in the field of applied science. Demonstrate the experimental techniques related to upstream and downstream process like chromatography, electrophoresis, centrifugation, etc
CO6	Apply modern techniques and their statistical knowledge for solving various scientific problems in laboratories.

Course code	**: MBTME 104**				
Course Name	**: Food and Beverages Biotechnology**				
Semester /Year	**: I**				
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. To provide scientific knowledge related to various techniques associated with Food and Beverages Biotechnology.
2. To impart laboratory skills for handling analytical tools in Food and Beverages industry and research institution.
3. To give the scientific knowledge regarding safety regulations for handling of instruments in the laboratory and industry.
4. To demonstrate the operating procedures associated with upstream and downstream process related to Food and Beverages.

Course Contents [Credit = 3]

Unit 1

Food and Microorganism: Microorganism in food & beverage industry, contamination of food. General principles underlying spoilage and chemical changes

Unit 2

Contamination and spoilage of different kinds of food & beverages: Cereals & cereal products, sugar and sugar products, vegetables and fruits, meat, fish, poultry & eggs, sea food, milk & milk products, canned foods, Alcohol & alcoholic beverages fruit juices & soft drinks etc.

Unit 3

Biotechnology of food and feed; cultures & fermentation, Beverage production: Alcohol & alcoholic beverages, fruit furies, soft drinks, feed production, SCP, fats, amino acid, food additives.

Unit 4

Food, Beverages & Disease : Food borne illness due to bacterial food poisoning, infection and intoxication. Food-borne disease outbreaks, Disease-investigation, Materials & Equipments, laboratory testing, field analysis, interpretation of data and preventive measures.

Unit 5

Food hygiene: Food sanitation, Bacteriology of water and food products, food manufacturing practice. Hazard Analysis Critical Points. Processing Industry and Microbial criteria of food. Principles of food preservation: Preservation by high temperature, low temperatures, Drying, Food additives and Radiation.

Suggested Reading and Text Books

1. Food Sciences and Food biotechnology- G.F.G. Lopez, G. Canaas, E.V.Nathan
2. Genetically Modified Foods- M.Ruse, D. Castle (Eds.)
3. Biotechnology of Food Crops in Developing Countries- T.Hohn and K.M. Leisinger (Eds.)
4. Biotechnology and Food Process Engineering- H.G. Schwartzberg, M.A. Rao (Eds.)
5. Food Biotechnology- (Eds.) R.Angold, G.A.Beech, J.Taggart.
6. Food Biotechnology—Microorganisms- (Ed.) Y.H. Hui et al.

CO6	**Constructing (Creating),** Evaluating, Analyzing, demonstrating, remembering, and understanding the take part in the scientific knowledge regarding safety regulations for handling of hazardous microbes, chemicals and food hygiene in the laboratory decision making knowledge of the biological systems information and the explanation of the key concepts of Food and Beverages Biotechnology. Acquire domain-specific knowledge and develop globally-relevant skills for academic and professional enhancement.	1,2,3,4,5,6 Remembering, Understanding, Applying, Analyzing, Evaluating Creating

Mapping of COs with POs & PSOs

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	3	3	2	2	2	3	2	2	2	3	2	3	2
CO2	3	2	2	2	3	3	3	2	3	2	2	3	3	3	2	2
CO3	2	2	2	2	2	2	2	3	3	2	2	2	2	2	2	2
CO4	3	2	2	2	3	2	2	2	2	1	3	2	2	2	2	2
CO5	3	2	2	2	2	2	2	2	3	2	2	2	2	2	2	2
CO6	2	2	2	2	2	2	2	2	2	3	3	2	2	2	3	3

3:High,2:Medium,1:Low

Course code	**: MBTME 105**			
Course Name	**: Research Methodology: Tools & Techniques**			
Semester /Year	**: I**			
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. To develop understanding on various kinds of research, objectives of doing research, research process, research designs and sampling.
2. To acquire knowledge on measurement & scaling techniques as well as the quantitative data analysis.
3. To acquire knowledge regarding awareness of data analysis-and hypothesis testing procedures.
4. To develop data analytics skills and meaningful interpretation to the data sets so as to solve the business/Research problem.

Course Contents [Credit = 3]

Unit 1

Importance and need of scientific research. Problem identification, objective, significance, scope and limitations. Literature survey: use of books, journal, libraries, online survey. Importance and designing of the problem to be undertaken.

Unit 2

Fiel Survey, Site Selection, Source selection for data acquisition. Sampling technique: Simple and random Sampling, Systematic sampling, Stratified sampling, multistage sampling, Cluster sampling, Multiphase sampling, sample size, frequency, Bias, Error

Unit 3

Methods: Data collection, type of data, Qualitative and quantitative data. Primary and secondary data. Data representation: Tabular and diagrammatic representation of data. Measures of central tendency: use of mean, mode, median, data interpretation.

Unit 4

Measures if dispersion: use of range , variance, standard deviation, standard error. Correlation, multiple correlations, Regression, multiple regressions, standard error of estimate. Test of significance: t-test, 95% confidence limit, Chi square test, F test, Multivariate test.

Unit 5

Project Report: Preparation, introduction of the problem, Materials and Methods, Review of literature, Results, Discussion (interpretation of results), Referencing technique, summary of research/abstract etc. Publication of scientific data, writing research paper and report.

Suggested Reading and Text Books

1. Holmes, Moody, Dine: Research Methods for the Biosciences, 1st Indian ed., Oxford University Press, 2006.
2. N. Gurumani: Research Methodology for Biological Sciences, 1st ed., MJP Publishers, 2008.
3. Wilson and Walker: Principles & Techniques, 4th ed. Cambridge low price ed., 1995.
4. Schmauder: Methods in Biotechnology, Taylor & Francis Publishers, 2003

Course Outcomes (COs): On completion of this course, the students will be:

CO	Description	Bloom's Taxonomy Level
CO1	Remember the basic concepts of research methodology, tools and techniques: Acquire knowledge on measurement & scaling techniques as well as the quantitative data analysis. Importance and need of scientific research, Field Survey, Site Selection, Source selection for data acquisition, Methods: Data collection, type of data, Qualitative and quantitative data, Measures if dispersion and project report.	1 Remembering
CO2	**Understand** and remember the specific and basic concepts and applications of research methodology, tools and techniques: Acquire knowledge on measurement & scaling techniques as well as the quantitative data analysis. Importance and need of scientific research, Field Survey, Site Selection, Source selection for data acquisition, Methods: Data collection, type of data, Qualitative and quantitative data, Measures if dispersion and project report.	1,2 Remembering, Understanding
CO3	**Applying,** understanding and remembering the detailed processes and features of research methodology, tools and techniques: Acquire knowledge on measurement & scaling techniques as well as the quantitative data analysis. Importance and need of scientific research, Field Survey, Site Selection, Source selection for data acquisition, Methods: Data collection, type of data, Qualitative and quantitative data, Measures if dispersion and project report. Publication of scientific data, writing research paper and	1,2,3 Remembering, Understanding, Demonstrating
CO4	**Analyzing,** applying, remembering and understanding the detailed study related to research methodology, tools and techniques: Acquire knowledge on measurement & scaling techniques as well as the quantitative data analysis. Importance and need of scientific research, Field Survey, Site Selection, Source selection for data acquisition, Methods: Data collection, type of data, Qualitative and quantitative data, Measures if dispersion and project report. Publication of scientific data, writing research paper and report.	1,2,3,4 Remembering, Understanding, Applying, Analyzing
CO5	**Evaluating,** analyzing, applying, remembering, and understanding the research methodology, tools and techniques: Acquire knowledge on measurement & scaling techniques as well as the quantitative data analysis. Importance and need of scientific research, Field Survey, Site Selection, Source selection for data acquisition, Methods: Data collection, type of data, Qualitative and quantitative data, Measures if dispersion and project report. Publication of scientific data, writing research paper and	1,2,3,4,5 Remembering, Understanding, Applying, Analyzing, Evaluating

CO6	**Constructing (Creating),** Evaluating, Analyzing, demonstrating, remembering, and understanding the take part in research methodology, tools and techniques: Acquire knowledge on measurement & scaling techniques as well as the quantitative data analysis. Importance and need of scientific research, Field Survey, Site Selection, Source selection for data acquisition, Methods: Data collection, type of data, Qualitative and quantitative data, Measures if dispersion and project report. Publication of scientific data, writing research paper and report.	1,2,3,4,5,6 Remembering, Understanding, Applying, Analyzing, Evaluating Creating

Mapping of COs with POs & PSOs

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	2	2	2	2	2	3	2	2	2	2	2	3	2	2
CO2	2	2	2	3	3	3	3	2	3	2	3	2	2	2	2	2
CO3	3	2	2	2	2	2	2	3	3	2	3	3	3	2	2	3
CO4	3	3	2	3	3	2	2	2	3	1	3	2	3	3	3	3
CO5	2	3	2	2	2	2	2	2	3	2	2	3	3	3	3	3
CO6	2	2	2	2	2	2	2	2	3	2	2	2	2	2	2	2

3:High, 2:Medium, 1:Low

Course code	**: MBTME 106**			
Course Name	**: Chemical Sciences & Biomaterials**			
Semester /Year	**: I**			
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. To acquire knowledge polymer materials, biodegradable materials and bioactive polymers.
2. To develop knowledge about Biocompatibility of biomaterials.
3. To acquire knowledge regarding awareness of chemical sciences and biomaterials.
4. To develop analytics skills and meaningful interpretation to blood compatibility, Interactions of bacteria with biomaterials, Cardio vascular applications and Orthopaedic applications

Course Contents [Credit = 3]

Unit 1

Polymer materials: synthesis, characterization (inter polymers, biodegradable polymers, hydro gels, natural polymers, genetically engineered polymers, Bioactive polymers).

Unit 2

Biocompatibility of biomaterials, protein structure, interaction of proteins with synthetic materials; methods for evaluating protein adsorption.

