SARDAR PATEL UNIVERSITY

M.Sc. in Toxicology (2 years course) from June 2016

Course Structure & Detailed Syllabus

Eligibility Criteria: Graduates of any Bioscience subject, Life Science, Chemistry, Pharmacy, MLT, Forensic Science, Medicine, Homeopathy, Physiotherapy, Occupational Therapy, B.D.S., science graduate of B group or related field are eligible.

M.Sc. Part I					
Course code	**Name of Paper**	**Marks**		**Total**	**Exam Duration**
		Internal	**External**		
PS01MTOX01	Human anatomy and Physiology	20	80	100	3 hours
PS01MTOX02	Biochemistry and Histopathology	20	80	100	3 hours
PS01MTOX03	Principles of Toxicology	20	80	100	3 hours
PS01MTOX04	Systemic and Environmental Toxicology	20	80	100	3 hours
PS01MTOX05	Instrumentation in Toxicology	20	80	100	3 hours
M.Sc. Part II					
PS02MTOX01	Biochemical and Molecular Toxicology	20	80	100	3 hours
PS02MTOX02	Toxicology of Heavy Metals and Applied Toxicology	20	80	100	3 hours
PS02MTOX03	Biostatistics and Bioinformatics	20	80	100	3 hours
PS02MTOX04	Toxicology of Pesticides and Insecticides and Carcinogens	20	80	100	3 hours
PS02MTOX05	Occupational and Industrial Toxicology	20	80	100	3 hours
	Theory total	200	800	1000	
PS02MTOX06	Practical examination	60*	240**	300	3 days***
	Grand total	**260**	**1040**	**1300**	**---**

*Internal 20 marks for each practicals

** External 80 marks for each practicals

*** One day for each practicals on above mentioned subjects

SARDAR PATEL UNIVERSITY
M.Sc. in Toxicology (2 years course) from June 2016
Course Structure & Detailed Syllabus

M.Sc. Toxicology part I (First year)

PS01MTOX01: HUMAN ANATOMY AND PHYSIOLOGY

Unit 1: Basics of tissue and muscular system

General Anatomy, Histology of Epithelial, Connecting muscular, nervous tissues

Musculo skeletal Anatomy: Superior extremity, Inferior extremity, Spine, head & neck, Facial & pelvic floor muscle & T.M. joint, Surface Anatomy

Unit 2: Systemic anatomy 1

Neuro Anatomy, Basics of CNS, Basics of peripheral nervous system

Alimentary system

Uro-genital system

Micro - Anatomy (cartilage, bone, nerve, muscle) Cardio - vascular [including Lymphatic]

Unit 3: Systemic anatomy 2

Respiratory system

Sensory organs

Endocrine glands

Unit 4: Basics of Physiology

General Physiology, Structure of cell membrane, Transport across cell membrane and Homeostasis

Unit 5: Systemic Physiology

Nervous System and Special Senses

Blood and Muscle Physiology

Digestive System and Excretory System

Cardiovascular and Respiratory System

Endocrinology and Reproductive System

PS01MTOX02: BIOCHEMISTRY AND HISTOPATHOLOGY

Unit 1: Cell organelles and nucleus

Cell organelles – Origin, structure and function of mitochondria, endoplasmic reticulum, Golgi complex, ribosomes, endosome, lysosomes, paroxysms, centrosome

The nucleus- Nuclear envelope, nucleolus, chromosomes, type, structure and chemical composition of chromosomes, organization of genes and noncoding DNA. Cell division- Mitotic & meiotic cell division, the central cell cycle control system

Unit 2: Study of Carbohydrates and proteins

Classification and biological role of carbohydrates

Classification and biological role of proteins

Unit 2: Study of Lipids and nucleic acids

Classification and biological role of lipids

Classification and biological role of nucleic acids

Unit 4: Minerals, vitamins and enzymology

RDA, sources, biological role, associated diseases for vitamins and minerals in brief

Classification of enzymes and clinical enzymology

Unit 5: Introduction of Histopathology

Instruments and reagents used in Histopathology

Histopathology techniques- fixatives and stains used

Frozen section preparation and their special uses

PS01MTOX03: PRINCIPLES OF TOXICOLOGY

Unit 1: Introduction and classification of toxins

Definition, history, scope & sub-divisions of toxicology. Dose-effect and dose-response relationship-acute toxicity, chronic toxicity reversible & irreversible effects

