Programme Bye-laws & Syllabus of B.Sc.-M.Sc. Dual Degree in Toxicology

Based on
CHOICE-BASED CREDIT SYSTEM (CBCS) &
CREDIT TRANSFER SYSTEM

APPROVED IN THE BOARD OF STUDIES MEETING - 24.05.2022
(Revised)

Department of Medical Elementology & Toxicology
School of Chemical & Life Sciences
JAMIA HAMDARD (Deemed to be University)
NEW DELHI – 110 062

Department of Medical Elementology & Toxicology

The Department of Medical Elementology and Toxicology is one of the few Departments in India having full-fledged academic programme at Postgraduate and Doctoral levels in Toxicology. The Department has made its mark in toxicological research and has been supported by the Department of Science and Technology (DST) through Fund for Improvement of S&T (FIST) Infrastructure in Universities & Higher Educational Institutions programme and University Grants Commission (UGC) Special Assistance Programme (SAP). Ph.D. degree in Toxicology is being awarded in different fields of toxicology. The Department has collaborative programmes with many reputed institutes such as Indian Institute of Toxicological Research (IITR-CSIR), Lucknow; Central Drug Research Institute (CDRI-CSIR), Lucknow; Indian Institute of Integrative Medicine (IIIM-CSIR), Jammu; Institute of Nuclear Medicine and Allied Sciences (INMAS-DRDO), New Delhi etc.

The Department has received funding support from agencies such as Council of Scientific and Industrial Research (CSIR), Central Council for Research in Unani Medicine (CCRUM), Department of AYUSH, Department of Biotechnology (DBT), Department of Science and Technology (DST), Indian Council for Medical Research (ICMR), Ministry of Environment and Forests and UGC. Every year a good number of students qualify fellowships offered by government agencies. Students who have obtained degree in toxicology have got placements in various companies and R&D institutes such as Sun Pharmaceuticals Ltd., CDRI, IITR, Dabur, Torrent, Cadila, Lupin, Dr. Reddy's Laboratory, Sri Ram Institute of Industrial Research, Nestle, Himalaya etc. The Department's distinguished Alumni as faculty or postdoctoral fellows are spread all over the globe. More emphasis is given to develop academic and research skills of the students. M.Sc. programme has integral component of dissertation work in the fourth semester. After completion of the course students have job opportunities in industry and research organizations. A good number of students qualify NET examinations conducted by UGC-CSIR in life science and forensic science streams. The Department is fully-equipped with sophisticated equipment to perform research in all major fields of toxicology including *in vitro* and *in vivo* toxicity studies.

Thrust Areas of Research

- Chemoprevention of cancer by plant products/indigenous medicines and standardization of such drugs.
- Toxic effects of endocrine disrupting chemicals (EDCs).
- Stress Biology: Oxidative stress and endoplasmic reticulum stress
- Neurodegenerative disorders and their protection.
- Role of trace elements in the manifestation of diseases.
- Ecotoxicity of environmental pollutants and their interactive effects.
- Immunotoxicity of drugs and environmental chemicals and its prevention.
- Molecular mechanism of nanoparticles in toxicity manifestation.
- Animal models of arthritis for study of mechanism of action of protective agents.
- Fruit fly (*Drosophila melanogaster*) as an alternate model of toxicology
- Protein assembly and amyloid toxicity
- Drug discovery against amyloidosis

- Fabrication of amyloid-based smart materials
- The enhancement of sirtuin protein expression through diet.

Research Facilities

The Department has well equipped research facilities and laboratories for research in toxicology and allied fields. There are following distinct research laboratories for – Molecular Carcinogenesis and Chemoprevention, Molecular Toxicology, Molecular Neurobiology, Clinical Toxicology, and Protein Assembly. Besides, there are specialized laboratory facilities as Fly Lab, Cell Culture Facility, and Neurobehavioural Assessment Facility. All the laboratories and research facilities are equipped with equipment and other essential tools.

Vision

To impart education and training to young professionals in the field of toxicology, medical elementology and forensic toxicology for assessment and mitigation of risk of chemicals and drugs to human health and environment.

Mission

1. To enable students to develop critical thinking with regard to impact of chemicals on biosphere.
2. To provide training using state of art tools and techniques to students to assess risk of chemicals and drugs to humans at various levels of biological organization and food web.
3. To train students to the latest development in the field of regulatory framework with respect to use, transport, storage and disposal of hazardous chemicals.
4. To expose students to application aspects of knowledge of toxicology, medical elementology and forensic toxicology for human welfare and environmental protection.

Qualification Descriptors

On completing B.Sc. component of B.Sc.-M.Sc. Dual Degree Programme in Toxicology, the graduates will be able to	
QD 1	Demonstrate scientific temperament and comprehensive knowledge and skills in areas related to toxicology, forensic sciences and other fields of life sciences.
QD 2	Use knowledge and skills required for identifying problems and issues, collection of relevant quantitative and/or qualitative data, analysis and evaluation using methodologies akin to toxicological sciences for formulating evidence-based solutions and arguments.
QD 3	Apply disciplinary knowledge and transferable skills in areas related to toxicological and pharmacological sciences, molecular and cell biology, genetics, biochemistry, ecotoxicology and environmental toxicology, biotechnology to new/unfamiliar contexts in order to solve complex problems with well-defined solutions.
QD 4	Communicate the results of studies undertaken in the biology and biotechnology of drugs and other toxicants accurately in a range of different contexts using the main concepts, constructs and techniques of toxicology.
QD 5	Demonstrate knowledge and transferable skills in teaching, research, scientific writing, patent analysis in organizations in government and private sectors engaged in risk assessment of chemicals in humans, environment, food supply and healthcare management (drugs and medical devices).

Programme Learning Outcomes (PLOs)

On completing B.Sc. component of B.Sc.-M.Sc. Dual Degree Programme in Toxicology, the graduates will be able to	
PLO 1	Propose logical and novel solutions to contemporary problems/issues supported by relevant facts and data;
PLO 2	Develop scientific outlook and the ability to question the existence and relevance of universally accepted scientific concepts in all aspects of life;
PLO 3	Identify, formulate and analyse complex scientific problems using principles of natural and applied sciences;
PLO 4	Comprehend concepts, frameworks and inventions through various learning methods and effectively communicate the same orally or in writing to the stakeholders;
PLO 5	Critically analyse the given scientific data, ascribe meaning to it and draw objective conclusions;
PLO 6	Demonstrate empathetic social concern, skills to effectively participate in civic affairs and democratic decision making;
PLO 7	Imbibe ethical, moral and social values to become cultured and civilised global citizens;
PLO 8	Apply concepts of sustainable development in daily life to carve out a socially relevant and environment friendly living; and
PLO 9	Foster and develop attitude and aptitude for acquisition of multidimensional skills by way of promoting lifelong learning.

Programme Specific Outcomes (PSO's)

On completing B.Sc. component of B.Sc.-M.Sc. Dual Degree Programme in Toxicology, the graduates will be able to	
PSO 1	Provide students basic understanding of toxicology in regards with human health and environment.
PSO 2	Develop student awareness of the importance of toxicology to the environment and society.
PSO 3	Enable students to handle/use appropriate tools/techniques/equipment with an understanding of the standard operating procedures, safety aspects and limitations.
PSO 4	Provide commitment to professional ethics and responsibilities.

Programmes Offered by the Department (Session 2021-22)

B.Sc.-M.Sc. Dual Degree (Toxicology)

Duration: Five years [with exit option at the end of III year (Sixth semester) with B.Sc. (Hons.) in Toxicology]

Seats: 20

Eligibility: Senior Secondary (XII/Intermediate) with Biology/Mathematics from CBSE or any other Board recognized by JH as equivalent thereto, securing at least 50% marks or equivalent CGPA in aggregate

M.Sc. Toxicology

Duration: Two years (Four semesters)

Seats: 40

Eligibility: Pass in B.Sc. or equivalent examination of a recognized university with Zoology/Botany/Chemistry/Toxicology/Forensic Sciences/Life Sciences as one of the subjects securing at least 50% marks in the aggregate.

Selection procedure: Selection for M.Sc. Program in Toxicology will be based on the merit in the qualifying examination. Qualifying exam takes into account the mean average of three years marks of B.Sc. programme. In case, where final year exam results are not declared, the average of last two years marks will be counted for provisional selection of candidates.

Ph.D. Toxicology

Duration: Minimum three years

Seats: As per the availability of the faculty mentors

Eligibility: As per the Ph.D. Ordinance

Selection procedure: Entrance test will be exempted for candidates who have secured fellowship. In case of candidates not possessing any fellowship, there will be entrance tests. Candidates (both with and without fellowship) will have to appear before a committee for a comprehensive interview. Admissions are held twice in a calendar year.

Faculty

Department of Medical Elementology & Toxicology

Prof. (Dr) Sheikh Raisuddin, Head
Dr. Haider A Khan, Associate Professor
Prof. (Dr) Suhel Parvez, Professor
Dr. Basir Ahmad, Assistant Professor (UGC-FRP)
Dr. Md Zeeshan Rasheed, Assistant Professor (Contractual)
Dr. Shahzad Ahmad, Assistant Professor (Contractual)
Dr. Shubhra Pande, Ramanujan Fellow

Structure of B.Sc. (Hons) component of B.Sc.-M.Sc. Dual Degree in Toxicology under CBCS

Core Courses

BTX-CC01: Basics of Computer Science and Statistics
BTX-CC02: Basics of Chemistry
BTX-CC03: Biomolecules
BTX-CC04: Cell Biology
BTX-CC05: Immunology
BTX-CC06: Enzymes and Proteins
BTX-CC07: Introduction to Toxicology
BTX-CC08: Basic Principles of Pharmacology
BTX-CC09: Molecular & Biochemical Basic of Toxicology
BTX-CC10: Drug and Food Toxicology
BTX-CC11: Methods of Toxicology
BTX-CC12: Mechanism in Toxicology
BTX-CC13: Analytical Toxicology
BTX-CC14: Computational Toxicology
BTX-CC15: Medical Chemistry and Drug Designing
BTX-CC16: Drug Regulatory Affairs

Discipline Specific Electives (*Any four*)

Generic Electives (*Any four*)

BTX-GE01-A TH: Basics of Physics and Biology
BTX-GE01-B TH: Basics of Physics and Mathematics
BTX-GE01 TU: Basics of Physics of Biology
BTX-GE02-A: Bioethics and Intellectual Property Rights
BTX-GE02-B: Biotechnology and Human Welfare
BTX-GE03: Virtual Lab in Toxicology
BTX -GE04: Introduction to Data Analysis
BTX -GE05: Biosafety and Bioethics
BTX -GE06: Pathobiology of Diseases

Ability Enhancement Compulsory Courses
BTX-AEC01: English Communication
BTX-AEC02: Environmental Studies

Skill Enhancement Elective Courses
BTX-SEC01: Fundamentals of Pathology
BTX-SEC02: Environmental Toxicology

SCHEME AND COURSE STRUCTURE
w.e.f. 2021-22
B.Sc.- M.Sc. Dual Degree Programme in Toxicology

Course Code	Name of the Paper	Paper Category	IA	SE	Total Marks	Course Credits
SEMESTER–I						
BTX-CC1TH	Basics of Computer Science and Statistics	Core	25	75	100	4
BTX-CC1TU	Basics of Computer Science and Statistics	Core	13	37	50	2
BTX-CC2TH	Basics of Chemistry	Core	25	75	100	4
BTX-AEC1	English Communication	AEC	13	37	50	2
BTX-AEC2	Environmental Studies	AEC	13	37	50	2
BTX-GE-ATH BTX-GE-BTH	Basics of Physics and Biology OR Basics of Physics and Mathematics	GE	25	75	100	4
BTX-GE-1TU	Basics of Physics of Biology	GE	13	37	50	2
For PCM stream students: BSC-GE1-A and For PCB stream students: BSC-GE1-B						
		Total	**141**	**359**	**500**	**20**
SEMESTER–II						
BTX-CC3 TH	Biomolecules	Core	25	75	100	4
BTX-CC4 TH	Cell Biology	Core	25	75	100	4
BTX-CC5 TH	Immunology	Core	25	75	100	4
BTX-CC6 TH	Enzymes and Proteins	Core	25	75	100	4
BTX-GE2-A TH BTX-GE2-B TH	Bioethics and IPR OR Biotechnology and Human Welfare	GE	25	75	100	4
		Total	**125**	**375**	**500**	**20**
SEMESTER–III						
BTX CC-07 TH	Introduction to Toxicology	Core	25	75	100	4
BTX CC-08 TH	Basic Principles of Pharmacology	Core	25	75	100	4
BTX CC-09 TH	Molecular & Biochemical Basic of Toxicology	Core	25	75	100	4
BTX CC-10 TH	Drug and Food Toxicology	Core	25	75	100	4
BTX CC-11 TH	Methods of Toxicology	Core	25	75	100	4
BTX -SEC-01TH	Fundamentals of Pathology	SEC	13	37	50	2
BTX-GEC-01TH	Virtual Lab in Toxicology	GE	13	37	50	2
		Total	**151**	**449**	**600**	**24**
SEMESTER–IV						
BTX-CC2 P	Basics of Chemistry	Core	13	37	50	2
BTX-CC3 P	Biomolecules	Core	13	37	50	2
BTX-CC4 P	Cell Biology	Core	13	37	50	2
BTX-CC5 P	Immunology	Core	13	37	50	2
BTX-CC6 P	Enzymes and Protein ssaed sir	Core	13	37	50	2
BTX CC-12 TH	Mechanism in Toxicology Suhel / Gues Faculty	Core	25	75	100	4
BTX CC-13 TH	Analytical Toxicology Haider /Bashir	Core	25	75	100	4
BTX SEC-02 TH	Environmental Toxicology Prof S. Rais	SEC	13	37	50	2
BTX-GEC-04 TH	Introduction to Data Analysis vikas sood	GE	25	75	100	4
BTX-GEC-04 P	Introduction to Data Analysis vikas sood	GE	13	37	50	2
		Total	**166**	**484**	**650**	**26**
SEMESTER–V						
BTX – CC14	Computational Toxicology	Core	25	75	100	4

BTX – CC15	Medical Chemistry and Drug Designing	Core	25	75	100	4
BTX – CC16	Drug Regulatory Affairs	Core	25	75	100	4
BTX – CC7P	Computational Toxicology –P	Core	25	75	100	4
BTX – CC8P	Medical Chemistry & Drug Designing- P	Core	25	75	100	4
BTX – GE5Th	Biosafety and Bioethics	GE	13	37	50	2
BTX – GE6Th	Pathobiology of Diseases	GE	13	37	50	2
BTX – SEC03	Seminar	SE	13	37	50	2
		Total	**164**	**486**	**650**	**26**
SEMESTER–VI						
BTX-CC17	Dissertation	Core	100	400	500	20
BTX-CC18	Seminar	Core	00	100	100	4
		Total	**100**	**500**	**600**	**24**

IA = Internal Assessment
SE=Semester Exams
TH = Theory
PR = Practical
TU = Tutorial; CC = Core Courses
AEC = Ability Enhancement Compulsory Courses
SEC = Skill Enhancement Courses
DSE = Discipline Specific Elective
GE = Generic Electives

List of Generic Electives from different areas

BIOLOGICAL SCIENCES (Any Three)

1. Entrepreneurship Development
2. Biotechnology and Human Welfare
3. Developmental Biology
4. Secondary Plant Metabolism
5. Post-Harvest Biotechnology
6. Stress Biotechnology
7. Biochemical Correlations in Diseases
8. Stress Biology
9. Bioethics and Biosafety
10. Bio-fertilizers
11. Plant Tissue Culture
12. Reproductive Biology of Angiosperms
13. Seed science Technology
14. Bioinstrumentation
15. Bioethics and IPR
16. Pre and Post-harvest techniques of Medicinal and Aromatic plants
17. Ethnobotany

MATHS (Any Three)

1. Object Oriented Programming in C++ (P)
2. Finite Element Methods
3. Mathematical Finance
4. Econometrics
5. Cryptography and Network Security
6. Information Security
7. Applications of Algebra
8. Combinatorial Mathematics

COMPUTER SCIENCE (Any Three)

1. Computer Fundamentals (4) + Lab (4)
2. Introduction to Database Systems (4) + Lab (4)
3. Introduction to Programming (4) + Lab (4)
4. Computer Networks and Internet Technologies (4) + Lab (4)
5. Multimedia and Applications (4) + Lab (4)
6. Programming in Visual Basic / Gambas (4) + Lab (4)
7. Information Security and Cyber Laws (4) + Lab (4)
8. Web and E-Commerce Technologies (4) + Lab (4)

CHEMISTRY (FOR OTHER COURSES) (Any Three)

1. Atomic Structure, Bonding, General Organic Chemistry, Aliphatic Hydrocarbons
2. Chemical Energetics, Equilibria and Functional Organic Chemistry - I
3. Solutions, Phase Equilibria, Conductance, Electrochemistry, & Functional Group Organic Chemistry - I
4. Transition Metal & Coordination Chemistry, States of Matter & Chemical Kinetics

5. Organometallics, Bio-inorganic Chemistry, Polynuclear Hydrocarbons & UV, IR Spectra
6. Quantum Chemistry, Spectroscopy & Photochemistry
7. Molecules of Life
8. Chemistry of Main Group Elements, Theories of Acids & Bases

- *Selection of GE courses will be from the list of courses to be compiled by the respective Departments in the School of Chemical and Life Sciences and recommended by the BoS of the respective departments. A list of GEs as listed in the UGC curricula has been provided for ready reference.*
- *A Generic elective will be taught when more than 30% of students in the B.Sc- M.Sc. Programme opt for it.*

Rules and Regulations of the Programme

1. Programme of Study: B.Sc.-M.Sc. Dual Degree Programme

In the School of Chemical & Life Sciences B.Sc.-M.Sc. Dual Degree Programme shall be offered in the following subjects

- Biochemistry
- Biotechnology
- Botany
- Chemistry
- Clinical Research
- Toxicology

The courses (papers) in the first two semesters will be the same across all the programmes of study in the school.

2. Programme Code: Each of the following programmes shall be denoted by three-digit code

- Biochemistry
- Biotechnology
- Botany
- Chemistry
- Clinical Research
- Toxicology (code BSc- 340; M.Sc. - 511)

3. Programme Abbreviation: Each course of the programme shall be given a course number which shall be preceded by a three-letter abbreviation identifying the discipline as (shown for Toxicology programme)

- Biochemistry
- Biotechnology
- Botany
- Chemistry
- Clinical Research
- Toxicology B.Sc. – BTX, M.Sc. - MTX

All these are regular full-time programmes.

4. Outline of CBCS Scheme

- **Core Course:** A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course.
- **Elective Course:** Generally, a course which can be chosen from a pool of courses and which may be very specific or specialized or advanced or supportive to the discipline/ subject of study or which provides an extended scope or which enables an exposure to

some other discipline/subject/domain or nurtures candidate's proficiency/skill is called an Elective Course.

- **Discipline Specific Elective (DSE) Course**: Elective courses may be offered by the main discipline/subject of study and are referred to as Discipline Specific Elective.
- **Dissertation/Project**: An elective course designed to acquire special/advanced knowledge, such as supplement study/support study to a project work, and a candidate studies such a course on his own with an advisory support by a teacher/faculty member is called Dissertation/Project.
- **Generic Elective (GE) Course**: An elective course chosen generally from an unrelated discipline/subject, with an intention to seek exposure is called a Generic Elective.
- **Ability Enhancement Courses (AEC)/Competency Improvement Courses/Skill Development Courses/Foundation Course:** The Ability Enhancement Courses (AECs) are the courses based upon the content that lead to knowledge enhancement. They include Environmental Science and. English/MIL Communication which are mandatory for all disciplines.

The Core, Discipline Specific and Generic Elective Courses shall be abbreviated as follows:

Core Course	:	CC
Discipline Specific Elective	:	DSE
Generic Elective	:	GE
Ability Enhancement Courses	:	AEC
Skill Enhancement Courses	:	SEC

These abbreviations shall precede the course number of each course of the programme.
During an academic year, a candidate who is enrolled in the B.Sc.-M.Sc. Dual Degree Programme, shall not be allowed to enroll for any other full-time programme of study and shall not appear in any other examination of a full-time course of this or any other university.

5. Duration: 3+2 Years

B.Sc-M.Sc. Dual Degree Programme is a 3+2 years full time academic program of study spread over 6+4 semesters. Every year, the new session commences in July. The session for the 6+4 semesters are as under.

B.Sc.

Semester I	(1 year)	August-December (Odd Semester)
Semester II	(1 year)	January-May (Even Semester)
Semester III	(2 year)	August-December (Odd Semester)
Semester IV	(2 year)	January-May (Even Semester)
Semester V	(3 year)	August-December (Odd Semester)
Semester VI	(3 year)	January-May (Even Semester)

M.Sc.

Semester I (1 year)	August-December (Odd Semester)
Semester II (1 year)	January-May (Even Semester)
Semester III (2 year)	August-December (Odd Semester)
Semester IV (2 year)	January-May (Even Semester)

The number of working days in a semester shall not be less than 90 days.

The candidate will have the option to exit after 3 years with B.Sc. Hons degree in the chosen subject.

6. Medium of instruction and examination: English

7. Eligibility for admission

Eligibility: A candidate seeking admission to the BSc-MSc Dual Degree Programme must have passed Senior Secondary (12 / Intermediate) examination with Biology /Mathematics from CBSE or any other Board recognized by Jamia Hamdard (JH) as equivalent thereto, securing at least 50% marks or equivalent CGPA in aggregate.

Selection procedure: Selection will be based on merit of qualifying examination.

8. Course Structure

For B.Sc. Component

a. The course, as approved by the Board of Studies of the respective Departments of the School and reviewed regularly, shall be divided into not less than 14 theory and practical core courses having 04 and 02 credits each. The course will have two ability enhancement courses of 2 credits each. The student will have to undertake two Skill enhancement elective courses of 02 credits each along with 04 discipline specific and 04 generic electives of 06 credits each in the first six semesters. Each discipline specific and generic elective will have 04 credits assigned to theory component and two credits to either tutorial or practical component.

b. In Semester I and II there will be common courses in basic subjects like Physics, Mathematics, Statistics, Computer Science, Biology and Chemistry across all the programmes.

c. A minimum of 02 credits and a maximum of 04 credits shall be assigned for each theory paper and 02 credits for each practical course. The lab work may also include a report or industrial visit.

d. One theory credit will be counted as 1 hour of contact per week, and two practical credits will be counted as 4 hours of contact per week.

e. There shall be no less than 20 credits and no more than 26 credits for each semester. This includes the lab work also.

f. The contents of each theory course shall be divided into four units. All the units shall preferably have equal teaching hours

9. Attendance

a) 100% attendance is desirable, but 75% attendance is mandatory in each paper for a student to enable him/her to appear in the Semester examination. In unforeseen contingencies, on the recommendation of the Dean of the School, 5% relaxation in attendance may be considered. This 5% shortage condoning may be on account of

sickness, provided the medical certificate, duly certified by a Registered Medical Practitioner/Public Hospital had been submitted in the office of the Head of the Department at the time of re-joining the classes, immediately after the recovery from illness. The Head of Department shall forward such cases along with all related documents to the Dean. The relaxation should not be considered as the right of the student.

b) In order to maintain the attendance record of a particular course, a roll call will be taken by the teacher in every scheduled lecture and practical class. For the purpose of attendance, each practical class will count as one attendance unit, irrespective of the number of contact hours. Attendance on account of participation in the prescribed and notified activities such as NCC, NSS, Inter-university sports, educational tours/field work, shall be granted provided the participation of the student is duly verified by the officer-in-charge and is sent to the Head of the Department within two weeks of the function/activity etc.

c) The subject teacher shall consolidate the attendance record for lectures and practical at the end of each month and submit to the Head of the Department. At the end of the semester, the teacher shall consolidate the attendance record for the whole semester and submit it to the Head of the Department. The statement of attendance of students shall be displayed by the Head of the Department on the Notice Board/University Website. A copy of the same shall be preserved as record. Attendance record displayed on the Notice Board/University Website shall deem to be a proper notification for the students and no individual notice shall be sent to any student.

d) If a student is found to be continuously absent from the classes without any information for a period of 30 days, the concerned teacher shall report the matter to the Head of the Department who in turn will then report the matter to the Dean for appropriate action that may include striking off the name of such student(s) from the roll. Such a student may, however, apply for readmission within 7 days from the date of issue of the notice of striking off the name from the rolls. The request for re-admission may be considered by the Dean of the School. Such a student shall not be eligible for re-admission after the prescribed period of 7 days. The re-admission shall be effected only after the payment of prescribed re-admission fee.

e) The cases of students with less than 70% attendance may be forwarded to the Vice-Chancellor through Dean for considering these cases to further condone the attendance shortage as a special case.

f) A student detained on account of shortage of attendance in any semester shall be readmitted to the same class in the subsequent academic year on payment of prescribed fees applicable in that year to complete the attendance requirement of that course.

10. Internal assessment

a) The performance of the student in each paper will be evaluated both continuously (Internal Assessment) and at the end of semester (Semester Examination). 25% marks for each theory paper will be allocated for internal assessment and 75% marks will be kept for semester end examination.

b) For the evaluation of the lab work, laboratory notebook, practical test/viva voce shall be taken into account. The marks shall be awarded by the respective teacher conducting the practical course. For sessional tests, discontinuance of classes will not be permitted and the teacher may take the test in his/her scheduled class. Under the compelling circumstance such as sickness of the student or mourning in the family, the candidate may be given another chance. For sickness only, a credible medical certificate issued by a hospital shall be considered. In case of casualties, a letter from the parents would be required.

c) Evaluation of tutorials will be done by conducting a written test or viva. Weightage shall also be given to the attendance in the tutorials.

11. Semester examination

a) Semester examination shall be held at the end of each semester as per schedule given in the Academic Calendar of the School.

b) Up to a maximum of seven days preparatory holidays may be given to the examinees before the start of the semester examinations.

c) There shall be not less than two theory courses and one lab course in each semester, except the 4 Semester. The detailed contents of the courses of studies shall be prescribed by the respective Board of Studies and shall be reviewed regularly.

d) Each theory paper having 04 credits shall be of 100 marks out of which 75% marks shall be for semester examination and 25% marks for internal assessment.

e) Each practical paper having 02 credits shall be of 50 marks out of which 75% marks shall be for semester examination and 25% marks for internal assessment.

f) The question paper for each theory paper shall have five questions. There shall be one question from each of the 4 units of the course and one question shall contain objective type/short answer questions covering all the units of the course. The candidate shall have to answer all the five questions. There shall, however, be internal choice within a unit. The choice shall be given by setting alternative questions from the same unit. The question paper should be such that it covers all the topics of that course.

g) The duration of the semester examination of a theory course shall be three hours. Practical exams of a lab course shall be of at least four hours duration. The practical examination shall be conducted by an internal and external examiner.

h) The question paper for semester examinations shall be set either by the external examiner or an internal examiner. The Board of Studies of the department shall draw a panel of names of examiners, both internal and external, for approval by the Vice Chancellor/Dean. If the external examiner is unable to send the question paper by the deadline set by the examination branch of the University, the dean after consultation with the examination branch shall get the paper set internally by a faculty. The papers set by the examiners can be moderated by a moderation committee. Teachers appointed on contractual basis with appointment of less than one academic session, and temporary as well as ad-hoc teachers may not ordinarily be appointed as examiners. All such teachers, however, will be expected to assist in the practical examination.

i) The botanical tour/educational tour shall be organized in the vacations. The final year students shall participate as per the University rules and regulations.

