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

(Two Year Course- Semester System)

School of Basic and Applied Sciences

(Effective from Academic Session 2021-2022-Onward)

C U R R I C U L U M

M. Sc. BIOTECHNOLOGY POSTGRADUATE DEGREE PROGRAMME (2021-22 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 two years (two full academic years) which shall be divided in to four semesters. Each semester will be of six. months . Actual teaching in each semester is required minimum of 90 days. The examination for the first and third semester will normally be held in the month of December and for the second and fourth 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 Two Year Full Time M.Sc. Biotechnology unless he/she has successfully completed a three year Under Graduate Degree (with any biological subject) 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 three year Bachelor Degree 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 counseling 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 and III Semester) : generally July to November/December

Even Semester (II and IV 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 practicals and dissertation.

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

8. Roll Numbers and Enrollment 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)-Two Year Programme- Choice Based Credit System (CBCS)

Master's Program in Biotechnology shall be based on the choice based credit system 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 a Master's Degree Program in Biotechnology after he/she has successfully completed a three year undergraduate degree or earned prescribed number of credits through the examinations conducted by University as equivalent to an undergraduate degree.
Core courses prescribed for every Semester shall be mandatory for all students registered for the Master's Program in Biotechnology and shall carry minimum 66 credits. There shall be Elective courses offered in semester III and IV and shall carry a minimum of 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 (III/IV). The self study course shall be based on advanced topics.
In order to qualify for a two year master's degree, a student must acquire a minimum of 86 credits including a minimum of 20 credits in electives choosing at least two electives in Semester III offered either by the parent department or other departments and one qualifying self-study course.
The dissertation is a semester long core course of 09 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 minor research work/ project work/ practical training. The students may complete the dissertation work in the department/ other research institutes/ industries/ hospitals etc.
The 2- Year Masters Programme will have the following components:

1) Core course (C): Minimum 66 credits

2) Elective course (E): Minimum 20 credits (11 credits in III Semester and 09 credits dissertation in IV Semester)
3) 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 65%.
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. A candidate who fails to put in at least 75% attendance in the II semester shall not be promoted to III semester. Such candidates may apply to the Dean/HOD for re-registration in the II 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.
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.

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: **2 Years**

STUDY & EVALUATION SCHEME
Choice Based Credit System /ECS
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	MBTC 101	Cell Biology, Developmental Biology & Biophysics	4	0	0	4	40	60	100
2	Core	MBTC 102	Biological Tools & Radiotracer Techniques	4	0	0	4	40	60	100
3	Core	MBTC 103	Molecular Biology & Genetics	4	0	0	4	40	60	100
4	Core	MBTC 104	Biochemistry	4	0	0	4	40	60	100
Practical										
1	Core	MBTL 105	Lab Course 1 based on course MBTC 101 & MBTC 102	0	0	3	3	40	60	100
2	Core	MBTL 106	Lab Course 2 based on course MBTC 103 & MBTC 104	0	0	3	3	40	60	100
			Total	16	0	6	22	240	360	600

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

Second 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	MBTC 201	Immunology	4	0	0	4	40	60	100
2	Core	MBTC 202	Microbiology & Microbial Genetics	4	0	0	4	40	60	100
3	Core	MBTC 203	Molecular Endocrinology & Enzymology	4	0	0	4	40	60	100
4	Core	MBTC 204	Biomaths, Biostats, Computers Programming & Applications	4	0	0	4	40	60	100
5	*Skill	MBTS 207	Epigenetics & Cancer Biology	4	0	0	4	40	60	100
6	*Skill	MBTS 208	Industrial Microbiology	4	0	0	4	40	60	100
Practical										
1	Core	MBTL 205	Lab Course 1 based on course MBTC 201 & MBTC 202	0	0	3	3	40	60	100
2	Core	MBTL 206	Lab Course 2 based on course MBTC 203 & MBTC 204	0	0	3	3	40	60	100
			Total	16	0	6	22	240	360	600

L – Lecture, T – Tutorial, P – Practical, C – Credit
*Skill= Not compulsory in II Semester

Third 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	MBTC 301	Recombinant DNA Technology & Genomics	4	0	0	4	40	60	100
2	Core	MBTC 302	Bioinformatics, Legal Biotechnology & Bio Business Management	4	0	0	4	40	60	100
3	Elective	MBTE 304	Food and Beverages Biotechnology	4	0	0	4	40	60	100
		MBTE 305	Research Methodology: Tools & Techniques	4	0	0	4	40	60	100
		MBTE 306	Chemical Sciences & Biomaterials	4	0	0	4	40	60	100
4	Elective	MBTE 307	Pharmaceutical Biotechnology & Drug Designing	4	0	0	4	40	60	100
		MBTE 308	Plant Biotechnology	4	0	0	4	40	60	100
		MBTE 309	Advanced Bioinformatics	4	0	0	4	40	60	100
5	Skill Self Study (Any one)	MBTS 311	Bio – Entrepreneurship	4	0	0	4	40	60	100
6		MBTS 312	IPR, Patenting & Bioethics	4	0	0	4	40	60	100
7		MBTS 313	Biomedical Technology	4	0	0	4	40	60	100
8		MBTS 314	Genomics and Proteomics	4	0	0	4	40	60	100
Practical										
1	Core	MBTL 303	Lab Course 1 based on course MBTC 301 & MBTC 302	0	0	3	3	40	60	100
2	Core	MBTL 310	Lab Course 2 based on course MBTE 304/305/306 & MBTE 307/308/309	0	0	3	3	40	60	100
			Total	20	0	6	26	280	420	700

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

Fourth 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	MBTC 401	Cell & Tissue Culture	4	0	0	4	40	60	100
2	Core	MBTC 402	Environmental Biotechnology & Bioprocess Engineering	4	0	0	4	40	60	100
3	Core	MBTE 404	Dissertation	0	0	0	9	60	240	300
4	*Skill	MBTS 405	Enzyme Technology	4	0	0	4	40	60	100
5	*Skill	MBTS 406	Molecular Virology & Infections	4	0	0	4	40	60	100
6	*Skill	MBTS 407	Basics of Forensic Science	4	0	0	4	40	60	100
7	*Skill	MBTS 408	Agriculture Biotechnology	4	0	0	4	40	60	100
Practical										
1	Core	MBTL 403	Lab Course 1 based on course MBTC 401 & MBTC 402	0	0	3	3	40	60	100
			Total	8	0	3	20	180	420	600

L – Lecture, T – Tutorial, P – Practical, C – Credit
*Skill= Not compulsory in IV Semester

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	**30 Marks**	**30 Marks**	**240 Marks**

Master of Science (Biotechnology)

Course code : MBTC 101				
Course Name : Cell Biology, Developmental Biology, Biophysics				
Semester /Year : I				
	L	**T**	**P**	**C**
	4	**0**	**0**	**4**

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

Course Objectives: The objectives of this course are

1. To study and provide profound knowledge about the cell ultrastructure, physiological and molecular pathways within cell.
2. To study the cell organelles, basic components of prokaryotic and eukaryotic cells. cellular motility and transportation mechanism
3. To study the cell-signaling pathways for cellular division or cell cycle and molecular level pathways in a living organisms.
4. To study about the cancer, types, molecular basis of cancer, mutation, genes for cancer and cell death and mode of action.

Couse Contents [Credit = 4]

Unit 1

Plasma membrane: Structure, organisation, lipid bilayer, proteins & glycoconjugates, liposomes. Function- Ionic transport, types of transport (symport, antiport, active & passive), channel proteins. Structure, organization and functions of Nucleus, Mitochondria, lysosome, Golgi body, Chloroplast, Peroxisome, Endoplasmic reticulum (Rough and smooth). Structure and functions, Microfilament, Microtubules and Intermediate filament.

Unit 2

Vesicular traffic in the secretory and endocytic pathway: transport from endoplasmic reticulum through the Golgi network to lysosome, endocytosis, exocytosis, Molecular mechanisms of vesicular transport and the maintenance of compartments diversity. Cell signaling: General principles (Types of signaling). Cell surface receptor mediated signaling (ion channel, G protein and enzyme linked).

Unit 3

Cell cycle, Molecular events and regulation. Cell division: General strategy and regulation, Molecular mechanism of mitosis and meiosis. Cancer- Biology: Types of cancer, onset of cancer, Proto-oncogenes and tumor suppresser genes, Oncogenic mutations affecting cell proliferation, cell cycle and genome stability.Programmed cell death, Apoptosis.

Unit 4

Developmental Biology: Gametogenesis: Spermatogenesis and Oogenesis including structure, differentiation and longevity of gametes. Chemical and metabolic events during gamete formation. Types of eggs. Fertilization: Significance of fertilization, approximation of gametes, Capacitation, Acrosome reaction, formation of fertilization membrane, egg activation, Blockage to polyspermy, Parthenogenesis.

Unit 5

Cleavage: Patterns, control of cleavage patterns, chemical changes during cleavage.
Physical phenomena and processes in the living organisms. Principle of measurement. Applications of ultrasound in medical diagnostics. X-rays, their properties.

Course outcomes (COs):

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

CO1	Acquire knowledge about structural organization of cellular components and methods of transport across cell membrane.
CO2	Identify different molecules involved in cell adhesion, intracellular communication and their significance.
CO3	Comprehend techniques, processes and mechanism involved in cellular signaling, cell division and analyzes their applications.
CO4	Understand and analyze molecular mechanism of cancer biology and their significance in studies related to health and medicine.