Unit 3

Cell: interactions with proteins and materials, characterization of cell material interaction, Blood compatibility: platelets adhesion and aggregation, coagulation effects.

Unit 4

The mechanical environment: In vitro assessment of blood compatibility, Interactions of bacteria with biomaterials: methods of sterilization, assessment of sterility. Design of biocompatible materials: modification of materials to improve biocompatibility.

Unit 5

Cardio vascular applications: grafts, catheters, stents valves, embolic agents. Orthopaedic applications: joint prostheses, fracture fixation devices, interaction of bone with implanted materials and resulting complications. Drug delivery: types of devices, targeting gene therapy, stability of drug in contact with biomaterials.

Suggested Reading and Text Books

1. Remingtons Pharmaceutical Sciences, 20th editions, Lippincott, William and Wilkins.
2. Ansel's Pharmaceutical Dosage forms and drug Delivery System 8th edition by Loyd V, Allen, Nicholas G., Popovich, Howardc. Ansel, Publisher Lippincott, Williams and wilkins.
3. Remingtons: The science and practice of Pharmacy.
4. An Introduction to Biocomposites Vol 1 (2004) by Seeram Ramakrishna et al World Scientific Publishing Compan

Course Outcomes (COs): On completion of this course, the students will be:

CO	Description	Bloom's Taxonomy Level
CO1	**Remember** the different basic concepts and introduction to chemical sciences and biomaterials: Polymer materials, biocompatibility of biomaterials, cell: interactions with proteins and materials, the mechanical environment, interaction of bacteria with biomaterials, cardio vascular applications and drug targeting.	1 Remembering
CO2	**Understand** and remember the specific and basic concepts of basic principle components of tools and techniques in the field of chemical sciences and biomaterials: Polymer materials, biocompatibility of biomaterials, cell: interactions with proteins and materials, the mechanical environment, interaction of bacteria with biomaterials, cardio vascular applications and drug targeting and their utilization to solve the society and industry-related problems.	1,2 Remembering, Understanding
CO3	**Applying,** understanding and remembering the detailed processes, essential techniques and features of apply modern techniques in spoilage and contamination for solving various scientific problems in food industry and food and beverages related research institution. decision making for higher studies, employment and advanced research in industrial and academic scale.	1,2,3 Remembering, Understanding, Demonstrating
CO4	**Analyzing,** applying, remembering and understanding the detailed study related to demonstrate the scientific knowledge of chemical sciences and biomaterials: Polymer materials, biocompatibility of biomaterials, cell: interactions with proteins and materials, the mechanical environment, interaction of bacteria with biomaterials, cardio vascular applications and drug targeting. Knowledge of the chemical sciences in biological systems information and the explanation of the key concepts. Demonstrate the biotechnological principles and working food and feed.	1,2,3,4 Remembering, Understanding, Applying, Analyzing
CO5	**Evaluating,** analyzing, applying, remembering, and understanding the principle, methods, properties and functions of chemical sciences and biomaterials: Polymer materials, biocompatibility of biomaterials, cell: interactions with proteins and materials, the mechanical environment, interaction of bacteria with biomaterials, cardio vascular applications and drug targeting. Knowledge of the chemical sciences in biological systems information and the explanation of the key conceptsand applications in health, agriculture and environment, alongwith associated social and environmental issues.	1,2,3,4,5 Remembering, Understanding, Applying, Analyzing, Evaluating

CO6	**Constructing (Creating),** Evaluating, Analyzing, demonstrating, remembering, and understanding the take part in the scientific knowledge regarding chemical sciences and biomaterials: Polymer materials, biocompatibility of biomaterials, cell: interactions with proteins and materials, the mechanical environment, interaction of bacteria with biomaterials, cardio vascular applications and drug targeting. Knowledge of the chemical sciences in biological systems information and the explanation of the key concepts. Knowledge Acquire domain-specific knowledge and develop globally-relevant skills for academic and professional enhancement.	1,2,3,4,5,6 Remembering, Understanding, Applying, Analyzing, Evaluating Creating

Mapping of COs with POs & PSOs

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	3	3	3	2	2	2	3	2	2	2	3	2	3	2
CO2	2	2	2	2	2	2	2	2	3	2	2	2	2	2	2	2
CO3	2	2	2	2	2	2	2	3	3	2	2	2	2	2	2	2
CO4	2	2	2	2	3	2	2	2	2	1	3	2	2	2	2	2
CO5	2	2	2	2	2	2	2	2	3	2	2	2	2	2	2	2
CO6	2	2	1	1	1	1	1	2	2	1	3	2	2	2	1	3

3:High, 2:Medium, 1:Low

Course code	**: MBTME 107**			
Course Name	**: Pharmaceutical Biotechnology & Drug Designing**			
Semester /Year	**: I**			
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. To understand the Concept, Need and Importance of Biotechnology in Pharmaceutical Biotechnology & Drug Designing.
2. To demonstrate the scientific method and the use of problem-solving within the field of Pharmaceutical Biotechnology & Drug Designing.
3. To develop scientific knowledge regarding vaccines and role of biotechnology in development of pharmaceutical drugs.
4. To demonstrate the scientific method and the use of Drug targeting and drug delivery systems.

Couse Contents [Credit = 3]

Unit 1

Delivery considerations of biotechnological products: Introduction, Stability profile, Barriers to proteins and peptide delivery, Delivery of protein & peptide drugs, Lymphatic transportation of proteins, Site specific protein modification(protein engineering), Toxicology profile characterization.

Unit 2

Drug targeting and drug delivery systems: Introduction, Historical perspectives, Drug targeting, Cellular levels events in targeting. Ligands as means of targeting, Blood cell receptors for endogenous compounds, Carrier system for targeting, Vesicular systems for ligand mediated drug targeting, Specialized liposomes for cellular drug targeting.

Unit 3

Vaccines: Introduction, Multivalent subunit vaccines, Purified macromolecules, Synthetic peptide vaccines, Immuno-adhesions, Recombinant antigen vaccines, Vector vaccines, Anti-idiotype vaccines, Targeted immune stimulants, Miscellaneous approaches, New generation vaccines, Novel vaccine delivery systems.

Unit 4

Introduction to drug design cycle: Structure Activity Relationship (SAR), Rational Drug Design, Pharmacophoric patterns, Quantitative Structure-Activity Relationship. (Q SAR) & Hans equation.

Unit 5

Introduction to molecular modelling: Quantum mechanical and molecular orbital methods, Introduction to semi empirical, molecular mechanics and techniques. Potential energy surface, Docking and modelling substrate – receptor interactions. Introduction to s/w tools for CADD.

Suggested Reading and Text Books

1. Leon Lachman. Theory and Practice of Industrial Pharmacy, 3 Edition, Lea and Febiger, 1986 .
2. Remington's Pharmaceutical Science, Mark Publishing and Co.

Course Outcomes (COs): On completion of this course, the students will be:

CO	Description	Bloom's Taxonomy Level
CO1	**Remember** the different basic concepts and introduction to Pharmaceutical Biotechnology & Drug Designing: Delivery considerations of biotechnological products, Drug targeting and drug delivery systems, Vaccines, drug design cycle and molecular modelling.	1 Remembering
CO2	**Understand** and remember the specific and basic concepts ofbasic principle components of tools and techniques in the field of Pharmaceutical Biotechnology & Drug Designing: Delivery considerations of biotechnological products, Drug targeting and drug delivery systems, Vaccines, drug design cycle and molecular modelling and their utilization to solve the society and industry-related problems.	1,2 Remembering, Understanding
CO3	**Applying,** understanding and remembering the detailed processes, essential techniques and features of apply modern techniques in Pharmaceutical Biotechnology & Drug Designing: Delivery considerations of biotechnological products, Drug targeting and drug delivery systems, Vaccines, drug design cycle and molecular modelling. related research institution. decision making for higher studies, employment and advanced research in industrial and academic scale.	1,2,3 Remembering, Understanding, Demonstrating
CO4	**Analyzing,** applying, remembering and understanding the detailed study related to demonstrate the scientific knowledge of Pharmaceutical Biotechnology & Drug Designing: Delivery considerations of biotechnological products, Drug targeting and drug delivery systems, Vaccines, drug design cycle and molecular modelling. Knowledge of the pharmaceutical sciences and drug designing in biological systems information and the explanation of the key concepts.	1,2,3,4 Remembering, Understanding, Applying, Analyzing
CO5	**Evaluating,** analyzing, applying, remembering, and understanding the principle, methods, properties and functions of Pharmaceutical Biotechnology & Drug Designing: Delivery considerations of biotechnological products, Drug targeting and drug delivery systems, Vaccines, drug design cycle and molecular modelling. Knowledge of the pharmaceutical sciences and drug designing in biological systems information and the explanation of the key conceptsand applications in health, agriculture and environment, along with associated social and environmental issues.	1,2,3,4,5 Remembering, Understanding, Applying, Analyzing, Evaluating

CO6	**Constructing (Creating),** Evaluating, Analyzing, demonstrating, remembering, and understanding the take part in the scientific knowledge regarding Pharmaceutical Biotechnology & Drug Designing: Delivery considerations of biotechnological products, Drug targeting and drug delivery systems, Vaccines, drug design cycle and molecular modelling. Knowledge Acquire domain-specific knowledge and develop globally-relevant skills for academic and professional enhancement.	1,2,3,4,5,6 Remembering, Understanding, Applying, Analyzing, Evaluating Creating

Mapping of COs with POs & PSOs

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	2	3	2	2	2	3	2	2	2	3	2	3	2
CO2	2	2	2	2	2	2	2	2	3	2	2	2	2	2	2	2
CO3	2	2	2	2	2	2	2	3	3	2	2	2	2	2	2	2
CO4	2	2	2	2	3	2	2	2	2	1	3	2	2	2	2	2
CO5	2	2	2	2	2	2	2	2	3	2	2	2	2	2	2	2
CO6	2	2	2	1	1	1	1	2	2	1	3	2	2	2	1	3

3:High, 2:Medium, 1:Low

Course code	**: MBTME 108**			
Course Name	**: Plant Biotechnology**			
Semester /Year	**: I**			
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. To enable students acquire knowledge of the fundamental principles of plant tissue culture.
2. To learn about different kinds of plant culture techniques.
3. To make students understand the principles of *Agrobacterium tumefaciens* biology and Ti-plasmid.
4. To impart knowledge about the diverse applications of plant biotechnology and genetically-modifiedcrops.