12. Choice Based Credit System (CBCS)

Definitions of keywords

a) **Academic Year:** Two consecutive (one odd + one even) semesters constitute one academic year.
b) **Choice Based Credit System (CBCS):** The CBCS provides choice for students to select from the prescribed courses (core, elective or minor or soft skill courses).
c) **Course:** Usually referred to as 'paper', course is a component of a programme. All courses need not carry the same weight. The courses should define learning objectives and learning outcomes. A course may be designed to comprise lectures/ tutorials/laboratory.
d) Work/ field work/ outreach activities/ project work/ vocational training/viva/ seminars/term papers/assignments/ presentations/ self-study etc. or a combination of some of these.
e) **Credit Point:** It is the product of grade point and number of credits for a course.
f) **Credit:** A unit by which the course work is measured. It determines the number of hours of instructions required per week. One credit is equivalent to one hour of teaching (lecture or tutorial) or two hours of practical work/field work per week.
g) **Cumulative Grade Point Average (CGPA):** It is a measure of overall cumulative performance of a student over all semesters. The CGPA is the ratio of total credit points secured by a student in various courses in all semesters and the sum of the total credits of all courses in all the semesters. It is expressed up to two decimal places.
h) **Grade Point:** It is a numerical weight allotted to each letter grade on a 10-point scale.
i) **Letter Grade:** It is an index of the performance of students in a said course. Grades are denoted by letters O, A+, A, B+, B, C, P and F.
j) **Programme:** An educational programme leading to award of a degree, diploma or certificate.
k) **Semester Grade Point Average (SGPA):** It is a measure of performance of work done in a semester. It is the ratio of total credit points secured by a student in various courses registered in a semester and the total course credits taken during that semester. It shall be expressed up to two decimal places.
l) **Semester:** Each semester will consist of 15-18 weeks of academic work equivalent to not less than 90 actual teaching days. The odd semester may be scheduled from July to December and even semester from January to May.
m) **Transcript or Grade Card or Certificate:** Based on the grades earned, a grade certificate shall be issued to all the registered students after every semester. The grade certificate will display the course details (code, title, number of credits, grade secured) along with SGPA of that semester and CGPA earned till that semester.

13. Semester System and Choice Based Credit System

The semester system accelerates the teaching-learning process and enables vertical and horizontal mobility in learning. The credit-based semester system provides flexibility in designing curriculum and assigning credits based on the course content and hours of teaching. The choice-based credit system provides a 'Cafeteria' type approach in which the students can take courses of their choice, learn at their own pace, undergo additional courses and acquire more than the required credits, and adopt an interdisciplinary approach to learning.

14. Types of Courses

The courses in a programme may be of three kinds according to CBCS: Core, Elective and Foundation

15. Classification of Result

a) Two methods - relative grading or absolute grading- have been in vogue for awarding grades in a course. The relative grading is based on the distribution (usually normal distribution) of marks obtained by all the students of the course and the grades are awarded based on a cut-off marks or percentile. Under the absolute grading, the marks are converted to grades based on predetermined class intervals. To implement the following grading system, the colleges and universities can use any one of the above methods.

b) Following grading system with a 10-point scale shall be followed to represent performance of students in the examination.

Letter Grade*	**Grade Point****
O (Outstanding)	10
A+ (Excellent)	9
A (Very Good)	8
B+ (Good)	7
B (Above Average)	6
C (Average)	5
P (Pass)	4
F (Fail)	0
Ab (Absent)	0

***Letter Grade**: It is an index of the performance of students in a said course. Grades are denoted by letters viz, O, A+, A, B+, B, C, P and F

****Grade Point**: It is numerical weight allotted to each letter grade on a 10-point scale

Converting the marks into letter grades

Letter Grade	**Grade Point**	**Range of Percentage of Marks**
O (Outstanding)	10	90 and above 100 (90 -100)
A+ (Excellent)	9	80 and above and less than 90 (80<90)
A (Very Good)	8	70 and above and less than 80 (70<80)
B+ (Good)	7	65 and above and less than 70 (65<70)
B (Above Average)	6	55 and above and less than 65 (55<65)
C (Average)	5	50 and above and less than 55 (50<55)
P (Pass)	4	40 and above and less than 50 (40<50)
F (Fail)	0	00 and above and less than 40 (00<40)

Ab (Absent)	0	--

A student obtaining Grade 'F' shall be considered failed and will be required to reappear in the examinations.

Computation of SGPA and CGPA

As per UGC norms, the following procedure will be adopted to compute the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA)

i. The SGPA is the ratio of sum of the product of the number of credits with the grade points scored by a student in all courses taken by a student and the number of credits of all the courses undergone by a student.
SGPA (Si) = ∑ (Ci x Gi) / ∑Ci where Ci is the number of credits of the ith course and Gi is the Grade point scored by the student in the ith course.

ii. The CGPA is also calculated in the same manner taking into account all the courses undergone by a student over all the semesters of a programme, i.e. CGPA = ∑ (Ci x Si) / ∑Ci where Si is the SGPA of the ith semester and Ci is the total number of credits in that semester.

iii. The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

Formula for Conversion of CGPA into Marks percentage

The percentage equivalent to the CGPA shall be obtained by using the following formula:

Equivalent percentage of CGPA = CGPA x 10

14. Criteria for award of CGPA

The result of successful candidates who fulfill the criteria for the award of M. Sc. shall be categorized after the IV semester, on the basis of his/her CGPA.

Award of division/class shall be done on the basis of following criteria

Range of CGPA	**Division/Class**
CGPA of 7.50 and above and upto 10	1st Division with Distinction
CGPA of 6.00 and above and less than 7.50	I Division
CGPA of 5.00 and above and less than 6.0	II Division
CGPA of 4.00 and above and less than 5.00	III Division

19. Promotion

a) Promotion from I semester to consecutive semesters shall be automatic. However, pre-registration is compulsory to move to a new semester.

b) A student shall be promoted from II to III semester and from IV to V semester of the programme provided that student has passed 50% papers of I and II semester taken together or III and IV semesters taken together, including practical and tutorial papers.

c) Students who do not fulfil the promotion criteria as given above shall be declared failed in the part concerned. However, they shall have the option to retain the marks in the papers in which they have secured Pass marks.

d) A student who has to reappear in a paper prescribed for Semester I/III/V may do so only in the Semester examinations to be held in November/December and a student who has to reappear in a paper prescribed for Semester II/IV/VI may do so only in the examinations to be held in April/May.

e) A candidate will be given a total number of 3 attempts, inclusive of the first attempt, to clear the papers in which he/she fails. The promotion to the next higher class will be considered subject to rules relating to passing I and II / III and IV semester examinations within two academic years.

f) The award of degree shall be subject to successful completion of all the requirements of the programme of study within six years from admission.

g) A detained student is not allowed to reappear in sessional tests.

h) The minimum marks required to pass any paper in a semester shall be 40% in theory and in practical. The student must secure 40% in the End Semester Examination and 40% in the aggregate (End Semester Examination & Internal Assessment) of the paper for both theory and practical separately.

i) In case of VI semester, a student can appear in a supplementary examination in all backlog papers after declaration of their final semester results.

20. Classification of successful candidates

The result of successful candidates who fulfil the criteria for the award of B.Sc. Hons after the VI semester shall be classified, on the basis of his/her CGPA of all the six semesters. The classification shall be done on the basis of following criteria:

a. He/she will be awarded "I Division" if his/her final CGPA is 6.75 or above.
b. He/she will be awarded "II Division" if his/her final CGPA is 6 or above but less than 6.75.
c. He/she will be awarded "Pass" if his/her final CGPA is 5 or above but less than 6.
d. He/she will be treated as "fail" if his/her final CGPA is less than 5.

21. Span period

(a) I and II Semester Exams: Within two years from the first admission to the programme

(b) All requirements of B.Sc. Hons. degree within a total period of **six years** from the date of their first admission.

23. Improvement

A candidate, with Grade C, D or E, who wishes to improve the previous performance will be allowed to do so after the declaration of the result of VI semester as per the following regulation:

- A student shall be allowed only once to reappear in the semester examination of up to six theory courses along with regular students of that semester to improve upon the previous performance. The examination fee which will be charged from such candidates shall be double the current examination fee.

- Such a student shall inform the Head of the Department in writing of his/her intention to improve performance, two months before the date of semester examination to be held.

- If the student improves the performance, he/she shall be required to submit the earlier mark-sheet/degree. A new mark-sheet and degree bearing the year in which the student improved the grade shall be issued.

- In case, the grade obtained in improvement is lower than the one obtained earlier, the higher grade shall prevail.

24. Conduct and discipline

- Disciplinary policies of Jamia Hamdard are put in place to promote civility on campus and to ensure a secure and academically enriching environment.

- Students are expected to show personal integrity, respect for university resources and respect for others' rights.

- Students are expected to adhere to the rules and regulations of the University. Any violation will be handled according to the rules set forth in the disciplinary policies of the university.

DEPARTMENT OF MEDICAL ELEMENTOLOGY & TOXICOLOGY

Name of the Academic Programme : **B.Sc.-M.Sc. Dual Degree**

Course Code : **BTX-CC01/ BTX-CC01-TU**

Title of the Course : **Basics of Computer Science and Statistics (Theory/Tutorial)**

Credits : **4+2**

L=Lecture; T=Tutorial; P=Practical : L=**60,** T=**30**, **P=0**

Course Objectives

The course aims to provide basic knowledge of computers. Students will be introduced to hardware and software of computers. Students will also be introduced to commonly used software in research. Students will also learn basic concepts in information technology. In this course, students will be taught basic skills of statistics. This will allow them to develop analytical thinking and will also provide knowledge of statistical methods for critical evaluation of data.

Course Learning Outcomes (CLOs)

On completing this course, the students should be able to
CLO 1: Explain the basics of computer operations, concepts and terminology of statistics (understand);
CLO 2: recognize both hardware and software of a computer system (understand);
CLO 3: apply understanding of the use of computers for various applications (apply);
CLO 4: relate basic statistical methods to solve problems (analyze);
CLO 5: operate various statistical software packages (apply); and appreciate the importance of statistics in research (evaluate)

Mapping of Course Learning Outcomes (CLOs) with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO1				3										
CLO2				3										
CLO3			3					3						
CLO4			3											
CLO5									3					

Each CLOs may be mapped with one or more PLOs. Write '3' in the box for high-level mapping, '2' for medium level mapping and '1' for low-level mapping. Map with PSOs wherever applicable.

Detailed Syllabus

Unit-I: Elements of Computer Systems
Computer: Definition, Characteristics, Hardware & Software, Computer Organization. Operating Systems: Multi-tasking, Multi programming, Multiuser. Types of Operating System: MS-Windows, Unix/Linux, Mac OS. Database Models: Network, Hierarchical, Relational, Object Oriented. MS-Office: MS-Word, MS-Excel, MS-Power Point, MS-Access.

Unit-II: Information Technology
Elements of Computer Network. Network Topologies: Ring, Bus, Star, Mesh, Hybrid. Internet, Intranet, WWW, URL, Email, HTTP, HTML, Website, Portal, Web Browser, E-Commerce, IP Address. Issues and Threats of Cyber & Information Security: Virus, Worms, Trojan, Malware, Ransom ware, Anti-Virus, Basics of Computer Trouble Shooting.

UNIT-III: Statistics
Types of Data, Collection of data; Primary & Secondary data, Classification and Graphical representation of Statistical data. Measures of central tendency and Dispersion. Measures of Skewness and Kurtosis. Probability classical & axiomatic definition of probability, Theorems on total and compound probability, Elementary ideas of Binomial, Poisson and Normal distributions.

UNIT-IV: Advanced Statistics
Confidence level, critical region, testing of hypothesis and standard error, large sample test and small sample test. Problems on test of significance, t-test, chi-square test for goodness of fit and analysis of variance (ANOVA) Correlation and Regression. Emphasis on examples from Biological Sciences.

Reference Books:

1. Rajaraman V., Adabala, Neeharika, "Fundamentals of Computer" 6th ed., PHI
2. Sinha & Sinha, "Computer Fundamentals", 6th ed., BPB Publications
3. Kahate A., "Introduction to Database Management System", Pearson's Education
4. Norton P, "Introduction to Computers", Mc Graw Hills
5. Online Tutorial, Jone L. & Curtis F., "Microsoft Office 2016: Step by Step", Microsoft Press
6. Le CT. Introductory Biostatistics. 1st edition, John Wiley, USA
7. Glaser AN. High Yield TM Biostatistics. Lippincott Williams and Wilkins, USA
8. Edmondson A and Druce D. Advanced Biology Statistics, Oxford University Press.
9. Danial W. Biostatistics: A foundation for Analysis in Health Sciences, John Wiley
10. M.V. Ismail. Biostatistics, Ist Edition, Laxmi ublication Pvt. Ltd.

Teaching – Learning Strategies in brief

Board (black and jam board) and chalk teaching, learning through discussion among the peer group, classroom interactions, quizzes, presentations, Q & A sessions and reflective learning are some of the teaching - learning strategies adopted by the department.

Assessment methods and weightages in brief

There are two components of assessment namely internal assessment and end semester examination. Internal assessment consists of assessment through administration of three sessional exams/tests. The average marks of best of two sessional exams/tests are computed for internal assessment. Sessional exam/test is conducted and computed for 25 marks. End semester exam is of 75 marks.

Total Marks are 100 for the subject (Internal Assessment: 25 Marks and End semester examination: 75 Marks).

Assessment methods for tutorials: The internal tutorial sessional exam is conducted for 13 marks. End semester exam is of 37 marks. Total Marks are 50 for the subject (Internal Assessment: 13 Marks and End Semester Examination: 37 Marks).

DEPARTMENT OF MEDICAL ELEMENTOLOGY & TOXICOLOGY

Name of the Academic Programme : **B.Sc.-M.Sc. Dual Degree**

Course Code : **BTX-CC02**

Title of the Course : **Basics of Chemistry (Theory)**

Credits : **4**

L=Lecture; T=Tutorial; P=Practical : L=**60,** T=**0**, **P=0**

Course Objectives

The course aims to provide basic knowledge of chemistry which is indispensable for an understanding of the several biomolecules and the way they interact to effect life processes in a plant. Thus, a sound understanding of basic principles of chemistry is required for appreciating biochemistry of plants.

Course Learning Outcomes (CLOs)

On completing this course, the students should be able to
CLO 1: understand molecular structures and associated bonds (understand);
CLO 2: analyze concepts of energy transductions and transformations (analyze);
CLO 3: apply basic principles of organic chemistry (apply);
CLO 4: illustrate molecular conformations and stereochemistry (analyze); and
CLO 5: critically analyze chemical information, synthesize the information, and present the information to a technical audience (analyze)**.**

Mapping of Course Learning Outcomes (CLOs) with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO1		3									3			
CLO2			3											
CLO3			3					3	3					
CLO4		2												
CLO5					3									

Detailed Syllabus

Unit-I: Chemical Bonding and Molecular Structure Ionic Bonding

Lattice energy and solvation energy. Born-Haber cycle and its applications, polarizing power and polarizability, Fajan's rules, ionic character in covalent compounds, Covalent Bonding: VB Approach, Lewis theory, VSEPR theory to explain the shapes of molecules, salient features of the Valence bond (VB) theory and the concept of hybridization, MO Approach: limitations of the VB approach, salient features of the MO theory. Rules for the LCAO

method, bonding and anti-bonding MOs and their characteristics for s-s-, s-p and p-p combinations of atomic orbitals, nonbonding combinations of orbitals MO treatment of homonuclear diatomic molecules of 1st period and heteronuclear diatomic molecules such as CO, HF.

Unit-II: Chemical Thermodynamics

Qualitative idea of thermodynamics. First Law of Thermodynamics: Calculation of work (w), heat (q), changes in internal energy (ΔE) and enthalpy (ΔH) for expansion or compression of ideal gases under isothermal and adiabatic conditions for both reversible and irreversible processes. Calculation of w,q, ΔE, and ΔH for processes involving changes in physical states. Important principles and definitions of thermochemistry. Concept of standard state and standard enthalpies of formation, integral and differential enthalpies of solution and dilution. Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data. Variation of enthalpy of a reaction with temperature Kirchhoff's equation. Second law of thermodynamics, concept of entropy, Gibbs free energy and Helmoltz free energy. Calculations of entropy change and free energy change for reversible and irreversible processes under isothermal and adiabatic conditions. Criteria of spontaneity, Gibbs Helmholtz equation. Maxwell's relations. Statements of Third Law of thermodynamics: calculation of absolute entropies of substances.

Unit-III: Fundamentals of Organic Chemistry

Hybridization in organic compounds, cleavage of covalent bond, homolysis and heterolysis, Electronic effects: Electronic effects and their applications inductive, resonance and hyperconjugation effects. Structure and relative stability of reactive carbon species – carbocations, carbanions, free radicals and carbenes, Molecular Forces: types of intermolecular and intra-molecular forces and their characteristics: dipole-dipole, dipole induced dipole and dispersion (London) forces. Hydrogen bond (both intramolecular and intermolecular), Effect of inter/intramolecular forces on physical properties such as solubility, vapour pressure, melting and boiling points of different compounds, Aromaticity.

Unit-IV: Stereochemistry

Stereochemistry and its importance. Geometrical isomerism, cis-trans and E/Z nomenclature Optical isomerism – optical activity, plane polarized light, enantiomerism, chirality, specific molar rotation, Stereoisomerism with two chiral centres: Diastereomers, mesoisomers, Resolution of racemic modification. Projection diagrams of stereoisomers: Fischer, Newman and Sawhorse projections. Relative Configuration: D/L designation. Absolute Configuration: R/S designation of chiral centres, Conformational isomerism – ethane, butane and cyclohexane, diagrams and relative stability of conformers.

Reference Books:

1. J.D.Lee: A New Concise Inorganic Chemistry, E.L.B.S.
2. P.W. Atkins: Physical Chemistry, Oxford University Press
3. R.T. Morrison & R.N. Boyd: Organic Chemistry, Prentice Hall
4. James E.Huheey etal. : Inorganic Chemistry: Principles of Structure and reactivity
5. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education
6. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry, 5th Ed., Pearson

Teaching – Learning Strategies in brief

Board (black and jam board) and chalk teaching, learning through discussion among the peer group, classroom interactions, quizzes, presentations, Q & A sessions and reflective learning are some of the teaching - learning strategies adopted by the department.

Assessment methods and weightages in brief

There are two components of assessment namely internal assessment and end semester examination. Internal assessment consists of assessment through administration of three sessional exams/tests. The average marks of best of two sessional exams/tests are computed for internal assessment. Sessional exam/test is conducted and computed for 25 marks. End semester exam is of 75 marks.

Total Marks are 100 for the subject (Internal Assessment: 25 Marks and End semester examination: 75 Marks).

DEPARTMENT OF MEDICAL ELEMENTOLOGY & TOXICOLOGY

Name of the Academic Programme : **B.Sc.-M.Sc. Dual Degree**

Course Code : **BTX-AEC01**

Title of the Course : **English Communication (Theory)**

Credits : **2**

L=Lecture; T=Tutorial; P=Practical : L=**30,** T=**0**, **P=0**

Course Objectives

The course aims to train students to be more effective at communicating successfully in interviews, public speaking, letter writing, report writing, presentations, and inter-personal debates and conversations. The learner also imbibes the fundamentals of communication and the art of persuasive speaking and writing which depends crucially on clarity of thought and contextual understanding expressed through appropriate vocabulary.

Course Learning Outcomes (CLOs)

On completing this course, the students will be able to
CLO 1: identify deviant use of English both in written and spoken forms (remember);
CLO 2: recognize the errors of usage and correct them and write simple sentences without committing errors of spelling and grammar (understand);
CLO 3: understand and appreciate English spoken by others (understand and evaluate);
CLO 4: understand the importance of reading for life and develop an interest for reading (understand and create); and
CLO 5: understand the importance of writing in academic life and career (understand).

Mapping of Course Learning Outcomes (CLOs) with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO1					3									
CLO2				3										
CLO3						3								
CLO4									3					
CLO5				3										

Detailed Syllabus

UNIT – 1
Introduction: Theory of Communication, Types and modes of Communication
Language of Communication: Verbal and Non-verbal (Spoken and Written) Personal, Social and Business Barriers and Strategies Intra-personal, Inter-personal and Group communication

Speaking Skills: Monologue, Dialogue Group Discussion, Effective Communication/ Mis-Communication Interview, Public Speech

UNIT – 2

Reading and Understanding: Close Reading, Comprehension, Summary Paraphrasing, Analysis and Interpretation, Translation (from Indian language to English and vice-versa) Literary/Knowledge Texts

Writing Skills: Documenting, Report Writing, Making notes, Letter writing

Reference Books:

1. Fluency in English - Part II, Oxford University Press.
2. Business English, Pearson.
3. Language, Literature and Creativity, Orient Blackswan.
4. Language through Literature (forthcoming) ed. Dr. Gauri Mishra, Dr Ranjana Kaul, Dr Brati Biswas

Teaching – Learning Strategies in brief

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Assessment methods and weightages in brief

There are two components of assessment namely internal assessment and end semester examination. Internal assessment consists of assessment through administration of three sessional exams/tests. The average marks of best of two sessional exams/tests are computed for internal assessment. Sessional exam/test is conducted and computed for 13 marks. End semester exam is of 37 marks.

Total Marks are 50 for the subject (Internal Assessment: 13 Marks and End semester examination: 37 Marks).

DEPARTMENT OF MEDICAL ELEMENTOLOGY & TOXICOLOGY

Name of the Academic Programme : **B.Sc.-M.Sc. Dual Degree**

Course Code : **BTX-AEC02**

Title of the Course : **Environmental Studies (Theory)**

Credits : **2**

L=Lecture; T=Tutorial; P=Practical : L=**30,** T=**0**, **P=0**

Course Objectives

The objective of this course is to provide basic concept of environment, ecology, natural resources, importance of biodiversity and need for its conservation along with various environmental issues and Government policies and movements.

Course Learning Outcomes (CLOs)

On completing this course, the students will be able to
CLO 1: identify the concepts related to the environmental global scenario (remember);
CLO 2: comprehend the natural resources and environmental organizations (understand);
CLO 3: apply the acquired knowledge to sensitize individuals and public about the environmental crisis (apply);
CLO 4: analyze the causes and changes in the structure of biodiversity (analyze); and
CLO 5: enhance their skills in the society by solving the environmental problems and preserving nature by the acquired knowledge (evaluate).

Mapping of Course Learning Outcomes (CLOs) with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1			3									3		
CLO 2				3								3		
CLO 3								3				3		
CLO 4					3							3		
CLO 5								3	3			3		

Detailed Syllabus

UNIT – 1: The multidisciplinary nature of environmental studies

Definition, scope and importance, Need for public awareness.

UNIT – 2: Natural resources: Renewable and non-renewable resources

a) Natural resources and associated problems
- Forest resources: Use and over-exploitation, deforestation, case studies, Timber extraction, mining, dams and their effects on forests, and tribal people.

- Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dam's benefits and problems.
- Mineral Resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.
- Food Resources: World food problems, changes caused by agriculture and over grazing, effects of modern agriculture, fertilizers- pesticides problems, water logging, salinity, case studies.
- Energy Resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources, case studies
- Land Resources: Land as a resource, land degradation, man induced landslides, soil erosion, and desertification.

b) Role of individual in conservation of natural resources.
c) Equitable use of resources for sustainable life styles.

UNIT – 3: Ecosystems

- Concept of an eco-system
- Structure and function of an eco-system.
- Producers, consumers, decomposers.
- Energy flow in the eco systems.
- Ecological succession.
- Food chains, food webs and ecological pyramids.
- Introduction, types, characteristic features, structure and function of the following eco systems:
- Forest ecosystem
- Grass land ecosystem
- Desert ecosystem.
- Aquatic eco systems (ponds, streams, lakes, rivers, oceans, estuaries)

UNIT – 4: Biodiversity and its conservation

- Introduction-Definition: genetics, species and ecosystem diversity.
- Biogeographically classification of India.
- Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values
- Biodiversity at global, national and local level.
- India as a mega diversity nation.
- Hot-spots of biodiversity.
- Threats to biodiversity: habitats loss, poaching of wild life, man wildlife conflicts.
- Endangered and endemic spaces of India.
- Conservation of biodiversity: in-situ and ex-situ conservation of biodiversity.

UNIT – 5: Environmental pollution

- Definition Causes, effects and control measures of:
  a. Air pollution
  b. Water pollution
  c. Soil pollution
  d. Marine pollution
  e. Noise pollution
  f. Thermal pollution
  g. Nuclear hazards
- Solid waste Management: Causes, effects and control measures of urban and

- industrial wastes
- Role of an individual in prevention of pollution
- Pollution case studies
- Disaster management: Floods, earth quake, cyclone and land slides

Reference Books:

1. Textbook of Environmental Studies, Erach Bharucha, UGC
2. Fundamental concepts in Environmental Studies, D D Mishra, S Chand & Co Ltd

Teaching – Learning Strategies in brief

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Total Marks are 50 for the subject (Internal Assessment: 13 Marks and End semester examination: 37 Marks).

DEPARTMENT OF MEDICAL ELEMENTOLOGY & TOXICOLOGY

Name of the Academic Programme : **B.Sc.-M.Sc. Dual Degree**

Course Code : **BTX-GE01-A/BTX-GE01-A-TU**

Title of the Course : **Basics of Physics and Biology (Theory/Tutorial)**

Credits : **4+2**

L=Lecture; T=Tutorial; P=Practical : L=**60,** T=**30**, **P=0**

Course Objectives

The aim of the course is to provide basic concepts in physics. The natural laws of physics have shaped the evolution of all bodies, both human and non-human. As a result of this, biologists need to understand physics in order to understand how the human body works. The course also provides basic concepts in biology. This portion will help students coming from diverse backgrounds.

Course Learning Outcomes (CLOs)

On completion of this course, the student will be able to
CLO 1: review the basic principles of motion (understand);
CLO 2: outline the components of electromagnetic spectrum (analyze);
CLO 3: describe the principles of waves (understand);
CLO 4: outline the classification of plants and animals (analyze); and
CLO 5: infer basic principles in physiology of plants and animals, concepts in genetics and cell structure and function (understand).