Suggested Reading and Text Books

1. Lodish et al.: Molecular Cell Biology (4th ed.)
2. Alberts et al.: Molecular Biology of the cell (3rd ed.)
3. Scott F. Gilbert: Developmental Biology (5th ed.)
4. Zubay, Parson & Vance: Principles of Biochemistry
5. De Robertes & Robertis: Cell & Molecular Biology, 1987, Lee & Fabiger Philadelplna

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	3	3	3	2	2	3	2	3	3
CO2	3	2	3	2	3	2	3	2	3	2	3	3
CO3	2	2	2	2	3	2	2	2	3	2	3	3
CO4	2	2	3	2	3	2	3	2	3	2	3	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code : MBTC 102				
Course Name : Biological & Radiotracer Techniques				
Semester /Year : I				
	L	**T**	**P**	**C**
	4	**0**	**0**	**4**

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.

Couse Contents [Credit = 4]

Unit 1

Analytical separation methods : Chromatography - General principle and application Adsorption chromatography, Partition chromatography, Gas chromatography, liquid chromatography, Paper chromatography, Thin layer chromatography, Gel filtration chromatography, Ion exchange chromatography, Affinity chromatography, HPLC (High Performance/Pressure Liquid chromatography).

Unit 2

Electrophoresis - General principle and application of Paper electrophoresis, Moving boundary method, Gel electrophoresis (Native, Denaturing & Reducing), Disc Gel electrophoresis, Slab Gel electrophoresis, Isoelectrofocussing (IEF), Isotachophoresis.

Unit 3

Centrifugation: Basic principles. Common centrifuges used in laboratory (clinical, high speed & ultra centrifuges). Sedimentation rate, Sedimentation coefficient, Zonal centrifugation, Equilibrium density gradient centrifugation, Types of rotors (fixed angle, swing bucket), Types of centrifugation: Preparative, differential & density gradient

Unit 4

Basic knowledge of the principles and applications of Microscopy: Light, phase contrast, Fluorescence and Confocal microscopy, Scanning and Transmission Electron microscopy. Biosensors: Introduction & principles. First, second & third generation instruments, cell based biosensors, enzyme immunosensors.

Unit 5

Spectroscopic methods: principle and applications of UV-visible, IR, NMR, ESR Spectroscopy. Principle & application of X-ray crystallography. Application of radioisotopes in biology. Properties and units of radioactivity. Radioactive isotopes and half life. Measurement of radioactivity: GM Counter, gamma counter, liquid scintillation counter. Tracer techniques of Autoradiography, Radioimmunoassay. Safety rules in handling of radioisotopes and hazardous chemicals.

Course outcomes (COs):

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

CO1	Development of scientific, computational and analytical knowledge regarding various tools and techniques in the field of applied science
CO2	Apply modern techniques and their statistical knowledge for solving various scientific problems in industry and research institution.
CO3	Demonstrate the scientific knowledge regarding safety regulations for handling of radioisotopes and other hazardous chemicals in the laboratory
CO4	Demonstrate the principles and working of bio-analytical and radiotracer techniques associated with various techniques related to upstream and downstream process like chromatography, electrophoresis, centrifugation, etc

Suggested Reading and Text Books

1. Sharma, V.K.: Techniques in Microscopy and Cell Biology Tata McGraw Hill, 1991.
2. Alberts et al.: Molecular Biology of the cell (2nd ed.), Garland, 1989.
3. Biochemical Technique: Theory & Practical J.F. Robyt & B.J. White $ 30.95. Waveland Press, Inc.
4. Wilson & Walker: Practical Biochemistry (4th ed) University of Hertfordshire Cambridge University Press.
5. Jayraman: Laboratory Manual in Biochemistry
6. Arnold L. Demain & Julian E. Davies: Manual of Industrial Microbio. & Biotech. 2nd ed.

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	3	3	3	2	2	3	2	3	3
CO2	3	2	3	2	3	2	3	2	3	2	3	3
CO3	2	2	2	2	3	2	2	2	3	2	3	3
CO4	2	2	3	2	3	2	3	2	3	2	3	2

7. 3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code : MBTC 103				
Course Name : Molecular Biology & Genetics				
Semester /Year : I				
	L	**T**	**P**	**C**
	4	**0**	**0**	**4**

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

Course Objectives: The objectives of this course are

1. To provide fundamental aspects of molecular biology with detailed basics of cellular organization and biochemical molecules present in the cell.
2. To understand the basic knowledge molecular events like replication, transcription and translation that is important for cell.
3. To provide basic knowledge and understanding of principle and mechanism of inheritance.
4. To provide students basic knowledge of gene expression ant its regulation in prokaryotes and eukaryotes.

Couse Contents [Credit = 4]

Unit 1

Chemical and physical properties of nucleic acids, Structure and types of RNA and DNA, The Watson-Crick model. DNA as genetic material. Different forms of DNA. Topological properties of DNA. DNA renaturation kinetics.

Unit 2

Mechanism of DNA replication in prokaryotes and eukaryotes. Mechanism of transcription in prokaryotes and eukaryotes. Reverse transcription. Post transcriptional processing of RNA: (capping, polyadenylation, splicing, RNA editing). Mechanism of translation in prokaryotes and eukaryotes.

Unit 3

Concept of genetic code, Gene expression and regulation in prokaryotes (Lac operon and tryptophan operon). Gene expression and regulation in eukaryotes. Introduction to various types of DNA damage and repair. Retrovirus and cancer.

Unit 4

Mendelism: The basic principles and applications of inheritance, exceptions to mendelian law. The chromosomal basis of Mendelism (chromosomal theory of heredity). The molecular structure of chromosome in eukaryotes: structure of chromatin and Higher order packaging in chromosome. Centromere and telomere Giant chromosome : polytene and lampbrush chromosome. Linkage, Recombination and chromosome mapping in eukaryotes. Cytoplasmic inheritance.

Unit 5

Chromosomal Aberrations: Change in Number and Structure. Allelic variation and Gene function. Sex chromosome and sex determination. Dosage compensation of X-linked gene. Sex linked gene in human. Pedigree analysis in man.

Course outcomes (COs):

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

CO1	Depict an understanding of principle, mechanism of basic and advanced molecular biology concepts and techniques.
CO2	Acquire domain-specific knowledge and develop globally relevant skills related to concepts of genetics.
CO3	Identify underlying principle of various methods and techniques utilized in studies related to molecular biology and genetics
CO4	Demonstrate an understanding of molecular pathways that are altered in cancers including oncogenes, tumor suppressors, apoptosis, angiogenesis, and DNA repair.

Suggested Reading and Text Books

1. Lewin: Genes, Vol. VII Oxford, 1998, Inded.
2. Straehan & Read: Human Molecular Genetics 1999, John Wiley & Sons Pte. Ltd.
3. Snustad et al: Principles of Genetics 1997, John Wiley & Sons.
4. De Robertes & Robertis: Cell & Molecular Biology, 1987, Lee & Fabiger Philadelplna.
5. Strickberger: Genetics, 1996, Prentice Hall.
6. Friefelder: Molecular Biology (2^{nd} ed.), 1996 Narosa Publ. House.
7. Alberts et al: Molecular biology of the cell (4^{th} ed.) 1994, Garland Publ. New York.

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	3	3	3	2	2	3	2	3	3
CO2	3	2	3	2	3	2	3	2	3	2	3	3
CO3	2	2	2	2	3	2	2	2	3	2	3	3
CO4	2	2	3	2	3	2	3	2	3	2	3	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code : MBTC 104				
Course Name : Biochemistry				
Semester /Year : I				
	L	**T**	**P**	**C**
	4	**0**	**0**	**4**

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

Course Objectives: The objectives of this course are

1. To provide exposure to the students on biochemical reactions & processes inside the living system providing the detailed concepts on biomolecules.
2. To broadened the understanding of biochemical changes related to physiological alteration in the body and understanding the chemical aspects of biological processes.
3. To instill students the techniques to analyze kinetic data with the aid of quantification experiments and other qualitative & quantitative analysis as of enzymes and how they catalyze reactions as well as enzyme kinetics.
4. To elucidate metabolism of living system well enough for the prediction and control the various changes that occur in cells with the help of theoretical and practical concepts

Couse Contents [Credit = 4]

Unit 1

Enzymes: Classification, overview and specific example Zymogens and their activation (protease and Prothrombin) Enzyme substrate complex: concept of E-S complex, binding sites, active site, specificity, Lock and Key Hypothesis, Induced –Fit Hypothesis, Michaelis-Menten equation and its derivation, Different plots for the determination of Km and Vmax . Enzyme inhibition: types of inhibition, suicide Inhibitor.

Unit 2

Carbohydrate – Classification, structure and functions. Carbohydrate Metabolism I: Pathway and regulation of Glycolysis, Gluconeogenesis, Glycogenolysis, Glycogenesis. Carbohydrate Metabolism II: Citric acid cycle and its regulation, electron transport chain and oxidative phosphorylation, pentose phosphate pathway and its regulation.

Unit 3

Protein – Classification, structure and functions. Urea cycle and its regulation. Conversion of nitrogen to ammonia by microorganisms, overview of amino-acid biosynthesis. N_2 fixation.

Unit 4

Fatty Acids - Classification and structure, Fatty Acid Metabolism: Fatty Acid Oxidation and regulation β-oxidation, Oxidation of unsaturated fatty acids and odd chain fatty acids. Ketone bodies and their over production. Fatty Acid Biosynthesis and Regulation. Cholesterol biosynthesis.

Unit 5

Nucleic Acid - structure and functions. Nucleic Acid Metabolism: Purine biosynthesis and its regulation, pyrimidine biosynthesis and its regulation. Formation of deoxyribonucleotides. Salvage pathway for purine & pyramid in nucleotides, Degradation of purines and pyrimidines into uric acid and urea.