Classification of toxic agents, natural toxins, animal toxins, plant toxins, food toxins, genetic poisons and chemical toxins. Factors affecting toxicity - species and strain, age, sex, nutritional status, hormones, environmental factors, circadian rhythms

Unit 2: Entry, distribution and action of toxins

Absorption and distribution of toxicants-portals of entry-skin, gastro intestinal tract, gills and respiratory system. Bio-distribution, bio-magnification biotransformation of xenobiotics- brief introduction to Phase-I and Phase-II reactions

Reactions of toxins with target molecules- Covalent binding, Non-covalent binding, Hydrogen abstraction, Electron transfer, Enzymatic reactions

Elimination of toxicants-renal, hepatic, DMES, pulmonary systems, milk, egg and foetus

Unit 3: Basics of immune system, immune deficiency

Introduction to immunology: Basics of the immune system, structure and function of primary and secondary lymphoid organs, structure and function of immunoglobulins, MHC molecules, introduction to complements.

Immunodeficiencies: Acquired and inborn

Unit 4: Immunotoxicity

Mechanisms of immuno-toxicity, immuno-suppression, direct effects of xenobiotics, indirect effects of xenobiotics, immune mediated diseases, immunotoxicity of lead, imunotixicity of TCDD.

Immunotoxicity in animals: Invertebrate, immunotoxicology, vertebrate immunetoxicology, mammalian immunotoxicology.

Unit 5: Hypersensitivity

Allergy and hyper sensitive reactions: Allergy to chemicals and proteins, respiratory allergy and occupational asthma, chemical allergy, food allergy, drug allergy (Penicillin and Halothane), idiosyncratic reactions and danger hypothesis.

PS01MTOX04: SYSTEMIC AND ENVIRONMENTAL TOXICOLOGY

Unit 1: Basics of organ toxicity

Target organs, Organ selectivity and specificity

Unit 2: Systemic toxicology 1

Cutaneous toxicology- Structure of the skin, Functions of the skin, Dermatological effects of toxic agents, Allergic contact dermatitis, Cutaneous carcinogenesis.

Pulmonary toxicity- Structure of the lung, Lung injury, Systematic lung toxins, Lung pathology Hepatic toxicity- Anatomy and physiology of the liver, Organization of the hepatic parenchyma, Other cell types of the liver, Actions of toxins on the liver, Chronic liver injury

Renal toxicity- Renal structure and functions, susceptibility of kidney to toxic insult, chemically induced renal injury. Cardiotoxicity- Cardiac structure and function, Cardiac contraction, pathology of cardiac toxicity, mechanisms of cardiotoxicity

Unit 3: Systemic toxicology 2

Neurotoxicity- Cell types in the nervous system, Effect of toxic agents on neurons, axonopathy, myelinopathies, Ion channel neurotoxins, Convulsants, Lesions of specific neurons

Reproductive and endocrine toxicity – Teratogenicity, Reproductive organs, Chemicals affecting reproduction, General idea of endocrine glands, Toxicity to adrenal glands, Thyroid glands and Pancreas.

Unit 4: Environmental pollution

Sources and types of pollution, Important pollution events, Priority pollutants

Examples of ecotoxicology, Scientific approach to ecotoxicology, Entry, movement, and fate of pollutants in ecosystems, Air pollution- Classification and properties of air pollutants, Behaviour and fate of air pollutants, Photochemical smog, Acid Rain, health effects of air pollution

Unit 5: Water pollution, land pollution and radio active pollution

Origin of Wastewater, Domestic Water Pollution, Industrial water pollution, Agricultural water pollution, Toxic water pollutants and their health effects, Groundwater pollution, marine pollution. Noise pollution- Sources of noise pollution, Industrial noise pollution, domestic noise pollution, traffic noise, other sources of noise pollution, Effects of noise pollution in man

Sources of exposure to radiation, Biological effects of radiation, Famous accidents of radioactive pollution. Solid waste pollution- Sources and classification, Public health aspects

Heavy metal contamination, Industrial soil pollutants, agricultural soil pollution, petroleum products as soil pollutants

PS01MTOX05 : INSTRUMENTATION IN TOXICOLOGY

Unit 1: Centrifugation

Principles of centrifugation, Types of centrifuges, ultracentrifugation, Applications of centrifugation.