Mapping of Course Learning Outcomes (CLOs) with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1				3										
CLO 2				3										
CLO 3				3										
CLO 4				3						3		3		
CLO 5				3							3			

Detailed Syllabus

SECTION A: BASICS OF PHYSICS (02 CREDITS)

UNIT – 1

a) Oscillations: Periodic motion, time period, frequency, Simple Harmonic Motion (SHM) and its equations, phase, restoring force, Kinetic Energy and Potential Energy in SHM.
b) Electromagnetic waves: Electromagnetic Spectrum, Electromagnetic waves and their characteristics, Maxwell's Equations

UNIT – 2

a) Interference due to division of amplitude and division of wave fronts, Young's double slit Experiment, Principle of Superposition, Theory of Biprism, Newtons' Rings.
b) LASER: Introduction, Temporal and Spatial Coherence, Principle of LASER, Stimulated and spontaneous emission. Einstein's Coefficients, He-Ne Laser, Ruby Laser, Applications of Lasers.

SECTION B: BASICS OF BIOLOGY (02 CREDITS)

UNIT – 3

a) **Animal and Plant Kingdom**
Salient features and classification of plants into major groups - Algae, Bryophyta, Pteridophyta, Gymnospermae and Angiospermae. Salient features and classification of animals, non-chordates up to phyla level and chordates up to class.

b) **Cell-The Unit of Life**
Cell as the basic unit of life: Structure of prokaryotic and eukaryotic cells; Plant cell and animal cell; Cell envelope, cell membrane, cell wall; Cell organelles - structure and function. Elementary idea of cell cycle, mitosis, meiosis and their significance.

c) **Biomolecules**
Chemical constituents of living cells: biomolecules, structure and function of proteins, carbodydrates, lipids, nucleic acids.

UNIT – 4

a) Human and Plant Physiology
Plant: basic concepts of transport, photosynthesis, respiration and reproduction in higher plants.
Human: Basic concepts of digestion and absorption; respiration, body fluids and circulation; excretion, nervous system, and reproduction.

b) **Basic Principles of Inheritance and Variation**
Mendelian Inheritance; Deviations from Mendelism-Incomplete dominance, Co-dominance, Multiple alleles and Inheritance of blood groups, Pleiotropy; Elementary idea of polygenic inheritance; Chromosome theory of inheritance; Chromosomes and genes

Reference Books:

1. Ajoy Ghatak, Optics, TMH
2. D.S.Mathur, Mechanics
3. Griffith, Electrodynamics
4. Brij Lal and Subramaniyam, Optics

Teaching – Learning Strategies in brief

Board (black and jam board) and chalk teaching, learning through discussion among the peer group, classroom interactions, quizzes, presentations, Q & A sessions and reflective learning are some of the teaching - learning strategies adopted by the department.

Assessment methods and weightages in brief

There are two components of assessment namely internal assessment and end semester examination. Internal assessment consists of assessment through administration of three sessional exams/tests. The average marks of best of two sessional exams/tests are computed for internal assessment. Sessional exam/test is conducted and computed for 25 marks. End semester exam is of 75 marks.

Total Marks are 100 for the subject (Internal Assessment: 25 Marks and End semester examination: 75 Marks).

Assessment methods for tutorials: The internal tutorial sessional exam is conducted for 13 marks. End semester exam is of 37 marks. Total Marks are 50 for the subject (Internal Assessment: 13 Marks and End Semester Examination: 37 Marks).

DEPARTMENT OF MEDICAL ELEMENTOLOGY & TOXICOLOGY

Name of the Academic Programme : **B.Sc.-M.Sc. Dual Degree**

Course Code : **BTX-GE01-B/ BTX-GE01-B-TU**

Title of the Course : **Basics of Physics and Mathematics (Theory/Tutorial)**

Credits : **4+2**

L=Lecture; T=Tutorial; P=Practical : L=**60,** T=**30**, **P=0**

Course Objectives

The aim of the course is to provide basic concepts in physics. The natural laws of physics have shaped the evolution of all bodies, both human and non-human. As a result of this, biologists need to understand physics in order to understand how the human body works. The course also provides basic concepts in math. Mathematics plays a key role in many disciplines of science, primarily as a mathematical modelling tool. New innovations and developments in physics are by the influence of mathematics.

Course Learning Outcomes (CLOs)

On completion of this course, the student will be able to
CLO 1: review the basic principles of motion (understand);
CLO 2: outline the components of electromagnetic spectrum (analyze);
CLO 3: describe the principles of waves (understand);
CLO 4: indicate basic concepts in matrices and determinants (understand); and
CLO 5: analyze the principles of differentiation and integration (analyze).

Mapping of Course Learning Outcomes (CLOs) with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1				3										
CLO 2				3										
CLO 3				3										
CLO 4				3										
CLO 5					3									

Detailed Syllabus

SECTION A: BASICS OF PHYSICS (02 CREDITS)

UNIT – 1

Oscillations: Periodic motion, time period, frequency, Simple Harmonic Motion (SHM) and its equations, phase, restoring force, Kinetic Energy and Potential Energy in SHM.

Electromagnetic waves: Electromagnetic Spectrum, Electromagnetic waves and their characteristics, Maxwell's Equations

UNIT – 2

Interference due to division of amplitude and division of wave fronts, Young's double slit Experiment, Principle of Superposition, Theory of Biprism, Newtons' Rings.

LASER: Introduction, Temporal and Spatial Coherence, Principle of LASER, Stimulated and spontaneous emission. Einstein's Coefficients, He-Ne Laser, Ruby Laser, Applications of Lasers.

SECTION B: BASICS OF MATHEMATICS (02 CREDITS)

UNIT – 1: **Matrices and Determinants**

Matrices: Concept, notation, order, equality, types of matrices, zero and identity matrix, transpose of a matrix, symmetric and skew symmetric matrices. Operation on matrices: Addition and multiplication and multiplication with a scalar. Simple properties of addition, multiplication and scalar multiplication.

Determinants: Determinant of a square matrix (up to 3 x 3 matrices), properties of determinants, minors, co-factors and applications of determinants in finding the area of a triangle. Adjoint and inverse of a square matrix.

UNIT – 2: Calculus

Continuity and Differentiability: Continuity and Derivative, derivative of composite functions, chain rule, derivative of implicit functions. Concept of exponential and logarithmic functions.

Derivatives of logarithmic and exponential functions. Logarithmic differentiation, derivative of functions expressed in parametric forms. Second order derivatives.

Integrals: Integration as inverse process of differentiation. Integration of a variety of functions by substitution, by partial fractions and by parts, Evaluation of simple integrals of the following types and problems based on them. Definite integrals as a limit of a sum, Basic properties of definite integrals and evaluation of definite integrals.

Differential Equations: Definition, order and degree, general and particular solutions of a differential equation. Formation of differential equation whose general solution is given.

Reference Books:

1. Ajoy Ghatak, ***Optics***, TMH
2. D.S.Mathur, ***Mechanics***
3. Griffith, ***Electrodynamics***
4. Brij Lal and Subramaniyam, ***Optics***

Teaching – Learning Strategies in brief

Board (black and jam board) and chalk teaching, learning through discussion among the peer group, classroom interactions, quizzes, presentations, Q & A sessions and reflective learning are some of the teaching - learning strategies adopted by the department.

Assessment methods and weightages in brief

There are two components of assessment namely internal assessment and end semester examination. Internal assessment consists of assessment through administration of three sessional exams/tests. The average marks of best of two sessional exams/tests are computed for internal assessment. Sessional exam/test is conducted and computed for 25 marks. End semester exam is of 75 marks.

Total Marks are 100 for the subject (Internal Assessment: 25 Marks and End semester examination: 75 Marks).

Assessment methods for tutorials: The internal tutorial sessional exam is conducted for 13 marks. End semester exam is of 37 marks. Total Marks are 50 for the subject (Internal Assessment: 13 Marks and End Semester Examination: 37 Marks).

DEPARTMENT OF MEDICAL ELEMENTOLOGY & TOXICOLOGY

Name of the Academic Programme : **B.Sc.-M.Sc. Dual Degree**

Course Code : **BTX-CC03**

Title of the Course : **Biomolecules (Theory)**

Credits : **4**

L=Lecture; T=Tutorial; P=Practical : L=**60,** T=**0**, **P=0**

Course Objectives

The course aims to provide students with an understanding of biomolecules, the basic building blocks of living organisms, focusing on their structural underpinnings, unique properties, biological roles, functions and interrelationships. The course will outline the importance of water as a biological solvent and vitamins as vital ingredients of life. Emphasis will be on the association between structure and function of various biomolecules at a chemical interface with a biological perspective as well as hands-on approach.

Course Learning Outcomes (CLOs)

On completing this course, students should be able to
CLO 1: understand the molecular and chemical foundations of life and appreciate the role of water in biological systems (understand);
CLO 2: comprehend the structure, function and acid base properties of amino acids (understand);
CLO 3: analyze the structure, properties and roles of carbohydrates, lipids and nucleic acids (analyze);
CLO 4: recognize the importance of vitamins in biological systems (understand); and
CLO 5: identify and differentiate between various biomolecules in the laboratory (analyze).

Mapping of Course Learning Outcomes (CLOs) with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1				3							3			
CLO 2				3							3			
CLO 3				3							3			
CLO 4				3							3			
CLO 5			3								3			

Detailed Syllabus

UNIT – 1: Introduction to Biomolecules
Introducing carbohydrates, proteins, fats. Biochemistry and its scope, physicochemical properties of water, weak interactions in aqueous systems, ionization of water, water as a reactant, buffers, fitness of the aqueous environment, structure and classification of amino acids, physical and chemical properties of amino acids.

UNIT – 2: Carbohydrates
Characteristic features of sugars. Monosaccharides-structure of aldoses, ketoses, conformation of sugars, anomers, epimers, enantiomers, conformation of sugars, mutarotation, structure of biologically important sugar derivatives, disaccharides: formation, structure, reducing, non-reducing disaccharides. Polysaccharides: classification and function. Structure and function of glycoproteins and proteoglycans. Carbohydrates as signals.

UNIT – 3: Lipids
Classification of fats, structure of fatty acids, triacylglycerol and waxes. Membrane lipids-glycerophospholipids, galactolipids, sphingolipids, sterols: types, structure and function of membrane lipids, gangliosides and lipopolysaccharides. Plant steroid, lipids as signals.

UNIT – 4: Nucleic acids and Vitamins
Nucleotides, nucleosides-structure, properties, Nucleic acids: Deoxyribonucleic acid and Ribonucleic acid, Watson and Crick model of DNA, structure and function of messenger RNA, ribosomal RNA, transfer RNA, nucleic acid chemistry: UV absorption, physicochemical properties of DNA, nucleotides: energy source, coenzyme components, second messengers. Vitamins: classification, active forms, deficiency disorders, symptoms, hypervitaminosis.

Reference Books:

1. Nelson, D.L. & Cox, M.M.. Principles of Biochemistry, 5th Edn., W.H. Freeman & Company.
2. Berg, M.J., Tymockzo, J.L. & Stryer, L. Biochemistry, 6th Edition, W.H. Freeman & Company.
3. Wood. E.J. & Pickering, W.R. Introducing Biochemistry. John Murray, London.
4. Nelson, D.L. & Cox, M.M. Lehninger: Principles of Biochemistry, 6th Edn, W.H. Freeman and Company, New York.
5. Devlin, T.M. Textbook of Biochemistry with Clinical Correlations, 7th Edn, John Wiley & Sons, New York.

Teaching – Learning Strategies in brief

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Assessment methods and weightages in brief

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Total Marks are 100 for the subject (Internal Assessment: 25 Marks and End semester examination: 75 Marks).

DEPARTMENT OF MEDICAL ELEMENTOLOGY & TOXICOLOGY

Name of the Academic Programme : **B.Sc.-M.Sc. Dual Degree**

Course Code : **BTX-CC04**

Title of the Course : **Cell Biology (Theory)**

Credits : **4**

L=Lecture; T=Tutorial; P=Practical : L=**60,** T=**0**, **P=0**

Course Objectives

The objective of this paper is to offer insights into the basic structure and function of cell and organelles. The course also aims to impart understanding of cell cycle, cell death, cell renewal processes and various techniques in cell biology.

Course Learning Outcomes (CLOs)

On completing this course, students should be able to
CLO 1: discuss cell theory and basic cell structure (understand);
CLO 2: explain various tools and techniques in cell biology (evaluate);
CLO 3: relate the structure with the function of various cell organelles in an eukaryotic cell (evaluate);
CLO 4: express knowledge about the composition of cytoskeleton and extracellular matrix (understand); and
CLO 5: examine mechanisms of cell division and cell death (analyze).

Mapping of Course Learning Outcomes (CLOs) with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1				3							3			
CLO 2		3									3			
CLO 3			3								3			
CLO 4				3							3			
CLO 5					3						3			

Detailed Syllabus

UNIT – 1: Introduction to cell biology, structure of different cell organelles
Prokaryotic (Achaea and eubacteria) and eukaryotic cell (animal and plant cells), cells as experimental models, structure of nuclear envelope, nuclear pore complex, ER structure, Organization Golgi, Lysosome. Structure and function of mitochondria, chloroplast and peroxisomes, Zellweger syndrome.

UNIT – 2: Tools of cell biology
Light microscopy, phase contrast microscopy, fluorescent microscopy, confocal microscopy, electron microscopy, FACS, centrifugation for sub cellular fractionation.

UNIT – 3: Cell wall, extracellular matrix and cytoskeletal protein
Prokaryotic and eukaryotic cell wall, cell matrix protein, cell matrix interaction and cell to cell interaction, Adherence j unction, tight junctions, gap junction, desmosomes, hemidesmosomes, focal adhesion and plasmodesmata. Structure and organization of actin filaments, treadmilling and role of ATP in microfilament polymerization, organization of actin filament. Non muscle myosin, intermediate filament proteins, assembly and intracellular organization. Assembly, organization, and movement of cilia and flagella.

UNIT – 4: Cell cycle, cell death and cell renewable
Eukaryotic cell cycle, restriction point, checkpoints. Cell division, Apoptosis and necrosis-brief outline. Salient feature of transformed cell.

Reference Books:

1. Becker, W.M., Kleinsmith, L.J., Hardin, J., Bertoni, G. P. The World of the Cell, 7th edition. San Francisco, Cambridge: Pearson Benjamin Cummings Publishing
2. Cooper, G.M., Hausman, R.E. The Cell: A Molecular Approach, 5th edition. Washington, D.C.: ASM Press & Sunderland, Sinauer Associates, MA.
3. Karp, G. Cell Biology, 6th edition. New Jersey, U.S.A.: John Wiley & Sons.
4. Majumdar, R., Sisodia, R. Laboratory Manual of Cell Biology, with reference to Plant Cells. New Delhi, Delhi: Prestige Publication.
5. Reven, F.H., Evert, R.F., Eichhorn, S.E. Biology of Plants. New York, NY: W.H.Freeman and Company.
6. Lodish, H., Berk, A. Zipursky, S.L., Matsudaira, P., Baltimore, D. & Darnell, J. Molecular Cell Biology, 7th Edn., W.H. Freeman & Company, New York.
7. Alberts, B., Johnson, A., Lewis, J. & Enlarge, M. Molecular Biology of the Cell, 5th Edn., Garland Science (Princeton).

Teaching – Learning Strategies in brief

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Assessment methods and weightages in brief

There are two components of assessment namely internal assessment and end semester examination. Internal assessment consists of assessment through administration of three sessional exams/tests. The average marks of best of two sessional exams/tests are computed for internal assessment. Sessional exam/test is conducted and computed for 25 marks. End semester exam is of 75 marks.

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DEPARTMENT OF MEDICAL ELEMENTOLOGY & TOXICOLOGY

Name of the Academic Programme : **B.Sc.-M.Sc. Dual Degree**

Course Code : **BTX-CC05**

Title of the Course : **Immunology (Theory)**

Credits : **4**

L=Lecture; T=Tutorial; P=Practical : L=**60,** T=**0**, **P=0**

Course Objectives

This course describes the molecular and cellular basis of the development and function of the immune system. The course provides the basic framework in immunology that will cover the major topics including innate and adaptive immunity, antibodies and antigens, molecular events leading to the generation of antibody, humoral and cell-mediated adaptive immune response, hypersensitivity, self-tolerance, autoimmunity and vaccines.

Course Learning Outcomes (CLOs)

On completing this course, students should be able to
CLO 1: explain the cellular constituents of the immune system including cells, organs and receptors (apply);
CLO 2: describe the structure & functions of different classes of Immunoglobulins and mechanisms of antibody diversity (understand/evaluate);
CLO 3: sketch the players and processes involved in mediating an immune response - humoral and cell mediated (apply);
CLO 4: elaborate the mechanisms of tolerance, autoimmunity and transplantation (understand); and
CLO 5: relate and apply the concepts of immunology learnt in translational research (evaluate).

Mapping of Course Learning Outcomes (CLOs) with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1				3										
CLO 2				3										
CLO 3					3									
CLO 4				3										
CLO 5								3						

Detailed Syllabus

UNIT – 1: Cells and organs of the immune system: Hematopoiesis, cells of the immune system, primary and secondary lymphoid organs and tissues (MALT).

Innate immunity and leucocyte extravasation: Anatomical barriers, cell types of innate immunity, soluble molecules and membrane associated receptors (PRR), connections between innate and adaptive immunity, cell adhesion molecules, chemokines, leukocyte extravasation, localized and systemic response.

Immunogens and antigens: Antigens and haptens, factors that dictate immunogenicity, B and T cell epitopes.

UNIT – 2: **Antibody structure and function**: Structure and distribution of classes and subclasses of immunoglobulins (lg), lg fold, Effector functions of antibody, antigenic determinants on lg and lg super family.
Complement system: Complement activation by classical, alternate and MB lectin pathway, biological consequences of complement activation, regulation and complement deficiencies.
Generation of receptor diversity: Dreyer-Bennett hypothesis, multigene organization of lg locus, mechanism of V region DNA rearrangement, ways of antibody diversification.

UNIT – 3: Biology of B lymphocyte
Antigen independent phase of B cell maturation and selection, humoral response T-dependent and T-independent response, anatomical distribution of B cell populations.
MHC complex cind antigen presentation: General organization and inheritance of MHC, structure, distribution and role of MHC class **I** and class **II** proteins, linkage disequilibrium, pathways of antigen processing and presentation.

UNIT – 4:
Biology of the T lymphocyte: Structure and role of T cell receptor, and co-receptor, T cell development, generation of receptor diversity, selection and differentiation.
Cell mediated cytotoxic responses: General properties of effector T cells, cytotoxic T cells (Tc), natural killer cells; NKT cells and antibody dependent cellular cytotoxicity (ADCC).
Tolerance, autoimmunity and hypersensitivity.
Organ specific and systemic autoimmune diseases, possible mechanisms of induction of autoimmunity, Gell and Coombs classification, lgE mediated (Type I) hypersensitivity.

Reference Books:

1. Kindt, T.L., Goldsby, R.A. & Osborne, B.A. Kuby Immunology, 6th Edn., W.H. Freeman Company, New York.
2. Coico, R. & Sunshine, G. Immunology: A Short Course, 6th Edn., Jonh Wiley & Sons, New Jersey.
3. Murphy, K., Mowat, A. & Weaver, C.T. Janeway's Immunobiology, 8th Edn., Garland Science (London & New York.)

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Assessment methods and weightages in brief

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DEPARTMENT OF MEDICAL ELEMENTOLOGY & TOXICOLOGY

Name of the Academic Programme : **B.Sc.-M.Sc. Dual Degree**

Course Code : **BTX-GE01-B**

Title of the Course : **Enzymes and Proteins (Theory)**

Credits : **4**

L=Lecture; T=Tutorial; P=Practical : L=**60,** T=**0**, **P=0**

Course Objectives

The objective of the course is to provide detailed knowledge about enzymes, the biological catalysts with remarkable properties that sustain life. The course also aims to outline the diverse applications of enzymes in disease diagnosis and therapy as well as in industry. Further, it introduces "proteins" and stresses on their importance in modern biochemistry, highlighting their structural features and unique characteristics that help them participate in most of the physiological processes.

Course Learning Outcomes (CLOs)

On completing this course, students should be able to
CLO 1: explore the nature, importance and methods of isolation and analysis of proteins in living systems (understand);
CLO 2: appreciate the importance of structural diversity and levels of organization of proteins (evaluate);
CLO 3: outline the mechanism of enzyme catalyzed reaction and the kinetics involved (analyze);
CLO 4: appreciate enzyme inhibition and regulation of enzymes (evaluate);
CLO 5: estimate the applications of enzymes in diagnostics, therapy and industry (evaluate).

Mapping of Course Learning Outcomes (CLOs) with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1	3										3			
CLO 2		3									3			
CLO 3				3							3			
CLO 4				3							3			
CLO 5								3			3			

Detailed Syllabus

Unit – 1: Proteins: Introduction, isolation and analysis
Polypeptides and proteins. Subunit structures, conjugated proteins, diversity of function. Techniques to isolate and analyze proteins- salt fractionation, ion-exchange chromatography, gel permeation, HPLC, SDS-PAGE, and IEF. Protein primary structure -

sequencing by Edman degradation, use of enzymes and chemical reagents to obtain overlap peptides. Synthesis of peptides using Merrifield method.

UNIT – 2: Introduction to protein three-dtri1ensional structures

Secondary structure- helices and sheets, Ramachandran maps. Nature of non-covalent bonds and covalent bonds in protein folding. Tertiary and quaternary structures. Oxygen binding curves, cooperativity models for hemoglobin.

UNIT – 3: Introduction to enzyme catalysis and kinetics

Features of enzyme catalysis, superior catalytic power. General mechanisms of catalysis. Nomenclature. Principles of reaction rates, order of reactions and equilibrium constants. Derivation of Michaelis-Menten equation. Significance of Km and Vmax. Catalytic efficiency parameters. Competitive and mixed inhibitions. Kinetics and diagnostic plots. Types of irreversible inhibitors.

UNIT – 4: Mechanisms of enzyme action and regulation

Mechanism of action of chymotrypsin. Inhibitors of enzymes - antibiotics. Regulation of enzyme activity and its importance - aspartate transcarboxylase. Enzymes used in clinical biochemistry as reagents, diagnostics and therapy. Role of immobilized enzymes in industry.

Reference Books:

1. Nelson, D.L. & Cox, M.M. Lehninger: Principles of Biochemistry, 6th Edn, W.H. Freeman and Company, New York.
2. Price, N.C. & Stevens, L. Fundamentals of Enzymology, 3rd Edn., Oxford University Press Inc, New York.

Teaching – Learning Strategies in brief

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Assessment methods and weightages in brief

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DEPARTMENT OF MEDICAL ELEMENTOLOGY & TOXICOLOGY

Name of the Academic Programme : **B.Sc.-M.Sc. Dual Degree**

Course Code : **BTX-GE02-A**

Title of the Course : **Bioethics and IPR (Theory)**

Credits : **4**

L=Lecture; T=Tutorial; P=Practical : L=**60,** T=**0**, **P=0**

Course Objectives

Through this course, students will learn the significance and framework of intellectual property rights and understand the protocols of patenting. Students will also learn the importance of biosafety protocols and bioethics. This course helps to adhere to the ethical practices appropriate to the discipline and to adopt safe working practices relevant to the bioindustries and field of research.

Course Learning Outcomes (CLOs)

On completion of this course, the students will be able to
CLO 1: gain awareness about Intellectual Property Rights (IPRs) and take measures for their protection (understand);
CLO 2: devise business strategies on the basis of IPRs (create);
CLO 3: assist in technology upgradation and enhancing competitiveness (understand);
CLO 4: review the basics of biosafety protocols (understand);
CLO 5: employ biosafety protocols in experimental research (apply).

Mapping of Course Learning Outcomes (CLOs) with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1				3										
CLO 2					3									
CLO 3	3													
CLO 4				3										
CLO 5								3						

Detailed Syllabus

UNIT – 1: Fundamentals of bioethics
Definition, historic evolution, codes and guidelines, universal principles of bioethics. Codes, agreements, Declarations and Guidelines. Define the term "Bioethics" in relation to profession, society, and biomedicine, learn about gradation of moral and ethical norms and learn about prayers, oaths, agreements, declarations, guidelines and codes which have relevance to bioethics Clinical ethics. Describe the sanctity of human life and the need to

preserve human life, explain about issues related to prenatal screening, clinical trials (Phase I/II/III/IV) studies. Informed consent, Ethics committees.

UNIT – 2: Bioethics in practice
Medical errors and Negligence Medical error and medical negligence difference, remedies against medical negligence, protection and compensation related to it. Care in infectious diseases, identify ethical issues in clinical practice of HIV, TB, leprosy and its prevention, research ethics related to infectious diseases Ethical use of animals in the laboratory

UNIT – 3: Introduction to intellectual property rights
Basics of Intellectual Property, History and Evolution of Intellectual Property, Treaty and Convention on IP, World Intellectual Property Organization and International Cooperation, Types of IPR, Economic importance of IPR

UNIT – 4: Intellectual property laws and its role in development
Patents, Trademarks, Copyright, Designs, Geographical Indications, Other related rights, Prosecution of IPR, Infringement and Enforcement of IPRs, Effect of Intellectual Property Protection in Development, Ideal industrial and institutional setup for Intellectual Property Outcomes, Role of Licensing and commercialization, IP Cells and Technology Transfer Offices, Future scope and career in Intellectual Property Field

Reference Books:

1. IPR, Biosafety and Bioethics by Goel and Parashar
2. Genetically Modified Crops and Agricultural Development (Palgrave Studies in Agricultural Economics and Food Policy)" by Matin Qaim
3. Biosafety and Bioethics" by Rajmohan Joshi
4. Bioethics and Biosafety in Biotechnology" by V Sree Krishna
5. "An Introduction to Ethical, Safety and Intellectual Property Rights Issues in Biotechnology" by Padma Nambisan

Teaching – Learning Strategies in brief

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Assessment methods and weightages in brief

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DEPARTMENT OF MEDICAL ELEMENTOLOGY & TOXICOLOGY

Name of the Academic Programme : **B.Sc.-M.Sc. Dual Degree**

Course Code : **BTX-GE02-B**

Title of the Course : **Biotechnology and Human Welfare (Theory)**

Credits : **4**

L=Lecture; T=Tutorial; P=Practical : L=**60,** T=**0**, **P=0**

Course Objectives

The course aims to introduce applications of these techniques in production of recombinant therapeutic proteins and vaccines will also be outlined in this course. The course aims to provide an understanding of the applications of biochemistry in forensic sciences through analysis of evidences, which will help students develop analytical and problem-solving skills for real life situation. The course also introduces various environmental pollutants that affect human health.

Course Learning Outcomes (CLOs)

On completion of this course, the students will be able to
CLO 1. Understand the concepts in protein engineering
CLO 2. Introduces concept in Forensic sciences
CLO 3. Understanding of plant microbe introduction
CLO 4. Outline the environmental pollutants affecting human health
CLO 5. Understand concepts in gene therapy

Mapping of Course Learning Outcomes (CLOs) with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1				3							3			
CLO 2				3										
CLO 3				3										
CLO 4				3								3		
CLO 5				3										2

Detailed Syllabus

UNIT – 1
Protein engineering; enzyme and polysaccharide synthesis, activity and secretion, alcohol and antibiotic formation. Forensic science: e.g. solving violent crimes such as murder and rape; solving claims of paternity and theft etc. using various methods of DNA finger printing.