Course outcomes (COs):

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

CO1	Appraise and compare classifications of the biomolecules such as proteins, carbohydrates, amino acids etc in the living system.
CO2	Students to learn the fundamental biochemical principles, such as metabolic pathways, and the regulation of biological/biochemical processess, with applications in the scientific experiments& hypothesis testing.
CO3	Identify concepts and methods isolation & characterization of biomolecules and apply various techniques of allied sciences and come up with ideas resolving issues related to health.
CO4	Comprehend an effective scientific skill and data analysis with qualitative as well as quantitative analysis to understand the base of scientific research and diagnostics.

Suggested Reading and Text Books

1. Lehninger: Principles of Biochemistry, 4th ed., Nelson & Cox, WH Freeman and Company, 2007
2. Voet & Voet: Biochemistry, 2nd ed., Wiley & Sons.
3. Berg, Tymoczko, Stryer: Biochemistry, 5th ed., WH Freeman and Company, 2003.
4. Garett & Grisham: Biochemistry, 4th ed., Brooks/Cole Cengage learning, 2010.
5. Murray, Granner, Rodwell: Harper's Illustrated Biochemistry, 27th ed. McGraw Hill, 2006.
6. Conn & Stumpf: Outlines of Biochemistry, 5th ed., Willey India, 2007.

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	3	3	3	2	2	3	2	3	3
CO2	3	2	3	2	3	2	3	2	3	2	3	3
CO3	2	2	2	2	3	2	2	2	3	2	3	3
CO4	2	2	3	2	3	2	3	2	3	2	3	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code : MBTL 105				
Course Name : Laboratory Course-I				
Semester /Year : I				
	L	**T**	**P**	**C**
	0	**0**	**3**	**3**

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

Couse Contents [Credit = 3]

1. To study the cell organelles, basic components of prokaryotic and eukaryotic cells. cellular motility and transportation mechanism
2. To study and provide profound knowledge about the cell ultrastructure, physiological and molecular pathways within cell.
3. To study about the cancer, types, molecular basis of cancer, mutation, genes for cancer and cell death and mode of action.
4. To study the cell-signaling pathways for cellular division or cell cycle and molecular level pathways in a living organisms
5. To provide scientific and computational knowledge related to various techniques associated with biotechnology.
6. To impart laboratory skills for handling analytical tools in industry and research institution.
7. To give the scientific knowledge regarding safety regulations for handling of instruments in the laboratory and industry.
8. 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	Depict ability to utilize microscopes for study of biological samples and identify applicability of same in biological research.
CO2	Demonstrate skills to prepare temporary mounts to study cell biology, interpret data from observations made and identify applicability of slide preparation in biological research.
CO3	Exhibit conceptual understanding of cellular components and practical skill to isolate cell organelles.
CO4	Identify mechanism involved in transport of molecules across cell membrane and practical significance of the same.
CO5	Development of experimental and operating knowledge regarding various tools and techniques in the field of applied science
CO6	Apply modern techniques and their statistical knowledge for solving various scientific problems in laboratories.
CO7	Demonstrate the scientific knowledge regarding safety regulations for handling of scientific instruments and radioisotopes and other hazardous chemicals in the laboratory.
CO8	Demonstrate the experimental techniques related to upstream and downstream process like chromatography, electrophoresis, centrifugation, etc

Course code : MBTL 106				
Course Name : Laboratory Course-II				
Semester /Year : I				
	L	**T**	**P**	**C**
	0	**0**	**3**	**3**

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

Couse Contents [Credit = 3]

1. To provide students basic knowledge of DNA isolation from various tissues using molecular biology techniques.
2. To understand, learn and apply the principle, tools and techniques of molecular biology, which prepares students for further study and /or higher education and employment.
3. To provide basic knowledge of Mendelian inheritance, concept and principle of pedigree analysis.
4. To provide basic learning of different genetic crosses to enhance the analytical skills in the students.
5. To provide exposure to the students on biochemical reactions & processes inside the living system providing the detailed concepts on biomolecules.
6. To instill students the techniques to analyze kinetic data with the aid of quantification experiments and other qualitative & quantitative analysis as of enzymes and how they catalyze reactions as well as enzyme kinetics.
7. To broadened the understanding of biochemical changes related to physiological alteration in the body and understanding the chemical aspects of biological processes.
8. To elucidate metabolism of living system well enough for the prediction and control the various changes that occur in cells with the help of theoretical and practical concepts.

Course outcomes (COs):

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

CO1	Acquire knowledge about principle and applicability of different techniques, instruments utilized in molecular biology studies.
CO2	Conduct experiments for molecular analysis of biomolecules and analyze results.
CO3	Depict ability to conduct molecular biology studies, interpret observations and data to derive a solution to a problem.
CO4	Identify practical applications of concepts of genetics through experimental and statistical analysis.
CO5	Identify underlying principle of quantitative estimation and applicability of same in biological research.
CO6	Exhibit ability to conduct qualitative analysis for identification of biomolecules.
CO7	Exhibit proficiency in isolation and characterization of biomolecules.
CO8	Demonstrate technical skill to analyze biomolecules through estimation of biochemical parameters and data interpretation.

Course code : MBTC 201				
Course Name : Immunology				
Semester /Year : II				
	L	**T**	**P**	**C**
	4	**0**	**0**	**4**

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.

Couse Contents [Credit = 4]

Unit 1

Overview of the Immune System. Cells and Organs of the Immune System. Antigens. Haptens & Epitopes.

Unit 2

Immunoglobulins: Structure and Function. Major Histocompatibility Complex. Antigen processing and presentation. Structure and functions of BCR & TCR.

Unit 3

Cytokines. Complement System. Cell mediated cytotoxicity: Mechanism of T cell & NK cell mediated lysis. Ab-dependent cell mediated cytotoxicity (ADCC).

Unit 4

Overview of Hypersensititivity and Introduction to Transplantation. Vaccines: Active and Passive Immunization.

Unit 5

Introduction to Monoclonal Antibodies and polyclonal Antibodies. Antigen-Antibody Interactions RIA, ELISA, Western Blotting, Immuno precipitation, Immuno-fluorescence.

Course outcomes (COs):

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

CO1	Acquire knowledge about structure, function and organization of immune system.
CO2	Identify principle, concept and mechanism of various immunological process and techniques and inculcate critical thinking ability to analyze their applicability.
CO3	Identify components of immune response (antibodies, complement system, cytokines, others) their synthesis / activation alongwith understanding of concept of vaccine and vaccination.
CO4	Avail lifelong learning about conceptual and technical aspects of immunological studies as diagnostic tools and utilization in fields of molecular diagnostics, medicine and solving global health issues.

Suggested Reading and Text Books

1. Kuby : Immunology (4^{th} ed.)
2. Roitt, Male & Brostof : Immunology (3^{rd} ed).
3. Elgert & Elgert : Immunology
4. Wilson & Walker: Practical Biochemistry (4^{th} ed.)

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	3	3	3	2	2	3	2	3	3
CO2	3	2	3	2	3	2	3	2	3	2	3	3
CO3	2	2	2	2	3	2	2	2	3	2	3	3
CO4	2	2	3	2	3	2	3	2	3	2	3	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: MBTC 202**			
Course Name	**: Microbiology & Microbial Genetics**			
Semester /Year	**: II**			
	L	**T**	**P**	**C**
	4	**0**	**0**	**4**

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

Course Objectives: The objectives of this course are

1. To provide knowledge about the microbial world, classification and study about the branch of bacteriology, virology, and their distinguishing features associated with them such as morphological, chemical, structural and metabolic characteristics.
2. To learn and study about the laboratory guidelines, sterilization methods, aseptic conditions for microbial culture, genetics, microbial nutrients, culture medium, their type and metabolic pathways.
3. To study about the extra-chromosomal genome or plasmids, their types, properties and bacteriophages genetics and understand the techniques used to study the genetic recombination in bacteria and their role in genetic mapping.
4. To study about the different techniques used to elucidate physiological processes of microbes their growth process and their mode of action, principles, tools and techniques for the screening of microbes and to know their beneficial and harmful effects.

Couse Contents [Credit = 4]

Unit 1

Classification of living organisms and general account of microorganisms: Bacteria, Fungi and Viruses. Introduction to bacteriology: Fine structure of bacteria; Laboratory identification and staining techniques.

Unit 2

Media for microbial culture, selective Differential media and Enriched media; Pure culture techniques, Sterilization techniques. Introduction to virology: classification, general structure and reproduction of viruses. Cultivation of bacteriophages, Plant Viruses, Animal Viruses.

Unit 3

Microbial growth: Synchronous & Diauxic, Factors affecting Microbial growth, Measurement of microbial growth (cell number & cell count). Modes of nutrition: Photoautotrophs, photoorganotrophs, chemolithotrophs, Chemoorganotrophs. Microbial metabolism: Overview of Energy production and utilization, N_2 fixation.

Unit 4

Modes of Genetic Recombination in Bacteria: Conjugation – F-factor, conjugal transfer process, high frequency recombination (hfr) strains. Transformation – competence, DNA uptake by competent cells. Mechanism of transformation.

Unit 5

Transduction – General & specialized transduction. Genetics of bacteriophages: Lytic and lysogenic cycle, expression of phage genes in regulation of lytic and lysogenic circuit.