Unit 2: Spectrophotometry

Beer-Lambert relationship, Instrumentation, Applications of spectrophotometry, Atomic absorption spectrophotometry. Radiological techniques- Radioimmuno assay (RIA), ELISA- competitive ELISA, indirect ELISA, sandwich ELISA, applications of ELISA

Unit 3: Chromatography

Adsorption chromatography, thin layer chromatography, Paper chromatography, High performance liquid chromatography (HPLC), Gas- liquid chromatography their applications. Electrophoresis- Introduction to electrophoresis, Instrumentation,

Unit 4: Electrophoresis

Protein electrophoresis, Electrophoresis of enzymes, Isoelectric focusing, Isotachophoresis, Southern, northern & western blotting

Unit 5: Microscopy

Components of microscope and their function

Types of microscope and their special use

M.Sc. Toxicology part 2 (Second year)

PS02MTOX01: BIOCHEMICAL AND MOLECULAR TOXICOLOGY

Unit 1: Interrelationships in macromolecular synthesis

A brief idea of cellular macromolecules, covalent adducts to macromolecules, cellular heterogeneity within the tissues, interrelationships in the synthesis of macromolecules.

Unit 2: Effect of toxins on macromolecules

DNA synthesis, modification of DNA metabolism by toxicants, toxicological consequences of DNA alkylation, RNA synthesis, modification of RNA metabolism by toxicants.

Proteins synthesis, modification and inactivation of proteins, modification of protein metabolism by toxicants. Introduction to gene expression changes, toxicogenomics, toxicoproteomics and metabolonomics.

Unit 3: Necrosis and apoptosis

Mechanisms of necrosis, Mechanisms of Apoptosis. Mechanisms of toxicity-I – Delivery, Absorption, Distribution and Excretion of xenobiotics. Reaction of toxicants with target molecules, Cellular dys-repair and repair mechanisms

Unit 4: Oxidative stress and Lipid peroxidation

Introduction to the process of lipid peroxidation, ROS & RNS, Mechanism of reactive oxygen species production and their role

Definition of oxidative stress, Toxicological consequences of oxidative stress, Oxidative stress and protein damage, Oxidative stress and DNA damage, Oxidative stress and lipid damage, Antioxidativedefence mechanisms- Enzymatic and Non enzymatic antioxidants, Role of glutathione, Superoxide dismutase, Metallothionein and α-tocopherol as antioxidants

Unit 5: Calcium and disruption of cellular energy production

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

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

PS02MTOX02 : TOXICOLOGY OF HEAVY METALS AND APPLIED TOXICOLOGY

Unit 1: Trace elements toxicity

Introduction to Bioinorganic Chemistry, Definition of trace element, Nutritionally required trace elements, Non-nutritive trace elements as environmental contaminants

Toxicity of trace elements- Iodine, iron, zinc, copper, manganese, selenium, molybdenum, and cobalt

Unit 2: Heavy metal toxicity

Mechanisms of heavy metal toxicity- Induction of metallothionein, heat shock proteins, cyto skeletal effects, heamporphyrin metabolism, lipid peroxidation

Cyto-toxicity of heavy metals- Cadmium, mercury, arsenic, chromium and lead. Metal protein interaction, metal nucleic acid interactions

Carcinogenicity and genotoxicity of heavy metals, arsenic & chromium. Metal- Ligand interactions in biological fluids, metal ion interactions with macromolecules

Unit 3: Regulatory and cosmetic toxicology

Regulatory toxicology, Regulatory agencies, Regulation of Industrial chemicals in USA and EU, Regulation of pesticides, regulation of pharmaceuticals, regulation of food additives

Cosmetic toxicology- Toxicity of shampoos, conditioners, bleachers, dyes, allergic and respiratory disorders.

Unit 4: Wildlife toxicology and laboratory animal care

Susceptibility of wildlife to chemicals, Acute ecological hazards, Toxicology of chemicals in birds and mammals, Integrated approach to wildlife toxicology. Veterinary toxicology- Common toxicity in dogs, cats, horses and poultry, by herbicides, house hold chemicals, heavy metals, mycotoxins, blue green algae and toxic plants

Animal environment, Animal husbandry, Animal care & maintenance accreditation, CPCSEA

Unit 5: Medical toxicology and Toxicology of chemical warfare agents

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

Chemical weapons, classification of chemical warfare agents, mustard gas, lewisite, nerve agents, hydrogencyanide, management of chemical warfare agents. Preventive toxicology- Bioremediation, Toxic site reclamation, prevention of occupational diseases