UNIT – 2

Nitrogen fixation: transfer of pest resistance genes to plants; interaction between plants and microbes; qualitative improvement of livestock.

UNIT – 3

Environments: e.g. chlorinated and non-chlorinated organ pollutant degradation; degradation of hydrocarbons and agricultural wastes, stress management, development of biodegradable polymers such as PHB.

UNIT – 4

Health: e.g. development of non-toxic therapeutic agents, recombinant live vaccines, gene therapy, diagnostics, monoclonal in E. coli, human genome project.

Reference Books:

1. Biotechnology and Human Welfare for Competitive Examinations by Dr. Subroto Biswas

Teaching – Learning Strategies in brief

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Assessment methods and weightages in brief

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Total Marks are 100 for the subject (Internal Assessment: 25 Marks and End semester examination: 75 Marks).

DEPARTMENT OF MEDICAL ELEMENTOLOGY & TOXICOLOGY

Name of the Academic Programme : **B.Sc.-M.Sc. Dual Degree**

Course Code : **BTX-CC07**

Title of the Course : **Introduction to Toxicology**

Credits : **4**

L=Lecture; T=Tutorial; P=Practical : L=**60,** T=**0**, **P=0**

Course Objectives

Course Learning Outcomes (CLOs)

After completing this Course, the students should be able to

CLO-1 Understanding the basics of toxicology, its historical background and various branches, toxic responses and their assessments

CLO-2 Studying the various terms and concepts of toxicology, toxicity actions in terms of dose and toxicity testing

CLO-3 Understanding the various routes of exposure of toxicants, its movement and biotransformation in our body and its mechanism of action

CLO-4 Application of various detoxification reaction in distribution, storage and elimination of toxicants

CLO-5 Evaluation of various targets of toxicants in our body at different levels including molecular, cellular, histological, organ, organ system and organism

Mapping of Course Learning Outcomes (CLOs) with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1		3	3	3						3				
CLO 2		3	3							3		3		
CLO 3		3	3							3		2		
CLO 4		3	3					3		3				3

Detailed Syllabus

UNIT-I:General account of toxicology

Definition and types of toxicants.

History, scope and various branches of toxicology.

Types of toxic responses.

Different types of toxicities (acute, subacute, chronic, sub-chronic toxicity).

A brief outline of methods of toxicity assessment.

Animal use in toxicology and animal welfare.

UNIT-II: Toxicity in action

Dose-response relationship.

ED50, LD50, EC50, LC50.

Regulatory requirement of toxicity testing.

UNIT-III: Journey of a toxicant in our body

Different routes of exposure to toxicants.

Toxicokinetics.Absorption, distribution, and storage of toxic chemicals. Sites of metabolism of a toxicant.

Biotransformation and detoxification reactions; Phase l and Phase II reactions (various types of Hydrolysis, Oxidation, Reduction and Conjugation reactions with appropriate examples) Distribution, storage and elimination of toxicants.

UNIT-IV: Mechanisms of action of toxicants

Effects of toxicants on target molecules, toxicant- induced cellular dysfunction, molecular and cellular repair. Chemical interactions (additive effect, potentiation, synergism and antagonism) and their consequences. Factors affecting toxicity and metabolism of toxicants.

A brief introduction to systemic toxicity.

(Number of Units may be decided by the School/Department/Centre)

Reference Books:

1. Casarett &Doull's Toxicology: The Basic Science of Poisons, 9th Edition. (2018). Greece: McGraw-Hill Education.
2. Burcham, P. C. (2013). An Introduction to Toxicology. United Kingdom: Springer London.

Teaching-Learning Strategies in brief (4 to 5 sentences)

Toxicology is a field of science that helps us understand the harmful effects that chemicals, substances, or situations, can have on people, animals, and the environment. It overlaps with biology, chemistry, pharmacology, and medicine which involves the study of the adverse

effects of chemical substances on living organisms and the practice of diagnosing and treating exposures to toxins and toxicants. Lectures, seminars and other interactive sessions with the students are the main learning strategies along with the discussion of important case studies and specific assignments will be given to students with the interest of improving discussion about the various ranges of topics in the course.

Assessment methods and weightages in brief (4 to 5 sentences)

Students will be assessed on three parameters. (1). Active participation (10%): this includes attendance, class room discussion and learning activities. Learning activities will mainly include practice to solve different problems covered in class (2) Assignments and Tests (15): Assisnments will be based on topics and problems related with syllabus (10%). 3. Semester Examination (75%). Exams to evaluate understanding of material covered in class.

DEPARTMENT OF MEDICAL ELEMENTOLOGY & TOXICOLOGY

Name of the Academic Programme : **B.Sc.-M.Sc. Dual Degree**

Course Code : **BTX-CC08**

Title of the Course : **Basic Principles of Pharmacology**

Credits : **4**

L=Lecture; T=Tutorial; P=Practical : L=**60,** T=**0**, **P=0**

Course Learning Outcomes (CLOs)

After completing this Course, the students should be able to:

CO1	Learn the process of development of Pharmacology field through study of historical aspects and significance of the field. (Understand level)
CO2	To understand jargons of the pharmacology(Understand level)
CO3	To calculate Pharmacodynamics and Pharmacodynamic parameters . (Analyzelevel)
CO4	Learn to analyses drug-protein integration and it significance (Evaluate level)
CO5	explain the mechanism of drug action (Analyse level)

Mapping of Course Learning Outcomes (CLOs) with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1		3	2							3				
CLO 2		3	2							3		3		
CLO 3		3	2							3				
CLO 4		3	2	3						3				3

Detailed Syllabus

UNIT-I: Introduction of Pharmacology

Definition and the History of Pharmacology, Aims and significance of Pharmacology. Source of Drugs: Natural products, Synthetic and semi-synthetic molecules. Classification of Pharmacology: Clinical Pharmacology Vs Toxicology

UNIT-II: Pharmacodynamics Principles

The Nature of Drugs: The Physical Nature of Drugs, DrugSize. Drug Reactivity and Drug-Receptor Bonds. Ligand-receptor interaction: Binding affinities. Analysis of ligand receptor interactions usingSchatchard, double reciprocal plot, Hill plot.

UNIT-III: Pharmacokinetics Principles

Permeation, Fick's Law of Diffusion, Ionization of Weak Acids and Weak Bases; the Henderson-Hasselbalch Equation. Volume of Distribution. Clearance: Capacity-Limited Elimination, Flow-Dependent Elimination. Half-Life of Drugs. Drug Accumulation. Bioavailability. The Time Course of Drug Effect.

UNIT-IV: Drug Classes and Their Mode of Action

Classification of drugs. Structure and mode of action of selected drugs. Anaesthetics and Sedatives. Anti-parkinsonism drug, Anti-Alzheimer's drug. Anticoagulants, ACE Inhibitors and BetaBlockers Antibiotics and Drug Resistance. Drug Addiction and Drug Abuse.

Reference Books:

1. Mannfred A. Hollinger, Introduction to Pharmacology, 3rd Edison, ISBN 9781420047417Published October 19, 2007 by CRC Press
2. Bertram G Katzung, BASIC AND CLINICAL PHARMACOLOGY 15ED, McGraw Hill Medical; Fifteenth edition (5 December 2020); McGraw Hill Education (India) Private Limited, B-4, Sector-63, Dist. Gautam Budh Nagar, Noida – 201 301, UP

Teaching-Learning Strategies in brief:

1. The learning abilities are incorporated with the help of visualization technology enriched with the advanced text

2. Discussions and presentation by the students utilized during lectures enhances problem-based learning among the students

3. Incorporation of assessment based on tests in timed google form has elated the active participation of the students

Assessment methods and weightages in brief

The performance of the student in each paper will be evaluated both continuously (Internal Assessment) and at the end of semester (Semester Examination). 25% marks for each theory paper will be allocated for internal assessment and 75% marks will be kept for semester examination at the end of each semester.

DEPARTMENT OF MEDICAL ELEMENTOLOGY & TOXICOLOGY

Name of the Academic Programme : **B.Sc.-M.Sc. Dual Degree**

Course Code : **BTX-CC09**

Title of the Course : **Biochemical Toxicology**

Credits : **4**

L=Lecture; T=Tutorial; P=Practical : L=**60,** T=**0**, **P=0**

Course Learning Outcomes (CLOs)

After completing this Course, the students should be able to:

CO1	Students will learn about the definition of oxidative stress and the kind of toxicological consequence of oxidative stress on the biomolecules. (Evaluate level)
CO2	To disseminate knowledge on antioxidant defense mechanism through different enzymatic and non-enzymatic antioxidant. (Evaluate level)
CO3	To understand the xenobiotics induced calcium homeostasis disturbance and its toxicological consequence. (Analyzelevel)
CO4	In this topic students will learn about the mitochondria and its consequence after the disruption of cellular energy production by different evaluating parameter(Analyze level)
CO5	Identify and explain the impact of neurotoxicant on oxidative stress and cellular disruption through mitochondrial dysfunctions (Analyze level)

Mapping of Course Learning Outcomes (CLOs) with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO1		2	3								3			
CLO2		2	3								3			
CLO3		2	3								3			
CLO4		2	3								3			
CLO5		2	3		2						3			

Detailed Syllabus

UNIT-I:Oxidative Stress

Definition of oxidative stress, Toxicological consequences of oxidative stress, Oxidative stress and protein damage, Oxidative stress and DNA damage, Oxidative stress and lipid damage

UNIT-II: Antioxidative Defence Mechanisms

Enzymatic and Non enzymatic antioxidants, Role of glutathione, Superoxide dismutase, Metallothionein and α-tocopherol as antioxidants, Necrotic and apoptotic cell death mechanisms

UNIT-III: Disturbances in Calcium Homeostasis

Xenobiotic-induced alterations in intracellular calcium distribution, Toxicological consequences of increased intracellular calcium concentrations

UNIT-IV: Disruption of Cellular Energy Production

Mitochondrial targets, Protonophoretic and uncoupling activity of xenobiotics, Inhibition of NADH production, Inhibition of electron transport change, Change in mitochondrial membrane permeability

Reference Books:

1. Casarett& Doull's Toxicology: The Basic Science of Poisons, 9th Edition
2. Byung-Mu Lee, Sam Kacew, Hyung Sik Kim: Lu's Basic Toxicology
3. Comprehensive Toxicology by Charlene McQueen (Editor-In-Chief)
4. Illustrated Handbook of Toxicology by Franz-Xaver Reichl; Leonard Ritter; Jochen Benecke; Herbert Desel; Jürgen Durner.
5. Robert C. Smart (Editor), Ernest Hodgson: Molecular and Biochemical Toxicology, 5th Edition.

Teaching-Learning Strategies in brief:

1. The learning abilities are incorporated with the help of visualization technology enriched with the advanced text

2. Discussions and presentation by the students utilized during lectures enhances problem-based learning among the students

3. Incorporation of assessment based on tests in timed google form has elated the active participation of the students

Assessment methods and weightages in brief

The performance of the student in each paper will be evaluated both continuously (Internal Assessment) and at the end of semester (Semester Examination). 25% marks for each theory paper will be allocated for internal assessment and 75% marks will be kept for semester examination at the end of each semester.

DEPARTMENT OF MEDICAL ELEMENTOLOGY & TOXICOLOGY

Name of the Academic Programme : **B.Sc.-M.Sc. Dual Degree**

Course Code : **BTX-CC10**

Title of the Course : **Drugs Toxicology**

Credits : **4**

L=Lecture; T=Tutorial; P=Practical : L=**60,** T=**0**, **P=0**

Course Learning Outcomes (CLOs)

After completing this Course, the students should be able to

CLO-1	Have a knowledge of basic toxicological concepts, different types of toxicological effects registered in preclinical toxicity studies and the importance of metabolism for a drug's pharmacokinetics, pharmacodynamics and toxicity. Having completed the course, the student shall also have a knowledge of the general principles of safety assessment of drugs. **(Cognitive level: Understanding)**
CLO-2	To established methods, facilities for pharmacological investigations of drugs; including (ADME) - Administration e.g. Absorption, Distribution ; look for target organ, Metabolism e.g. Excretion: duration of drug from entry to exit. **(Cognitive level: Apply)**
CLO-3	List common mechanisms of detoxification, discuss the difference between general defense mechanisms and detoxication pathways. **(Cognitive level: Analyse)**
CLO-4	They shall be able to describe key enzymes that aid metabolism of toxic substances and list common toxins and toxicants and how they are specifically detoxicated. **(Cognitive level: Analyse)**
CLO-5	Written examinations (sessional and final exams) are held in between and at the end of the course. Students are required to pass the written examination and compulsory parts of the course. (**Cognitive level: Evaluate)**

Mapping of Course Learning Outcomes (CLOs) with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1		3	3		2						3			
CLO 2		3	3		2						3			
CLO 3		3	3								3			
CLO 4		3	3								3			

Detailed Syllabus

UNIT-I: Definition and categories of drugs, Mode of drug administration, General toxicities of drugs. Over dose management, Routes of Drug Administration, ADME, Acetoaminophen toxicity.

UNIT II: Drug abuse : definition, with special reference to sports medicines, current reports, banned classes of drug : a brief survey, role of different agencies, drug overdose

UNIT III: Drug nutrient interrelationship, age, sex, body weight etc. factors affecting this relationship. Various modes of drug administration, role in mechanism of action of drug. Management of drug overdose toxicity and rehabilitation (specially narcotics).

UNIT IV: Over dose toxicity symptoms and mechanism of action of barbiturates (short and long), non barbiturates, narcotic analgesics, INH toxicity (case study), CNS stimulants drug, tricyclic antidepressant: discussion with appropriate examples, signs and symptoms of toxicity treatment and prevention.

Reference Books:

1. Fundamentals of Toxicologic Pathology (Ed. Matthew A. Wallig, Wanda M. Haschek, Colin G. Rousseaux), 2nd edition Academic Press; 5A Bhawani Dutta Lane,Kolkata-700073,West Bengal, India.
2. Microsomes and Drug Oxidations (Ed. James R. Gillette, Allan H. Conney, George J. Cosmides), 17th edition. Elsevier publications, Radarweg 29, 1043 NX Amsterdam, The Netherlands.

Teaching-Learning Strategies in brief (4 to 5 sentences)

When a student becomes interest in a subject, it is likely that he/she is self-motivated. When this is combined with the ability to be proactive and reflective, the student is also more likely to acquire deep knowledge and develop advanced analytical skills. The present subject includes various learning activities besides lecturing, including colloquiums, graded project assignments with oral presentations. Latest research developments on topics of curriculum are majorly emphasized.

Assessment methods and weightages in brief (4 to 5 sentences)

Students will be assessed on three parameters. (1). **Class performance (10%): this includes attendance, class room discussion and learning activities. Learning activities will mainly include practice to solve different problems**covered in class (2) **Oral presentations and tests (15)**: Assignments will be based on topics and problems related with syllabus. **3. Semester Examination (75%)** Comprising of evaluation of written answers of tests.

DEPARTMENT OF MEDICAL ELEMENTOLOGY & TOXICOLOGY

Name of the Academic Programme : **B.Sc.-M.Sc. Dual Degree**

Course Code : **BTX-CC01P**

Title of the Course : **Toxicology Lab I**

Credits : **4**

L=Lecture; T=Tutorial; P=Practical : L=**60,** T=**0**, **P=0**

Course Learning Outcomes (CLOs)

After completing this Course, the students should be able to

CLO-1	Learn concepts and the principals and methods of solution preparation. **(Cognitive level: Understanding)**
CLO-2	Measure solution properties such as concentrations and pH. **(Cognitive level: Apply)**
CLO-3	Learn lab safety rules and handling of different chemicals. **(Cognitive level: apply)**
CLO-4	Able to handle common lab equipment **(Cognitive level: Apply)**
CLO-5	Evalute simple data on solution preparation and concentrations dedermination. **(Cognitive level: Evaluate)**

Mapping of Course Learning Outcomes (CLOs) with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1		3	3						3				3	
CLO 2		3	3										3	
CLO 3		3	3										3	
CLO 4		3	3										3	
CLO 5		3	3			3		2					3	

Detailed Syllabus

Experiments

UNIT-I: Solutions concentration and dilution

Safety measures in Lab

Concept of concentration units: w/w, w/v, v/v, % concentration, Molarity, Molality, Normality, PPM, PPB etc.

Preparation of solution of different concentrations using weighing balance.

Concept of Stock solution

Preparation of solutions of different dilutions from Stock solution

UNIT-II: Concept of pH and Buffer
Concept of acidic, neutral and alkaline buffers
Preparation of buffer solution using Henderson–Hasselbalch equation
Preparation of buffer using pH meter
Determination of buffering capacity using pH meter.

UNIT-III: Estimation
Calibrations of pipette, burette, standard flasks
TLC
Absorption spectroscopy
Determination of protein/DNA concentration using extinction coefficients.
Amino Acid Titration

UNIT-IV: Pharmacology Experiments
Introduction to Commonly used instruments in experimental pharmacology.
Recording of basal mass index
Qualitative analysis of urine Physical Properties
Retrieve the information of a drug and its adverse effects using online tools

Reference Books:

1.Studies on Experimental Toxicology and Pharmacology (Ed. Stephen M. Roberts, James P. Kehrer, Lars-Oliver Klotz)1st Edition, Humana Cham, Springer International Publishing Switzerland.

Teaching-Learning Strategies in brief (4 to 5 sentences)
When a student becomes interest in a subject, it is likely that he/she is self-motivated. When this is combined with the ability to be proactive and reflective, the student is also more likely to acquire deep knowledge and develop advanced analytical skills. The present subject includes various learning activities besides lecturing, including colloquiums, graded project assignments with oral presentations. Latest research developments on topics of curriculum are majorly emphasized.

Assessment methods and weightages in brief (4 to 5 sentences)
Students will be assessed on three parameters. (1). **Class performance (10%): this includes attendance, class room discussion and learning activities. Learning activities will mainly include practice to solve different problems** covered in class (2) **Oral presentations and tests (15)**: Assignments will be based on topics and problems related with syllabus. **3. Semester Examination (75%)**Comprising of evaluation of written answers of tests.

DEPARTMENT OF MEDICAL ELEMENTOLOGY & TOXICOLOGY

Name of the Academic Programme : **B.Sc.-M.Sc. Dual Degree**

Course Code : **BTX-SEC01**

Title of the Course : **Fundamentals of Pathology**

Credits : **2**

L=Lecture; T=Tutorial; P=Practical : L=**30,** T=**0**, **P=0**

Course Learning Outcomes (CLOs)

After completing this Course, the students should be able to:

CO1	Understand general terms used in for the area ofpathology that deals with the gross and microscopic analysis of organs, tissues,and cells.
CO2	Pathology is the study of reaction of cells or tissues to injury with focus on itmechanism of response. This chapter describe in detail the mechanism of cell'sresponses to various harmful stimuli.
CO3	Understand how inflammation enablesour body to attack infections, how inflammation is resolved and how uncontrolledinflammation can lead to collateral damage.
CO4	Tissue healing and repair mechanism involves intricate interactions at woundsite initiated by vascular derived cells. This chapter give a detailed understanding ofthe mechanism controlling the inflammatory response during healing and repairprocess.
CO5	Pathology identifies cause of disease based on morphological findings andancillary tests. This chapter will help students to identify morphological alterations inthe injured or diseased tissues.

Mapping of Course Learning Outcomes (CLOs) with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1		2						3						3
CLO 2		2	3					3						3
CLO 3		2												3
CLO 4		2				3	3							3
CLO 5		2				3	3							3

Detailed Syllabus

UNIT-I:

Definition of pathology, Health and Disease, Terminology in pathology, Evolution of pathology, causes and mechanisms of cell injury, reversible and irreversible injury, Necrosis, Apoptosis, subcellular and intracellular response, cellular ageing, cellular adaptations: Hyperplasia, Hypertrophy, Atrophy, Metaplasia

UNIT-II: Tissue Renewal and Repair, Healing and Fibrosis

Regeneration and its mechanism. Role of Extracellular Matrix, repair and its types and mechanisms wound healing, healing-scar formation and fibrosis, applications of Pathology in understanding diseases

Reference Books:

Teaching-Learning Strategies in brief:

1. The learning abilities are incorporated with the help of visualization technology enriched with the advanced text
2. Discussions and presentation by the students utilized during lectures enhances problem-based learning among the students
3. Incorporation of assessment based on tests in timed google form has elated the active participation of the students

Assessment methods and weightages in brief

The performance of the student in each paper will be evaluated both continuously (Internal Assessment) and at the end of semester (Semester Examination). 25% marks for each theory paper will be allocated for internal assessment and 75% marks will be kept for semester examination at the end of each semester.

DEPARTMENT OF MEDICAL ELEMENTOLOGY & TOXICOLOGY

Name of the Academic Programme : **B.Sc.-M.Sc. Dual Degree**
Course Code : **BTX-GE03**
Title of the Course : **Environmental Toxicology (Theory)**
Credits : **4**
L=Lecture; T=Tutorial; P=Practical : L=**60,** T=**0**, **P=0**

Course Learning Outcomes (CLOs)

After completing this Course, the students should be able to

CLO-1	Understanding the concepts and importance of environmental toxicology
CLO-2	Studying the sources, fate and properties of major classes of hazardous environmental chemicals
CLO-3	Overview of bioaccumulation and biomagnifications of toxic environmental chemicals
CLO-4	Understanding the effects of environmental toxic chemicals on human health
CLO-5	Studying the risk assessment of exposure to toxic environmental chemicals and their legislation

Mapping of Course Learning Outcomes (CLOs) with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1		3	3			3				3		3		
CLO 2		3	3									3		
CLO 3		3	3			3						3		
CLO 4		3	3				3		3			3		
CLO 5		3	3					3				3	3	

Detailed Syllabus

Unit-I

1) Introduction to environmental toxicology (**scope** and **elements of the subjects**).
2) Hazardous substances in environment sources and fate of major classes of hazardous environmental chemical.
3) Properties of toxic chemical influencing their distribution and transformation action of environment forces affecting toxicant breakdown, movement and accumulation.
4) Bioaccumulation and biomagnifications of environmental chemicals.

Unit- II

1) Hazardous chemical substance and human health (exposure scenario; exposure episodes).
2) Risk assessment of environmental chemical exposure.
3) Rules and regulation governing release of hazardous chemicals into the environmental in India.

(Number of Units may be decided by the School/Department/Centre)

Reference Books:

1. Yu, M., Sofield, R., Landis, W. (2017). Introduction to Environmental Toxicology: Molecular Substructures to Ecological Landscapes, Fifth Edition. United States: CRC Press.
2. Shane, B. S., Cockerham, L. G. (2019). Basic Environmental Toxicology. United States: CRC Press.

Teaching-Learning Strategies in brief (4 to 5 sentences)

Environmental toxicology is a multidisciplinary field of science concerning with the toxic effects of environmental chemicals exposed through various sources such as industries, automobiles, packaging materials and other consumer products. Lectures, seminars and other interactive sessions with the students are the main learning strategies along with the discussion of important case studies and specific assignments will be given to students with the interest of improving discussion about the various ranges of topics in the course.

Assessment methods and weightages in brief (4 to 5 sentences)

Students will be assessed on three parameters. (1). **Active participation (10%): this includes attendance, class room discussion and learning activities. Learning activities will mainly include practice to solve different problems** covered in class (2) **Assignments and Tests (15)**: Assignments will be based on topics and problems related with syllabus (10%). **3. Semester Examination (75%).** Exams to evaluate understanding of material covered in class.

DEPARTMENT OF MEDICAL ELEMENTOLOGY & TOXICOLOGY

Name of the Academic Programme : **B.Sc.-M.Sc. Dual Degree**

Course Code : **BTX-CC02 P**

Title of the Course : **Basics of Chemistry (Practical)**

Credits : **2**

L=Lecture; T=Tutorial; P=Practical : L=**00,** T=**0**, **P=30**

Course Objectives

The lab course intends to provide students the basic knowledge of chemistry including the techniques, concepts, and calculations related to the foundation for a better understanding of processes in chemistry to enable students for future work and thinking.

Course Learning Outcomes (CLOs)

On completing this course, students should be able to
CLO 1: describe and understand the purification of organic compounds by the application of crystallization using different solvents (understand);
CLO 2: learn and analyse the melting point of compounds using different methods (analyse);
CLO3: determine the mixed melting point of liquid compounds with the impact of impurities on melting point determination (understand, apply); and
CLO 4: determination of boiling point of liquid compounds (apply)

Mapping of Course Learning Outcomes (CLOs) with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1				3										
CLO 2			3											
CLO 3					3									
CLO 4					3									

Detailed Syllabus

Checking the calibration of the thermometer

- Purification of organic compounds by crystallization using the following solvents:
  - Water
  - Alcohol
  - Alcohol-Water
- Determination of the melting points of above compounds and unknown organic compounds (Kjeldahl method and electrically heated melting point apparatus)
- Effect of impurities on the melting point – mixed melting point of two unknown organic compounds

- Determination of boiling point of liquid compounds. (Boiling point lower than and more than 100 °C by distillation and capillary method)

Teaching – Learning Strategies in brief

The teaching learning strategy followed is learning by doing.

Assessment methods and weightages in brief

The internal practical sessional exam is conducted for 13 marks. End semester exam is of 37 marks. Total Marks are 50 for the subject (Internal Assessment: 13 Marks and End Semester Examination: 37 Marks).

DEPARTMENT OF MEDICAL ELEMENTOLOGY & TOXICOLOGY

Name of the Academic Programme : **B.Sc.-M.Sc. Dual Degree**

Course Code : **BTX-CC03 P**

Title of the Course : **Biomolecules (Practical)**

Credits : **2**

L=Lecture; T=Tutorial; P=Practical : L=**0,** T=**0**, **P=30**

Course Objectives

The practicals in this course aim to provide students with an understanding of basics in biomolecules study. It will enhance the analytical skill together with expertise in dealing with experimental procedure with safety. The course will enhance knowledge about various biomolecules and techniques.

Course Learning Outcomes (CLOs)

On completing this course, students should be able to
CLO 1: learn about the safety measures in laboratory (apply);
CLO 2: acquire skill in preparing normal and molar solution (apply);
CLO 3: determine pKa of acetic acid and glycine (apply);
CLO 4: knowledge about the qualitative analysis of carbohydrates, lipids, amino acids, proteins and nucleic acid (understand);
CLO 5: learn the technique of thin layer chromatography for separation of aminoacids, sugars and nitrogenous bases (apply); and

Mapping of Course Learning Outcomes (CLOs) with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1	2										3			
CLO 2		3									3			
CLO 3		3									3			
CLO 4				3							3			
CLO 5				4							3			

Detailed Syllabus

1. Safety measures in laboratories.
2. Preparation of normal and molar solutions.
3. Preparation of buggers.
4. Determination of pKa of acetic acid and glycine.
5. Qualitative tests for carbohydrates, lipids, amino acids, proteins and nucleic acids.
6. Separation of amino acids/sugars/bases by thin layer chromatography.
7. Estimation of vitamin C.