Course outcomes (COs):

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

CO1	Prior knowledge and acquaintance of microbial diversity, classification systems, and distinguishing features associated with them based on morphological, chemical, structural and metabolic characteristics and their applications.
CO2	Edification of the safety guidelines, agencies and skills to explain the key concepts in population, evolutionary and quantitative genetics of microbes as well as the awareness about the impact of GMO's.
CO3	Proficiency to develop informatics and diagnostic skills, including the use and interpretation of laboratory tests, diagnostic tools to design, implement and analyze data, thereby the technology to overcome the environmental problems and health issues.
CO4	The implication of scientific principles and methods for the screening of desired microbe (s) from the biosphere, to design new models or GMO's for the better management of microbiology techniques, their application and produce cost-effective products.

Suggested Reading and Text Books

1. Tortora, Funke, Case: Microbiology, (9th ed.) Pearson Education, Inc, 2009.
2. Prescott, Harley & Kliens: Microbiology (7th ed.) McGraw-Hill International Edition, 2008.
3. Michael J. Pelczar, E.C.S. Chan, Noel R. Krieg: Microbiology (5th ed.) Tata McGrall-Hill, 2008.
4. Alcamo's Jeffrey C. Pommerville: Fundamental of Microbiology (8th ed.) Jones & Bartlet Publ. 2007.

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	2	2	2	3	3	3	2	2	3	2	3	3
CO2	2	2	3	2	3	2	3	2	3	2	3	3
CO3	2	2	2	2	3	2	2	2	3	2	3	3
CO4	2	2	3	2	3	2	3	2	3	2	3	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: MBTC 203**			
Course Name	**: Molecular Endocrinology & Enzymology**			
Semester /Year	**: II**			
	L	**T**	**P**	**C**
	4	**0**	**0**	**4**

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

Course Objectives: The objectives of this course are

1. To provide the basic knowledge of endocrinology and their molecular aspects.
2. To provide the basic knowledge of endocrine glands, functions and their molecular aspects.
3. To provide the basic knowledge about enzymatic reactions and factors effecting it.
4. To instill the concept and fundamentals about the classification of enzymes.
5. To provide exposure to students about mechanism of enzyme actions and industrial use of enzyme.

Couse Contents [Credit = 4]

Unit 1

Mechanism of hormone action: Signal discrimination, signal transduction and signal amplification. Receptors: identification and physico-chemical properties. Hormone-receptor interaction, binding to cellular receptors. Pineal hormone.Pineal as a photo-transducer. Biosynthesis, secretion and physiological actions of protein hormones.

Unit 2

Biosynthesis, control of secretion & physiological actions of amino acid derived hormones (Thyroid).Environmental Iodine deficiency disorders and thyroid.Pancreatic hormones. Hormonal regulation of carbohydrate, lipid, protein and nucleic acid metabolism.

Biosynthesis of steroid hormones: Steroidogenesis, cellular sites of synthesis. Physiological actions of estrogen, progesterone. Hormonal control of Estrus/ Menstrual cycle. Brief introduction to female & male infertility (causes and diagnosis).

Unit 3

Biosynthesis and control of secretion of adreno corticoids & catecholamines & their physiological actions. Stress & Adrenal. Phytohormones: Introduction to plant growth regulators. Auxins, Gibberlins, Cytokinins. Ethylene: A volatile hormone, Triacontanol, Brassins, Polyamines and Absicisic acid, its role and function. Environment & Hormonal control of flowering in plants.

Unit 4

Historical perspectives of enzyme. Isolation, crystallization and purification of enzymes, Methods of enzyme analysis. Enzyme technology: Methods for large scale production of enzymes. Immobilized and soluble enzymes and their application. Artificial enzyme. Enzyme electrodes, Enzyme reactors. Two substrate reactions: Random ordered and ping pong mechanism.

Unit 5

Mechanism of enzyme action: General mechanistic principle, factors associated with catalytic efficiency: nucleophillic and covalent. Mechanism of reactions catalyzed by enzymes. Specific examples: chymotrypsin, lysozyme, ribonuclease and carboxypeptidase. Allosteric enzymes with special reference to aspartate transcarbomylase and

phosphofructokinase. Concerted and sequential models. Isozymes special reference to lactate dehydrogenase. Ribozymes.

Course outcomes (COs):

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

CO1	To analyze structure, functions and applications of endocrine systems.
CO2	Analyse molecular aspects of endocrinal glands
CO3	Analyze effect of temperature, pH and substrate concentration on reaction rate.
CO4	Interpret the application of Michaelis - Menten equation and enzyme kinetics.
CO5	Understand and illustrate mechanism of enzyme action.
CO6	Compare different methods of enzyme immobilization and analyze their respective industrial application, functional relationship of enzyme.

Suggested Reading and Text Books

1. Endocrinology, Mac E. Hadley: Prentice-Hall International Sixth ed. 2009.
2. Basic and Clinical Endocrinology, F.S. Greenspan & P.H. Forsham: Maruzen Asian Ed. Lange Medical Publ. USA, Singapore
3. Williams Textbook of Endocrinology, Wilson Foster, VII Ed..Saunders Inter. ed. London, 1985.
4. Essential Endocrinology John F. Laycock Peter H. Wise:
5. Lodish et al. Molecular Cell Biology
6. Ross & Stanbury: Plant Physiology

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	3	3	3	2	2	3	2	3	3
CO2	3	2	3	2	3	2	3	2	3	2	3	3
CO3	3	2	2	2	3	2	2	2	3	2	3	3
CO4	2	2	3	2	3	2	3	2	3	2	3	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code : MBTC 204				
Course Name : Biomaths, Biostats, Computers Programming & Applications				
Semester /Year : II				
	L	**T**	**P**	**C**
	4	**0**	**0**	**4**

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

Course Objectives: The objectives of this course are

1. To learn to define and find the solution of arithmetic mean, median and mode, Quartiles, deciles and percentiles.
2. To demonstrate knowledge of chi square test, t-test, distributions, correlation and regression.
3. To develop the concepts of moments, skewness and kurtosis and determining whether the given distribution is normal or not.
4. To understand and illustrate the theory and applications of the probability.
5. To demonstrate computer programming and components of a computer system.

Couse Contents [Credit = 4]

Unit 1

Relation of Life Science with mathematics, Linear function concept, 0.5 coordinate system, trigonometry relations, differentiation & integration concept, logarithms, complex numbers, Plotting of graphs, matrices.

Unit 2

Importance of statistics in biomedical research. Mean, Mode, median, range, mean deviation, standard deviation, standard error, skewness & kurtosis. Correlation & Regression. Probability: Theorems, Addition rules, multiplication rules, probability applications, probability distributions- Binomial, Poisson & Normal Distributions.

Unit 3

Chi square test-characteristics of Chi square test, validity of Chi square test, applications of Chi square test. Test for significance- comparison of means of two samples, comparison of means of three or more samples (f-test, t-test).

Unit 4

Introduction to algorithm, flowchart, problem solving methods, need for computer language, reading C Programs, C Character sets, identifier & keywords, data types, constants & variables, pre-processor directives, operators & expressions, control statements, for, while, do-while loops, if-else, switch, break, continue & goto statements.

Unit 5

Introduction to Computers: Mini, micro, mainframe and super computers. Components of a computer system (CPU, I/O units). Data storage device, Memory concepts. Software and types of software. Elementary idea of Disk operating system (DOS). Elementary ideas of applications of common packages, WINDOWS (95, 98). Computer applications in biology and information communications (databases,e-mail and local networks). Applications of common packages, Microsoft Office: Microsoft word, Microsoft excel, Microsoft Power Point.

Course outcomes (COs):

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

CO1	Learnt the basic knowledge of probability axioms, distributions such as binomial, poison and normal and its applications in multidisciplinary environment.
CO2	Acquired the knowledge of rank correlation, Correlation coefficient, skewness and kurtosis
CO3	Enhanced critical thinking ability by learning Testing of goodness of fit by applying Sampling test such as chi square and t- test, testing of single Mean and two Means.
CO4	Assessed information statistically and explanation of the results to the real-world situations.
CO5	Assessed information computer programming and components of a computer system.

Suggested Reading and Text Books

1. Rajaraman V: Computer Programming in "C". PHI.
2. Yashwant Kanetker: Let us "C" BPB.
3. Peter Norton's: Introduction to Computer.
4. Hoel, P.G: Elementary Statistics John Wiley & Sons, Inc. New York.
5. Mahajan: Methods in Biostatistics (4^{th} ed.) Jaypee Bros. 1984.
6. Sokal & Rohlf: Introduction to Biostatistics, Freeman, Toppan, 1993.
7. D. Rajaraman & V. Rajaraman: Computer primer (2^{nd} ed.) Prentice Hall of India, New Delhi.
8. Roger Hunt & John Shelley: Computer and Commonsense Prentice Hall of India, New Delhi.
9. Norton, Peter: Introduction to Computers (2^{nd} ed.), TMH Publishing Company Ltd., New Delhi.

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	2	2	2	3	3	3	2	2	3	2	3	3
CO2	2	2	3	2	3	2	3	2	3	2	3	3
CO3	2	2	2	2	3	2	2	2	3	2	3	3
CO4	2	2	3	2	3	2	3	2	3	2	3	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code : MBTL 205				
Course Name : Laboratory Course-I				
Semester /Year : II				
	L	**T**	**P**	**C**
	0	**0**	**3**	**3**

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

Couse Contents [Credit = 3]

1. To teach students about the diagnostic significance, Principles of ELISA, RIA, Immunodiffusions etc in clinical approaches and their limitations.
2. To introduce students to the challenges involved in diagnostics & health.
3. To adhere skills regarding the use of all laboratory devices related to immunological tests and kits.
4. Demonstrate the ability to recognize and admit mistakes or discrepancies in laboratory protocols or results and, take appropriate corrective measures.
5. To study about the microbiology techniques and methods for sterilization.
6. To be expertise in isolation, identification, preservation of microbial cell.
7. To learn the about the methods of the preparation of culture media for the cultivation, microbial culture and their analysis.
8. To be expertise in handling of biological samples and analysis of microbial growth pattern or data.