Course Contents [Credit = 3]

Unit 1

Clonal propagation/ micro propagation and its applications to horticulture and forestry. Production of disease free plants. Incompatibility in plants. Methods to overcome incompatibility.

Unit 2

Somatic embryogenesis and production of synthetic seeds. Selection of stress tolerant cell lines, resistance to cold, high temperature, salt, drought, diseases and inhibitors. Conservation of plant genetic resources in vitro, its applications and limitations.

Unit 3

Agrobacterium mediated genetic Transformation. Application of Plant Transformation for productivity and performance: herbicide resistance, insect resistance, Bt genes, non-Bt like protease inhibitors, alpha amylase inhibitor, disease resistance, nematode resistance.

Unit 4

Control mechanisms and manipulation of phenyl propanoid pathway, shikimate pathway; alkaloids, industrial enzymes, biodegradable plastics, therapeutic proteins.

Unit 5

Bio fertilisers, Ecological risks of transgenic crop and global market, Biodiversity and its conservation, germplasm collection. Restoration of degraded lands , Nursery technology, green house technology.

Suggested Reading and Text Books

1. P.K. Gupta: Elements of Biotechnology, Rastogi and Co. Meerut, 1996
2. R.J. Hanry: Practical Application of Plants Molecular Biology, Champan and Hall, 1997
3. H.D. Kumar: Modern Concepts of Biotechnology, Vikas Publ. Pvt. Ltd.
4. B.D. Singh: Biotechnology, Kalyani Publ.

Course Outcomes (COs): On completion of this course, the students will be:

CO	Description	Bloom's Taxonomy Level
CO1	**Remember** the different basic concepts of introduction to general character of plant biotechnology, cryo and organogenic differentiation, types of culture, In vitro haploid production, protoplast Isolation and fusion and Plant Growth Promoting bacteria.	1 Remembering
CO2	**Understand** and remember the specific and basic concepts of plant biotechnology, cryo and organogenic differentiation, types of culture, Somatic embryogenesis and production of synthetic seeds, In vitro haploid production, protoplast Isolation and fusion and Plant Growth Promoting bacteria. Somaclonal variation nomenclautre, methods, applications basis and disadvantages.	1,2 Remembering, Understanding
CO3	**Applying,** understanding and remembering the detailed processes and features of plant biotechnology, cryo and organogenic differentiation, types of culture, In vitro haploid production, protoplast Isolation and fusion and Plant Growth Promoting bacteria. Somaclonal variation nomenclature, methods, applications basis and disadvantages.	1,2,3 Remembering, Understanding, Demonstrating
CO4	**Analyzing,** applying, remembering and understanding the detailed study related to plant biotechnology, cryo and organogenic differentiation, types of culture, In vitro haploid production, protoplast Isolation and fusion and Plant Growth Promoting bacteria. Somaclonal variation nomenclautre, methods, applications basis and disadvantages.	1,2,3,4 Remembering, Understanding, Applying, Analyzing
CO5	**Evaluating,** analyzing, applying, remembering, and understanding the plant biotechnology, cryo and organogenic differentiation, types of culture, In vitro haploid production, protoplast Isolation and fusion and Plant Growth Promoting bacteria. Control mechanisms and manipulation, Somaclonal variation nomenclature, methods, applications basis and	1,2,3,4,5 Remembering, Understanding, Applying, Analyzing, Evaluating
CO6	**Constructing (Creating),** Evaluating, Analyzing, demonstrating, remembering, and understanding the take part in plant biotechnology, cryo and organogenic differentiation, types of culture, In vitro haploid production, protoplast Isolation and fusion and Plant Growth Promoting bacteria. Bio fertilisers, Ecological risks of transgenic crop and global market, Biodiversity and its conservation Somaclonal variation nomenclature, methods, applications basis and disadvantages.	1,2,3,4,5,6 Remembering, Understanding, Applying, Analyzing, Evaluating Creating

Mapping of COs with POs & PSOs

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
CO2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
CO3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
CO4	2	2	2	3	2	2	2	2	2	1	3	2	2	2	2	2
CO5	2	2	2	2	2	2	2	2	3	2	2	2	2	2	2	2
CO6	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2

3:High, 2:Medium, 1:Low

Course code	**: MBTME 109**			
Course Name	**: Advanced Bioinformatics**			
Semester /Year	**: I**			
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. To acquire sound knowledge pertaining to concepts of bioinformatics, its resources on Internet and to identify their application and scope.
2. To study structure, format and applications of biological databases; different softwares and techniques utilized for sequence alignment, searching databases, phylogentic studies, gene identification tools, search engines.
3. To comprehend concepts and acquire knowledge of advanced bioinformatics.
4. To make students understand about various bioinformatics tools used for DNA, RNA and protein sequence analysis.
5. To impart knowledge about biological sequence alignment.

Course Contents [Credit = 3]

Unit 1

Introduction to Bioinformatics: Definition and History of Bioinformatics, Introduction to internet, Bibliographic and non bibliographic search, Pub Med. Introduction to various biological databases (primary, secondary and composite databases). Introduction to biological information system: SRS, ENTREZ (Structure and use on web).

Unit 2

Introduction to Data mining**:** Classification, Clustering, Data collection, Data Warehousing, Data preprocessing, Applications of Data Mining and Genomes mining. Data Bases: Nucelotide sequence information sources: GenBank, EMBL, EBI, DDBJ, UCSC. Protein sequence information sources: PIR, ExPASy, UniProt KB, SwissProt, TrEMBL, Protein structure information sources: PDB, SCOP, CATH, HSSP.

Unit 3

Biocomputing **:** Introduction to String Matching Algorithms, Database Search Techniques, Sequence Comparison and Alignment Techniques, Use of Biochemical Scoring Matrices, Introduction to Graph Matching Algorithms, Automated Genome Comparison and its Implication, Automated Gene Prediction, Gene Arrays, Analysis of Gene Arrays. Introduction to Signaling Pathways and Pathway Regulation (KEGG), Systems Biology-an introduction.

Unit 4

Genoinformatics. Genome Annotation-: Introduction, ORF's. Gene mapping and applications: Genetic and Physical Mapping, Transcriptome and Proteome- General Account. Sequence Alignment: Pairwise and multipule alignment, Dynamic programming. Soft wares (SSearch, BLAST, FASTA, CLUSTAL W), Phylogenetic analysis: phenatic and cladistic approach. Phylogenetic Tree Construction (rooted and unrooted method), Completed Genomes: Bacterium, Nematode, Plant and Human.

Unit 5

Production of Protein Structure & Modeling. Protein Primary & Secondary Structure, Prediction Methods – Introduction to various methods. Tertiary structure prediction (Homology & Threading Methods) Profiles, Motifs – Regular Expressions. Repeat Finding and pattern Recognition Molecular modeling, Docking and Rational Drug design.

Suggested Reading and Text Books

1. Moorhouse & Barry: Bioinformatics, Biocomputing and Perl (Wiley-liss publications).
2. Jones & Prvzner: Introduction to Bioinformatics Algorithm, Anne Press.
3. Pevsner: Bioinformatics & Functional Genomics, Wiley-publication.
4. Zimmerman: Introduction to Protein Information.
4. Bourne & Weissig: Structural Bioinformatics, Wiley-Liss Publication.
5. Gustafson, Shoemaker, Snape: Genome Data Mining Exploitation: the Genome.
6. Richard S Larson: Bioinformatics and drug discovery, humana press.
7. Sharma, Munjal & Shankar: A Text Book of Bioinformatics, Rastogi Publication.

Course Outcomes (COs): On completion of this course, the students will be:

CO	Description	Bloom'sTaxonomyLevel
CO1	**Remember** the different basic concepts of introduction to general character of Bioinformatics, history of Bioinformatics, Sequence Information Sources, Protein Information Sources, techniques for data identifications, Sequence and Phylogeny analysis, Searching Databases and genome annotation.	1 Remembering
CO2	**Understand** and remember the specific and basic concepts of Bioinformatics, history of Bioinformatics, Sequence Information Sources, Protein Information Sources, techniques for data identifications, Sequence and Phylogeny analysis, Searching Databases and genome annotation.	1,2 Remembering, Understanding
CO3	**Applying,** understanding and remembering the detailed processes and features of Bioinformatics, history of Bioinformatics, Sequence Information Sources, Protein Information Sources, techniques for data identifications, Sequence and Phylogeny analysis, Searching Databases and genome annotation.	1,2,3 Remembering, Understanding, Demonstrating
CO4	**Analyzing,** applying, remembering and understanding the detailed study related to Bioinformatics, history of Bioinformatics, Sequence Information Sources, Protein Information Sources, techniques for data identifications, Sequence and Phylogeny analysis, Searching Databases and genome annotation.	1,2,3,4 Remembering, Understanding, Applying, Analyzing
CO5	**Evaluating,** analyzing, applying, remembering, and understanding the Bioinformatics, history of Bioinformatics, Sequence Information Sources, Protein Information Sources, techniques for data identifications, Sequence and Phylogeny analysis, Searching Databases and genome annotation.	1,2,3,4,5 Remembering, Understanding, Applying, Analyzing, Evaluating
CO6	**Constructing (Creating),** Evaluating, Analyzing, demonstrating, remembering, and understanding the take part in Bioinformatics, history of Bioinformatics, Sequence Information Sources, Protein Information Sources, techniques for data identifications, Sequence and Phylogeny analysis, Searching Databases and genome annotation.	1,2,3,4,5,6 Remembering, Understanding, Applying, Analyzing, Evaluating Creating