Reference Books:

1. Nelson, D.L. & Cox, M.M. Principles of Biochemistry, 5th Edn., W.H. Freeman & Company.
2. Berg, M.J., Tymockzo, J.L. & Stryer, L. Biochemistry, 6th Edition, W.H. Freeman & Company.
3. Wood. E.J. & Pickering, W.R. Introducing Biochemistry. John Murray, London.
4. Nelson, D.L. & Cox, M.M. Lehninger: Principles of Biochemistry, 6th Edn, W.H. Freeman and Company, New York.
5. Devlin, T.M. Textbook of Biochemistry with Clinical Correlations, 7th Edn, John Wiley & Sons, New York.

Teaching – Learning Strategies in brief

The teaching learning strategy followed is learning by doing.

Assessment methods and weightages in brief

The internal practical sessional exam is conducted for 13 marks. End semester exam is of 37 marks. Total Marks are 50 for the subject (Internal Assessment: 13 Marks and End Semester Examination: 37 Marks).

DEPARTMENT OF MEDICAL ELEMENTOLOGY & TOXICOLOGY

Name of the Academic Programme : **B.Sc.-M.Sc. Dual Degree**

Course Code : **BTX-CC04 P**

Title of the Course : **Cell Biology (Practical)**

Credits : **2**

L=Lecture; T=Tutorial; P=Practical : L=**0,** T=**0**, **P=30**

Course Objectives

On completing this course, students would gain hand-on training in current cell biological methods and familiarize with techniques used in cell biology. They will learn to identify different stages of amitosis and mitosis and learn sub-cellular fractionation and comprehend the basic of cellular functions.

Course Learning Outcomes (CLOs)

On completing this course, students should be able to
CLO 1: visualization and differentiation of animal and plant cell (analyse);
CLO 2: knowledge about identification of the different stages of amitosis and mitosis (apply);
CLO 3; understand the different cell components and sub cellular fractionation (analyse);
CLO 4: learn about the temperature effect on cell membrane permeability (evaluate); and
CLO 5: acquire the knowledge to stain and visualize mitochondria (apply).

Mapping of Course Learning Outcomes (CLOs) with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1			3								3			
CLO 2				3							3			
CLO 3				3							3			
CLO 4			3								3			
CLO 5	3										3			

Detailed Syllabus

1. Visualization of animal and plant cell by methylene blue.
2. Identification of different stages of amitosis in onion root tip.
3. Identification of different stages of meiosis in onion bud.
4. Micrographs of different cell components (dry lab).
5. Sub-cellular fractionation.
6. Effect of temperature and organic solvent on the permeability of cell membrane
7. Staining and visualization of mitochondria by Janus green stain.

Reference Books:

1. Cooper, G.M. & Hausman, R.E. (2009). The Cell: A Molecular Approach, 5th Edn., ASM Press &* Sunderland (Washington DC), Sinauer Associates, M.A.
2. Lodish, H., Berk, A. Zipursky, S.L., Matsudaira, P., Baltimore, D. & Darnell, J. (2012). Molecular Cell Biology, 7th Edn., W.H. Freeman & Company, New York.
3. Alberts, B., Johnson, A., Lewis, J. & Enlarge, M. (2008). Molecular Biology of the Cell, 5th Edn., Garland Science (Princeton).

Teaching – Learning Strategies in brief

The teaching learning strategy followed is learning by doing.

Assessment methods and weightages in brief

The internal practical sessional exam is conducted for 13 marks. End semester exam is of 37 marks. Total Marks are 50 for the subject (Internal Assessment: 13 Marks and End Semester Examination: 37 Marks).

DEPARTMENT OF MEDICAL ELEMENTOLOGY & TOXICOLOGY

Name of the Academic Programme : **B.Sc.-M.Sc. Dual Degree**

Course Code : **BTX-CC05 P**

Title of the Course : **Immunology (Practical)**

Credits : **2**

L=Lecture; T=Tutorial; P=Practical : L=**0,** T=**0**, **P=30**

Course Objectives

The course will help students to identify the cellular and molecular basis of immune responsiveness and hands-on on different techniques used in immunology for concept clearance and understanding.

Course Learning Outcomes (CLOs)

On completing this course, students should be able to

CLO1: learn to purify immunoglobulins (apply)
CLO2: understand the assays based on precipitation reactions – Ouchterlony double diffusion (ODD) and Mancini radial immunodiffusion (understand)
CLO3: acquire knowledge about agglutination reactions – Blood typing (active) & passive agglutination (apply)
CLO4: perform ELISA, DOT blot and Immonoblot (apply).

Mapping of Course Learning Outcomes (CLOs) with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1			3											
CLO 2				3										
CLO 3			3											
CLO 4			3											

Detailed Syllabus

1. Purification of immunoglobulins.
2. Assays based on precipitation reactions – Ouchterlony double diffusion (ODD) and Mancini radial immunodiffusion.
3. Assays based on agglutination reactions – Blood typing (active) & passive agglutination.
4. Enzyme linked immune-sorbent assay (ELISA).
5. DOT blot
6. Immunoblot

Reference Books:

1. Kindt, T.L., Goldsby, R.A. & Osborne, B.A. Kuby Immunology, 6th Edn., W.H. Freeman Company, New York.
2. Coico, R. & Sunshine, G. Immunology: A Short Course, 6th Edn., Jonh Wiley & Sons, New Jersey.
3. Murphy, K., Mowat, A. & Weaver, C.T. Janeway's Immunobiology, 8th Edn., Garland Science (London & New York.)

Teaching – Learning Strategies in brief

The teaching learning strategy followed is learning by doing.

Assessment methods and weightages in brief

The internal practical sessional exam is conducted for 13 marks. End semester exam is of 37 marks. Total Marks are 50 for the subject (Internal Assessment: 13 Marks and End Semester Examination: 37 Marks).

DEPARTMENT OF MEDICAL ELEMENTOLOGY & TOXICOLOGY

Name of the Academic Programme : **B.Sc.-M.Sc. Dual Degree**

Course Code : **BTX-CC06 P**

Title of the Course : **Enzymes and Proteins (Practical)**

Credits : **2**

L=Lecture; T=Tutorial; P=Practical : L=**0,** T=**0**, **P=30**

Course Objectives

The practical in this course will provide knowledge about the basic properties and characteristics of enzymes and their action and students can learn enzyme kinetics and role of the inhibitors of enzymes in enzyme catalysed reactions.

Course Learning Outcomes (CLOs)

On completing this course, students should be able to

CLO1: estimate proteins by UV absorbance and Biuret, Lowry/Bradford method (evaluate);
CLO2: perform ammonium sulfate fractionation of crude homogenate from germinated mungbean and set up assay for acid phosphatase and activity measurement of ammonium sulfate fractions (apply);
CLO3: determine Km and Vmax of enzyme enriched fraction (apply); and
CLO4: understand inhibition of acid phosphatase by inorganic phosphate (understand).

Mapping of Course Learning Outcomes (CLOs) with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1			3		3						3			
CLO 2			3								3			
CLO 3			3								3			
CLO 4				3							3			

Detailed Syllabus

1. Protein estimation by UV absorbance and Biuret method.
2. Protein micro assay by Lowry/Bradford method.
3. Ammonium sulphate fractionation of crude homogenate from germinated mung bean.
4. Setting up assay for acid phosphatase and activity measurements of the ammonium sulphate fractions (progress curve and effect of pH).
5. Determination of Km and Vmax of enzyme enriched fraction.
6. Inhibition of acid phosphatase activity by inorganic phosphate.

Reference Books:

1. Nelson, D.L. & Cox, M.M. ***Lehninger: Principles of Biochemistry***, 6th Edn, W.H. Freeman and Company, New York.
2. Price, N.C. & Stevens, L. ***Fundamentals of Enzymology***, 3rd Edn., Oxford University Press Inc, New York.

Teaching – Learning Strategies in brief

The teaching learning strategy followed is learning by doing.

Assessment methods and weightages in brief

The internal practical sessional exam is conducted for 13 marks. End semester exam is of 37 marks. Total Marks are 50 for the subject (Internal Assessment: 13 Marks and End Semester Examination: 37 Marks).

DEPARTMENT OF MEDICAL ELEMENTOLOGY & TOXICOLOGY

Name of the Academic Programme : **B.Sc.-M.Sc. Dual Degree**

Course Code : **BTX-CC12**

Title of the Course : **Mechanism of Toxicology**

Credits : **4**

L=Lecture; T=Tutorial; P=Practical : L=**60,** T=**0**, **P=0**

Course Learning Outcomes (CLOs)

After completing this Course, the students should be able to:

CO1	Explain about the history of the immunology, brief idea about immune cells and organs and toxicity and its impact on the immune system (Evaluate level)
CO2	Describe the various fundamentals of basic toxicology like doses, its responses and the factors that affect the doses response (Evaluate level)
CO3	Identify and explain the differentcells and organs of the immune systems of the human body. (Analyzelevel)
CO4	Identify and explain about the cancer-causing substance, its adverse effect at the genetic level and test their impact with the help of different available *in vitro* and *invivo* methods(Analyze level)
CO5	Identify and explain the impact of neurotoxicant metals, pesticides and solvents on the behavioral abnormalities with the help of different behavioral assessment tests (Analyze level)

Mapping of Course Learning Outcomes (CLOs) with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1		3	3									3		
CLO 2		3	3									3		
CLO 3		3	3					3				3		
CLO 4		3	3									3		

Detailed Syllabus

UNIT-I:Immunotoxicology Effects and their Clinical Consequences

Definition and History of Immunotoxicology, Overview of the Immune System, Immunosuppression and Immunodepression, Immuno-stimulation, Hypersensitivity, Autoimmunity.

UNIT-II: Biochemical Toxicology

Introduction , Fundamentals of Toxicology and Dose- Response Relationships , Factors Affecting Toxic Responses: Disposition , Factors Affecting Toxic Responses, Biochemical Mechanisms of Toxicity

UNIT-III: Genotoxicity: Mechanisms and Methods

Introduction and Importance of genotoxicity studies, classification of carcinogens, Mechanism of genotoxicity, Standard test battery for genotoxicity, In-Vitro testing methods, bacterial reverse mutation test, Mammalian chromosome aberration test, In-Vivo genotoxicity testing methods: comet assay, micronuclei test.

UNIT-IV: Behavioural Toxicology

Definition and scope of behavioural toxicology. Behavioural abnormalities induced by neurotoxicant Metals, Pesticides & Solvents. Behavioural disorder & mechanism underlying the clinical action of drugs. Behavioural assessment water-maze, Inhibitory avoidance task, Novel object recognition, Conditioned taste aversion, Contextual fear conditioning.

Reference Books:

1. Casarett& Doull's Toxicology: The Basic Science of Poisons, 9th Edition
2. Byung-Mu Lee, Sam Kacew, Hyung Sik Kim: Lu's Basic Toxicology
3. Michael J. Derelanko: The Toxicologist's Pocket Handbook
4. Matthew A. Wallig, Wanda M. Haschek, Colin G. Rousseaux: Fundamentals of Toxicologic Pathology
5. Laura Robinson: A practical guide to Toxicology and human health risk assessment

Teaching-Learning Strategies in brief:

This course is an introduction to different mechanism of toxicology including immune toxicity, biomolecular toxicity and to under stands their outcome with the help of behavioural toxicology.We would try to teach this with respect to its significance in identification and prevention strategies. Student would be encouraged for toxicological research where they could use the concepts and fundamentals of this course. The interdisciplinary objective of this course could then be achieved.

Assessment methods and weightages in brief

The performance of the student in each paper will be evaluated both continuously (Internal Assessment) and at the end of semester (Semester Examination). 25% marks for each theory paper will be allocated for internal assessment and 75% marks will be kept for semester examination at the end of each semester.

DEPARTMENT OF MEDICAL ELEMENTOLOGY & TOXICOLOGY

Name of the Academic Programme : **B.Sc.-M.Sc. Dual Degree**

Course Code : **BTX-CC13**

Title of the Course : **ANALYTICAL TOXICOLOGY**

Credits : **4**

L=Lecture; T=Tutorial; P=Practical : L=**60,** T=**0**, **P=0**

Course Learning Outcomes (CLOs)

After completing this Course, the students should be able to

CLO-1 Understanding the concepts of sampling of biological matrices and chromatographic and spectroscopic methods of their analysis

CLO-2 Studying the methods analysis of the various biological samples of human body such as blood, urine, other body fluids and tissues

CLO-3 Application of different chromatographic methods in the analysis of pesticides, heavy metals and other hazardous chemicals

CLO-4 Application of various chromatographic, spectrophotometric and other molecular biological techniques in the forensic analysis

CLO-5 Evaluation of various analytical techniques in the application of forensic and toxicological aspects

Mapping of Course Learning Outcomes (CLOs) with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1		3	3						3			3		
CLO 2		3	3					3	3			3		
CLO 3		3	3						3			3		
CLO 4		3	3		3				3			3	3	
CLO 5		3	3					3	3			3		3

Detailed Syllabus

UNIT-I: Analysis of pesticides by Chromatography Method.

Sample handling of pesticides in food and environmental samples; Determination of pesticides in food of vegetable origin; Determination of pesticides in food of animal origin; Determination of pesticides in water and soil.

UNIT-II: Analysis of heavy metals by Spectrophotometric Methods.

Sample handling of heavy metals in food and environmental samples, Determination of heavy metals by Atomic Absorption Spectrophotometer. Determination of heavy metals by Atomic Emission Spectrophotometer, Inductively Coupled Plasma Spectrophotometers, Determination of heavy metals in food and environmental samples, Determination of heavy metals in petroleum products.

UNIT-III: Analytical Methods in Forensic Science:

Determination of drug of abuse in blood,urine, oral fluid, hair, sweat, breath, and nail clippings. DNA fingerprinting.

UNIT-IV: Immunoassay Techniques:

Immunoassay types, Enzyme Immunoassay (EIA), Radio Immunoassay (RIA), Chemiluminescent immunoassay (CLIA). Applications in Forensic Toxicology and Food Industry.

(Number of Units may be decided by the School/Department/Centre)

Reference Books:

1. Jaiswal, A. K., Millo, T. (2014). Handbook of Forensic Analytical Toxicology. India: Jaypee Brothers Medical Pub.
2. Clarke's Analytical Forensic Toxicology. (2013). United Kingdom: Pharmaceutical Press.
3. Lappas, C. M., Lappas, N. T. (2021). Forensic Toxicology: Principles and Concepts. Netherlands: Elsevier Science.

Teaching-Learning Strategies in brief (4 to 5 sentences)

Analytical Toxicology posses a central position in the field of toxicology dealing with determination of quantity, quality and types of toxic material in a given sample with the help of suitable analytical technique such as chromatographic, spectroscopic, hyphenated and other molecular biology techniques. Lectures, seminars and other interactive sessions with the students are the main learning strategies along with the discussion of important case studies and specific assignments will be given to students with the interest of improving discussion about the various ranges of topics in the course.

Assessment methods and weightages in brief (4 to 5 sentences)

Students will be assessed on three parameters. (1). **Active participation (10%): this includes attendance, class room discussion and learning activities. Learning activities will mainly include practice to solve different problems** covered in class (2) **Assignments and Tests (15)**: Assisnments will be based on topics and problems related with syllabus (10%). **3. Semester Examination (75%).** Exams to evaluate understanding of material covered in class.

DEPARTMENT OF MEDICAL ELEMENTOLOGY & TOXICOLOGY

Name of the Academic Programme : **B.Sc.-M.Sc. Dual Degree**

Course Code : **BTX-CC08P**

Title of the Course : **TOXICOLOGY LAB II**

Credits : **4**

L=Lecture; T=Tutorial; P=Practical : L=**60,** T=**0**, **P=0**

Course Learning Outcomes (CLOs)

After completing this Course, the students should be able to

CLO-1	Having completed the course, the student shall have a knowledge of basic toxicological concepts and the principals and methods of estimating toxicants in food and other samples
CLO-2	Estimate tests for different types of toxicological effects, quantify toxins, and determine quality of sample.
CLO-3	Having completed the course, the student shall have knowledge of the general principles of safety assessment of drugs.
CLO-4	Ascertain toxicants and their concentration.
CLO-5	Students are required to pass the written examination and compulsory parts of the course.

Mapping of Course Learning Outcomes (CLOs) with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1		3	3					3						3
CLO 2		3	3							3				3
CLO 3		3	3											3
CLO 4		3	3						3					3
CLO 5		3	3						3					3

Detailed Syllabus

Experiments

1. Centrifugation of the cell contents at varying speeds such that the subcellular fractions separate out based on their density differences
2. MTT Assay
3. Antibacterial activity of dyes (Gradient Plate techniques)
4. Milk quality analysis by MBRT & RRT and Phosphatase test for milk
5. Testing the α-Amylase Inhibitor of the Common Bean
6. *In vitro* evaluation of antifungal activity of plant extracts

7. Enzyme kinetics: Determination of Km and Vmax
8. DNA/Protein and toxins binding
9. Determination of Toxin binding affinity using fluorescence quenching
10. Evaluation of the Hill coefficient from Scatchard and Klotz plots
11. Conformational characterization of proteins and nucleic acids
12. Use of three-dimensional excitation and emission matrix fluorescence spectroscopy for predicting the dissolved toxins/moleculs in drinking and waste water
13. Media Preparation: Preparing and inoculating solid and liquid nutrient media for culturing microorganisms
14. Growth Curve: Generating a bacterial growth curve under various pH and environmental conditions (steady and shaking), Calculations of Growth rate constant (μ), Calculation of generation time
15. Study of different routes of drugs administration in mice/rats
16. Study of local anesthetics by different methods

Reference Books:

1. Studies on Experimental Toxicology and Pharmacology (Ed. Stephen M. Roberts, James P. Kehrer, Lars-Oliver Klotz) 1st Edition, Humana Cham, Springer International Publishing Switzerland.

Teaching-Learning Strategies in brief (4 to 5 sentences)

When a student becomes interest in a subject, it is likely that he/she is self-motivated. When this is combined with the ability to be proactive and reflective, the student is also more likely to acquire deep knowledge and develop advanced analytical skills. The present subject includes various learning activities besides lecturing, including colloquiums, graded project assignments with oral presentations. Latest research developments on topics of curriculum are majorly emphasized.

Assessment methods and weightages in brief (4 to 5 sentences)

Students will be assessed on three parameters. (1). **Class performance (10%): this includes attendance, class room discussion and learning activities. Learning activities will mainly include practice to solve different problems** covered in class (2) **Oral presentations and tests (15)**: Assignments will be based on topics and problems related with syllabus. **3. Semester Examination (75%)** Comprising of evaluation of written answers of tests.

DEPARTMENT OF MEDICAL ELEMENTOLOGY & TOXICOLOGY

Name of the Academic Programme : **B.Sc.-M.Sc. Dual Degree**

Course Code : **BTX-CC-15**

Title of the Course : **Drug Discovery**

Credits : **4**

L=Lecture; T=Tutorial; P=Practical : L=**60,** T=**0**, **P=0**

Course Learning Outcomes (CLOs)

After completing this Course, the students should be able to

CLO 1	Understanding the concepts of drug designing and the targets of drugs working as agonist, antagonist etc (understanding level)
CLO 2	Understanding the interactions between drug and receptor and various effects of drug (Analysis level)
CLO 3	Understanding the physic-chemical actions of drugs and dose response relationships (Application level)
CLO 4	Studying the various steps of drug developments and their genomic and pathogenic targets (Evaluation level)
CLO 5	Studying the application of various computational resources used in drug discovery and development (Evaluation level)

Mapping of Course Learning Outcomes (CLOs) with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1		3			2				3					3
CLO 2		3			2			3	3					3
CLO 3		3			2				3					3
CLO 4		3			2			3	3					3

Detailed Syllabus

Unit-I: General Introduction

Definition and scope of drug design. Proteins as drug targets: Receptors - receptor role, Ion channels, Membrane bound enzyme activation. Agonist and antagonists, Concept of inverse agonist, Desensitization and sensitization of receptors, Affinity, Efficacy and potency. Enzymes: Enzyme inhibitors (competitive, non- competitive, suicide inhibitors), Medicinal use of enzyme inhibitors. Nucleic acids as drug targets: Classes of drugs that interact with DNA: DNA intercalators and DNA alkylators.

Unit-II: Drug Receptor Interactions and Drug Designing

Kinetic analysis of ligand receptor interactions using Scatchard plot, Double reciprocal plot, Hill plot, Forces involved, Relationship between dose and effect (graded and quantal response). Introduction to SAR, Strategies in the search for new lead compounds, Analogue synthesis versus rational drug design, Concept of prodrugs.

Unit-III: Physicochemical Principles of Drug Action and Drug Receptor Interactions

Assess relevant physic-chemical properties and their influences on mechanism of pharmacologic actions (Structure activity relationship). Describe the kinetics of drug receptor interactions and relationship between the dose and response of drug

Unit-IV: Drug Discovery and Pharmainformatics

Drug discovery pipeline, Drug target identification and validation for microbial pathogen, Selection of gene unique to the pathogen, screening for its presence in other microbes and human host. Drug Databases, Pub Chem, calculating drug-like properties, Introduction to rational drug design methods, Optimization of lead compounds, Protein 30 structure and binding site analysis, Similarity based virtual screening using online tools.

Reference Books:

1. Blass, B. E. (2021). Basic Principles of Drug Discovery and Development. Netherlands: Elsevier Science.
2. Drug Discovery and Drug Development: The Indian Narrative. (2021). Germany: Springer Nature Singapore.
3. Drug Discovery and Development: From Targets and Molecules to Medicines. (2021). Germany: Springer Singapore.

Teaching – Learning Strategies in brief

The teaching learning strategy followed is learning by doing.

Assessment methods and weightages in brief

The internal practical sessional exam is conducted for 25 marks. End semester exam is of 75 marks. Total Marks are 100 for the subject (Internal Assessment: 25 Marks and End Semester Examination: 75 Marks).

DEPARTMENT OF MEDICAL ELEMENTOLOGY & TOXICOLOGY

Name of the Academic Programme : **B.Sc.-M.Sc. Dual Degree**

Course Code : **BTX-CC-16**

Title of the Course : **DRUG REGULATORY AFFAIRS**

Credits : **4**

L=Lecture; T=Tutorial; P=Practical : L=**60,** T=**0**, **P=0**

Course Learning Outcomes (CLOs)

After completing this Course, the students should be able to

CLO-1 Understanding the concepts and importance of drug regulatory affairs and legislation involved in the drug development

CLO-2 Studying the historical background legislation of drugs and laws governing the development of drug

CLO-3 Overview of various laws governing different aspects of drugs including development, manufacturing, marketing, selling, possession and use

CLO-4 Understanding the application of various drug laws at various stages of process of drug development

CLO-5 Evaluation of efficacy of various laws in the regulation of drugs

Mapping of Course Learning Outcomes (CLOs) with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1		3	3					3						3
CLO 2		3	3					3						3
CLO 3		3	3											3
CLO 4		3	3	2										3
CLO 5		3	3					2						3

Detailed Syllabus

UNIT-I: Historical Background

Drug legislation in India

UNIT-II- Drug Laws

1. Drugs and cosmetic Act 1940, Rules 1945.

2. Pharmacy Act 1948.
3. Narcotic Drugs and Psychotropic Substances Act, and Rules there under.
4. Prevention of cruelty of animals act.
5. Drugs and Magic Remedies (Objectionable Advertisements) Act 1954.
6. Medicinal and Toilet Preparations (Excise Duties) Act 1955, Rules 1976.
7. Poison Act.
8. Factory Act.
9. Delhi shops and Establishment Act.
10. Medical termination of pregnancy Act.
11. The Drug (price control) order.
12. The Insecticide Act.
13. Indian Patents Act as applicable to drugs and pharmaceuticals.
14. AICTE Act, 1987.

(Number of Units may be decided by the School/Department/Centre)

Reference Books:

1. Bigonia, P. (2020). Drug Regulatory Affairs. India: CBS Publishers & Distributors.
2. Ali, J., Baboota, S. (2021) Regulatory Affairs in the Pharmaceutical Industry. Netherlands: Elsevier Science.
3. Agarwal, G. (2016). Drug Regulatory Affairs. India: CBS Publishers & Distributors.

Teaching-Learning Strategies in brief (4 to 5 sentences)

Drug regulatory affairs posses a key position in the drug development, production, manufacturing, marketing, selling, possession and end use. Ignorance of the law itself is a crime and drug regulatory laws are meant for the public safety. Lectures, seminars and other interactive sessions with the students are the main learning strategies along with the discussion of important case studies and specific assignments will be given to students with the interest of improving discussion about the various ranges of topics in the course.

Assessment methods and weightages in brief (4 to 5 sentences)

Students will be assessed on three parameters. (1). **Active participation (10%): this includes attendance, class room discussion and learning activities. Learning activities will mainly include practice to solve different problems** covered in class (2) **Assignments and Tests (15)**: Assisnments will be based on topics and problems related with syllabus (10%). **3. Semester Examination (75%).** Exams to evaluate understanding of material covered in class.

DEPARTMENT OF MEDICAL ELEMENTOLOGY & TOXICOLOGY

Name of the Academic Programme : **B.Sc.-M.Sc. Dual Degree**

Course Code : **BTX-CC-17**

Title of the Course : **APPLIED TOXICOLOGY**

Credits : **4**

L=Lecture; T=Tutorial; P=Practical : L=**60,** T=**0**, **P=0**

Course Learning Outcomes (CLOs)

After completing this Course, the students should be able to

CLO-1 Understanding the basic features of wildlife toxicology such as susceptibility of *flora* and *fauna* to chemicals (Understanding level)

CLO-2 Understanding the risk assessment of toxic chemicals for human population and application of toxicological tools to human welfare (Application level)

CLO-3 Understanding the concepts of chemical warfare and chemical weapons and their management (Evaluation level)

CLO-4 Studying the risk of toxic chemicals to pets and street animals such as cats and dogs etc (Analysis level)

CLO-5 Understanding the risk of house hold chemicals, heavy metals and plant toxins such as mycotoxins (Analysis level)

Mapping of Course Learning Outcomes (CLOs) with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1		3	3					3						3
CLO 2		3	3					3						3
CLO 3		3	3											3
CLO 4		3	3	2										3
CLO 5		3	3					2						3

Detailed Syllabus

UNIT-I Wildlife Toxicology

Susceptibility of wildlife to chemicals, Acute ecological hazards, Toxicology of chemicals in birds and mammals, Integrated approach to wildlife toxicology

UNIT-IIMedical Toxicology

Mission of medical toxicology, Comparative toxicology, Human risk assessment, Toxicological database

UNIT-IV Toxicology of Chemical Warfare Agents

Chemical weapons, classification of chemical warfare agents, mustard gas, lewisite, nerve agents, hydrogen cyanide, management of chemical warfare agents

UNIT-IV Veterinary Toxicology

Common toxicity in dogs, cats, horses and poultry, by herbicides, house hold chemicals, heavy metals, mycotoxins, blue green algae and toxic plants

Reference Books:

1. General and Applied Toxicology. (2009). United Kingdom: John Wiley & Sons.
2. Perspectives in Basic and Applied Toxicology. (2016). United Kingdom: Elsevier Science.
3. Applied toxicology: approaches through basic science. (1997). Germany: Springer Verlag.