Course outcomes (COs):

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

CO1	Identify principle, procedure laboratory working of various techniques and instruments utilized in immunological studies.
CO2	Availing skill-based learning while performing practical's and acknowledging the applications of immunology in the field of allied sciences to design solution to complex problems.
CO3	Inculcate critical thinking ability to analyze and interpret date obtained from immunological process / response.
CO4	Identify application and employability of immunology in the field of medical diagnostics, researches and industries.
CO5	Practical knowledge of microbiology techniques for microbial sample collection and data analysis.
CO6	Expertise in isolation, identification and preservation of microbial samples.
CO7	Expertise in instrument for sample handling, preparation and their analysis.
CO8	Proficiency in data analysis and perception of samples.

Course code : MBTL 206				
Course Name : Laboratory Course-II				
Semester /Year : II				
	L	**T**	**P**	**C**
	0	**0**	**3**	**3**

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

Couse Contents [Credit = 3]

1. To provide the basic knowledge of endocrinology and their molecular aspects.
2. To provide the basic knowledge of endocrine glands, functions and their molecular aspects.
3. To provide the basic knowledge about enzymatic reactions and factors effecting it.
4. To instill the concept and fundamentals about the classification of enzymes.
5. To provide exposure to students about mechanism of enzyme actions and industrial use of enzyme.
6. To learn to define and find the solution of arithmetic mean, median and mode, Quartiles, deciles and percentiles.
7. To demonstrate knowledge of chi square test, t-test, distributions, correlation and regression.
8. To develop the concepts of moments, skewness and kurtosis and determining whether the given distribution is normal or not.
9. To understand and illustrate the theory and applications of the probability.
10. To demonstrate computer programming and components of a computer system.

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

CO1	To analyze structure, functions and applications of endocrine systems.
CO2	Analyse molecular aspects of endocrinal glands
CO3	Analyze effect of temperature, pH and substrate concentration on reaction rate.
CO4	Interpret the application of Michaelis -Menten equation and enzyme kinetics.
CO5	Understand and illustrate mechanism of enzyme action.
CO6	Compare different methods of enzyme immobilization and analyze their respective industrial application, functional relationship of enzyme.
CO7	Learnt the basic knowledge of probability axioms, distributions such as binomial, poison and normal and its applications in multidisciplinary environment.
CO8	Acquired the knowledge of rank correlation, Correlation coefficient, skewness and kurtosis.
CO9	Enhanced critical thinking ability by learning Testing of goodness of fit by applying Sampling test such as chi square and t- test, testing of single Mean and two Means.
CO10	Assessed information statistically and explanation of the results to the real-world situations.

Course code : MBTS 207				
Course Name : Epigenetics and Cancer Biology				
Semester /Year : II				
	L	**T**	**P**	**C**
	4	**0**	**0**	**4**

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

Course Objectives: The objectives of this course are

1. To provide the basic knowledge of cancer biology and their molecular aspects.
2. To provide the basic knowledge of morphological and ultrastructural properties of cancerous cells.
3. To provide the basic knowledge about cancer biology, cancer biochemistry mode of infection of cancerous cells, possible treatments and preventions.
4. To instill the concept and fundamentals about the classification of carcinogenesis and therapies of cancer.

Couse Contents [Credit = 4]

Unit 1

Introduction, growth characteristics of cancers cells; Morphological and ultrastructural properties of cancer cells. Types of growth: hyperplasia, dysplasia, anaplasia and neoplasia. Nomenclature of neoplasms. Differences between benign and malignant tumors. Epidemiology of cancer.

Unit 2

Cancer biology and biochemistry- Aberrant metabolism during cancer development; Paraneoplastic syndromes; Tumor markers; cellular protooncogenes- oncogene activation. Growth factors-EGF, TNF- and TGF- and growth factor receptors. Signal transduction in cancer. Role of transcription factors.

Unit 3

Carcinogenesis- radiation and chemical carcinogenesis- stages in chemical carcinogenesis- Initiation, promotion and progression. Free radicals, antioxidants in cancer; Viral carcinogenesis -DNA and RNA Viruses. Hormone mediated carcinogenesis in humans.

Unit 4

Cell Cycle Regulation-Tumor suppressor genes p53, p21, Rb, BRACA1 and BRACA2. Telomeres, Telomerase, and Immortality; cell- cell interactions, cell adhesion-invasion And metastasis - VEGF signaling, angiogenesis; Epigenetics-Role of DNA methylation in gene silencing- epigenetic silencing of tumor-suppressor genes; Apoptosis in cancer-Cell death by apoptosis, role of caspases; Death signaling pathways-mitochondrial and death receptor pathways.

Unit 5

Detection of Cancers, Prediction of aggressiveness of Cancer, Different forms of therapy, Chemotherapy, radiation Therapy, and Immuno therapy: advantages and limitations. Epigenetics of cancer, Identification of targets for drug development.

Course outcomes (COs):

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

CO1	To analyze structure, functions and mode of infections of cancerous cells.
CO2	Analyse molecular aspects of carcinogenesis
CO3	Analyze effect of cancer and the reaction rate on human body.
CO4	Interpret the application of Michaelis - Menten equation and enzyme kinetics.
CO5	Understand and illustrate mechanism of preventions against cancer.

Suggested Reading and Text Books

1. The Biological Basis of Cancer: R. G. McKinnell, et al 2nd Ed, Cambridge University Press, 2006.
2. The Biology of Cancer: R. A. Weinberg. Garland Science. 2006.
3. The Molecular Biology of Cancer: S. Pelengaris, M. Khan. Blackwell Publication.
4. Virology a practical approach, Maly B.W.J. IRL Press, Oxford, 1987.
5. Introduction to modern Virology, Dunmock N.J and Primrose.S.B., Blackwel Scientific Publications. Oxford, 1988.
6. An Introduction to Cellular & Molecular Biology of Cancer, Oxford Medical publications, 1991.
7. Gene expression systems. Joseph M. Fernandez & James P. Hoeffler. Academic Press, 1999.
8. Cancer Biology IV Ed Volume2 Raymond W Ruddon M.D. (2007).
9. Cancer Biology (3rd_Edition) Roger J.B. et al (2006).

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	2	2	2	3	3	3	2	2	3	2	3	3
CO2	2	2	3	2	3	2	3	2	3	2	3	3
CO3	2	2	2	2	3	2	2	2	2	2	3	3
CO4	2	2	3	2	3	2	3	2	3	2	3	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: MBTS 208**			
Course Name	**: Industrial Microbiology**			
Semester /Year	**: II**			
	L	**T**	**P**	**C**
	4	**0**	**0**	**4**

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

Course Objectives: The objectives of this course are

1. To familiarize students with the production of industrial chemicals.
2. To impart knowledge about metabolic engineering of secondary metabolism.
3. To teach students about the enzyme and cell immobilization techniques relevant to industrialprocessing.
4. To make students understand the different methods of experimental model for design of microbialgrowth systems.
5. To teach about the enzyme kinetics used in industrial microbiology and bioprocess technology.

Couse Contents [Credit = 4]

Unit 1

Microbes: Classical Domain and Kingdom concepts in classification of microorganisms; Classification of Bacteria according to Bergey's manual; Molecular methods such as Denaturing Gradient Gel Electrophoresis (DGGE), Temperature Gradient Gel Electrophoresis (TGGE), Amplified rDNA Restriction Analysis and Terminal. Restriction Fragment Length Polymorphism (T-RFLP) in assessing microbial diversity; 16S rDNA sequencing.

Unit 2

Microbial Growth: Ultra structure of Archaea (Methanococcus); Eubacteria (E.coli); Unicellular Eukaryotes (Yeast) and viruses (Bacterial, Plant, Animal and Tumor viruses); Microbial growth: Batch, fed-batch, continuous kinetics, synchronous growth, yield constants, stringent response, death of a bacterial cell. Microbial physiology: Physiological adoption and life style of Prokaryotes; Unicellular Eukaryotes and the Extremophiles.

Unit 3

Role of microorganisms in natural system and artificial system; Influence of Microbes on the Earth's Environment and Inhabitants; Ecological impacts of microbes; Symbiosis (Nitrogen fixation and ruminant symbiosis); Microbes and Nutrient cycles; Microbial communication system; Quorum sensing; Microbial fuel cells; Prebiotics and Probiotics; Vaccines.

Unit 4

Microbial Interactions and Infection. Host–Pathogen interactions; Microbes infecting humans, veterinary animals and plants; Pathogenicity islands and their role in bacterial virulence. Basic principles in bioprocess technology; Media Formulation; Sterilization; Thermal death kinetics; Batch and continuous sterilization systems; Primary and secondary metabolites.

Unit 5

Extracellular enzymes; Biotechnologically important intracellular products; exopolymers; Bioprocess control and monitoring variables such as temperature, agitation, pressure, pH. Microbial processes-production, optimization, screening, strain improvement, factors

affecting downstream processing and recovery; Representative examples of ethanol, organic acids, antibiotics etc.

Course outcomes (COs):

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

CO1	Understand about biological and biochemical technology, with a focus on biological products, thedesign and operation of industrial practices.
CO2	Learn about microbial growth systems, history, types of bioprocess technology.
CO3	Know about the diverse applications of bioprocess technology in fermentation industry.
CO4	Understand about the role of microorganisms in natural system and artificial system.