Mapping of COs with POs & PSOs

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	2	2	2	2	3	3	3	3	3	3	3	2	2
CO2	3	3	3	3	3	3	3	2	2	2	2	2	2	2	2	2
CO3	3	3	3	3	3	3	3	2	2	2	3	3	3	3	3	3
CO4	2	2	2	3	2	2	2	2	2	1	3	2	2	2	2	2
CO5	2	2	3	3	2	2	3	3	3	2	2	2	2	2	2	2
CO6	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

3:High, 2:Medium, 1:Low

Course code	: MBTML 110			
Course Name	: Laboratory Course-II			
	L	T	P	C
	0	0	4	4

L - Lecture T – Tutorial P – Practical C – Credit

Course Contents [Credit = 4]

1. To demonstrate the experimental techniques associated with aseptic process, media preparation and related upstream and downstream process
2. To provide the knowledge related to needs of various parts of fermenter and their operation in laboratory as well as industrial level.3. To identify the ethical values related to transgenic and recombinant DNA technology.
3. To acquire knowledge regarding awareness of data analysis-and hypothesis testing procedures.
4. To develop data analytics skills and meaningful interpretation to the data sets so as to solve the business/Research problem.
5. To acquire knowledge regarding awareness of chemical sciences and biomaterials.
6. To develop analytics skills and meaningful interpretation to blood compatibility, Interactions of bacteria with biomaterials, Cardio vascular applications and Orthopedic applications.
7. To develop scientific knowledge regarding vaccines and role of biotechnology in development of pharmaceutical drugs.
8. To demonstrate the scientific method and the use of Drug targeting and drug delivery systems.
9. Toenablestudentsacquireknowledgeofthefundamentalprinciplesofplanttissueculture.
10. To learn about different kinds of plant culture techniques.
11. To study structure, format and applications of biological databases; different softwares and techniques utilized for sequence alignment, searching databases, phylogentic studies, gene identification tools, search engines.
12. TomakestudentsunderstandaboutvariousbioinformaticstoolsusedforDNA,RNAandprotein sequence analysis.

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Development of scientific and analytical knowledge regarding various tools and techniques in the field of Food and Beverages Biotechnology.
CO2	Acquire knowledge regarding awareness of data analysis-and hypothesis testing procedures.
CO3	Acquire knowledge on measurement quantitative data analysis of blood compatibility, Interactions of bacteria with biomaterials, Cardio vascular applications and Orthopaedic applications
CO4	Demonstrate and understanding the scientific method and the use of Drug targeting, drug delivery systems and products in pharmaceuticals.
CO5	Understand the Need, Importance and Practical applications of plant biotechnology. Exhibit ability to characterize and select biological databases to obtain required data and identify applicability of same in biological research.
CO6	Understand the concepts of plasticity and totipotency, which are the foundations for plant tissue culture. Acquisition of technical skills to operate search engines through internet interface for data retrieval and recognize significance in biological studies.

Course code	**: MBTMS 111**				
Course Name	**: Bio –Entrepreneurship**				
Semester /Year	**: I**				
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. To understand the meaning and importance of Entrepreneurship.
2. To understand the various forms of business organisation.
3. To analyze the importance of finance in an enterprise.
4. To analyze the importance of marketing management in an enterprise.
5. To understand the meaning of international business.

Course Contents [Credit = 3]

Unit 1

Starting a venture; Assessment of feasibility of a given venture/ new venture; Approach a bank for a loan; Sources of financial assistance; Making a business proposal/ Plan for seeking loans from financial institution & Banks; Funds from bank for capital expenditure and for working; Statutory and legal requirements for starting a company/venture; Budget planning and cash flow management.

Unit 2

Basics in accounting practices: concepts of balance sheet, P&L account, and double entry bookkeeping. Estimation of income, expenditure, profit. Assessment of market demand for potential product(s) of interest; Market conditions, segments; Prediction of market changes; Identifying needs of customers including gaps in the market, packaging the product; Market linkages, branding issues; Developing distribution channels; Pricing/Policies/Competition; Promotion/Advertising.

Unit 3

Services Marketing Negotiations/Strategy with financiers, bankers, Government/ law enforcement authorities; with companies/Institutions for technology transfer; Dispute resolution skills; External environment/changes; Crisis/Avoiding/Managing. Information Technology: How to use IT for business administration; Use of IT in Improving business performance; Available software for better financial management; E-business setup, management.

Unit 4

Human Resource Development (HRD): Leadership skills; Managerial skills; Organization structure, pros & cons of different structures; Team building, teamwork; Appraisal; Rewards in small scale set up. Fundamentals of Entrepreneurship, Support mechanism for entrepreneurship in India.

Unit 5

Role of knowledge centre and R&D. Knowledge centres like universities and research institutions; Role of technology and up-gradation; Assessment of scale of development of Technology; Managing Technology Transfer; Regulations for transfer of foreign technologies; Technology transfer agencies. Case Studies.

Suggested Reading and Text Books

1. Handbook of Bio entrepreneurship Vol 4. by Holger Patzelt & Thomas Brenner (ed) Springer(2008)
2. Handbook of Entrepreneurship Research, 2005. Zoltan J. Acs and David B. Audretsch (eds.)
3. Handbook of Entrepreneurship Research: Interdisciplinary Perspectives, 2005. Sharon A. Alvarez, Rajshree Agarwal, and Olav Sorenson (eds.):
4. The Life Cycle of Entrepreneurship Ventures, 2005.Simon Parker (ed.)
5. Handbook of Bioentrepreneirship, Holger Patzelt and Thomas Brenner (eds.)

Course Outcomes (COs): On completion of this course, the students will be:

CO	Description	Bloom's Taxonomy Level
CO1	**Remember** and define the terms and basic concepts of entrepreneurship development and their different roles to influencing entrepreneurship, features of a successful Entrepreneurship	1 Remembering
CO2	**Understand** and Remember the introduction and principle, mechanism of entrepreneurship, features, financing the enterprise, marketing management and entrepreneurship and international business.	1,2 Remembering, Understanding
CO3	**Applying,** understanding and remembering the detailed processes of mechanism of entrepreneurship, features, financing the enterprise, marketing management and entrepreneurship and international business.	1,2,3 Remembering, Understanding, Demonstrating
CO4	**Analyzing,** Applying, remembering, understanding the detailed and complete study related to Biotechnological entrepreneurship features for the growth or individual person and society	1,2,3,4 Remembering, Understanding, Applying, Analyzing
CO5	**Evaluating,** analyzing, applying, remembering, and understanding the properties of mechanism of entrepreneurship, features, financing the enterprise, marketing management and entrepreneurship and international business.	1,2,3,4,5 Remembering, Understanding, Applying, Analyzing, Evaluating
CO6	**Constructing (Creating), Evaluating, Analyzing, demonstrating, remembering, and understanding** the entrepreneurship and the awareness, appreciation and applicability in environment, and their diverse functions.	1,2,3,4,5,6 Remembering, Understanding, Applying, Analyzing, Evaluating Creating

Mapping of COs with POs & PSOs

Course Outcomes	Program Outcomes(POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	2	2	2	2	2	2	3	1	1	1	3	2	1	2
CO2	2	2	2	2	2	2	1	1	3	2	2	2	2	2	1	2
CO3	2	2	2	2	2	2	2	2	3	2	2	2	2	2	2	2
CO4	2	2	2	2	2	2	1	1	3	1	1	1	2	2	2	2
CO5	2	2	3	1	1	1	2	2	3	2	2	1	2	2	2	2
CO6	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1

3:High,2: Medium, 1:Low

Course code	**: MBTMS 112**				
Course Name	**: IPR, Patenting and Bioethics**				
Semester /Year	**: I**				
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. To acquire sound knowledge of IPR, Patenting & Bioethics.
2. To study structure, format and applications of bioethics. Social and ethical issues in Biotechnology.
3. To comprehend concepts and issues of Intellectual property rights and assess the application of same in licensing of bio product, marketing of biotechnological invention along with associated trade regulation.
4. To compare and contrast types of patent, treaties, amendments, drafting patent application along with aspects of international patenting.
5. To study social and ethical issues in biotechnology.

Course Contents [Credit = 3]

Unit 1

Introduction to Intellectual Property: Types of IP: Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications, Protection of GMOs. IP as a factor in R&D; IPs of relevance to Biotechnology and few.

Unit 2

Agreements and Treaties: History of GATT & TRIPS Agreement; Madrid Agreement; Hague Agreement; WIPO Treaties; Budapest Treaty; PCT; Indian Patent Act 1970 & recent amendments.

Unit 3

Patents: Basics of Patents and Concept of Prior Art. Introduction to Patents: Types of patent applications: Ordinary, PCT, Conventional, Divisional and Patent of Addition; Specifications: Provisional and complete; Forms and fees Invention in context of "prior art"; Patent databases; Searching International Databases; Country-wise patent searches (USPTO, esp@cenet (EPO), PATENTScope (WIPO), IPO, etc.).

Unit 4

Patent filing procedures: National & PCT filing procedure; Time frame and cost; Status of the patent applications filed; Precautions while patenting– disclosure/non-disclosure; Financial assistance for patenting- introduction to existing schemes. Patent licensing and agreement. Patent infringement- meaning, scope, litigation, case studies

Unit 5

Introduction to Bioethics. Social and ethical issues in Biotechnology, causes of unethical acts, ignorance of laws, codes, policies and Procedures, recognition, friendship, personal gains. Professional ethics - professional conduct, Ethical decision making, ethical dilemmas, good laboratory practices, good manufacturing practices, laboratory accreditation.