Teaching-Learning Strategies in brief (4 to 5 sentences)

Applied toxicology explains the application of toxicology in various fields of sciences and disciplines. Lectures, seminars and other interactive sessions with the students are the main learning strategies along with the discussion of important case studies and specific assignments will be given to students with the interest of improving discussion about the various ranges of topics in the course.

Assessment methods and weightages in brief (4 to 5 sentences)

Students will be assessed on three parameters. (1). **Active participation (10%): this includes attendance, class room discussion and learning activities. Learning activities will mainly include practice to solve different problems** covered in class (2) **Assignments and Tests (15)**: Assisnments will be based on topics and problems related with syllabus (10%). **3. Semester Examination (75%).** Exams to evaluate understanding of material covered in class.

SCHEME AND COURSE STRUCTURE
w.e.f. 2021-22
M.Sc. Programme in Toxicology

Course Code	Name of the Paper	Paper Category	IA	SE	Total Marks	Course Credits
SEMESTER–I						
MTX-CC 101	Principles of Toxicology	Core	25	75	100	4
MTX-CC 102	Systemic Toxicology	Core	25	75	100	4
MTX-CC 103	Molecular Mechanism of Toxicity	Core	25	75	100	4
MTX- CC 104	Lab Course - I	Core	50	150	200	8
MTX DCE 101	Fundamental of Biostatistics	DCE	13	37	50	2
MTX DCE 102	Animal Welfare in Toxicology	DCE	13	37	50	2
		Total	**151**	**449**	**600**	**24**
SEMESTER–II						
MTX-CC 201	Food and Cosmetics Toxicology	Core	25	75	100	4
MTX-CC202	Forensic Toxicology	Core	25	75	100	4
MTX-CC 203	Pesticide and Heavy Metal Toxicology	Core	25	75	100	4
MTX-CC 204	Lab Course – II	Core	50	150	200	8
Discipline Centric Elective (One course to be opted)						
MTX DCE 201	Occupational Toxicology	DCE	13	37	50	2
MTX DCE 202	Neurotoxicology					
Open Elective (One course to be opted)						
MTX OE-201	Ecotoxicology	OE	13	37	50	2
MTX OE-202	Nanotoxicology					
		Total	**151**	**449**	**600**	**24**
SEMESTER–III						
MTX-CC 301	Regulatory Toxicology	Core	25	75	100	4
MTX-CC302	Methods of Toxicology	Core	25	75	100	4
MTX-CC 303	Carcinogenicity & Teratogenicity of Drugs and Chemicals	Core	25	75	100	4
MTX-CC 304	Lab Course III	Core	50	150	200	8
Discipline Centric Elective (One course to be opted)						
MTX DCE 301	Ornics in toxicology	DCE	13	37	50	2
MTX DCE 302	Pre-clinical Toxicology for Drug Development					
Open Elective (One course to be opted)						
MTX OE 301	Trace Elements in Human Nutrition and Health	OE	13	37	50	2
MTX OE 302	Fundamentals of Intellectual Property Rights					
MTX DCE 303	Applied Statistics					
		Total	**151**	**449**	**600**	**24**
SEMESTER–IV						
MTX-CC 401	Research Methodology and Ethics	Core	13	37	50	2
MTX-CC 402	Seminar & Review	Core	0	150	150	6
MTX -CC 403	Dissertation/Project	Core	0	400	400	16
		Total	**13**	**587**	**600**	**24**

DEPARTMENT OF MEDICAL ELEMENTOLOGY & TOXICOLOGY

Name of the Academic Programme : **M.Sc. (Toxicology)**

Course Code : **MTX-101**

Title of the Course : **PRINCIPLES OF TOXICOLOGY**

Credits : **4**

L=Lecture; T=Tutorial; P=Practical : L=**60,** T=**0**, **P=0**

Course Learning Outcomes (CLOs)

After completing this Course, the students should be able to

CO1	Identify and classify potential toxic chemicals
CO2	Determine dose dependence of toxic chemicals
CO3	Apply structure-activity relations to toxins
CO4	Understand mechanisms of systemic and organ toxicity induced by xenobiotics
CO5	Learn to analyze and interpret complex data sets in toxicological research

Mapping of Course Learning Outcomes (CLOs) with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1		3	3					3						3
CLO 2		3	3					3						3
CLO 3		3	3											3
CLO 4		3	3	2										3
CLO 5		3	3					2						3

Detailed Syllabus

UNIT I - History and general account of toxicology

- Definition, scope and various branches of toxicology.
- History of toxicology.
- Different types of toxicities (acute, subacute, chronic, subchronic) and toxic manifestations.
- Different routes of exposure to toxicants.
- Chemical interactions (additive effect, potentiation, synergism and antagonism) and their consequences.
- Dose-response relationship.
- Concepts of ED_{50}, LD_{50}, EC_{50}, LC_{50}.
- Reversible and irreversible effects, idiosyncratic effects, target effect, non-target effect.
- Animal welfare and alternate models in toxicology.

UNIT II - Toxicokinetics - I

- Absorption, distribution, and storage of toxic chemicals.
- Sites of metabolism of toxicant (Metabolizing enzymes of Skin, Liver, Kidney, Lung, GI tract and their role in activation and detoxification of drugs and chemicals).
- Xenobiotic biotransformation: Phase I and Phase II reaction concept.
- Various types of Phase I reactions- Hydrolysis, Oxidation, and Reduction reactions with appropriate examples).
- Cytochrome P450: its nomenclature, various forms and involvement in toxicity and carcinogenicity of environmental chemicals.

UNIT III - Toxicokinetcs - II

- Xenobiotic biotransformation: Phase II - Detoxification of toxic chemicals.
- Glutathione S-transferase (GST), and its role in detoxification.
- Phase III reactions and their role in toxicity.
- Excretion of xenobiotics.
- Physiological, nutritional and environmental affecting metabolism, detoxification and toxic responses of toxicants.

UNIT IV - Mechanisms of Action of Toxicants

- Effects of toxicants on target molecules.
- Toxicant-induced cellular dysfunction,
- Molecular and cellular repair mechanisms.
- Oxidative stress and antioxidant defenses of cells.

Reference Books:

There is no required textbook, however you are referred to:

1. Klaassen, C. D., Ed., Casarett and Doull's Toxicology: The Basic Science of Poisons, 9th edition, McGraw-Hill, New York, 1454 pp. (2019)
2. Mercurio, S., Understanding Toxicology, Jones and Bartlett Learning, Burlington, MA, 952 pp.(2017).
3. Stine, K. E., Brown, T. M., Principles of Toxicology, 3rd edition, CRC Press, Boca Raton, FL, 437pp.(2015).

Teaching-Learning Strategies in brief (4 to 5 sentences)

Lectures, seminars and other interactive sessions with the students are the main learning strategies along with the discussion of important case studies and specific assignments will be given to students with the interest of improving discussion about the various ranges of topics in the course.

Assessment methods and weightages in brief (4 to 5 sentences)

The performance of the student in each paper will be evaluated both continuously (Internal Assessment) and at the end of semester (Semester Examination). 25% marks for each theory paper will be allocated for internal assessment and 75% marks will be kept for semester examination at the end of each semester.

DEPARTMENT OF MEDICAL ELEMENTOLOGY & TOXICOLOGY

Name of the Academic Programme : **M.Sc. (Toxicology)**

Course Code : **MTX-102**

Title of the Course : **SYSTEMIC TOXICOLOGY**

Credits : **4**

L=Lecture; T=Tutorial; P=Practical : L=**60,** T=**0**, **P=0**

Course Learning Outcomes (CLOs)

After completing this Course, the students should be able to

CLO-1	Understand the basic structures of vital organs of important toxic response such as liver, kidneys, lungs and reproductive organs.
CLO-2	Overview of toxic materials such as environmental toxicants and drugs causing toxicities to these vital organs
CLO-3	Learning the mechanism of toxicities of major toxic materials in the vital organs
CLO-4	Applying the pathological conditions of vital organs for the toxicological response of these organs
CLO-5	Comparing the pathological condition of vital organ systems with the toxic response of various toxicants

Mapping of Course Learning Outcomes (CLOs) with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1		3	3					3						3
CLO 2		3	3					3						3
CLO 3		3	3											3
CLO 4		3	3	2										3
CLO 5		3	3					2						3

Detailed Syllabus

UNIT I

Hepatic Toxicology

Anatomy and physiology of the liver, Types of liver injury (acute and chronic), Hepatotoxic chemicals (with special reference to ethyl alcohol and paracetamol) and their mechanism of action, evaluation of hepatic injury in vivo and in vitro, histological analysis of liver injury.

UNIT II

Renal Toxicology

Renal structure and functions, chemically induced renal injury (acute and chronic), nephrotoxic potential of drugs and chemicals (with special reference to paraquat and amphotericin B) and their mechanism of action, evaluation of renal injury in vivo and in vitro, histological analysis of renal injury.

UNIT III

Pulmonary Toxicology

Structure and function of the lung, Lung toxicants (silica, asbestos, acid fumes) and their effects (acute and chronic), pulmonary diseases and dysfunction (Asthma, COPD, and Lung cancer) by inhaled toxicants, in vitro and in vivo assessment of pulmonary injury, histological characterization of pulmonary injury.

UNIT IV

Reproductive Toxicology

Reproductive process and organs, toxicants (with special reference to phthalates and DDT) and their effect on Male and Female reproductive system, in vitro and in vivo methods for assessment of reproductive injury, histologic manifestations of male and female reproductive system.

Reference Books:

1. Casarett & Doull's Essentials of Toxicology, Fourth Edition McGraw-Hill Education Australia
2. Burcham, P. C. (2013). An Introduction to Toxicology. United Kingdom: Springer London.

Teaching-Learning Strategies in brief (4 to 5 sentences)

This course will give the brief introduction of anatomy and physiology of vital organs and their pathological conditions. Furthermore, exposure to toxic chemicals and the response and pathological conditions of vital organs against these toxic chemicals is the core learning of this course. Lectures, seminars and other interactive sessions with the students are the main learning strategies along with the specific assignments will be given to students with the interest of improving discussion about the various range of topics in the course.

Assessment methods and weightages in brief (4 to 5 sentences)

Students will be assessed on three parameters. (1). **Active participation (10%):** this includes attendance, class room discussion and learning activities. Learning activities will mainly include practice to solve different problems covered in class (2) **Assignments and Tests (15)**: Assisnments will be based on topics and problems related with syllabus (10%). **3. Semester Examination (75%).** Exams to evaluate understanding of material covered in class.

DEPARTMENT OF MEDICAL ELEMENTOLOGY & TOXICOLOGY

Name of the Academic Programme : **M.Sc. (Toxicology)**

Course Code : **MTX-103**

Title of the Course : **MOLECULAR MECHANISM OF TOXICITY**

Credits : **4**

L=Lecture; T=Tutorial; P=Practical : L=**60,** T=**0**, **P=0**

Course Learning Outcomes (CLOs)

After completing this Course, the students should be able to

CO1	Describe the basics of biomacromolecules their synthesis and metabolism as well as the toxicity effect on them (Evaluate level)
CO2	Understanding the various fundamentals of molecular and cellular toxicology. (Evaluate level)
CO3	Apply the fundamental concept to identify cellular transport and type of cell signaling and molecular aspects of toxic response (Analyzelevel)
CO4	Identify and explain about the receptor classification and the associated type of interaction and responses. (Apply level)
CO5	Identify and apply different molecular methods to determine the effect of toxicant. (Analyze level)

Mapping of Course Learning Outcomes (CLOs) with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1		3	3					3						3
CLO 2		3	3					3						3
CLO 3		3	3											3
CLO 4		3	3	2										3
CLO 5		3	3					2						3

Detailed Syllabus

UNIT I- Introduction to Molecular Biology16 hrs	
	A brief idea of cellular macromolecules, covalent adduct to macromolecules, cellular heterogeneity within the tissues, interrelationship in the synthesis of macromolecules, DNA synthesis, modification of DNA metabolism by toxicants, toxicological consequence of DNA alkylation, RNA synthesis, modification of RNA metabolism by toxicants.
UNIT II- Molecular Processes and Cell Signaling 16 hrs	
	Molecular and cellular toxicology: Recent advances within research and development in molecular and cellular toxicology-methods for the assessment of

	reliability of studies in the area of toxicological research; Replication, Transcription; Translation. Cellular transport; Introduction to cell signaling and their relevance; Types of cell signaling - autocrine, paracrine and hormonal; Second messengers; Receptor-ligand interactions; Molecular aspects of Toxic response.
UNIT III- Receptor Mediated Cellular Toxicity	**16 hrs**
	Receptor classifications; Types of Interaction and response; Receptor phosphorylation and methylation; Protein kinases and phosphatases; intracellular receptors; Channel linked Receptors; G-Protein coupled receptors; Tyrosine kinase and Guanyle-cyclase linked receptors; Receptors that regulate gene transcription.
UNIT IV- Methods of Molecular Toxicology	**16 hrs**
	A basic molecular biological method for the analysis of DNA, RNA, proteins and enzyme activity: PCR, Western Blot, Southern Blot, Northern Blot, Cell Culture; Gene Regulation and Reporter Assays; Proteomics and Metabolomics; Micro-Array technology; Computational models of xenobiotic metabolism

Reference Books:

1. Cell and Molecular Biology: Concepts and Experiments. Karp, G. (2010). VI Edition. John Wiley & Sons. Inc.
2. Toxicogenomics: Principles and Applications. Hisham K. Hamadeh, Cynthia A. Afshari (2004).
3. The Cell: A Molecular Approach. Cooper, G.M. and Hausman, R.E. (2009).V Edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. Molecular Biology of the Gene (VI Edition.). Cold Spring Harbour Lab. Press, Pearson Pub.Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R., (2008)
5. Principles and Techniques of Practical Biochemistry, Keith Wilson (Editor), Joh Walker (Editor), John M. Walker, 5thEdition, Cambridge University Press, 2000.
6. Lehningers Principles of Biochemistry, David L. Nelson and Michel M. Cox., 7th Edition, WH Freeman, 2017.

Teaching-Learning Strategies in brief (4 to 5 sentences)

This course is an introduction to molecular processes and xenobiotic metabolism. We would try to teach this with respect to its significance in identification and prevention strategies. Moreover, after learning the molecular response due to toxin exposure, students might be able to target the pathway with precision. Student would be encouraged for toxicological research where they could use the concepts and fundamentals of this course. The interdisciplinary objective of this course could then be achieved.

Assessment methods and weightages in brief

The performance of the student in each paper will be evaluated both continuously (Internal Assessment) and at the end of semester (Semester Examination). 25% marks for each theory paper will be allocated for internal assessment and 75% marks will be kept for semester examination at the end of each semester.

DEPARTMENT OF MEDICAL ELEMENTOLOGY & TOXICOLOGY

Name of the Academic Programme : **M.Sc. (Toxicology)**

Course Code : **MTX-104**

Title of the Course : **LAB COURSE I**

Credits : **4**

L=Lecture; T=Tutorial; P=Practical : L=**0,** T=**0**, **P=60**

Course Learning Outcomes (CLOs)

After completing this Course, the students should be able to

CO1	Students will be skilled in handling the animals of rodent model including its dissection (Understanding level)
CO2	Understanding the preparation of sub-cellular fractions of various tissues for biochemical analysis (Analysis level)
CO3	Studying the estimation of different biomarkers of toxicity such as non-enzymatic and enzymatic anti-oxidants (Evaluation level)
CO4	Understanding the measurement of water quality by assessing the dissolved oxygen, BOD, COD and total solid (Analysis level)
CO5	Learn to analyze and interpret complex data sets in toxicological research

Mapping of Course Learning Outcomes (CLOs) with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1		3	3					3						3
CLO 2		3	3					3						3
CLO 3		3	3											3
CLO 4		3	3	2										3
CLO 5		3	3					2						3

Detailed Syllabus

- Good Laboratory Practices
  - Handling of chemicals, solutions, reagents and biological samples. Health hazards, washing and disposal techniques, storage and record keeping etc.
  - Preparation of SOPs

- Mole concept
  - How to prepare solutions of varying strengths (Molarity and Normality of solutions)

- Concept of pH, pKa and buffers

- Beer's law and spectrophotometric determination of optical density of solutes

- Determination of concentrations of the following in blood along with their clinical significance by Standard Curve Method.
  - Protein
  - Glucose
  - Creatinine
  - Uric acid
  - Bilirubin
  - Cholesterol
  - ALT
  - AST

- Agarose gel electrophoresis
  - DNA isolation from different biological samples, buffer preparation, agarose gel casting,
  - DNA loading dye preparation, Running DNA sample, gel documentation.

- Polyacrylamide Gel Electrophoresis (SDS-PAGE)
  - Protein isolation from different biological samples, SDS PAG casting, loading and running protein sample on the gel, staining methods, gel documentation

Reference Books:

1. Basic Practical Molecular Biology. (2020). (n.p.): APD SKEG Pte Ltd.
2. Flowers, P., Robinson, W. R., Langley, R., Theopold, K. H. (2019). Chemistry 2e. United States: OpenStax.
3. Stephenson, F. H. (2010). Calculations for Molecular Biology and Biotechnology: A Guide to Mathematics in the Laboratory. Netherlands: Elsevier Science.

Teaching-Learning Strategies in brief (4 to 5 sentences)

Lectures, seminars, practical training and other interactive sessions with the students are the main learning strategies along with the discussion of important case studies and specific assignments will be given to students with the interest of improving discussion about the various ranges of topics in the course.

Assessment methods and weightages in brief (4 to 5 sentences)

The performance of the student in each paper will be evaluated both continuously (Internal Assessment) and at the end of semester (Semester Examination). 25% marks for each theory paper will be allocated for internal assessment and 75% marks will be kept for semester examination at the end of each semester.

DEPARTMENT OF MEDICAL ELEMENTOLOGY & TOXICOLOGY

Name of the Academic Programme : **M.Sc. (Toxicology)**

Course Code : **MTX-DCE-101**

Title of the Course : **FUNDAMENTALS OF BIOSTATISTICS**

Credits : **2**

L=Lecture; T=Tutorial; P=Practical : L=**30,** T=**0**, **P=0**

Course Learning Outcomes (CLOs)

After completing this Course, the students should be able to

CLO-1	Recognizefundamental concepts of Measures of central tendency, Measures of dispersion, Correlation Analysis, Regression Analysis and Hypothesis testing.**(Cognitive level: Understanding)**
CLO-2	Apply the concepts for the analysis of experimental and survey data. **(Cognitive level: Apply)**
CLO-3	Analyse the data at sample and population level **(Cognitive level: Analyse)**
CLO-4	Apply statistical hypothesis to decide whether to accept or reject the hypothesis **(Cognitive level: Analyse)**
CLO-5	Compare the variation between statistical significance and practical significance. (**Cognitive level: Evaluate)**

Mapping of Course Learning Outcomes (CLOs) with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1		3	3					3						3
CLO 2		3	3					3						3
CLO 3		3	3											3
CLO 4		3	3	2										3
CLO 5		3	3					2						3

Detailed Syllabus

Unit 1:

Measures of central tendency: Mean, median, mode.

Measures of dispersion: Mean deviation, Standard Deviation, Standard Error, Variance, Coefficient of variation. (Numerical Examples).

Correlation Analysis: positive and negative correlation, scattered diagram, Karl Pearson's coefficient of correlation, Spearman's rank correlation. (Numerical Examples).

Regression Analysis: Regression coefficient, regression line y on x and x on y. Least square method, Interpolation and extrapolation, Experimental design with suitable examples of our own laboratory experiments. (Numerical Examples).

UNIT - II:

Hypothesis testing of categorical and ranked data

Fisher's Test: test for equality of two variances. Chi Square test: Independence of attributes, Goodness of fit. (Numerical Examples).

Hypothesis testing: Univariate parametric test

Student t-test: paired t-test, F test, ANOVA: one way and two way classification. (Numerical Examples).

(Number of Units may be decided by the School/Department/Centre)

Reference Books:

1. Bernard Rosner (2015), *Fundamentals of Biostatistics*, 7th Edition, Brooks/Cole,20Channel Center StreetBoston, MA 02210, USA
2. Veer Bala Rastogi (2015) Biostatistics, Medtech; 3rd edition, New Delhi-110002

Teaching-Learning Strategies in brief (4 to 5 sentences)

This course is an introduction to statistical methods used in life science, medical research and toxicological research.I would try to emphasize the significance of the course. For example, why they have to go through this course (other than the course requirement)? , and where else they could use the concepts and fundamentals of this course? I have observed that once students understand the importance of a course, they are more engaged in the lectures. I will adopt a problem-solving practice-based approach to teach this course and students are allowed to apply the concepts to other courses to emphasize the interdisciplinary nature of learning.

Assessment methods and weightages in brief (4 to 5 sentences)

Students will be assessed on three parameters. (1). **Active participation (10%):this includes attendance, class room discussion and learning activities. Learning activities will mainly include practice to solve different problems** covered in class (2) **Assignments and Tests (15)**: Assisnments will be based on topics and problems related with syllabus (10%).**3. Semester Examination (75%).** Exams to evaluate understanding of material covered in class.

DEPARTMENT OF MEDICAL ELEMENTOLOGY & TOXICOLOGY

Name of the Academic Programme : **M.Sc. (Toxicology)**

Course Code : **MTX-DCE-102**

Title of the Course : **Animal Welfare in Toxicology**

Credits : **2**

L=Lecture; T=Tutorial; P=Practical : L=**30,** T=**0**, **P=0**

Course Learning Outcomes (CLOs)

After completing this Course, the students should be able to

CO1	Analyzed level	Discussed the qualities of optimal model systems and why low maintenance costs, a high number of offspring, and simplicity are among them.
CO2	Evaluate level	Students should be able to learn how evolution is fundamental to the use of model systems in toxicology
CO3	Analyze level	To understand the ethical reasons for using model organisms
CO4	Apply level	Described how reduction, refinement, and replacement (the 3 R's) ensure the best ethical treatment of animals used in research
CO5	Analyze level	Discussed how the use of a common model system contributes to the reproducibility across laboratories

Mapping of Course Learning Outcomes (CLOs) with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1		3	3					3						3
CLO 2		3	3					3						3
CLO 3		3	3											3
CLO 4		3	3	2										3
CLO 5		3	3					2						3

Detailed Syllabus

UNIT I. Animal handling and its maintenance

- Animal ethics and regulatory requirements, CPCSEA guidelines.
- Concept of 3Rs (reduce, refine, replacement) and additional R (rehabilitation).
- Alternative models in toxicity testing (non-mammalian and non-animal models)
- *In vitro* toxicity testing

UNIT II. Alternative models

- Examples of successful replacement: Draize test.

- Alternative models of toxicity testing.
  1. Zebrafish
  2. Drosophila
  3. *C. elegans*

REFERENCES:

1. Shayne C. Gad.Animal Models in Toxicology
2. WS Stokes. Animals and the 3Rs in toxicology research and testing: The way forward
3. Michael E Peterson. Small Animal Toxicology

Teaching-Learning Strategies:

Students will learn animal handling,and acquire knowledgeof how people respond to and interact with animals within the animal's environment. With regard to its importance in identification and implementation techniques, we would endeavor to impart this knowledge.By putting the theories and principles from this course into practice, students will be inspired to animal handling methods require training, skill, and behavioral knowledge of the species.The course's multidisciplinary goal would then be accomplished.

Assessment methods and weightages in brief

At the end of the semester and continuously (internal assessment), the student's performance on each paper will be assessed (Semester Examination). Each theoretical paper will receive 25% of the possible points for internal evaluation, with the remaining 75% going toward the final exam at the end of each semester.

DEPARTMENT OF MEDICAL ELEMENTOLOGY & TOXICOLOGY

Name of the Academic Programme : **M.Sc. (Toxicology)**

Course Code : **MTX-CC-201**

Title of the Course : **FOOD AND COSMETICS TOXICOLOGY**

Credits : **4**

L=Lecture; T=Tutorial; P=Practical : L=**60,** T=**0**, **P=0**

Course Learning Outcomes (CLOs)

After completing this Course, the students should be able to

CO1	Define the most important contaminants in food, the toxicology of various additives and environmental toxins, as well as their sources and should be able to explain what risk analysis, assessment and management in relation to food safety is, and know which organizations are involved in this type of work nationally and internationally **(Cognitive level: Understanding)**
CO2	Apply the knowledge of additives, cosmetics and environmental toxins within other areas in the fields of nutrition or biology and should be able to master terminology related to food toxicology (concepts within toxicology, toxicokinetics (turnover of contaminants) and toxicodynamics (the effect of contaminants) **(Cognitive level: Apply)**
CO3	Analyze instructions about food safety.Identify and apply appropriate methods for analysis of xenobiotics in variety food **(Cognitive level: Analyse)**
CO4	Apply legal arrangement and instructions about safety of foods and cosmetics **(Cognitive level: Analyse)**
CO5	Evaluate the reliability of food packaging materials and their labels, cosmetics labels, hidden ingredients etc. (**Cognitive level: Evaluate)**

Mapping of Course Learning Outcomes (CLOs) with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1		3	3					3						3
CLO 2		3	3					3						3
CLO 3		3	3											3
CLO 4		3	3	2										3
CLO 5		3	3					2						3

Detailed Syllabus

UNIT I: Toxicants in food Enzyme inhibitors, antivitamins, glycoalkaloids, saponins, goitrogens, teratogens. Mycotoxins with special emphasis on Aflatoxin B1 and its metabolism, toxicity and preventive measures, different stages involved in hepatocarcinogenesis by Aflatoxin B1.

UNIT II: Food adulterants, contaminants and Food additives toxicity Agricultural and industrial contaminants in foods (pesticides residues in fruits and vegetables, metal contaminants such as lead, arsenic and mercury in foods), Food additives and its mode of action in packed food, classification and mechanism of toxicity of food additives with special reference to BHT (Butylated hydroxyl toluene) and BHA (Butylated hydroxyl anisole), Food borne bacterial illness with reference to Staphylococcus aureus and Bacillus cerus.

UNIT III: Toxic Constituents of Marine & Fungal Origin and Food allergies Puffer fish, paralytic shellfish poisoning, ciguatera poisoning, toxic algae, Mushrooms (amanita toxins), Definition of food intolerance and food allergies, allergenic food components and their effects, IgE mediated allergies, food sensitivities (anaphylactoid reactions, metabolic food disorders and idiosyncratic reactions), Treatment and prevention of food allergies.