Suggested Reading and Text Books

1. Pelczar MJ Jr., Chan ECS and Kreig NR., Microbiology, 5th Edition, Tata McGraw Hill, 1993.
2. Maloy SR, Cronan JE Jr., and Freifelder D, Microbial Genetics, Jones Bartlett Publishers, Sudbury, Massachusetts, 2006.
3. Crueger and A Crueger, (English Ed., TDW Brock); Biotechnology: A textbook of Industrial Microbiology,
4. G Reed, Prescott and Dunn's, Industrial Microbiology, 4th Edition, CBS Publishers, 1987
5. M.T. Madigan and J.M. Martinko, Biology of Microorganisms, 11th Edition, Pearson Prentice Hall, USA, 2006.

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	3	3	3	2	2	3	2	3	3
CO2	3	2	3	2	3	2	3	2	3	2	3	3
CO3	2	2	2	2	3	2	2	2	3	2	3	3
CO4	2	2	3	2	3	2	3	2	3	2	3	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: MBTC 301**			
Course Name	**: Recombination DNA Technology & Genomics**			
Semester /Year	**: III**			
	L	**T**	**P**	**C**
	4	**0**	**0**	**4**

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.

Couse Contents [Credit = 4]

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.

Course outcomes (COs):

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

CO1	Apply the basic and advanced recombinant DNA techniques for higher studies, employment and advanced research in industrial and academic scale.
CO2	Develop understanding of various modern tools, instruments and RDT techniques and their utilization to solve the society and industry-related problems.
CO3	Acquire domain-specific knowledge and develop globally-relevant skills for academic and professional enhancement.

CO4	Demonstrate an understanding of transgenic technology and applications in health, agriculture and environment, alongwith associated social and environmental issues.
CO5	Knowledge of the biological systems information and the explanation of the key concepts Omics technologies-genomics.
CO6	Comprehend the range of molecular biology techniques for DNA or genome profiling, DNA sequencing/synthesis.

Suggested Reading and Text Books

1. Gene cloning T.A Brown.
2. Molecular Biotechnology, Glick & Pasternak: Panima Publ. Corporation, 1994
3. Molecular biology & Biotechnology (3rded), 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)

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	2	2	2	3	3	3	2	2	3	2	3	3
CO2	2	2	3	2	3	2	3	2	3	2	3	3
CO3	2	2	2	2	2	2	2	2	3	2	3	3
CO4	2	2	3	2	3	2	3	2	3	2	3	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: MBTC 302**			
Course Name	**: Bioinformatics, Legal Biotechnology & Bio Business Management**			
Semester /Year	**: III**			
	L	**T**	**P**	**C**
	4	**0**	**0**	**4**

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.

Couse Contents [Credit = 4]

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, Bibliographics, 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, Biobusiness prospective in India. Management Process & organization, General analysis of Indian Biobusiness, 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 behavior, Marketing of pharmaceuticals and other bioproducts.

Course outcomes (COs):

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

CO1	Development of scientific, computational and analytical knowledge regarding various tools and techniques in the field of applied science
CO2	Apply modern techniques and their statistical knowledge for solving various scientific problems in industry and research institution.
CO3	Demonstrate the scientific knowledge regarding safety regulations for handling of radioisotopes and other hazardous chemicals in the laboratory
CO4	Demonstrate the principles and working of bio-analytical and radiotracer techniques associated with various techniques related to upstream and downstream process like chromatography, electrophoresis, centrifugation, etc

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.

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	3	3	3	2	2	3	2	3	3
CO2	3	2	3	2	3	2	3	2	3	2	3	3
CO3	2	2	2	2	3	2	2	2	3	2	3	3
CO4	3	2	3	2	3	2	3	2	3	2	3	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code : MBTL 303				
Course Name : Laboratory Course-I				
Semester /Year : III				
	L	**T**	**P**	**C**
	0	**0**	**3**	**3**

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

Couse Contents [Credit = 3]

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.
CO5	Development of experimental and operating knowledge regarding various tools and techniques in the field of applied science
CO6	Apply modern techniques and their statistical knowledge for solving various scientific problems in laboratories.
CO7	Demonstrate the scientific knowledge regarding safety regulations for handling of scientific instruments and radioisotopes and other hazardous chemicals in the laboratory.
CO8	Demonstrate the experimental techniques related to upstream and downstream process like chromatography, electrophoresis, centrifugation, etc

Course code	**: MBTE 304**			
Course Name	**: Food and Beverages Biotechnology**			
Semester /Year	**: III**			
	L	**T**	**P**	**C**
	4	**0**	**0**	**4**

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 Biotechbology.
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.

Couse Contents [Credit = 4]

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.

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 Biotechbology.
CO2	Apply modern techniques in spoilage and contamination for solving various scientific problems in food industry and food and beverages related research institution.
CO3	Demonstrate the scientific knowledge regarding safety regulations for handling of hazardous microbes, chemicals and food hygiene in the laboratory
CO4	Demonstrate the biotechnological principles and working food and feed.

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.

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	3	3	3	2	2	3	2	3	3
CO2	2	2	3	2	3	2	3	2	3	2	3	3
CO3	2	2	2	2	3	2	2	2	3	2	3	3
CO4	3	2	3	2	3	2	3	2	3	2	3	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code : MBTE 305				
Course Name : Research Methodology: Tools & Techniques				
Semester /Year : III				
	L	**T**	**P**	**C**
	4	**0**	**0**	**4**

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.

Couse Contents [Credit = 4]

Unit 1

Importance and need of scientific research. Problem identification, obective, 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 representationof 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

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

Course outcomes (COs):

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

CO1	Acquire knowledge on measurement & scaling techniques as well as the quantitative data analysis.
CO2	Development and understanding the various kinds of research, objectives of doing research, research process, research designs and sampling.
CO3	Acquire knowledge regarding awareness of data analysis-and hypothesis testing procedures.
CO4	Develop data analytics skills and meaningful interpretation to the data sets so as to solve the business/Research problem.

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

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	2	2	2	3	3	3	2	2	3	2	3	3
CO2	3	2	3	2	3	2	3	2	3	2	3	3
CO3	2	2	2	2	3	2	2	2	3	2	3	3
CO4	2	2	3	2	3	2	3	2	3	2	3	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: MBTE 306**			
Course Name	**: Chemical Sciences & Biomaterials**			
Semester /Year	**: III**			
	L	**T**	**P**	**C**
	4	**0**	**0**	**4**

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 Orthopedic applications

Couse Contents [Credit = 4]

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. Orthopedic 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.

Course outcomes (COs):

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

CO1	Acquire knowledge on measurement quantitative data analysis of blood compatibility, Interactions of bacteria with biomaterials, Cardio vascular applications and Orthopedic applications.
CO2	Development and understanding the various kinds of research, objectives of doing research related to chemical sciences and biomaterials.
CO3	Acquire knowledge regarding awareness of chemical sciences and biomaterials and several testing procedures.
CO4	Develop data analytical skills and meaningful interpretation to the chemical sciences and 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

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	2	2	2	3	3	2	2	2	3	2	3	3
CO2	3	2	3	2	2	2	3	2	3	2	3	3
CO3	2	2	2	2	3	2	2	2	2	2	3	3
CO4	2	2	3	2	3	2	3	2	3	2	3	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code : MBTE 307				
Course Name : Pharmaceutical Biotechnology & Drug Designing				
Semester /Year : III				
	L	**T**	**P**	**C**
	4	**0**	**0**	**4**

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 = 4]

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 modeling: Quantum mechanical and molecular orbital methods, Introduction to semiempirical, molecular mechanics and ab initio techniques. Potential energy surface, Docking and modeling substrate – receptor interactions. Introduction to s/w tools for CADD.

Course outcomes (COs):

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

CO1	Understand the Need, Importance and applications of biotech products in pharmaceuticals.
CO2	Demonstrate and understanding the scientific method and the use of Drug targeting and drug delivery systems.
CO3	Development of skills and scientific knowledge regarding vaccines and role of biotechnology in development of pharmaceutical drugs. .
CO4	Identify the role of the Pharmaceutical product and their control.

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.

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	2	3	2	2	2	3	2	3	3
CO2	2	2	3	2	2	2	3	2	3	2	2	2
CO3	2	2	2	2	3	2	2	2	2	2	2	3
CO4	2	2	3	2	3	2	3	2	3	2	3	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code : MBTE 308				
Course Name : Plant Biotechnology				
Semester /Year : III				
	L	**T**	**P**	**C**
	4	**0**	**0**	**4**

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- modified crops.

Couse Contents [Credit = 4]

Unit 1

Clonal propagation/micropropagation 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

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

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

Course outcomes (COs):

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

CO1	Understand the Need, Importance and applications of plant biotechnology.
CO2	Understand the concepts of plasticity and totipotency, which are the foundations for plant tissueculture.
CO3	Learn about different kinds of plant culture techniques.
CO4	Understand how Ti plasmid biology been utilized for making transgenic plants.

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.

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	2	2	2	3	3	2	2	2	3	2	3	3
CO2	3	2	3	2	2	2	3	2	3	2	3	3
CO3	3	2	2	2	3	3	2	2	3	2	3	3
CO4	2	2	2	2	3	2	3	2	3	2	3	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code : MBTE 309				
Course Name : Advanced Bioinformatics				
Semester /Year : III				
	L	**T**	**P**	**C**
	4	**0**	**0**	**4**

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.