Suggested Reading and Text Books

1. BAREACT, Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt. Ltd., 2007
2. Kankanala C., Genetic Patent Law & Strategy, 1st Edition, Manupatra Information Solution Pvt. Ltd., 2007

Course Outcomes (COs): On completion of this course, the students will be

CO	Description	Bloom's Taxonomy Level
CO1	**Remember** the different basic concepts of introduction to Indian Patent Law, IPR Entrepreneurship, the basic regulations of excise, Bioethics and Bio safety.	1 Remembering
CO2	**Understand** and remember the specific and basic concepts of Indian Patent Law, IPR Entrepreneurship, the basic regulations of excise, Bioethics and Bio safety, Good Laboratory Practices (GLP) and Good Manufacturing Practices (GMP).	1,2 Remembering, Understanding
CO3	**Applying,** understanding and remembering the detailed processes, essential techniques and features of Patent Law, IPR Entrepreneurship, the basic regulations of excise, Bioethics and Bio safety, Good Laboratory Practices (GLP) and Good Manufacturing Practices (GMP).	1,2,3 Remembering, Understanding, Demonstrating
CO4	**Analyzing,** applying, remembering and understanding the detailed study related to concepts of Patent Law, IPR Entrepreneurship, the basic regulations of excise, Bioethics and Bio safety, Good Laboratory Practices (GLP) and Good Manufacturing Practices (GMP).	1,2,3,4 Remembering, Understanding, Applying, Analyzing
CO5	**Evaluating,** analyzing, applying, remembering, and understanding the principle, methods, properties and functions of Patent Law, IPR Entrepreneurship, the basic regulations of excise, Bioethics and Bio safety, Good Laboratory Practices (GLP) and Good Manufacturing Practices (GMP).	1,2,3,4,5 Remembering, Understanding, Applying, Analyzing, Evaluating
CO6	**Constructing (Creating),** Evaluating, Analyzing, demonstrating, remembering, and understanding the Take part in essential techniques and features of Patent Law, IPR Entrepreneurship, the basic regulations of excise, Bioethics and Bio safety, Good Laboratory Practices (GLP) and Good Manufacturing Practices (GMP).	1,2,3,4,5,6 Remembering, Understanding, Applying, Analyzing, Evaluating Creating

Mapping of COs with POs & PSOs

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	2	2	3	3	2	3	2	2	2	3	2	1	2
CO2	2	3	2	2	2	2	1	3	2	3	3	3	2	2	1	2
CO3	2	3	2	2	3	3	2	2	3	2	3	3	2	2	3	2
CO4	3	2	2	3	2	3	2	2	3	1	1	1	2	3	2	2
CO5	3	2	2	2	2	2	2	2	3	3	2	3	2	2	2	2
CO6	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2

3:High, 2:Medium, 1:Low

Course code	**: MBTMS 113**				
Course Name	**: Biomedical Technology**				
Semester /Year	**: I**				
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. To understand various types of cancer, tumor invasion, markers in cancer research and diagnosis
2. To acquire knowledge related to genetic disease, gene diagnosis, gene tracking & other diagnostic application of biomedical technology.
3. To understand the concept and types of mutations in Molecular biology.
4. To acquire knowledge related to cellular and molecular mechanisms in biomedical technology.

Couse Contents[Credit = 3]

Unit 1

Molecular diagnosis (genetic disease, gene diagnosis, gene tracking & other diagnostic application of RDT) Molecular diagnostic- direct gene diagnosis, Linkage analysis. Nucleic acid sequences as diagnostic tools, SNPs, VNTRs, Non-invasive methodology. MRI, CT-SCAN. Reproductive Health Technologies – ICSI, IVE.

Unit 2

Mutations and genetic disorders.Single gene disorders, Receptor proteins (hypercholesterolemia). Cytogenic disorders (Trisomy, Klienfelters). Mutation in mitochondrial genes (LHDN), Fragile X Syndrome.

Unit 3

Types and grading of cancer.Introduction to molecular diagnosis of cancer. (Southern & Northern blot analysis, PCR based diagnosis). Gene therapy, Immunotherapy and chemotherapy of cancer cells.

Unit 4

Chemical mutagens. Carcinogenic agents and their cellular interactions. Radiation as health hazard. (Types, measurements, effects & protective measures) Introduction to DNA damage and repair mechanism.

Unit 5

Cellular Pathology: causes of cell injury, necrosis, biochemical mechanism, Ischemic and hypoxic injury. Apoptosis (Biochemical features, mechanisms) Immunological basis of diseases: Hypersensitivity (I – IV) Autoimmune diseases, Preparation of polyclonal antisera: characterization of antisera, Immunodiagnostic – RIA, ELISA.

Suggested Reading and Text Books

1. Biomedical Technology and Devices Handbook, James E Moore, George Zouridakis, CRC Press (2004).

Course Outcomes (COs): On completion of this course, the students will be

CO	Description	Bloom's Taxonomy Level
CO1	**Remember** the different basic concepts and introduction to Biomedical technology: Molecular diagnosis, RDT, Reproductive Health Technologies, Mutations and genetic disorders, Types and grading of cancer, molecular diagnosis of cancer, Chemical mutagens and cellular pathology.	1 Remembering
CO2	**Understand** and remember the specific and basic concepts of Biomedical technology: Molecular diagnosis, RDT, Reproductive Health Technologies, Mutations and genetic disorders, Types and grading of cancer, molecular diagnosis of cancer, Chemical mutagens and cellular pathology and their utilization to solve the society and industry-related problems.	1,2 Remembering, Understanding
CO3	**Applying,** understanding and remembering the detailed processes, essential techniques and features of apply modern techniques in Biomedical technology: Molecular diagnosis, RDT, Reproductive Health Technologies, Mutations and genetic disorders, Types and grading of cancer, molecular diagnosis of cancer, Chemical mutagens and cellular pathology and their utilization to solve the society and industry-related problems and decision making for higher studies, employment and advanced research in industrial and academic scale.	1,2,3 Remembering, Understanding, Demonstrating
CO4	**Analyzing,** applying, remembering and understanding the detailed study related to demonstrate the scientific knowledge of Biomedical technology: Molecular diagnosis, RDT, Reproductive Health Technologies, Mutations and genetic disorders, Types and grading of cancer, molecular diagnosis of cancer, Chemical mutagens and cellular pathology and their utilization to solve the society and industry-related problems. Knowledge of the Biomedical technology in biological systems information and the explanation of the key concepts.	1,2,3,4 Remembering, Understanding, Applying, Analyzing
CO5	**Evaluating,** analyzing, applying, remembering, and understanding the principle, methods, properties and functions of Biomedical technology: Molecular diagnosis, RDT, Reproductive Health Technologies, Mutations and genetic disorders, Types and grading of cancer, molecular diagnosis of cancer, Chemical mutagens and cellular pathology and their utilization to solve the society and industry-related problems	1,2,3,4,5 Remembering, Understanding, Applying, Analyzing, Evaluating

CO6	**Constructing (Creating),** Evaluating, Analyzing, demonstrating, remembering, and understanding the take part in the scientific knowledge regarding Biomedical technology: Molecular diagnosis, RDT, Reproductive Health Technologies, Mutations and genetic disorders, Types and grading of cancer, molecular diagnosis of cancer, Chemical mutagens and cellular pathology and their utilization to solve the society and industry-related problems.	1,2,3,4,5,6 Remembering, Understanding, Applying, Analyzing, Evaluating Creating

Mapping of COs with POs & PSOs

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	2	3	2	2	2	3	2	2	2	3	2	3	2
CO2	2	2	2	2	2	2	2	2	3	2	2	2	2	2	2	2
CO3	2	2	2	2	2	2	2	3	3	2	2	2	2	2	2	2
CO4	2	2	2	2	3	2	2	2	2	1	3	2	2	2	2	2
CO5	2	2	2	2	2	2	2	2	3	2	2	2	2	2	2	2
CO6	2	2	2	1	1	1	1	2	2	1	3	2	2	2	1	3

3:High,2:Medium,1:Low

Course code	**: MBTMS 114**			
Course Name	**: Genomics and Proteomics**			
Semester /Year	**: I**			
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. To provide sound knowledge pertaining to different methods, tools and techniques utilized to study structure and function of genomics, proteomics and transcriptomics.
2. To study about the origin of genome and different molecular biology techniques for the design of synthetic genes, gene modification and expression analysis.
3. To study about basic concepts, methods and software for the analysis of genome and proteome.
4. To learn the various techniques and tools for genetic study and interpretation of collected data for the research purposes.

Couse Contents[Credit = 3]

Unit 1

The origin of genomes- Origin of macromolecules, RNA world and DNA world Acquisition of new genes (By gene duplication) and Gene families – (Types, Pseudogenes, Origin of gene families (lateral gene transfer, allopolyploidy).Synthetic genomes and their applications.

Unit 2

Introduction: Genome, Genomics, Omics and importance, Structural and Functioanl genomics, Application of genomics, Genome Mapping, DNA sequencing methods – Maxam & Gilbert and Sangers method. Pyrosequencing, Genome Sequencing: Shotgun & Hierarchical (clone contig) methods, Computer tools for sequencing projects: Genome sequence assembly software.

Unit 3

Genome databases, Annotation of genome. Genome diversity: taxonomy and significance of genomes – bacteria, Caenorhabditis, Homo sapiens, etc. Transcriptomics: Gene expression analysis, Identification of Biomarkers, techniques for studying the transcriptome: Microarray, Substractive Hybridization, Northern Blotting, SAGE, cDNA sequencing.

Unit 4

Introduction to Proteomics: Concept and applications, Isolation of Proteins, Separation of Proteins: Isoelectric Focussing, 2D-Gel electrophoresis, Protein Protein Interactions, Protein DNA Interaction, Native PAGE.

Unit 5

Mass spectrometry based methods for protein Sequencing and identification. *Denovo* sequencing using mass spectrometric data. MALDI-TOF, SELDI, ESI, Protein Sequencing – Edman degradation.Introduction to Comparative Genomics, Metagenomics, Protein engineering.

Suggested Reading and Text Books

1. Cantor, C. R. and Smith, C. L., Genomics, John Wiley & Sons, 1999.
2. Lesk, M., Introduction to Genomics, Oxford University Press, 2007.
3. Twyman, R.M., Principles of Proteomics, BIOS Scientific Publishers, 2004.