UNIT IV: Cosmetic toxicity Cosmetic induced disorders such as acne, comdones, pruritis, nodules, papules etc. Defense mechanism of skin against UV radiation, Agencies role in launching a cosmetic finish product, Toxicity of shampoos, conditioners, bleachers and dyes, Toxicities evaluation of cosmetic products.

(Number of Units may be decided by the School/Department/Centre)

Reference Books:

4. Food Toxicology (Ed. Debasis Bagchi, Anand Swaroop), 1st edition, CRC Press, Boca Raton, Florida, US.
5. Microsomes and Drug Oxidations (Ed. James R. Gillette, Allan H. Conney, George J. Cosmides), 17th edition. Elsevier publications, Radarweg 29, 1043 NX Amsterdam, The Netherlands.

Teaching-Learning Strategies in brief (4 to 5 sentences)

When a student becomes interest in a subject, it is likely that he/she is self-motivated. When this is combined with the ability to be proactive and reflective, the student is also more likely to acquire deep knowledge and develop advanced analytical skills. The present subject includes various learning activities besides lecturing, including colloquiums, graded project assignments with oral presentations. Latest research developments on topics of curriculum are majorly emphasized.

Assessment methods and weightages in brief (4 to 5 sentences)

Students will be assessed on three parameters. (1). **Class performance (10%):this includes attendance, class room discussion and learning activities. Learning activities will mainly include practice to solve different problems** covered in class (2) **Oral presentations and tests (15)**: Assignments will be based on topics and problems related with syllabus.**3. Semester Examination (75%)**Comprising of evaluation of written answers of tests.

DEPARTMENT OF MEDICAL ELEMENTOLOGY & TOXICOLOGY

Name of the Academic Programme : **M.Sc. (Toxicology)**

Course Code : **MTX-CC-202**

Title of the Course : **FORENSIC TOXICOLOGY**

Credits : **4**

L=Lecture; T=Tutorial; P=Practical : L=**60,** T=**0**, **P=0**

Course Learning Outcomes (CLOs)

After completing this Course, the students should be able to

CLO-1	Basic understanding of forensic science with special reference to forensic toxicology, history and development of forensic sciences, legal framework involved in poisoning and toxicity cases
CLO-2	Acquiring the information on different kind of poisons, their origin and pathological effects, management of poisoning cases
CLO-3	Learning the basic theoretical concepts of tools and techniques used in the forensic toxicological investigations including microscopic, spectroscopic, chromatographic, molecular biology techniques and analysis of different samples using these techniques
CLO-4	Applying the knowledge of tools and techniques for the analysis of toxicological samples collected in various cases
CLO-5	Understanding the medico-legal aspects of toxicological cases and post-mortem analysis of these cases

Mapping of Course Learning Outcomes (CLOs) with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1		3	3					3						3
CLO 2		3	3					3						3
CLO 3		3	3											3
CLO 4		3	3	2										3
CLO 5		3	3					2						3

Detailed Syllabus

UNIT – I

Forensic science and toxicology: Definitions, historical development and legal framework pertaining to toxicity and poisoning episodes.

UNIT – II

Poisons of animal, plant and mineral origin, man-made poisons, signs and symptoms of the poisons of above classes, sample collection, recording and legal requirements for criminal proceedings involving poisons of above classes.

UNIT- III:

Tools and techniques of forensic toxicology: Microscopy (light, fluorescence and electron), spectroscopy (UV, visible, IR and AAS), chromatography (TLC, GLC, GCMS, LCMS and HPLC), electrophoresis, DNA finger-printing, Real Time-PCR. Analysis of illicit liquor including methyl and ethyl alcohol and alcohol in body fluids and breath, chemical examination, physiological and pharmacological aspects of pesticides and psychotropic drugs.

UNIT- IV:

Identification of human tissues including hair and body fluids and excreta for forensic toxicological implications, Medico-legal aspects of injuries caused by poisons and its differentiation with the injuries inflicted by other means, postmortem examination of poisoning cases.

(Number of Units may be decided by the School/Department/Centre)

Reference Books:

1. Lappas, N. T., Lappas, C. M. (2021). Forensic Toxicology: Principles and Concepts. Netherlands: Elsevier Science.
2. Reddy, K. N. (2017). Essentials of Forensic Medicine and Toxicology. India: Jaypee Brothers Medical Publishers Pvt. Limited.
3. Clarke's Analytical Forensic Toxicology. (2013). United Kingdom: Pharmaceutical Press.

Teaching-Learning Strategies in brief (4 to 5 sentences)

This course will give the brief introduction of forensic science, its evolution and history along with the legal framework regulating the forensic science practices. Furthermore, understanding of various kinds of poisons, their origin and effects are also the essential part of the course. Lectures, seminars and other interactive sessions with the students are the main learning strategies along with the discussion of important case studies and specific assignments will be given to students with the interest of improving discussion about the various ranges of topics in the course.

Assessment methods and weightages in brief (4 to 5 sentences)

Students will be assessed on three parameters. (1). **Active participation (10%): this includes attendance, class room discussion and learning activities. Learning activities will mainly include practice to solve different problems** covered in class (2) **Assignments and Tests (15)**: Assisnments will be based on topics and problems related with syllabus (10%). **3. Semester Examination (75%).** Exams to evaluate understanding of material covered in class.

DEPARTMENT OF MEDICAL ELEMENTOLOGY & TOXICOLOGY

Name of the Academic Programme : **M.Sc. (Toxicology)**

Course Code : **MTX-CC-203**

Title of the Course : **PESTICIDE AND HEAVY METALS TOXICOLOGY**

Credits : **4**

L=Lecture; T=Tutorial; P=Practical : L=**60,** T=**0**, **P=0**

Course Learning Outcomes (CLOs)

After completing this Course, the students should be able to

CO1	Outline the history and classification of pesticide
CO2	Increase the understanding of processes involved in the toxic response in pest and human
CO3	Apply structure-activity relations of pesticide and toxic metal
CO4	Understand Therapeutic Use of Heavy Metals
CO5	Evaluate Acute and Chronic Toxicity of Metals

Mapping of Course Learning Outcomes (CLOs) with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1		3	3					3						3
CLO 2		3	3					3						3
CLO 3		3	3											3
CLO 4		3	3	2										3
CLO 5		3	3					2						3

Detailed Syllabus

UNIT- I

Pesticide Toxicity

Classification and use of pesticides, Biomagnification of pesticides, Pesticide management, Toxic effects of pesticides: Pyrethroids, DDT, Organophosphate pesticides, Cyclodienes, Lindane, Carbamate, Mechanism of action, Method of analysis.

UNIT- II

Herbicide Toxicity

Soil applied Herbicides, Foliar applied Herbicides, Herbicide Selectivity, mode of action, Benzoic acids (dicamba), Pyridines (picloram), Paraquat, Triazines (atrazine, cyanazine),

Sulfonylureas (chlorsulfuron, tribenuron), Aryloxyphenoxypropionates(diclofop), Isoxamolidinones (clomazone).

UNIT- III

Heavy Metal Toxicity

Acute and Chronic Toxicity of Metals, Lead, Mercury, Arsenic, Cadmium, Chromium, Mechanism of heavy metal toxicity, Heavy Metal Toxicity Pathway, Oxidative damage by heavy metals, Genotoxicity of heavy metals, Ecotoxicology of Metals

UNIT-IV

Therapeutic Use of Heavy Metals

Therapeutic use of heavy metals in Cancer, microbial infection, arthritis. Chelation therapy, BAL, DMSA, EDTA, Penicillamine, Desferoxime, Heavy Metals in Traditional Medicine. Method of analysis.

Reference Books:

Assessment methods and weightages in brief

The performance of the student in each paper will be evaluated both continuously (Internal Assessment) and at the end of semester (Semester Examination). 25% marks for each theory paper will be allocated for internal assessment and 75% marks will be kept for semester examination at the end of each semester.

DEPARTMENT OF MEDICAL ELEMENTOLOGY & TOXICOLOGY

Name of the Academic Programme : **M.Sc. (Toxicology)**

Course Code : **MTX-CC-204**

Title of the Course : **LAB COURSE II**

Credits : **8**

L=Lecture; T=Tutorial; P=Practical : L=**0,** T=**0**, **P=150**

Course Learning Outcomes (CLOs)

After completing this Course, the students should be able to

CO1	Analyze level	Learn how to handle animals, various routes of drugadministration, dissection practices & isolate rat organs
CO2	Evaluate level	Understanding of the principles and techniques of various enzymatic and non-enzymatic activity parameters
CO3	Analyze level	Study of the toxic effects of chemicals on the aquatic and terrestrial environment
CO4	Apply level	Apply their newly acquired knowledge to utilize and optimize appropriate cellular models and experimental techniques to determine the contribution of intracellular mechanisms
CO5	Analyze level	Practical exercises to create various organ sub-cellular fractions for biochemical analysis

Mapping of Course Learning Outcomes (CLOs) with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1		3	3					3						3
CLO 2		3	3					3						3
CLO 3		3	3											3
CLO 4		3	3	2										3
CLO 5		3	3					2						3

Detailed Syllabus

UNIT-I. ACUTE TOXICITY STUDIES:

- Handling laboratory animals (mice and rats) and different types of dosing techniques. Calculation of drug doses and their translation in different species. Collection of blood samples from laboratory animals and their necroscopy for collection of internal organs (liver/kidney/brain/lung/spleen/thymus) for toxicity measurement and storage.

- Preparation of different sub-cellular fractions of different organs for biochemical analysis: homogenate, post-nuclear supernatant, post-mitochondrial supernatant, microsomes, and mitochondria.

- Estimation of enzymatic antioxidants as biomarkers of oxidative stress induced by xenobiotics: Catalase, Glutathione-S-Transferase, Glutathione Peroxidase, Glutathione Reductase, and Xanthine Oxidase.

- Estimation of non-enzymatic antioxidants as biomarkers of oxidative stress induced by xenobiotics: Reduced Glutathione, Total Thiols, Non-Protein Thiols, Protein Thiols, Ascorbic Acid.

- Measurement of specific oxidative stress markers: Lipid Peroxidation and Protein Carbonylation.

UNIT II. ECOTOXICOLOGY:

- Water quality monitoring by measuring levels of dissolved oxygen, biological oxygen demand, chemical oxygen demand, and turbidity from water samples from different locations.

- Analysis of total solids, total dissolved solids, and total suspended solids in water samples for environmental monitoring.

UNIT III. MITOCHONDRIAL PERMEABILIZATION:

- Measurement of mitochondrial permeability transition parameters: Swelling and membrane potential.

UNIT IV. MOLECULAR TOXICOLOGY

- Amplification of known DNA segment using PCR technique and evaluation of amplification product.

UNIT V. STATISTICAL ANALYSIS:

- Analysis of data obtained from acute toxicity study using Bio-statistical methods.

REFERENCES:

1. **Saroj Dua.**Biochemical Methods of Analysis: Theory and Applications.
2. **Wilson and Walker's.**Principles and Techniques of Biochemistry and Molecular Biology.
3. **Archana Tiwari**.Molecular and Biochemical Analysis of Bloom Forming Cyanobacteria.
4. **Robyt J F.**Biochemical Techniques Theory and Practice.
5. **Ali M Ayub.**Biochemical and Molecular Biology Techniques for Animal Biotechnology.

Teaching-Learning Strategies:

Introduction to molecular mechanisms and xenobiotic metabolism are covered in this course. With regard to its importance in terms of identification and preventative techniques, we would endeavor to impart this knowledge. Students may also be able to precisely target the pathway after learning the molecular reaction brought on by toxin exposure. Students would be urged to pursue toxicological research in which they might apply the ideas and principles they learned in this course. The course's multidisciplinary goal would then be accomplished.

Assessment methods and weightages:

At the end of the semester and continuously (internal assessment), the student's performance on each paper will be assessed (Semester Examination). Each theoretical paper will receive 25% of the possible points for internal evaluation, with the remaining 75% being saved for the semester test.

DEPARTMENT OF MEDICAL ELEMENTOLOGY & TOXICOLOGY

Name of the Academic Programme : **M.Sc. (Toxicology)**

Course Code : **MTX-DCE-201**

Title of the Course : **OCCUPATIONAL TOXICOLOGY**

Credits : **2**

L=Lecture; T=Tutorial; P=Practical : L=3**0,** T=**0**, **P=0**

Course Learning Outcomes (CLOs)

After completing this Course, the students should be able to

CLO-1	Understanding the concepts and importance of Occupational Toxicology.
CLO-2	Develop understanding of current developments in the field of scientific research applicable to occupational toxicology
CLO-3	Learn about Regulatory Agencies in Occupational safety.
CLO-4	perform an initial toxicological hazard assessment of the toxicity of and industrial chemical product.
CLO-5	use a quantitative structure-activity relationship for an initial semi-quantitative assessment of skin absorption.

Mapping of Course Learning Outcomes (CLOs) with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1		3	3					3						3
CLO 2		3	3					3						3
CLO 3		3	3											3
CLO 4		3	3	2										3
CLO 5		3	3					2						3

Detailed Syllabus

UNIT- I

Occupational Diseases

Occupational Hazards; Physical Hazards, Chemical Hazards, Biological Hazards, Psychosocial Hazards, Occupational Exposure, Occupational Disease; Occupational Dermatitis, Chloracne, Occupational Lung Diseases; COPD, Silicosis, Asbestosis, Asthama.

UNIT- II

Regulatory Agencies in Occupational safety

Exposure limits, Epidemiology of Occupational Diseases, National Institue for Occupational safety and Health (NIOSH), International Lanour Organization, American Conference of Govermental Industrial Hygienists (ACGIH), Occupational Safety and Health Administration (OSHA), Control Measures.(Number of Units may be decided by the School/Department/Centre)

Reference Books:

1- Textbook (s): Hamilton and Hardy's industrial toxicology, Raymond Harbison, Marie Bourgeois and Giffe Johnson. 6th edition. 2015.

Assessment methods and weightages in brief (4 to 5 sentences)

Students will be assessed on three parameters. (1). **Active participation (10%): this includes attendance, class room discussion and learning activities. Learning activities will mainly include practice to solve different problems** covered in class (2) **Assignments and Tests (15)**: Assignments will be based on topics and problems related with syllabus (10%). **3. Semester Examination (75%).** Exams to evaluate understanding of material covered in class.

DEPARTMENT OF MEDICAL ELEMENTOLOGY & TOXICOLOGY

Name of the Academic Programme : **M.Sc. (Toxicology)**

Course Code : **MTX-DCE-202**

Title of the Course : **NEUROTOXICOLOGY**

Credits : **2**

L=Lecture; T=Tutorial; P=Practical : L=**32,** T=**0**, **P=0**

Course Learning Outcomes (CLOs)

After completing this Course, the students should be able to

CO1	Analyze level	Deeper understanding of nervous system including anatomical structures, basic physiology and pathophysiology of neurodegenrative disorders.
CO2	Evaluate level	Understanding of basic neurotoxicology principles.
CO3	Apply level	Be acquainted with various classes of neurotoxic agents and their mode of actions at molecular level.
CO4	Analyze level	Know the factors responsible for selective neurotoxic effects & Pesticide induced neuropathy and how these may contribute to human neurodevelopmental and neurodegenerative disorders
CO5	Apply Level	Be able to assess the hazard and risk of neurotoxic chemicals found in food, drugs and environment and how their exposure results in human neurological disorders.

Mapping of Course Learning Outcomes (CLOs) with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1		3	3					3						3
CLO 2		3	3					3						3
CLO 3		3	3											3
CLO 4		3	3	2										3
CLO 5		3	3					2						3

Detailed Syllabus

UNIT- I

- Classification of nervous system; structure and function of human brain. Structure and function of neuron, synapse and other types of neurological cells.
- Blood brain barrier and its importance.
- Classification of Neurotransmitters. Synaptic transmission.Neurodegenerative disorders.

UNIT II

- Neuropathy and delayed neuropathy: Definition and mechanism of action. Description of neurotoxic agents and types of neurotoxic effects (Axanopathy, Neuropathy, Neuronopathy, Myelinopathy).
- Modes of action of neurotoxins on the nervous system (mitochondrial mechanisms, calcium homeostasis, and cell death mechanisms).
- Pesticide induced neuropathy (special reference to organophosphates, carbamates andorganochlorines): mechanism of action and clinical signs/symptoms.
- Neurotoxic chemicals found in food, drugs and environment.

REFERENCES:

1. Aschner, M. and Costa, L., 2018. ***Advances in Neurotoxicology***. San Diego: Elsevier Science & Technology.

Teaching-Learning Strategies:

This course will explore neurotoxicological elements of toxicology, beginning with basic human anatomy and physiology of the nervous system and progressing to diverse neurological effects on human neuronal health. The aim of this course is to familiarize students with the consequences of neurotoxicty, mechanisms of neurotoxicity and exposure to numerous neurotoxicants found in environmenment, food and drugs by shedding light at the molecular level.

Assessment methods and weightages:

At the end of the semester and continuously (internal assessment), the student's performance on each paper will be assessed (Semester Examination). Each theoretical paper will receive 25% of the possible points for internal evaluation, with the remaining 75% being saved for the semester test.

DEPARTMENT OF MEDICAL ELEMENTOLOGY & TOXICOLOGY

Name of the Academic Programme : **M.Sc. (Toxicology)**

Course Code : **MTX-OE-201**

Title of the Course : **ECOTOXICOLOGY**

Credits : **2**

L=Lecture; T=Tutorial; P=Practical : L=**30,** T=**0**, **P=0**

Course Learning Outcomes (CLOs)

After completing this Course, the students should be able to

CLO-1	Understanding the concepts and importance of ecotoxicology
CLO-2	Studying the movement of toxic chemicals in various compartments of ecosystem
CLO-3	Overview of bioaccumulation and biomagnifications of toxic chemicals
CLO-4	Understanding the concept of bio-indicators, its types and signification in biomonitoring
CLO-5	Studying the concepts of biomarkers, bioassays and their significance in ecotoxicology

Mapping of Course Learning Outcomes (CLOs) with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1		3	3					3						3
CLO 2		3	3					3						3
CLO 3		3	3											3
CLO 4		3	3	2										3
CLO 5		3	3					2						3

Detailed Syllabus

UNIT I

General Concepts of Ecotoxicology

- Definition and scope of ecotoxicology
- Sources and movement of toxic chemicals in various compartments of ecosystem
- Bioaccumulation and biomagnifications of pollutants (Definitions, Mechanisms, Models andtheir importance in ecotoxicology studies).

UNIT II

- Bioindicators, types of bioindicators their significance in biomonitoring of pollution andecotoxicological studies
- Biomarkers of environmental pollutants, importance of biomarkers in environmental
- Bioassays of ecotoxicology and ecotoxicology tests.
- Regulatory significance of ecotoxicology

(Number of Units may be decided by the School/Department/Centre)

Reference Books:

1. Newman, M. C. (2019). Fundamentals of Ecotoxicology: The Science of Pollution, Fifth Edition. United States: CRC Press.
2. Sparling, D. W. (2016). Ecotoxicology Essentials: Environmental Contaminants and Their Biological Effects on Animals and Plants. Netherlands: Elsevier Science.
3. Walker, C. H. (2017). Principles of Ecotoxicology. United Kingdom: Taylor & Francis Group.

Teaching-Learning Strategies in brief (4 to 5 sentences)

Ecotoxicology is a multidisciplinary field of science offers the understanding of toxic effects of hazardous chemicals on different levels of various ecosystems. Lectures, seminars and other interactive sessions with the students are the main learning strategies along with the discussion of important case studies and specific assignments will be given to students with the interest of improving discussion about the various ranges of topics in the course.

Assessment methods and weightages in brief (4 to 5 sentences)

Students will be assessed on three parameters. (1). **Active participation (10%): this includes attendance, class room discussion and learning activities. Learning activities will mainly include practice to solve different problems** covered in class (2) **Assignments and Tests (15)**: Assignments will be based on topics and problems related with syllabus (10%). **3. Semester Examination (75%).** Exams to evaluate understanding of material covered in class.

DEPARTMENT OF MEDICAL ELEMENTOLOGY & TOXICOLOGY

Name of the Academic Programme : **M.Sc. (Toxicology)**

Course Code : **MTX-OE-202**

Title of the Course : **NANOTOXICOLOGY**

Credits : **2**

L=Lecture; T=Tutorial; P=Practical : L=**30,** T=**0**, **P=0**

Course Learning Outcomes (CLOs)

After completing this Course, the students should be able to

CO1	Analyze level	Deeper understanding of nervous system including anatomical structures, basic physiology and pathophysiology of neurodegenrative disorders.
CO2	Evaluate level	Understanding of basic neurotoxicology principles.
CO3	Apply level	Be acquainted with various classes of neurotoxic agents and their mode of actions at molecular level.
CO4	Analyze level	Know the factors responsible for selective neurotoxic effects & Pesticide induced neuropathy and how these may contribute to human neurodevelopmental and neurodegenerative disorders
CO5	Apply Level	Be able to assess the hazard and risk of neurotoxic chemicals found in food, drugs and environment and how their exposure results in human neurological disorders.

Mapping of Course Learning Outcomes (CLOs) with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1		3	3					3						3
CLO 2		3	3					3						3
CLO 3		3	3											3
CLO 4		3	3	2										3
CLO 5		3	3					2						3

Detailed Syllabus

UNIT- I

- Classification of nervous system; structure and function of human brain. Structure and function of neuron, synapse and other types of neurological cells.
- Blood brain barrier and its importance.
- Classification of Neurotransmitters. Synaptic transmission.Neurodegenerative disorders.

UNIT II

- Neuropathy and delayed neuropathy: Definition and mechanism of action. Description of neurotoxic agents and types of neurotoxic effects (Axanopathy, Neuropathy, Neuronopathy, Myelinopathy).
- Modes of action of neurotoxins on the nervous system (mitochondrial mechanisms, calcium homeostasis, and cell death mechanisms).
- Pesticide induced neuropathy (special reference to organophosphates, carbamates andorganochlorines): mechanism of action and clinical signs/symptoms.
- Neurotoxic chemicals found in food, drugs and environment.

REFERENCES:

2. Aschner, M. and Costa, L., 2018. ***Advances in Neurotoxicology***. San Diego: Elsevier Science & Technology.

Teaching-Learning Strategies:

This course will explore neurotoxicological elements of toxicology, beginning with basic human anatomy and physiology of the nervous system and progressing to diverse neurological effects on human neuronal health. The aim of this course is to familiarize students with the consequences of neurotoxicty, mechanisms of neurotoxicity and exposure to numerous neurotoxicants found in environmenment, food and drugs by shedding light at the molecular level.

Assessment methods and weightages:

At the end of the semester and continuously (internal assessment), the student's performance on each paper will be assessed (Semester Examination). Each theoretical paper will receive 25% of the possible points for internal evaluation, with the remaining 75% being saved for the semester test.

DEPARTMENT OF MEDICAL ELEMENTOLOGY & TOXICOLOGY

Name of the Academic Programme : **M.Sc. (Toxicology)**

Course Code : **MTX-301**

Title of the Course : **REGULATORY TOXICOLOGY**

Credits : **4**

L=Lecture; T=Tutorial; P=Practical : L=**60,** T=**0**, **P=0**

Course Learning Outcomes (CLOs)

After completing this Course, the students should be able to

CO1	Evaluate level	Learn about the national (CDSCO) and international (OECD) principles for assessment, test protocols and legislations.
CO2	Evaluate level	Know importance of *in vitro* and *in vivo* testing of chemicalsin Pre-clinical studies and toxicokentics procedures.
CO3	Analyze level	Understand the FDA and European Guidelines regarding Investigational New Drug Application (IND) and EURL-ECVAM guidelines for the use of alternatives to animal testing.
CO4	Analyze level	Be acquainted with Concepts, procedure and interpretation of acute, sub-acute, sub-chronic and chronic toxicity studies
CO5	Apply level	Be able to asses data bases used in the risk assessment and gather information on toxicological risk assessment and Hazard Identification.

Mapping of Course Learning Outcomes (CLOs) with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1		3	3					3						3
CLO 2		3	3					3						3
CLO 3		3	3											3
CLO 4		3	3	2										3
CLO 5		3	3					2						3

Detailed Syllabus

UNIT- I: Regulatory guidelines

· **OECD Guidelines:** OECD guidelines for the testing of chemicals and their amendments: Section 2 (effects on biotic systems) and Section 4 (health effects)

· **Regulations for toxicity testing in India**: Drugs & Cosmetics Act and Rules and their amendments (Schedule Y)

UNIT- II: FDA and European Guidelines

· **FDA:** Code of Federal Regulations- 21CFR312 (Investigational New Drug Application (IND))

· **The European Union Reference Laboratory for alternatives to animal testing (EURL-ECVAM)**: An introduction to validation and regulatory acceptance

UNIT- III: Pre-clinical investigation of toxicity

· Importance of in vitro and in vivo testing of chemicals

· Basics of toxicokinetics procedures

· Concepts, procedure and interpretation of acute, sub-acute, sub-chronic and chronic toxicity studies

UNIT- IV: Risk Assessment

· Hazard Identification and Exposure standards: an introduction to RfD, OEL, DNEL, MOE, MOS, ADI, TDI

· Mode of action (threshold and non-threshold)

· An introduction to Threshold of Toxicological Concern (TTC)

Teaching-Learning Strategies:

Students will understand the regulatory guidelines laid out by various national and internation regulatory bodies including OECD and CDSCO to sensitize students about rules and regulations that goes into testing of chemicals and drug discovery studies.This course will also cover Importance of in vitro and in vivo testing of chemicals, Basics of toxicokinetics procedures Concepts, procedure and interpretation of acute, sub-acute, sub-chronic and chronic toxicity studies. The aim of this course is to familiarize students with guidelines national (CDSCO) and international (OECD) principles for assessment, test protocols and legislation.

Assessment methods and weightages:

At the end of the semester and continuously (internal assessment), the student's performance on each paper will be assessed (Semester Examination). Each theoretical paper will receive 25% of the possible points for internal evaluation, with the remaining 75% going toward the final exam at the end of each semester.

DEPARTMENT OF MEDICAL ELEMENTOLOGY & TOXICOLOGY

Name of the Academic Programme : **M.Sc. (Toxicology)**

Course Code : **MTX-302**

Title of the Course : **METHODS OF TOXICOLOGY**

Credits : **4**

L=Lecture; T=Tutorial; P=Practical : L=**60,** T=**0**, **P=0**

Course Learning Outcomes (CLOs)

After completing this Course, the students should be able to

CO1	Evaluate level	Describe the basics of toxicity testing and usage of animal models including concepts and procedures of acute, sub acute and chronic toxicity testings.
CO2	Evaluate level	Understand the regulatory , systemic approaches and risk and hazard assessment in carcinogenicty testing.
CO3	Analyze level	Know about basic genetic concepts related to genotoxicity testing and assay selection guidelines.
CO4	Apply level	Basic understanding of cell culture and different cell lines used in pre clinical studies.
CO5	Analyze level	Identify various toxicokinetics procedures and alternate models of toxicology.