Couse Contents [Credit = 4]

Unit 1

Introduction to Bioinformatics: Definition and History of Bioinformatics, Introduction to internet, Bibliographic and non bibliographic search, PubMed. 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.

Course outcomes (COs):

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

CO1	Exhibit ability to characterize and select biological databases to obtain required data and identify applicability of same in biological research.
CO2	Acquisition of technical skills to operate search engines through internet interface for data retrieval and recognize significance in biological studies.
CO3	Demonstrate technical skill to select and operate appropriate scoring matrices, interpret data and utilize the same to derive solution / analyze biological data (DNA, RNA, protein).
CO4	Be able to retrieve biological sequence data from various databases. Understand the differences between local and global sequence alignments.

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

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	2	2	2	2	3	2	2	2	3	2	3	3
CO2	2	2	3	2	2	2	3	2	3	2	2	2
CO3	2	2	2	2	2	2	2	2	2	2	2	3
CO4	2	2	3	2	3	2	3	2	3	2	3	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code : MBTL 310				
Course Name : Laboratory Course-II				
Semester /Year : III				
	L	**T**	**P**	**C**
	0	**0**	**3**	**3**

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

Couse Contents [Credit = 3]

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. To enable students acquire knowledge of the fundamental principles of plant tissue culture.
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. To make students understand about various bioinformatics tools used for DNA, RNA and protein 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 Biotechbology.
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 Orthopedic 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.

CO6	Understand the concepts of plasticity and totipotency, which are the foundations for plant tissueculture.
CO7	Exhibit ability to characterize and select biological databases to obtain required data and identify applicability of same in biological research.
CO8	Acquisition of technical skills to operate search engines through internet interface for data retrieval and recognize significance in biological studies.

Course code : MBTS 311				
Course Name : Bio –Entrepreneurship				
Semester /Year : III				
	L	**T**	**P**	**C**
	4	**0**	**0**	**4**

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.

Couse Contents [Credit = 4]

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 upgradation; Assessment of scale of development of

Technology; Managing Technology Transfer; Regulations for transfer of foreign technologies; Technology transfer agencies. Case Studies.

Course outcomes (COs):

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

CO1	Understand the scope and relevance of entrepreneurship.
CO2	Know the detailed process of establishing and running an enterprise.
CO3	Have a sound knowledge of loans and their repayment policies.
CO4	Learn about the running an international entrepreneurial venture.

Suggested Reading and Text Books

1. Handbook of Bioentrepreneurship 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.)

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	2	3	2	2	2	3	2	3	3
CO2	2	2	3	2	2	2	3	2	3	2	2	2
CO3	2	2	2	2	2	2	2	2	2	2	2	3
CO4	2	2	3	2	3	2	3	2	3	2	3	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: MBTS 312**			
Course Name	**: IPR, Patenting and Bioethics**			
Semester /Year	**: III**			
	L	**T**	**P**	**C**
	4	**0**	**0**	**4**

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 licencing of bioproduct, 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.

Couse Contents [Credit = 4]

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.

Course outcomes (COs):

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

CO1	Identify the objectives, concept, applications and prospects of IPR, Patenting & Bioethics.
CO2	Demonstrate ability to utilize IPR, Patenting & Bioethics.
CO3	Exhibit an understanding of concept and types of intellectual property rights and implementation of IPR in protecting biological inventions.
CO4	Comprehend various aspects of drafting of patent application, types and specification of patent application, various treaties and amendments made with an exposure to concept of international patenting.

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

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	3	3	2	2	2	3	2	3	3
CO2	3	2	3	2	2	2	3	2	3	3	2	2
CO3	2	2	2	2	2	3	2	2	2	2	2	3
CO4	2	2	3	2	3	2	3	2	3	2	3	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code : MBTS 313				
Course Name : Biomedical Technology				
Semester /Year : III				
	L	**T**	**P**	**C**
	4	**0**	**0**	**4**

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 = 4]

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.

Course outcomes (COs):

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

CO1	Identify Understand various types of cancer, tumor invasion, markers in cancer research and diagnosis
CO2	Acquire knowledge related to genetic disease, gene diagnosis, gene tracking & other diagnostic application of biomedical technology.
CO3	Understand the concept and types of mutations in molecular biology
CO4	Acquire knowledge related to cellular and molecular mechanisms in biomedical technology.

Suggested Reading and Text Books

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

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	2	2	2	2	3	2	2	2	3	2	3	3
CO2	2	2	3	2	2	2	3	2	2	2	2	2
CO3	2	2	2	2	2	2	2	2	2	2	2	3
CO4	2	2	2	2	3	2	3	2	3	2	3	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code : MBTS 314				
Course Name : Genomics and Proteomics				
Semester /Year : III				
	L	**T**	**P**	**C**
	4	**0**	**0**	**4**

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 = 4]

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. *De novo* sequencing using mass spectrometric data. MALDI-TOF, SELDI, ESI, Protein Sequencing – Edman degradation. Introduction to Comparative Genomics, Metagenomics, Protein engineering.

Course outcomes (COs):

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

CO1	Knowledge of the biological systems information and the explanation of the key concepts Omics technologies-genomics, transcriptomics and proteomics.
CO2	Comprehend the range of molecular biology techniques for DNA or genome profiling, DNA sequencing/synthesis.
CO3	Knowledge of bioinformatics tools for the genomic data storage and analysis of the outgoing research in the area of genomic and proteomic studies
CO4	Erudition skills and computer software for data analysis of genetic data relevant to forensic, conservation, quantitative and evolutionary genetics, genome sequencing, assembly and annotation and summarise and interpretation of the outcomes.

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.

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	2	2	2	2	3	2	2	2	3	2	3	3
CO2	2	2	3	2	2	2	2	2	2	2	2	2
CO3	2	2	2	2	2	2	2	2	2	2	2	3
CO4	2	2	2	2	3	2	3	2	3	2	3	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code : MBTC 401				
Course Name : Cell & Tissue Culture				
Semester /Year : IV				
	L	**T**	**P**	**C**
	4	**0**	**0**	**4**

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

Course Objectives: The objectives of this course are

1. To identify the objectives of cell and tissue culture and understand principles, processes and widespread tools and techniques employed in animal and plant tissue culture studies.
2. To design for animal and plant tissue culture medium, laboratory protocols, data interpretation along with assessment of associated risk factors and safety measures.
3. To study widespread applications of cell and tissue culture (plant as well as animal) process pertaining to health, industry, research etc.
4. Compare and analyze different vectors and methods employed in transgenic technology and to assess applicability of transgenics.

Couse Contents [Credit = 4]

Unit 1

Tissue & Cell Culture: Objectives & goals. Structure & organization of animal and plant cell. Equipments and materials for culture technologies & Aseptic techniques. Safety: Risk assessment, general safety.

Unit 2

Animal cell culture medium: BSS & simple growth medium. Serum free media, Role of CO_2 serum & supplements. Primary cell culture & cell lines, Cell separation, Biology & characterization of cultured cells.

Unit 3

Cell cloning & cell transformation. Application of animal cell culture: stem cell culture, Embryonic stem cells, cell cultured based vaccines. Specialized cell.

Unit 4

Introduction to plant cell & tissue culture, Plant tissue culture media-composition & preparation. Micro propagation, Callus culture, suspension culture, organogenesis. Meristem culture. Haploid culture: Androgenesis & Gynogenesis.

Unit 5

Ti & Ri plasmids, Binary vector, expression vector, cointegrated vector. Transformation: Vector mediated and vector less DNA transfer (Particle bombardment, electroporation, microinjection) in plants. Detection of DNA transfer.

Course outcomes (COs):

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

CO1	Acquire knowledge pertaining to tools and techniques employed in cell and tissue culture studies alongwith assessment of associated risk factors and safety measures.
CO2	Identify different types and aspects of plant and animal cell culture process, including design of culture medium, maintenance of culture, cell separation, etc
CO3	To identify and appraise widespread applications of cell and tissue culture (plant and animal) process pertaining to health, environment, industry and research.
CO4	Compare and analyze different vectors and techniques utilized in transgenic technology and to assess applicability of transgenics.

Suggested Reading and Text Books

1. R. Ian Freshney: Culture of Animal Cells (3rd ed.), Wiley-Liss.
2. M. Butler & M. Dawson: Cell Culture Lab Fax. Eds. Bios Scientific Publ. Ltd. Oxford
3. M.K. Razdon; Plant tissue culture, IBH & Oxford publ. Pvt. Ltd.
4. H. S. Chawla: Introduction to Plant biotechnology. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	2	2	2	2	3	2	2	2	3	2	3	3
CO2	2	2	3	2	2	2	3	2	2	2	2	2
CO3	2	2	2	2	2	2	2	2	2	2	2	3
CO4	2	2	2	2	3	2	3	2	3	2	3	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: MBTC 402**			
Course Name	**: Environmental Biotechnology & Bioprocess Engineering**			
Semester /Year	**: IV**			
	L	**T**	**P**	**C**
	4	**0**	**0**	**4**

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

Course Objectives: The objectives of this course are

1. To provide knowledge related to environmental problems and implication of scientific principles for remediating the environmental problems.
2. To give knowledge related to solutions for effective management of different types of pollution and its remediation.
3. To demonstrate the experimental techniques associated with aseptic process, media preparation and related upstream and downstream process
4. To provide the knowledge related to needs of various parts of fermenter and their operation in laboratory as well as industrial level.