Course Outcomes (COs): On completion of this course, the students will be

CO	Description	Bloom's Taxonomy Level
CO1	**Remember** the different basic concepts of introduction to general character of genomics and proteonomics, Computer tools for sequencing projects, Managing and Distributing Genome Data, protein structure, interactions, Determination of sizes (Sedimentation analysis), Analysis of proteomes and genome and protein sequencing.	1 Remembering
CO2	**Understand** and remember the specific and basic concepts of genomics and proteonomics, Computer tools for sequencing projects, Managing and Distributing Genome Data, protein structure, interactions, Determination of sizes (Sedimentation analysis), Analysis of proteomes and genome and protein sequencing.	1,2 Remembering, Understanding
CO3	**Applying,** understanding and remembering the detailed processes and features of Mass spectrometry based methods for protein identification, Computer tools for sequencing projects, Managing and Distributing Genome Data, protein structure, interactions, Determination of sizes (Sedimentation analysis), Analysis of proteomes and genome and protein sequencing.	1,2,3 Remembering, Understanding, Demonstrating
CO4	**Analyzing,** applying, remembering and understanding the detailed study related to genomics and proteonomics, Computer tools for sequencing projects, Managing and Distributing Genome Data, protein structure, interactions, Determination of sizes (Sedimentation analysis), Analysis of proteomes and genome and protein sequencing.	1,2,3,4 Remembering, Understanding, Applying, Analyzing
CO5	**Evaluating,** analyzing, applying, remembering, and understanding the genomics and proteonomics, Computer tools for sequencing projects, Managing and Distributing Genome Data, protein structure, interactions, Determination of sizes (Sedimentation analysis), Analysis of proteomes and genome and protein sequencing.	1,2,3,4,5 Remembering, Understanding, Applying, Analyzing, Evaluating
CO6	**Constructing (Creating),** Evaluating, Analyzing, demonstrating, remembering, and understanding the take part in genomics and proteonomics, Computer tools for sequencing projects, Managing and Distributing Genome Data, protein structure, interactions, Determination of sizes (Sedimentation analysis), Analysis of proteomes and genome and protein sequencing.	1,2,3,4,5,6 Remembering, Understanding, Applying, Analyzing, Evaluating Creating

Mapping of COs with POs & PSOs

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	3	3	3	2	3	3	3	3	3	3	3	2	2
CO2	3	3	2	2	2	2	2	3	3	3	3	2	3	3	3	3
CO3	2	3	2	2	3	3	3	2	2	2	3	3	3	3	3	3
CO4	2	3	2	3	2	2	3	3	3	1	3	2	2	2	2	2
CO5	2	3	3	3	2	2	3	3	3	2	2	3	3	3	3	2
CO6	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2

3:High,2:Medium,1:Low

Course code	**: MBTMR 201**			
Course Name	**: Dissertation**			
Semester /Year	**: II**			
	L	**T**	**P**	**C**
	0	**0**	**20**	**20**

L - Lecture T – Tutorial P – Practical C – Credit

Couse Contents [Credit = 20]

1. To exhibit competent scientific writing (with critical analysis) and enhance presentation skills.
2. To demonstrate technical skills to conduct experiments operate various analytical techniques and instruments, and ability to interpret data to derive a solution / conclusion to complex problem.
3. To analyze scientific advancements to identify a research area, design objectives and utilize modern tools, e-resources for literature survey.
4. Each student will be allotted a supervisor and a specific topic on which the dissertation work will be carried out.
5. Each student will submit 3 (1 Departmental copy, 1 Exam Cell copy and 1 Supervisor copy) copies of hard bound in the department.
6. Final evaluation will be done on the basis of quality of work, performance presentation of findings in seminar/conference/workshop/ publications and final presentation.

Course Outcomes (COs): On completion of this course, the students will be

CO	Description	Bloom's Taxonomy Level
CO1	**Remember** the different basic concepts and introduction to Dissertation: Acquire ability to analyze scientific advancements to identify a research area, design objectives and utilize modern tools, e-resources for literature survey. Demonstrate technical skills to conduct experiments operate various analytical techniques and instruments, and ability to interpret data to derive a solution / conclusion to complex problem.	1 Remembering
CO2	**Understand** and remember the specific and basic concepts of Dissertation: Acquire ability to analyze scientific advancements to identify a research area, design objectives and utilize modern tools, e-resources for literature survey. Demonstrate technical skills to conduct experiments operate various analytical techniques and instruments, and ability to interpret data to derive a solution/conclusion to complex problem. Exhibit competent scientific writing (with critical analysis) and enhance presentation skills.	1,2 Remembering, Understanding

CO3	**Applying,** understanding and remembering the detailed processes, essential techniques and features of apply modern techniques in Dissertation: Acquire ability to analyze scientific advancements to identify a research area, design objectives and utilize modern tools, e-resources for literature survey. Demonstrate technical skills to conduct experiments operate various analytical techniques and instruments, and ability to interpret data to derive a solution/ conclusion to complex problem and decision making for higher studies, employment and advanced research in industrial and academic scale.	1,2,3 Remembering, Understanding, Demonstrating
CO4	**Analyzing,** applying, remembering and understanding the detailed study related to demonstrate the scientific knowledge ofDissertation: Acquire ability to analyze scientific advancements to identify a research area, design objectives and utilize modern tools, e-resources for literature survey. Demonstrate technical skills to conduct experiments operate various analytical techniques and instruments, and ability to interpret data to derive a solution / conclusion to complex problem. Knowledge of the dissertation in research of biological systems information and the explanation of the key concepts.	1,2,3,4 Remembering, Understanding, Applying, Analyzing
CO5	**Evaluating,** analyzing, applying, remembering, and understanding the principle, methods, properties and functions of Dissertation: Acquire ability to analyze scientific advancements to identify a research area, design objectives and utilize modern tools, e-resources for literature survey. Demonstrate technical skills to conduct experiments operate various analytical techniques and instruments, and ability to interpret data to derive a solution / conclusion to complex problem. Exhibit competent scientific writing (with critical analysis) and enhance presentation skills.	1,2,3,4,5 Remembering, Understanding, Applying, Analyzing, Evaluating
CO6	**Constructing (Creating),** Evaluating, Analyzing, demonstrating, remembering, and understanding the take part the scientific knowledge regarding Dissertation: Acquire ability to analyze scientific advancements to identify a research area, design objectives and utilize modern tools, e-resources for literature survey. Demonstrate technical skills to conduct experiments operate various analytical techniques and instruments, and ability to interpret data to derive a solution / conclusion to complex problem. Exhibit competent scientific writing (with critical analysis) and enhance presentation skills.and their utilization to solve the society and industry-related problems.	1,2,3,4,5,6 Remembering, Understanding, Applying, Analyzing, Evaluating Creating

Mapping of COs with POs & PSOs

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	2	3	2	2	2	3	2	2	2	3	2	3	2
CO2	3	2	2	2	2	2	2	2	3	2	2	2	2	2	2	2
CO3	1	2	2	2	2	2	2	3	3	2	2	2	2	2	2	2
CO4	2	2	2	2	3	2	2	2	2	1	3	2	2	2	2	2
CO5	2	2	2	2	2	2	2	2	3	2	2	2	2	2	2	2
CO6	2	2	2	1	1	1	1	2	2	1	3	2	2	2	1	3

3:High, 2:Medium, 1:Low

Course code	**: MBTMS 202**				
Course Name	**: Enzyme Technology**				
Semester /Year	**: II**				
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. To provide the basic knowledge about enzymatic reactions and factors effecting it.
2. To instil the concept and fundamentals about the classification of enzymes.
3. To provide exposure to students about mechanism of enzyme actions and industrial use of enzyme

Course Contents[Credit = 3]

Unit 1

Properties of enzymes : catalytic power, specificity, holoenzymes, apoenzyme, coenzyme and cofactor. Nomenclature and classification of enzymes, active site-Fischer and Koshland models. Collision theory, activation energy and transition state energy, the law of mass action and order reaction.

Unit 2

Enzyme kinetics: Kinetics of single substrate enzyme catalysed reaction, equilibrium steady state assumption (Michaelis-Menten), transformation of Michaelis Menten equation, Lineweaver Burk, Eadie-Hofstee, Hanes plots. Determination of Vmax, Km, Kcat and their significance.Effect of pH, temperature, enzyme and substrate concentration on enzyme activity.Single displacement and Double displacement reaction.

Unit 3

Enzyme Inhibition: Reversible inhibition- competitive, uncompetitive and non competitive inhibition, allosteric and irreversible inhibitions. Assay of enzymes: Coupled kinetic assay, units of enzyme activity (IU), Turnover number, purification of enzymes and criteria of purity.

Unit 4

Enzyme catalysis: Tapping the enzyme substratecomplex, use of substrate analogues, enzyme modifications by chemical procedures affecting aminoacid chain, treatment with protease, site directed mutagenesis, Factors contributing to the catalytic efficiency-proximity and orientation, covalent catalysis, acid-base catalysis, metal ion catalysis. Mechanisms of enzymes action-lysozyme, chymotrypsin and ribonuclease.

Unit 5

Vitamin coenzymes: structure and functions, enzyme regulation, feedback inhibition, allosteric kinetics(ATCase), cooperativity, symmetry and sequential models. Isoenzymes (LDH) Multi-enzyme complex (PDH complex), Ribozymes (catalytic RNA) Abzymes (catalytic antibodies), immobilized enzymes and applications.