Mapping of Course Learning Outcomes (CLOs) with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1		3	3					3						3
CLO 2		3	3					3						3
CLO 3		3	3											3
CLO 4		3	3	2										3
CLO 5		3	3					2						3

Detailed Syllabus

UNIT - I: ANIMAL MODELS OF TOXICITY TESTING

- Importance of in vitro and in vivo testing of chemicals, Concepts and procedures of acute, chronic, subchronic toxicity testing, Mammalian models (rat, mouse, guinea pig, hamster and rabbit), Non mammalian modes (daphnia, zebrafish),

UNIT - II: Carcinogenicity testing

- Regulatory requirement for testing, Systemic approaches to testing, Rodent cancer bioassays, Cancer hazard and risk assessment

UNIT - III: Genotoxicity testing

- Basic genetic concepts related to toxicity and carcinogenicity.
- Assay selection guidelines, Ames test, Single Cell Gel Electrophoresis (COMET) assay, Sister Chromatid Exchange, Micronucleus assay

UNIT – IV:

- Basics of cell culture, different cell lines used in toxicological studies, Basics of toxicokinetics procedures.
- Alternate models of toxicology

Teaching-Learning Strategies:

This course will cover methodology applied in toxicological experiments in pre clinical studies by covering the concepts of in vivo and in vitro testing of chemicals and drugs. Various toxicological parameters like carcinogenicity testing and genotoxicity testing will be taught in this course. Students will be able to identify regulatory requirement and systemic approaches for testing. At the end of this course, students will also be able to asses assay selection guidelines, know cell cultures used in toxicological studies and basics of toxicokinetics procedures.

Assessment methods and weightages:

The performance of the student in each paper will be evaluated both continuously (Internal Assessment) and at the end of the semester (Semester Examination). 25% of marks for each theory paper will be allocated for internal assessment and 75% of marks will be kept for semester examination at the end of each semester

DEPARTMENT OF MEDICAL ELEMENTOLOGY & TOXICOLOGY

Name of the Academic Programme : **M.Sc. (Toxicology)**

Course Code : **MTX-303**

Title of the Course : **CARCINOGENICITY & TERATOGENICITY OF DRUGS AND CHEMICALS**

Credits : **4**

L=Lecture; T=Tutorial; P=Practical : L=**60,** T=**0**, **P=0**

Course Learning Outcomes (CLOs)

After completing this Course, the students should be able to

CLO-1	Understanding the basic concepts of carcinogenesis, carcinogenic compounds and their mechanism of actions along with the genetic factors involved in carcinogenesis, DNA repair mechanism, apoptosis, teratogenesis and their molecular markers,
CLO-2	Application of basic understanding the above mentioned concepts to understand the various scientific studies answering the scientific problems
CLO-3	Analyzing the scientific problems on the mechanistic level of carcinogenesis and associated processes
CLO-4	Analyzing the hypothetical problems and designing the studies based on the hypothesis carcinogenesis, DNA repair mechanism, apoptosis, teratogenesis and molecular markers
CLO-5	Comparative evaluation of the scientific studies based on the above mentioned concepts

Mapping of Course Learning Outcomes (CLOs) with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1		3	3					3						3
CLO 2		3	3					3						3
CLO 3		3	3											3
CLO 4		3	3	2										3
CLO 5		3	3					2						3

Detailed Syllabus

UNIT I

Definition and Mechanism of carcinogenesis, Causative agents: Poly cyclic aromatic hydrocarbons (Benzo(a)pyrene), N-Nitroso compounds (Diethylnitrosamine), Sources, exposure, mechanism of action. Oncogenes and tumor suppressor genes (ras, myc, jun, p53, Rb, AP) and its role in carcinogenesis

UNIT II

DNA REPAIR MECHANISM AND APOPTOSIS

Types of DNA damage, DNA repair enzymes, types of DNA repair mechanisms, role in carcinogenesis. Apoptosis: Definition, requirement, bcl-2, bax, caspases, intracellular and extracellular pathways and their regulation. Cancer and apoptosis.

UNIT III

MOLECULAR TUMOUR MARKERS

Prostate specific antigen (PSA), Carcinoembryonic antigen (CEA), Alpha-fetoprotein (AFP), Beta-2 microglobulin (B2M), HER2, Bladder tumor antigen (BTA)

UNIT -IV: TERATOGENESIS

Teratogenesis: Definition, mechanisms, associated disorders and factors influencing teratogenesis. Species susceptibility, susceptible stage of development anddose dependence.

(Number of Units may be decided by the School/Department/Centre)

Reference Books:

1. Nelson, D. L., Cox, M. (2017). Lehninger Principles of Biochemistry: International Edition. United Kingdom: Macmillan Learning.
2. Feo, F., Pani, P. (2013). Chemical Carcinogenesis: Models and Mechanisms. Germany: Springer US.
3. Kirsch-Volders, M. (2012). Mutagenicity, Carcinogenicity, and Teratogenicity of Industrial Pollutants. United Kingdom: Springer US.
4. Chu, E. H. (2012). Mutation, Cancer, and Malformation. United Kingdom: Springer US.

Teaching-Learning Strategies in brief (4 to 5 sentences)

This course will give the brief introduction of the various cellular and molecular processes focussing on carcinogenesis, mutagenesis, apoptosis, teratogenesis and DNA repair mechanism. Furthermore, understanding of various factors affecting these processes with special references to chemicals exposure will also be the essential part of the course. Lectures, seminars and other interactive sessions with the students are the main learning strategies along with the discussion of important case studies and specific assignments will be given to students with the interest of improving discussion about the various ranges of topics in the course.

Assessment methods and weightages in brief (4 to 5 sentences)

Students will be assessed on three parameters. (1). **Active participation (10%): this includes attendance, class room discussion and learning activities. Learning activities will mainly include practice to solve different problems** covered in class (2) **Assignments and Tests (15)**: Assisnments will be based on topics and problems related with syllabus (10%). **3. Semester Examination (75%).** Exams to evaluate understanding of material covered in class.

DEPARTMENT OF MEDICAL ELEMENTOLOGY & TOXICOLOGY

Name of the Academic Programme : **M.Sc. (Toxicology)**

Course Code : **MTX-304**

Title of the Course : **LAB COURSE III**

Credits : **8**

L=Lecture; T=Tutorial; P=Practical : L=**150,** T=**0**, **P=0**

Course Learning Outcomes (CLOs)

After completing this Course, the students should be able to

CO1	To evaluate the effects of pesticide in vitro and in vivo on the following enzyme activities in rat brain (Evaluate level)
CO2	Observed the neurobehavioural changes in rat on administration of CNS acting drugs.(Evaluate level)
CO3	Evaluate the protective efficacy of facial creams on TCE-UVB induced dermal challenges. (Evaluate level
CO4	To evaluate the Draize irritancy potential in UVR-TCE induced damage in murine skin. (Evaluate level)
CO5	Attenuate UVB induced DNA integrity in Swiss albino mice by polyphenol. (Analyze level)

Mapping of Course Learning Outcomes (CLOs) with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1		3	3					3						3
CLO 2		3	3					3						3
CLO 3		3	3											3
CLO 4		3	3	2										3
CLO 5		3	3					2						3

Detailed Syllabus

Assessment of neurotoxic effects of pesticides and neurobehavioural modulation of drugs in animal model

1. **To evaluate the the effects of pesticide *in vitro* and *in vivo* on the following enzyme activities in rat brain:**

    a) $Na^+ K^+$ ATPase

    b) Acetyl Choline Esterase (AchE)

c) Superoxide dismutase (SOD)

d) Monoamine Oxidase (MAO)

2. **To observe the neurobehavioural changes in rat on administration of CNS acting drugs**

   a) Effect of drugs (e.g., diazepam) on the motor coordination using the Rotarod Performance test in rat

   b) To study the effect of anxiolytic drugs (eg.diazepam) on conditioned avoidance response (CAR) behavior using Cook's pole climbing apparatus

Dermal Toxicities experiment in mice

3. **To evaluate the protective efficacy of facial creams on TCE-UVB induced dermal challenges.**

   - MPO
   - NO
   - Catalase, SOD, GSH

4. **To evaluate the Draize irritancy potential in UVR-TCE induced damage in murine skin.**

   - Rating on Draize scale (Erythma and edema)
   - Sun protection factor (Facial creams)
   - Protein oxidation

5. **Attenuation of UVB induced DNA integrity in Swiss albino mice by polyphenol.**

   - Alkaline unwinding assay

Reference Books:

1. Biochemical Methods of Analysis: Theory and Applicationsby Saroj Dua
2. Principles and Techniques of Biochemistry and Molecular Biology by Wilson and Walker's
3. Molecular and Biochemical Analysis of Bloom Forming Cyanobacteria by Archana Tiwari.
4. Biochemical Techniques Theory and Practice by Robyt J F.
5. Biochemical and Molecular Biology Techniques for Animal Biotechnology by Ali M Ayub.

Teaching-Learning Strategies in brief

This course is an assessment of neurotoxic effects of pesticides and neurobehavioural modulation of drugs in animal model. We would try to teach this with respect to its significance in identification and prevention strategies. Moreover, after learning the molecular response due to toxin exposure, students might be able to target the pathway with precision. Student would be encouraged for toxicological

research where they could use the concepts and fundamentals of this course. The interdisciplinary objective of this course could then be achieved.

Assessment methods and weightages in brief

The performance of the student in each paper will be evaluated both continuously (Internal Assessment) and at the end of semester (Semester Examination). 25% marks for each theory paper will be allocated for internal assessment and 75% marks will be kept for semester examination at the end of each semester.

DEPARTMENT OF MEDICAL ELEMENTOLOGY & TOXICOLOGY

Name of the Academic Programme : **M.Sc. (Toxicology)**

Course Code : **MTX-DCE-301**

Title of the Course : **OMICS IN TOXICOLOGY**

Credits : **2**

L=Lecture; T=Tutorial; P=Practical : L=**30,** T=**0**, **P=0**

Course Learning Outcomes (CLOs)

After completing this Course, the students should be able to

CLO-1	Understanding the concepts of omics with special reference to proteomics using different spectroscopic, chromatographic, molecular biology and bioinformatics tools
CLO-2	Application of different omics concepts, techniques and bioinformatics tools in the toxicological studies
CLO-3	Understanding and analysis of the various omics techniques to be used in toxicological aspects
CLO-4	Analyzing the hypothetical problems and designing the studies based on the hypothesis of omics applications in toxicological scenario
CLO-5	Evaluation of various omics techniques in the application of toxicological aspects

Mapping of Course Learning Outcomes (CLOs) with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1		3	3					3						3
CLO 2		3	3					3						3
CLO 3		3	3											3
CLO 4		3	3	2										3
CLO 5		3	3					2						3

Detailed Syllabus

TOXICOPROTEOMICS

UNIT-I

Proteomics – introduction, concept and applications; Introduction, Concept, application, advantages and limitations of expressional Proteomics, Functional Proteomics, Structural

Proteomics. Protein separation techniques, Strategies in protein identification, 2D Gel electrophoresis, Isoelectric Focusing (IEF). Mass spectrometry in proteomics.

UNIT-II

Protein- Protein interactions- experimental and computational- two hybrid, Phage display; Protein Microarray- Preparation, working and analysis. Proteomics and Microarray databases and allied bioinformatics tools. Peptidomics/Drug discovery, Biomarkers in disease diagnosis, Identification and characterization of novel proteins in toxicology.

(Number of Units may be decided by the School/Department/Centre)

Reference Books:

1. Integrating 'omics' in Toxicology. (2013). United Kingdom: Royal Society of Chemistry.
2. Fowler, B. A., Kelly, R., Perkins, R., Liu, Z., Hong, H., Tong, W., Fang, H., Beresney, J. (2013). Computational Toxicology: Chapter 11. Omics Biomarkers in Risk Assessment: A Bioinformatics Perspective. United States: Elsevier Science.
3. James, R. C., Roberts, S. M., Williams, P. L. (2015). Principles of Toxicology: Environmental and Industrial Applications. Germany: Wiley.

Teaching-Learning Strategies in brief (4 to 5 sentences)

This course will give the brief introduction of the various omics technique and their application in toxicology. Furthermore, understanding of various bioinformatics tools to be used for toxicological analysis by spectroscopic, chromatographic and molecular biology techniques. Lectures, seminars and other interactive sessions with the students are the main learning strategies along with the discussion of important case studies and specific assignments will be given to students with the interest of improving discussion about the various ranges of topics in the course.

Assessment methods and weightages in brief (4 to 5 sentences)

Students will be assessed on three parameters. (1). **Active participation (10%): this includes attendance, class room discussion and learning activities. Learning activities will mainly include practice to solve different problems** covered in class (2) **Assignments and Tests (15)**: Assisnments will be based on topics and problems related with syllabus (10%). **3. Semester Examination (75%).** Exams to evaluate understanding of material covered in class.

DEPARTMENT OF MEDICAL ELEMENTOLOGY & TOXICOLOGY

Name of the Academic Programme : **M.Sc. (Toxicology)**

Course Code : **MTX-DCE-302**

Title of the Course : **PRE-CLINICAL TOXICOLOGY FOR DRUG DEVELOPMENT**

Credits : **2**

L=Lecture; T=Tutorial; P=Practical : L=**30,** T=**0**, **P=0**

Course Learning Outcomes (CLOs)

After completing this Course, the students should be able to

CLO-1	Understanding the concepts of pre-clinical toxicology and use and importance of animal in pre-clinical toxicological studies
CLO-2	Understanding and analysis of the various dosing factors used in animal studies such as LD50
CLO-3	Application of different pre-clinical concepts in the development of new drugs
CLO-4	Analyzing the hypothetical problems and designing the studies based on the hypothesis of pre-clinical and toxicity studies
CLO-5	Evaluation of various pre-clinical and toxicological studies in the development of drugs

Mapping of Course Learning Outcomes (CLOs) with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1		3	3					3						3
CLO 2		3	3					3						3
CLO 3		3	3											3
CLO 4		3	3	2										3
CLO 5		3	3					2						3

Detailed Syllabus

UNIT I:

Use of animals in preclinical toxicology studies, role of preclinical toxicology in drug discovery and development process. Experimental considerations for assessing possible human risk. Development of preclinical testing. Dose conversion factors, clinical signs of toxicity.

UNIT II:

Single dose and repeat dose toxicity studies; Factors influencing such studies such as species, sex, size, route, dose level; Data evaluation and regulatory requirements. Determination of Maximum Tolerated Dose (MTD) and LD50 as per revised OECD guidelines. Allergenicity testing, dermal toxicity, immunotoxicologyand*in vitro* methods of toxicology.

(Number of Units may be decided by the School/Department/Centre)

Reference Books:

1. Casarett, L. J., Doull, J. (2013). Casarett & Doull's Toxicology: The Basic Science of Poisons, Eighth Edition. United Kingdom: McGraw-Hill Education.
2. Veterinary Toxicology: Basic and Clinical Principles. (2011). Netherlands: Elsevier Science.
3. Dalefield, R. (2017). Veterinary Toxicology for Australia and New Zealand. Netherlands: Elsevier Science.

Teaching-Learning Strategies in brief (4 to 5 sentences)

This course will give the brief introduction of the various pre-clinical studies and their application in toxicology. Furthermore, understanding of various toxicity testing used for toxicological analysis will also be an essential part of the course. Lectures, seminars and other interactive sessions with the students are the main learning strategies along with the discussion of important case studies and specific assignments will be given to students with the interest of improving discussion about the various ranges of topics in the course.

Assessment methods and weightages in brief (4 to 5 sentences)

Students will be assessed on three parameters. (1). **Active participation (10%): this includes attendance, class room discussion and learning activities. Learning activities will mainly include practice to solve different problems** covered in class (2) **Assignments and Tests (15)**: Assisnments will be based on topics and problems related with syllabus (10%). **3. Semester Examination (75%).** Exams to evaluate understanding of material covered in class.

DEPARTMENT OF MEDICAL ELEMENTOLOGY & TOXICOLOGY

Name of the Academic Programme : **M.Sc. (Toxicology)**

Course Code : **MTX-OE-301**

Title of the Course : **TRACE ELEMENTS IN HUMAN NUTRITION AND HEALTH**

Credits : **2**

L=Lecture; T=Tutorial; P=Practical : L=**30,** T=**0**, **P=0**

Course Learning Outcomes (CLOs)

After completing this Course, the students should be able to

CLO-1	Understanding the concepts of medical elementology and interaction of nature and human (Understanding level)
CLO-2	Learning the biological classification of elements and trace elements and their biological significance (Analysis level)
CLO-3	Studying the importance of trace elements in different pathological conditions (Evaluation level)
CLO-4	Understanding the importance of elements in Indian system of medicine and their dietary intake
CLO-5	Studying the sophisticated methods of analysis of trace elements

Mapping of Course Learning Outcomes (CLOs) with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1		3	3					3						3
CLO 2		3	3					3						3
CLO 3		3	3											3
CLO 4		3	3	2										3
CLO 5		3	3					2						3

Detailed Syllabus

UNIT-I:

Principles of Medical Elementology, Theory of man as microcosm in relation to nature as macrocosm. Biological classification of elements. Criteria of essentiality. Trace elements requirements and safe ranges. Trace element bioavailability and interactions. Essential Trace

elements. Deficiency disorders of Iodine, Zinc, Selenium, Copper, Chromium and Molybdenum. Epidemiology and control of deficiency disorders.

UNIT-II: Elements in diseased states: Cardiovascular disease, Diabetes mellitus, Rheumatoid arthritis, Skin disease, Neuropsychiatric disorders, Renal disease and Liver disease. Concept of elements in Indian system of medicine. Dietary intakes of trace elements. Methods of analysis: AAS and ICP.

(Number of Units may be decided by the School/Department/Centre)

Reference Books:

Teaching-Learning Strategies in brief (4 to 5 sentences)

This course will give the brief introduction of the various elements of medical importance. Furthermore, understanding of toxicity of these elements and its importance will be focussed. Lectures, seminars and other interactive sessions with the students are the main learning strategies along with the discussion of important case studies and specific assignments will be given to students with the interest of improving discussion about the various ranges of topics in the course.

Assessment methods and weightages in brief (4 to 5 sentences)

Students will be assessed on three parameters. (1). **Active participation (10%): this includes attendance, class room discussion and learning activities. Learning activities will mainly include practice to solve different problems** covered in class (2) **Assignments and Tests (15)**: Assisnments will be based on topics and problems related with syllabus (10%). **3. Semester Examination (75%).** Exams to evaluate understanding of material covered in class.

DEPARTMENT OF MEDICAL ELEMENTOLOGY & TOXICOLOGY

Name of the Academic Programme : **M.Sc. (Toxicology)**

Course Code : **MTX-OE-302**

Title of the Course : **FUNDAMENTALS OF INTELLECTUAL PROPERTY RIGHTS**

Credits : **2**

L=Lecture; T=Tutorial; P=Practical : L=**30,** T=**0**, **P=0**

Course Learning Outcomes (CLOs)

After completing this Course, the students should be able to

CLO-1	Understanding the concepts of intellectual property, its history and national and international regulation of IP (Understanding level)
CLO-2	Learning the various terminology and kinds of IP including patents Trademarks, Industrial Designs, Copyrights, Geographical Indications, Various Other IPs (Analysis level)
CLO-3	Studying the importance of IP in personal and professional development (Evaluation level)
CLO-4	Understanding the importance of industrial and institutional set up for IP (Analysis level)
CLO-5	Studying the future scope and career opportunities in the field of IP (Application level)

Mapping of Course Learning Outcomes (CLOs) with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1		3	3					3						3
CLO 2		3	3					3						3
CLO 3		3	3											3
CLO 4		3	3	2										3
CLO 5		3	3					2						3

Detailed Syllabus

UNIT - I: INTELLECTUAL PROPERTY RIGHTS AND SCIENCE AS PERSPECTIVE

Concept of Intellectual Property, History and Evolution of Intellectual Property, Treaty and Convention on IP, World Intellectual Property Organization and International Cooperation, Patents, Drafting and Filing Procedures, Domestic and International Patents, Patents Vs. Generic, Trademarks, Industrial Designs, Copyrights, Geographical Indications, Various Other IPs and Patent and Trademark Attorney.

UNIT - II: ROLE OF INTELLECTUAL PROPERTY IN RESEARCH AND DEVELOPMENT

Effect of Intellectual Property Protection in Development, Ideal industrial and institutional setup for Intellectual Property Outcomes, Role of Licensing and commercialization, IP Cells and Technology Transfer Offices, Role of Inventors and Attorneys in Development, Future scope and career in Intellectual Property Field.

(Number of Units may be decided by the School/Department/Centre)

Reference Books:

Teaching-Learning Strategies in brief (4 to 5 sentences)

Lectures, seminars and other interactive sessions with the students are the main learning strategies along with the discussion of important case studies and specific assignments will be given to students with the interest of improving discussion about the various ranges of topics in the course.

Assessment methods and weightages in brief (4 to 5 sentences)

Students will be assessed on three parameters. (1). **Active participation (10%): this includes attendance, class room discussion and learning activities. Learning activities will mainly include practice to solve different problems** covered in class (2) **Assignments and Tests (15)**: Assisnments will be based on topics and problems related with syllabus (10%). **3. Semester Examination (75%).** Exams to evaluate understanding of material covered in class.

DEPARTMENT OF MEDICAL ELEMENTOLOGY & TOXICOLOGY

Name of the Academic Programme : **M.Sc. (Toxicology)**

Course Code : **MTX-OE-303**

Title of the Course : **APPLIED STATISTICS**

Credits : **2**

L=Lecture; T=Tutorial; P=Practical : L=**30,** T=**0**, **P=0**

Course Learning Outcomes (CLOs)

After completing this Course, the students should be able to

CLO-1	Understand concepts of Interpolation and Extrapolation and vital statistics.**(Cognitive level: Understanding)**
CLO-2	Apply the concepts for the analysis of experimental and survey data. **(Cognitive level: Apply)**
CLO-3	Analyse the data at sample level for actual experiments done in their lab class**(Cognitive level: Analyse)**
CLO-4	Apply Methods of obtaining vital sttatistics , measurement of fertility**(Cognitive level: Analyse)**
CLO-5	Compare the variation between statistical significance and practical significance for vital data. (**Cognitive level: Evaluate)**

Mapping of Course Learning Outcomes (CLOs) with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1		3	3					3						3
CLO 2		3	3					3						3
CLO 3		3	3											3
CLO 4		3	3	2										3
CLO 5		3	3					2						3

Detailed Syllabus

UNIT – I

Interpolation and Extrapolation : Significance of Interpolation and Extrapolation, Methods of Interpolation and Extrapolation; Graphic Method and Algebraic Method.

(i)Binomial Expansion Method for one and two missing values (Numerical Examples)

(ii) Newton's Method and Newton's Divided Difference Method (Numerical Examples).

(iii) Lagrange's Method (Numerical Examples).

UNIT – II

Vital Statistics : Simple explanation, uses of Vital Statistics, Methods of obtaining vital sttatistics , measurement of fertility

Crude birth rate, Specific fertility rate, General fertility rate, Gross reproduction rate, Net reproduction rate (Numerical Example).

Measurement of Mortality : Crude death rate , Specific Death Rate, Standardized Death Rate.

ProbitAnalysis : LD50, ED50 ; Simple explanation

(Number of Units may be decided by the School/Department/Centre)

Reference Books:

1. Bernard Rosner (2015), *Fundamentals of Biostatistics*, 7thEdition, Brooks/Cole,20Channel Center StreetBoston, MA 02210, USA
2. Veer Bala Rastogi (2015) Biostatistics, Medtech; 3rd edition, New Delhi-110002

Teaching-Learning Strategies in brief (4 to 5 sentences)

This course is an introduction to statistical methods used in life science, medical research and toxicological research.I would try to emphasize the significance of the course. For example, why they have to go through this course (other than the course requirement)? , and where else they could use the concepts and fundamentals of this course? I have observed that once students understand the importance of a course, they are more engaged in the lectures. I will adopt a problem-solving practice-based approach to teach this course and students are allowed to apply the concepts to other courses to emphasize the interdisciplinary nature of learning.

Assessment methods and weightages in brief (4 to 5 sentences)

Students will be assessed on three parameters. (1). **Active participation (10%):this includes attendance, class room discussion and learning activities. Learning activities will mainly include practice to solve different problems** covered in class (2) **Assignments and Tests (15)**: Assisnments will be based on topics and problems related with syllabus (10%).**3. Semester Examination (75%).** Exams to evaluate understanding of material covered in class.

DEPARTMENT OF MEDICAL ELEMENTOLOGY & TOXICOLOGY

Name of the Academic Programme : **M.Sc. (Toxicology)**

Course Code : **MTX-401**

Title of the Course : **DISSERTATION**

Credits : **16**

L=Lecture; T=Tutorial; P=Practical : L=**0,** T=**0**, **P=0**

Course Learning Outcomes (CLOs)

After completing this Course, the students should be able to

CLO-1	display the knowledge and capability required for independent work as a Master of Science in Toxicology
CLO-2	use a holistic view to critically, independently and creatively identify, formulate and deal with complex issues related to toxicology research
CLO-3	develop capability to create, analyse and evaluate different scientific problems.
CLO-4	identify the scientific issues that must be addressed within on priority basis
CLO-5	Develop capability to plan and use adequate methods to conduct qualified tasks in given frameworks and to evaluate this work.

Mapping of Course Learning Outcomes (CLOs) with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1		3	3					3						3
CLO 2		3	3					3						3
CLO 3		3	3											3
CLO 4		3	3	2										3
CLO 5		3	3					2						3

DEPARTMENT OF MEDICAL ELEMENTOLOGY & TOXICOLOGY

Name of the Academic Programme : **M.Sc. (Toxicology)**

Course Code : **MTX-402**

Title of the Course : **SEMINAR**

Credits : **6**

L=Lecture; T=Tutorial; P=Practical : L=**0,** T=**0**, **P=0**

Course Learning Outcomes (CLOs)

After completing this Course, the students should be able to

CLO-1	To develop skills in presentation and discussion of research topics in a public forum..
CLO-2	Allow students to learn from one another.
CLO-3	Introduce other topics that are related to the course, and serve to help students transition to new ideas.
CLO-4	Allows for opening up the floor for discussion of scientific problems
CLO-5	Expose students to new ideas and to the thoughts of people with different backgrounds

Mapping of Course Learning Outcomes (CLOs) with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

	PLO 1	**PLO 2**	**PLO 3**	**PLO 4**	**PLO 5**	**PLO 6**	**PLO 7**	**PLO 8**	**PLO 9**	**PLO 10**	**PLO 11**	**PLO 12**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**
CLO1	3	3	3	2	3	2	3	3	2	3						
CLO2	2	3	2	3	2	3	3	3	3	2						
CLO3	3	3	3	3	3	3	2	2	2	3						
CLO4	2	2	2	2	3	3	3	2	3	2						
CLO5	3	3	3	3	2	3	3	3	3	3						