PS02MTOX03 : BIOSTATESTICS AND BIOINFORMATICS

Unit 1: Biostatistics 1

General principles of biostatistics- Bias and Chance hypotheses testing, improbability, multiple comparisons. Sample size, Experimental designing, control v/s treatment results, robustness and significance

Unit 2: Biostatistics 2

Statistical calculations of acute toxicity, chronic toxicity, mortality, body weight, organ weight and histopathological findings. Statistical analysis- Statistical methods, SD, SE, t-test, one way ANOVA, Two way ANOVA

Unit 3: Basics of computer and data handling

Brief introduction to Computers- Computer education, e-mail and internet based learning

Databases in toxicology, Databanks, the internet and organizational resources in toxicology

Unit 4: Bioinformatics and molecular techniques

Introduction to bioinformatics- Applications of bioinformatics, Molecular biology and bioinformatics, Toxicology and bioinformatics

Unit 5: Genomics and Proteomics

Genome analysis, gene mapping and toxico-genomics, Introduction to proteomics, metabolonomics and drug discovery

PS02MTOX04 : TOXICOLOGY OF PESTICIDES AND INSECTICIDES AND CARCINOGENS

Unit 1: Introduction to pesticides

General classification of pesticides, herbicides fungicides, insecticides, pesticides in the environment, bio-magnification of pesticides

Reproductive & developmental effects, carcinogenicity, immunological effects

Unit 2: Environmental problems and case study

Environmental problems by organochlorine pesticides- Case studies of DDT, endosulphan, benzene hexachloride (Lindane), Environmental problems by organophosphate pesticides- Case studies of parathion, and malathion

Unit 3: Toxicity of food additives

Toxicity of food additives- Polycyclic hydrocarbons, Hydrocyclic amines, Nitrosoamines, Natural contaminants, Synthetic carcinogens

Unit 4: Neurotoxicity of pesticides and case study

Neuropathy, Toxicity of pesticides in fish, birds, poultry, wild animals, bioindicators of pesticide exposure

Toxicity of pesticides in man- Case studies, Handigodu syndrome, BHC poisoning in Turkey

Unit 5: Carcinogens and carcinogenesis

Mechanism of chemical carcinogenesis- Role of somatic mutation, Initiation and Promotion, Proliferation, The Miller and Miller theory

Human inorganic carcinogens- Arsenic, asbestos and chromium mechanism of their actions

Organic carcinogenesis- Polycyclic hydrocarbons, Polycyclic aromatic hydrocarbons, Alkalyting carcinogens, N-nitroso compounds mechanism of their actions

Target Oncogenes in Chemical carcinogenesis, Persistence of DNA, damage in relation to carcinogenesis, Assay of chemical carcinogens in mammalian systems, transgenic animal models in carcinogenesis, AMES test

PS02MTOX05 : OCCUPATIONAL AND INDUSTRIAL TOXICOLOGY

Unit 1: Occupational hazards

General principles of solvent toxicity- Nature of toxic effects, neuro toxic effects, Hepato toxic effects, Reno toxic effects, Metabolism of organic solvents- Enzyme induction and metabolic interactions

Toxicity of aliphatic solvents- Carbon tetrachloride, chloroform, trichloroethylene, tetrachloroethylene

Toxicity of aromatic hydro carbons- Benzene, Toluene, Xylene, Styrene

Toxicity of alcohols- Ethyl alcohol, Methyl alcohol, Isopropyl alcohol Physical hazards, Chemical hazards, Biological hazards, Mechanical hazards, Psychosocial hazards

Unit 2: Occupational diseases

Pneumoconiosis, silicosis, asbestosis, anthracosis, byssinosis, bagassosis, Farmers' lung. Occupational Cancer- Skin cancer, Lung cancer, Bladder cancer, Leukemia

Unit 3: Prevention of occupational diseases

Medical measures, Engineering measures, Legislative measures, Occupational health in India

Unit 4: Industrial toxicology

History and basic features, Industrial hygiene

Risk assessment – Risk assessment for industrial chemicals in EU, OECD and USA, Risk management of industrial chemicals. I

Unit 5: Industrial hygiene and biological monitoring

Concepts of Industrial hygiene, TLV, MAK, OES, ACGIH, OSHA etc.

Biological monitoring of industrial solvents and metals, pesticides

PS02MTOX06 Practicals based on above mentioned subjects