Suggested Reading and Text Books

1. Principles of Biochemistry general aspects 1983- Smith et al McGraw Hill.
2. Principles of Biochemistry, 2001, nelson & Cox, CBS India.
3. Biochemistry, Leninger, A.H.
4. Text book of Biochemistry, West,E.S., Todd, Manson & Vanbruggen. Macmillon.
5. Organic chemistry, I.L.Finar, ELBS, 1985.
6. Biochemistry, Zubay,C.Addison. Wesley 1986.
7. Biochemistry of Nucleic acides, Adams.e.T.Al. Chapmann and Hall, 1986

Course Outcomes (COs): On completion of this course, the students will be

CO	Description	Bloom's Taxonomy Level
CO1	**Remember** the different basic concepts and introduction to enzyme technology: effect of temperature, pH and substrate concentration on reaction rate. Interpret the application of Michaelis- Menten equation and enzyme kinetics. Understand and illustrate mechanism of enzyme action, Enzyme Inhibition, Enzyme catalysis, vitamins and coenzymes. Compare different methods of enzyme immobilization and analyze their respective industrial application, functional relationship of enzyme.	1 Remembering
CO2	**Understand** and remember the specific concepts ofenzyme technology: effect of temperature, pH and substrate concentration on reaction rate. Interpret the application of Michaelis- Menten equation and enzyme kinetics. Understand and illustrate mechanism of enzyme action, Enzyme Inhibition, Enzyme catalysis, vitamins and coenzymes. Compare different methods of enzyme immobilization and analyze their respective industrial application, functional relationship of enzyme.Exhibit competent scientific writing (with critical analysis) and enhance presentation skills.	1,2 Remembering, Understanding
CO3	**Applying,** understanding and remembering the detailed processes, essential techniques and features of enzyme technology: effect of temperature, pH and substrate concentration on reaction rate. Interpret the application of Michaelis - Menten equation and enzyme kinetics. Understand and illustrate mechanism of enzyme action, Enzyme Inhibition, Enzyme catalysis, vitamins and coenzymes. Compare different methods of enzyme immobilization and analyze their respective industrial application, functional relationship of enzyme. Demonstrate technical skills to conduct experiments operate various analytical techniques and instruments, and ability to interpret data to derive a solution/ conclusion to complex problem and decision making for higher studies, employment and advanced research in industrial and academic scale.	1,2,3 Remembering, Understanding, Demonstrating
CO4	**Analyzing,** applying, remembering and understanding the detailed study related to demonstrate the scientific knowledge ofenzyme technology: effect of temperature, pH and substrate concentration on reaction rate. Interpret the application of Michaelis - Menten equation and enzyme kinetics. Understand and illustrate mechanism of enzyme action, Enzyme Inhibition, Enzyme catalysis, vitamins and coenzymes. Compare different methods of enzyme immobilization and analyze their respective industrial application, functional relationship of enzyme.	1,2,3,4 Remembering, Understanding, Applying, Analyzing

CO5	**Evaluating,** analyzing, applying, remembering, and understanding the principle, methods, properties and functions of enzyme technology: effect of temperature, pH and substrate concentration on reaction rate. Interpret the application of Michaelis - Menten equation and enzyme kinetics. Understand and illustrate mechanism of enzyme action, Enzyme Inhibition, Enzyme catalysis, vitamins and coenzymes. Compare different methods of enzyme immobilization and analyze their respective industrial application, functional relationship of enzyme.Exhibit competent scientific writing (with critical analysis) and enhance presentation skills.	1,2,3,4,5 Remembering, Understanding, Applying, Analyzing, Evaluating
CO6	**Constructing (Creating),** Evaluating, Analyzing, demonstrating, remembering, and understanding the take part the enzyme technology: effect of temperature, pH and substrate concentration on reaction rate. Interpret the application of Michaelis - Menten equation and enzyme kinetics. Understand and illustrate mechanism of enzyme action, Enzyme Inhibition, Enzyme catalysis, vitamins and coenzymes. Compare different methods of enzyme immobilization and analyze their respective industrial application, functional relationship of enzyme.	1,2,3,4,5,6 Remembering, Understanding, Applying, Analyzing, Evaluating Creating

Mapping of COs with POs & PSOs

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	3	2	3	2	2	2	3	2	2	2	3	2	3	2
CO2	3	2	2	2	2	2	2	2	3	2	2	2	2	2	2	2
CO3	3	2	2	2	2	2	2	3	3	2	2	2	2	2	2	2
CO4	2	2	2	2	3	2	2	2	2	1	3	2	2	2	2	2
CO5	2	2	2	2	2	2	2	2	3	2	2	2	2	2	2	2
CO6	2	2	2	1	1	3	1	2	2	1	3	2	2	2	2	3

3:High, 2:Medium, 1:Low

Course code	**: MBTMS 203**				
Course Name	**: Molecular Virology and Infections**				
Semester /Year	**: II**				
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. To instill detailed study of the molecular and cellular components that comprises the immune system including their function and interaction to provide a lifelong learning &disciplinary knowledge to implement the concepts.
2. To appraise study of the different analytical techniques for the disease diagnosis, assist advancement and career options in the field of molecular diagnostics and applicate as well emerge with the solutions concerned with health and environment.
3. To broaden the area of understanding the structure, function, components of immune system for better advancement & comprehend the need of tools & techniques with broadening the area in distinguished fields.
4. To comprehend the essential elements of immune system clearing up the facts of theoretical and technical aspects and help in employing the scientific knowledge for development of medical interventions.

Course Contents[Credit = 3]

Unit 1

History of Virology and Bio safety: History and principles of virology, virus taxonomy. Structures of animal and plant viruses and their morphology. Principles of biosafety, containment facilities, maintenance and handling of laboratory animals, and requirements of virology laboratory.

Unit 2

Virus Replication: Structure and replication strategies of bacteriophages - T7, λ, ΦX174, and plant viruses - ss RNA virus (TMV) and ds DNA virus (CaMV). Structure and replication strategies of animal viruses - Influenza virus, Adeno virus and Retro virus.

Unit 3

Interferon and Antiviral Agents: Viral Interference and Interferons. Nature and source of interferons, Classification of interferons.Induction of interferon.Antiviral agents (chemical and biological) and their mode of actions.

Unit 4

Cultivation of Viruses and Viral Vaccines : Cultivation of viruses in embryonated egg, tissue culture and laboratory animals. Conventional vaccines - Killed and attenuated. Modern vaccines - Recombinant proteins, subunits, DNA vaccines, peptides, immunomodulators (cytokines).Vaccine delivery and adjuvants, large-scale manufacturing.

Unit 5

Virological Methods: Methods for purification of viruses with special emphasis on ultracentrifugation methods. Quantitative diagnostic methods - Haemagglutination, complement fixation, neutralization, Western blot, flow cytometry. Nucleic acid based diagnosis - PCR, microarray and nucleotide sequencing. Application of Microscopic techniques - Fluorescence, confocal and electron microscopic techniques.

Suggested Reading and Text Books

1. General Virology - Luria and Darnel Virology and Immunology - Jokli
2. Text book of Virology - Rhodes and Van Royen
3. Plant Virology - Smith
4. Genetics of bacteria and their viruses - W. Hayes
5. Molecular Biology of the gene - Watson, Roberts, Staitz and Weiner
6. A laboratgory guide in virology - Charles H. Lunningham
7. Basic lab procedures in diagnostic virology - Marty Cristensen
8. Review of medical microbiology - Jawitz et al
9. Medical laboratory Manual for tropical countries Vol I & II by Monica Cheesbrough
10. Text Book of Microbiology - Ananthanarayanan and Jayaram Paniker Viral and Ricketsial

Course Outcomes (COs): On completion of this course, the students will be

CO	Description	Bloom'sTaxonomyLevel
CO1	**Remember** the different basic concepts and introduction to Molecular virology and infections: History of Virology and Bio safety, Virus Replication, Interferon and Antiviral Agents, Cultivation of Viruses and Viral Vaccines, Virological Methods: Methods for purification of viruses with special emphasis on ultracentrifugation methods.	1 Remembering
CO2	**Understand** and remember the specific concepts of Molecular virology and infections: History of Virology and Bio safety, Virus Replication, Interferon and Antiviral Agents, Cultivation of Viruses and Viral Vaccines, Virological Methods: Methods for purification of viruses with special emphasis on ultracentrifugation methods. Exhibit competent scientific writing (with critical analysis) and enhance presentation skills.	1,2 Remembering, Understanding
CO3	**Applying,** understanding and remembering the detailed processes, essential techniques and features of Molecular virology and infections: History of Virology and Bio safety, Virus Replication, Interferon and Antiviral Agents, Cultivation of Viruses and Viral Vaccines, Virological Methods: Methods for purification of viruses with special emphasis on ultracentrifugation methods. Demonstrate technical skills to conduct experiments operate various analytical techniques and instruments, and ability to interpret data to derive a solution/ conclusion to complex problem of virology and infections.	1,2,3 Remembering, Understanding, Demonstrating
CO4	**Analyzing,** applying, remembering and understanding the detailed study related to demonstrate the scientific knowledge of Molecular virology and infections: History of Virology and Biosafety, Virus Replication, Interferon and Antiviral Agents, Cultivation of Viruses and Viral Vaccines, Virological Methods: Methods for purification of viruses with special emphasis on ultracentrifugation methods.	1,2,3,4 Remembering, Understanding, Applying, Analyzing
CO5	**Evaluating,** analyzing, applying, remembering, and understanding the principle, methods, properties and functions of Molecular virology and infections: History of Virology and Bio safety, Virus Replication, Interferon and Antiviral Agents, Cultivation of Viruses and Viral Vaccines, Virological Methods: Methods for purification of viruses with special emphasis on ultracentrifugation methods. Exhibit competent scientific writing (with critical analysis) and enhance presentation skills.	1,2,3,4,5 Remembering, Understanding, Applying, Analyzing, Evaluating
CO6	**Constructing (Creating),** Evaluating, Analyzing, demonstrating, remembering, and understanding the Molecular virology and infections: History of Virology and Biosafety, Virus Replication, Interferon and Antiviral Agents, Cultivation of Viruses and Viral Vaccines, Virological Methods: Methods for purification of viruses with special emphasis on ultracentrifugation methods.	1,2,3,4,5,6 Remembering, Understanding, Applying, Analyzing, Evaluating Creating

Mapping of COs with POs & PSOs

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	2	3	3	2	2	3	2	2	2	3	2	3	2
CO2	3	2	3	2	2	2	3	2	3	2	2	2	2	2	2	2
CO3	3	2	2	2	2	2	2	3	3	2	2	2	2	2	2	2
CO4	2	2	2	2	3	2	2	2	2	1	3	2	2	2	2	2
CO5	2	3	2	3	2	2	2	2	3	2	2	2	2	2	2	2
CO6	2	2	2	2	1	3	1	2	2	1	3	2	2	2	2	3

3:High, 2:Medium, 1:Low

Course code	**: MBTMS 204**			
Course Name	**: Basics of Forensic Science**			
Semester /Year	**: II**			
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. To understand the Concept, Need, Importance and History of Forensic Science.
2. To demonstrate the scientific method and the use of problem-solving within the field of forensic science in criminal cases.
3. To demonstrate competency in the collection, processing, analyses, and evaluation of evidence under forensic science.
4. To understand the role of the biotechnology and bioanalytical tools for forensic science within the criminal justice system.