Couse Contents [Credit = 4]

Unit 1

Environmental Biotechnology: Concept, components of environment Air pollution and its control through Biotechnology (deodorization, reduction in CO_2 emission, bioscrubbers, biobeds, biofilters etc). Water pollution and its controls: Sources of water pollution, waste water treatment-physical, chemical and biological processes (aerobic & anaerobic processes) Solid waste: Sources and management (composting, vermiculture and biogas production)

Unit 2

Xenobiotics in Environment: Xenobiotic compounds, Recalcitrance, Bioleaching and Biomining. Bioremediation: Types, in situ and ex situ bioremediation; Bioremediation for herbicides, Pesticides, hydrocarbons and oil spills. Hospital wastes, hazardous waste and their management. Biopesticides in integrated pest management. Biofertilizers.

Unit 3

Global Environmental Problems: Ozone depletion, UV-B, green-house effect and acid rain, their impact and biotechnological approaches for management. Restoration of waste land/degraded ecosystem. Industrial pollution and its control: Pulp & Paper, Tannery, Dairy and Petroleum. Basic concepts of Environmental Impact Assessment (EIA). Environment Management: Concept & Approaches.

Unit 4

Introduction to fermentation processes and types of fermentation Microbial Growth Kinetics; Isolation, Preservation and Improvement of industrially important microorganisms. Production of solvents (Ethanol, Butanol), Antibiotics (Penicillin, Tetracycline) and Alcoholic beverages by fermentation.

Unit 5

Bioreactors: Types and Design; medium rheology. K_{La} measurement and kinetics of media sterilization. Downstrem processing and product recovery.

Course outcomes (COs):

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

CO1	Acquire skills to undertake the environmental problems and implication of scientific principles to design new models with respect to modern trends through biotechnology.
CO2	Interpret and propose solutions for effective management of different types of pollution and its remediation.
CO3	Demonstrate the experimental techniques associated with aseptic process, media preparation and related upstream and downstream process.
CO4	Elaborate the needs of various parts of fermenter and their design operations in laboratory as well as in industrial level.

Suggested Reading and Text Books

1. Bioprocesses and Biotechnology for Functional Foods and Nutraceuticals., Jean R Neeser & J. B German –CRC Press (2004)
2. Environmental Biotechnology, T.R.Srinivas, [1st Ed. ed.] New Age International Pvt Ltd Publishers (2008)
3. Environmental Biotechnology, R.A.Sharma, Pointer Publishers (2007)
4. Environmental Biotechnology (Handbook of Environmental Engineering, Volume 10), Yung-Tse Hung, Lawrence K. Wang, Volodymyr Ivanov, Joo-Hwa Tay, Humana Press. (2010) (1st Ed ed.)

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	2	2	2	2	3	2	2	2	3	2	3	3
CO2	2	2	3	2	2	2	3	2	2	2	2	2
CO3	2	2	2	2	2	2	2	2	2	2	2	3
CO4	2	2	2	2	3	2	3	2	3	2	3	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code : MBTL 403				
Course Name : Laboratory Course-I				
Semester /Year : IV				
	L	**T**	**P**	**C**
	0	**0**	**3**	**3**

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

Couse Contents [Credit = 3]

1. 1. To identify the objectives of cell and tissue culture and understand principles, processes and widespread tools and techniques employed in animal and plant tissue culture studies.
2. To design for animal and plant tissue culture medium, laboratory protocols, data interpretation along with assessment of associated risk factors and safety measures.
3. To study widespread applications of cell and tissue culture (plant as well as animal) process pertaining to health, industry, research etc.
4. Compare and analyze different vectors and methods employed in transgenic technology and to assess applicability of transgenics.
5. To provide knowledge related to environmental problems and implication of scientific principles for remediating the environmental problems.
6. To give knowledge related to solutions for effective management of different types of pollution and its remediation.
7. To demonstrate the experimental techniques associated with aseptic process, media preparation and related upstream and downstream process
8. To provide the knowledge related to needs of various parts of fermenter and their operation in laboratory as well as industrial level.

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

CO1	Identify designing and organization of cell and tissue culture laboratory working and application of various instruments, techniques utilized in culture process.
CO2	Exhibit technical skill required for explants selection, optimize media preparation, sterilization process and inoculation technique.
CO3	Expertise technique of micropropagation for conservation and mass propagation of plant species and ability to interpret observations and data.
CO4	Demonstrate skills to carry out successful transplantation of micropropagated plants from laboratory to natural conditions and application of same in environment conservation.
CO5	Exhibit laboratory skills to undertake the environmental problems and implication of scientific principles to design new models with respect to modern trends through biotechnology.
CO6	Design, develop and analyze the solutions for effective management of different types of pollution and its remediation.and propose solutions for effective management of different types of pollution and its remediation.
CO7	Demonstrate the experimental techniques for media preparations, associated with aseptic process and related upstream, downstream process.
CO8	Development of operating and designing skills of fermenter and various parts of fermenter in laboratory level.

Course code : MBTE 404				
Course Name : Dissertation				
Semester /Year : IV				
	L	**T**	**P**	**C**
	0	**0**	**27**	**27**

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

Couse Contents [Credit = 9]

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

CO1	Acquire ability to analyze scientific advancements to identify a research area, design objectives and utilize modern tools, e-resources for literature survey.
CO2	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.
CO3	Exhibit competent scientific writing (with critical analysis) and enhance presentation skills.

Course code : MBTS 405				
Course Name : Enzyme Technology				
Semester /Year : IV				
	L	**T**	**P**	**C**
	4	**0**	**0**	**4**

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 instill 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

Couse Contents [Credit = 4]

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.

Course outcomes (COs):

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

CO1	Analyze effect of temperature, pH and substrate concentration on reaction rate.
CO2	Interpret the application of Michaelis - Menten equation and enzyme kinetics.
CO3	Understand and illustrate mechanism of enzyme action.
CO4	Compare different methods of enzyme immobilization and analyze their respective industrial application, functional relationship of enzyme.

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

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	2	2	2	2	3	2	2	2	3	2	3	3
CO2	2	2	3	2	2	2	3	2	2	2	2	2
CO3	2	2	2	2	2	2	2	2	2	2	2	3
CO4	2	2	2	2	3	2	3	2	3	2	3	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code : MBTS 406				
Course Name : Molecular Virology and Infections				
Semester /Year : IV				
	L	**T**	**P**	**C**
	4	**0**	**0**	**4**

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.

Couse Contents [Credit = 4]

Unit 1

History of Virology and Biosafety: 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, flowcytometry. Nucleic acid based diagnosis - PCR, microarray and nucleotide sequencing. Application of Microscopic techniques - Fluorescence, confocal and electron microscopic techniques.

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

CO1	At the end of this course students will have through knowledge of the viruses, structures and their properties.
CO2	At the end of the course students will have through knowledge of the viral diagnostic methods and their analysis.
CO3	At the end of this course students will have through knowledge of the virus cell interactions and host cell damage mechanisms.
CO4	By the end of the course students will have through knowledge of the viral replication of DNA and RNA viruses.

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
11. Infections of Man - Horsfall and Jam
12. Virological Procedures - Mitchal Hasking Virologoy - Wilson and Topley
13. Infection and Immunity DH Davies, MA Halablab,, et al (1998) Taylor & Francis Ltd, 1, London
14. Infection and Immunity-Informa_Healthcare, Jon S. Friedland, Liz Lightstone (2004) Taylor & Francis Ltd, 1, London

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	2	3	2	2	2	3	2	3	3
CO2	3	2	3	2	2	2	3	2	2	2	2	2
CO3	2	2	2	2	2	2	2	2	2	2	2	3
CO4	2	2	2	2	3	2	3	2	3	2	3	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code : MBTS 407				
Course Name : Basics of Forensic Science				
Semester /Year : IV				
	L	**T**	**P**	**C**
	4	**0**	**0**	**4**

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.

Couse Contents [Credit = 4]

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, eDiscovery, Evidence Preservation, Search and Seizure of Computers, Introduction to Cyber security.

Course outcomes (COs):

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

CO1	Understand the Need, Importance and History of Development of Forensic Science in India.
CO2	Demonstrate and understanding of the scientific method and the use of problem-solving within the field of forensic science.
CO3	Demonstrate competency in the collection, processing, analyses, and evaluation of evidence under forensic science.
CO4	Identify the role of the biotechnology and bioanalytical tools for forensic science within the criminal justice system.

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.

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	2	2	2	2	3	2	2	2	3	2	3	3
CO2	2	2	3	2	2	2	3	2	2	2	2	2
CO3	2	2	2	2	2	2	2	2	2	2	2	3
CO4	2	2	2	2	3	2	3	2	3	2	3	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code : MBTS 408				
Course Name : Agriculture Biotechnology				
Semester /Year : IV				
	L	**T**	**P**	**C**
	4	**0**	**0**	**4**

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.

Couse Contents [Credit = 4]

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.

Course outcomes (COs):

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

CO1	Exhibit technical skill to isolate plant growth promoting bacteria and ability to record and analyze observations.
CO2	Investigate plant growth promoting activities of microorganism (bacteria) and analyze data to interpret ability of and to function as potent biopesticides in agriculture.
CO3	Expertise technique of plant tissue culture, record observations and interpret data alongwith analyzing impact of vermicomposting, IPM on agriculture and environment.
CO4	Illustrate potential to conduct biochemical analysis of water, soil sample and analyze data to derive solution for agriculture related problems.

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.

CO-PO Mapping

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	2	2	2	2	3	2	2	2	3	2	3	3
CO2	2	2	3	2	2	2	3	2	2	2	2	2
CO3	2	2	2	2	2	2	2	2	2	2	2	3
CO4	2	2	2	2	3	2	3	2	3	2	3	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated