**P.G. Diploma in Toxicology**

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

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| --- | --- | --- | --- | --- |
| **Course code** | **Name of Paper** | **Marks** | **Total** | **Exam Duration** |
| **Internal** | **External**  |
| DTOX-101 | Human anatomy and physiology  | 20 | 80 | 100 | 3 hours |
| DTOX-102 | Biochemical toxicology and chemical carcinogens  | 20 | 80 | 100 | 3 hours |
| DTOX-103 | Principles of toxicology and systemic toxicology | 20 | 80 | 100 | 3 hours |
| DTOX-104 | Occupational and experimental toxicology  | 20 | 80 | 100 | 3 hours |
| DTOX-105 | Environmental toxicology, toxicology of pesticides  | 20 | 80 | 100 | 3 hours |
|  | Practicals and viva voce | 60\* | 240\*\* | 300 | 3 days\*\*\* |
|  | **Total** | **160** | **640** | **800** |  |

\*Internal 20 marks for each practicals

\*\* External 80 marks for each practicals

\*\*\* One day for each Paper DTOX101, DTOX 102+ DTOX 103 and DTOX 104+ DTOX 105

**DTOX-101: Human Anatomy AND PHYSIOLOGY**

**Unit 1: Basic and systemic anatomy**

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

Elementary system, Uro-genital system, Micro - Anatomy (cartilage, bone, nerve, muscle) Cardio - vascular [including Lymphatic], Respiratory Sensory organs, Endocrine glands, Neuro Anatomy, Basics of CNS, Basics of peripheral nervous system

**Unit 2: Introduction of physiology**

General Physiology, Structure of cell membrane, Transport across cell membrane and Homeostasis; Nervous System and Special Senses, Neuron and Neuroglia, Properties of nerve fiber, Reflex mechanism and Receptors, Mechanism of vision and hearing, Taste and smell

**Unit 3:** **Blood and Muscle Physiology**

Composition & Function of Blood o Erythropoiesis and Leucopoiesis o Hemostasis r Action potential and mechanism of Muscle contraction o Neuro-muscular junction

**Unit 4: Systemic physiology**

Digestive System and Excretory System, Movement and Alimentary tract. Mechanism of Urine formation, Endocrinology and Reproductive System, Spermatogenesis and Menstrual cycle

**Unit 5: Cardiovascular and Respiratory System**

Heart rate and sound of Blood pressure, Cardiac cycle and output, Mechanism of breathing, Oxygen and Carbon dioxide Transport

**DTOX-102: Biochemical Toxicology and CHEMICAL CARCINOGENS**

**Unit1: Introduction of cell organelles and nucleus**

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

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

**Unit 2: 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 3: Study of biological macromolecules and enzymes**

Classification and biological role of carbohydrates, proteins, lipids and nucleic acids

Minerals and vitamins (RDA, sources, biological role, diseases in brief)

Classification of enzymes and clinical enzymology

**Unit 4: Biochemical toxicity 1**

Lipid peroxidation – Introduction to the process of lipid peroxidation, ROS & RNS, Mechanism of reactive oxygen species production, The key role of super oxide anion radical, Hydrogen peroxide and hydroxyl radicals in toxicity of xenobiotics

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, Antioxidative defence mechanisms- Enzymatic and Non enzymatic antioxidants, Role of glutathione, Superoxide dismutase, Metallothionein and α-tocopherol as antioxidants

**Unit 5: Biochemical toxicity 2**

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

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

Mechanism of chemical carcinogenesis- Role of somatic mutation, Initiation and Promotion, Proliferation, 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, Oncogenes

**DTOX-103: PRINCIPLES OF TOXICOLOGY AND SYSTEMIC TOXICOLOGY**

**Unit 1: Introduction to toxicology**

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

Absorption and distribution of toxicants-portals of entry-skin, gastro intestinal tract, gills and respiratory system. Bio-distribution, biomagnification 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 2: Systemic toxicology**

Basics of organ toxicity- Target organs, Organ selectivity and specificity,

Cutaneous toxicology- Dermatological effects of toxic agents, Allergic contact dermatitis, Cutaneous carcinogenesis. Pulmonary toxicity- Lung injury, Systematic lung toxins, Lung pathology, Hepatic toxicity- Actions of toxins on the liver, Chronic liver injury, Renal toxicity- susceptibility of kidney to toxic insult, chemically induced renal injury, Cardiotoxicity- pathology of cardiac toxicity, mechanisms of cardiotoxicity, Neurotoxicity- 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, Toxicity to adrenal glands, Thyroid glands and Pancreas.

**Unit 3: Regulatory toxicology and cosmetic toxicology**

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

Toxicity of shampoos, conditioners, bleachers, dyes, allergic and respiratory disorders

**Unit 4: Wildlife toxicology and Medical toxicology**

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

**Unit 5: Toxicology of chemical warfare agents**

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

**DTOX-104: OCCUPATIONAL AND EXPERIMENTAL TOXICOLOGY**

**Unit 1: Occupational hazards and diseases**

Physical hazards, Chemical hazards, Biological hazards, Mechanical hazards, Psychosocial hazards

Occupational diseases- Pneumoconiosis, silicosis, asbestosis, anthracosis, byssinosis, bagassosis, Farmers’ lung. Occupational Cancer- Skin cancer, Lung cancer, Bladder cancer, Leukaemia

Prevention of occupational diseases- Medical measures, Engineering measures, Legislative measures, Occupational health in India

**Unit 2: Experimental toxicology 1**

Laboratory animals- Animal environment, Animal husbandry, Animal care &maintenance accredition, CPCSEA, Centrifugation- Principles of centrifugation, Types of centrifuges, Spectophotometry- 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: Experimental toxicology 2**

Chromatography- Adsorption chromatography, thin layer chromatography, Paper chromatography, High performance liquid chromatography (HPLC), Gas- liquid chromatography their applications. Electrophoresis- Introduction to electrophoresis, Instrumentation, Electrophoresis of proteins, Electrophoresis of enzymes, Isoelectric focusing, Isotachophoresis, Southern, northern & western blotting

**Unit 4: Biostatistics**

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

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 5: Bioinformatics**

Introduction to bioinformatics- Applications of bioinformatics, Molecular biology and bioinformatics, Toxicology and bioinformatics, toxico-genomics, Introduction to proteomics.

**DTOX-105: environmental toxicology, Toxicology of pesticides**

**Unit 1: Environmental pollution and ecotoxicology**

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 2: Water pollution and Noise pollution**

Origin of Wastewater, Domestic Water Pollution, Industrial water pollution, Agricultural water pollution, Toxic water pollutants and their health effects, Groundwater pollution, marine pollution.

Sources of noise pollution, Industrial noise pollution, domestic noise pollution, traffic noise, other sources of noise pollution, Effects of noise pollution in man

**Unit 3:** **Toxicology of heavy metal and radioactive pollution**

Introduction to Bioinorganic Chemistry, Definition of trace element, Nutritionally required trace elements, Non-nutritive trace elements as environmental contaminants, Mechanisms of heavy metal toxicity- Induction of metallothionein, heat shock proteins, cyto skeletal effects, heamporphyrin metabolism, lipid peroxidation

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

Sources of exposure to radiation, Biological effects of radiation, Famous accidents of radioactive pollution.

**Unit 4: Introduction to pesticides and its toxicity**

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

Fundamentals of pesticide toxicity- Reproductive & developmental effects, carcinogenicity, immunological effects

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 5: Pesticide toxicity on biological system**

Neurotoxicity of pesticides- 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

**Practicals based on DTOX-101, DTOX-102+ DTOX-103, DTOX-104+ DTOX-105**