Course Contents [Credit = 3]

Unit 1

Introduction and principles of forensic science, forensic science laboratory and its organization and service, tools and techniques in forensic science, branches of forensic science, causes of crime, role of modus operandi in criminal investigation. Classification of injuries and their medico-legal aspects, method of assessing various types of deaths.

Unit 2

History of Development of Forensic Science in India Functions of forensic science. Historical aspects of forensic science. Definitions and concepts in forensic science. Scope of forensic science. Need of forensic science. Basic principles of forensic science.

Unit 3

Classification of fire arms and explosives, introduction to internal, external and terminal ballistics. Chemical evidence for explosives. General and individual characteristics of handwriting, examination and comparison of handwritings and analysis of ink various samples.

Unit 4

Role of the toxicologist, significance of toxicological findings, Fundamental principles of fingerprinting, classification of fingerprints, development of finger print as science for personal identification

Unit 5

Principle of DNA fingerprinting, application of DNA profiling in forensic medicine, Investigation Tools, e-Discovery, Evidence Preservation, Search and Seizure of Computers, Introduction to Cyber security.

Suggested Reading and Text Books

1. Fundamentals of forensic science Book by Max M Houck.
2. Forensic Science: The Basics, Second Edition by Jay A. Siegel and Kathy Mirakovits.

Course Outcomes (COs): On completion of this course, the students will be

CO	Description	Bloom's Taxonomy Level
CO1	**Remember** the different basic concepts of introduction and principles of forensic science, forensic science laboratory and its organization and service, Classification of fire arms and explosives, Role of the toxicologist and findings, Principle of DNA fingerprinting, application of DNA profiling in forensic medicine and introduction to Cyber security.	1 Remembering
CO2	**Understand** and remember the specific and basic concepts of forensic science, forensic science laboratory and its organization and service, Classification of fire arms and explosives, Role of the toxicologist and findings, Principle of DNA fingerprinting, application of DNA profiling in forensic medicine and introduction to Cyber security.	1,2 Remembering, Understanding
CO3	**Applying,** understanding and remembering the detailed processes, essential techniques and features of forensic science, forensic science laboratory and its organization and service, Classification of fire arms and explosives, Role of the toxicologist and findings, Principle of DNA fingerprinting, application of DNA profiling in forensic medicine and introduction to Cyber security.	1,2,3 Remembering, Understanding, Demonstrating
CO4	**Analyzing,** applying, remembering and understanding the detailed study related to concepts of crime scene detection methods, forensic science, forensic science laboratory and its organization and service, Classification of fire arms and explosives, Role of the toxicologist and findings, Principle of DNA fingerprinting, application of DNA profiling in forensic medicine and introduction to Cyber security.	1,2,3,4 Remembering, Understanding, Applying, Analyzing
CO5	**Evaluating,** analyzing, applying, remembering, and understanding the principle, methods, properties and functions of forensic science, forensic science laboratory and its organization and service, Classification of fire arms and explosives, Role of the toxicologist and findings, Principle of DNA fingerprinting, application of DNA profiling in forensic medicine and introduction to Cyber security.	1,2,3,4,5 Remembering, Understanding, Applying, Analyzing, Evaluating
CO6	**Constructing (Creating),** Evaluating, Analyzing, demonstrating, remembering, and understanding the take part in forensic science, forensic science laboratory and its organization and service, Classification of fire arms and explosives, Role of the toxicologist and findings, Principle of DNA fingerprinting, application of DNA profiling in forensic medicine and introduction to Cyber security.	1,2,3,4,5,6 Remembering, Understanding, Applying, Analyzing, Evaluating Creating

Mapping of COs with POs & PSOs

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	3	3	3	3	3	3	2	3	2	2	2	3	2	3	2
CO2	3	3	2	2	2	2	3	3	2	3	3	3	2	2	3	2
CO3	3	3	2	2	2	2	2	2	3	2	2	3	3	2	3	2
CO4	3	2	2	3	2	3	2	2	3	1	3	3	2	2	3	3
CO5	3	2	2	2	2	2	2	2	3	3	2	3	2	2	2	2
CO6	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2

3:High, 2:Medium, 1:Low

Course code	**: MBTMS 205**			
Course Name	**: Agriculture Biotechnology**			
Semester /Year	**: II**			
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. To acquire sound knowledge pertaining to concepts, principles widespread tools and techniques involved in agricultural biotechnology along with designing of protocols for crop improvement and conservation.
2. To study about microbes (plant growth promoting rhizobacteria) which support plant growth and development along with specific reference to siderophores, biofertilizer, biopesticides and nitrogen fixation.
3. To acquire conceptual and practical knowledge pertaining to tools and techniques involved in plant genetic engineering along with critical analysis of ethical issues associated with production and release on GMO's and concept of integrated pest management.
4. To identify and appraise widespread applications of agriculture biotechnology and gene transfer technology pertaining to enhancing crop productivity, increasing shelf life producing biotic and abiotic stress tolerant plants.

Course Contents[Credit = 3]

Unit 1

Introduction to Agricultural biotechnology, Crop improvement hybridization and plant breeding techniques. Micropropagation and plant tissue culture technique and its application in agriculture. Somatic hybridization, haploid production and cryopreservation.

Unit 2

Agricultural microbiology: Introduction, Biofertilizers: VAM production and applications, *Azolla, Azospirillum, Frankia, Azotobacter, Cyanobacteria*. Microbial insecticides, biocontrol agents and applications.Concepts on plant growth promoting bacteria, Siderophores.Bacterial diseases of agriculture and aquaculture.Mechanism of biological nitrogen fixation process, study of NIF, NOD and HUP genes in nitrogen fixation process.

Unit 3

Different methods of gene transfer to plant genetic engineering for crop improvement. Current status of transgenic, Bioethics and biosafety norms and controlled field trials and release of transgenic (GMOs).

Unit 4

Applications of Plant Genetic Engineering – crop improvement, herbicide resistance, insect resistance, virus resistance, plants as bioreactors. BT gene, Application of Plant Transformation for productivity and performance, Study of biopesticides used in agriculture (neem as example), integrated pest management.

Unit 5

Genetic modification in Agriculture, Transgenic Plants and Crop Improvement Transgene plants with beneficial traits (biotic stresses, Virus resistance, Abiotic stresses, Herbicide resistance, storage, Protein quality, increasing shelf-life) in plant genetic engineering.

Suggested Reading and Text Books

1. Nag. A., Textbook of Agricultural Biotechnology, PHI Learning, 2008, 1st Edition.
2. George, A., Principles of Plant Genetics and Breeding, Wiley-Blackwell, 2012, 2nd Edition.
3. Bonnen, J. J. 1983. Historical sources of U.S. agricultural productivity: implications for R&D policy and social science research. Am. J. Agric. Eco. 65:958–966.

Course Outcomes (COs): On completion of this course, the students will be:

CO	Description	Bloom's Taxonomy Level
CO1	**Remember** the different basic concepts of introduction to general character of agriculture biotechnology, crop hybridization and differentiation, Agricultural microbiology, Different methods of gene transfer to plant, transgenesis, Plant Genetic Engineering and gene modification in agriculture.	1 Remembering
CO2	**Understand** and remember the specific and basic concepts of agriculture biotechnology, crop hybridization and differentiation, Agricultural microbiology, Different methods of gene transfer to plant, transgenesis, Plant Genetic Engineering and gene modification in agriculture, methods, applications basis and disadvantages.	1,2 Remembering, Understanding
CO3	**Applying,** understanding and remembering the detailed processes and features of plant biotechnology, cryo and organogenic differentiation, types of culture, In vitro haploid production, protoplast Isolation and fusion and Plant Growth Promoting bacteria. Somaclonal variation nomenclature, methods, applications basis and disadvantages.	1,2,3 Remembering, Understanding, Demonstrating
CO4	**Analyzing,** applying, remembering and understanding the detailed study related to agriculture biotechnology, crop hybridization and differentiation, Agricultural microbiology, Different methods of gene transfer to plant, transgenesis, Plant Genetic Engineering and gene modification in agriculture.	1,2,3,4 Remembering, Understanding, Applying, Analyzing
CO5	**Evaluating,** analyzing, applying, remembering, and understanding the agriculture biotechnology, crop hybridization and differentiation, Agricultural microbiology, Different methods of gene transfer to plant, transgenesis, Plant Genetic Engineering and gene modification in agriculture methods, applications basis and disadvantages.	1,2,3,4,5 Remembering, Understanding, Applying, Analyzing, Evaluating
CO6	**Constructing (Creating),** Evaluating, Analyzing, demonstrating, remembering, and understanding the take part in agriculture biotechnology, crop hybridization and differentiation, Agricultural microbiology, Different methods of gene transfer to plant, transgenesis, Plant Genetic Engineering and gene modification in agriculture. Applications of agriculture biotechnology.	1,2,3,4,5,6 Remembering, Understanding, Applying, Analyzing, Evaluating Creating

Mapping of COs with POs & PSOs

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
CO2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
CO3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
CO4	3	2	2	3	2	2	2	2	2	1	3	2	2	2	2	2
CO5	2	2	2	2	2	2	2	2	3	2	2	2	2	2	2	2
CO6	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2

3:High,2:Medium,1:Low