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CH. CHARAN SINGH UNIVERSITY, MEERUT

चौ० चरण सिंह विश्वविद्यालय, मेरठ



**Revised Syllabus for M.Sc.
Toxicology/B.Sc. in Research or
Honors' Under NEP-2020**

w.e.f. July 2022

Modules (Compulsory Courses)

Ist Semester

1. Principles of toxicology
2. Environmental Toxicology
3. Systemic Toxicology
4. Cellular and molecular toxicology

Project/Practical exercises based on the above courses

IInd Semester

5. Immunotoxicology
6. Biochemical Toxicology
7. Chemical carcinogenesis
8. Occupational and industrial toxicology

Project/Practical exercises based on the above courses

IIIrd Semester

9. Toxicology of heavy metals
10. Toxicology of pesticides
11. Toxicology of organic solvents
12. Regulatory toxicology

Project/Practical exercises based on the above courses

IV Semester

13. Tools and techniques in toxicology
14. Applied toxicology
15. Forensic Toxicology
16. Experimental design and Biostatistics

Research Project: Students of fourth semester of M.Sc., a research project report to be submitted and presented in department as oral presentation in the presence of external examiner.

All students may be asked to take up one of the open elective as MOOC's of SWAYAM during the 2 year course of PG, which will be treated equally as one of the open electives out of the best 3.

Covered in several modules are-

Non clinical safety

Nutritional Toxicology

Occupational Health

In vitro toxicology

Risk assessment and risk management

Requirements for completion

Successful attendance in each semester and respective modules

Documentation of practical training

A dissertation on research project as prescribed by NEP

Passing marks at each examination (theory and practical both) conducted by the University

Medium of instructions - English

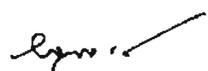

(M.K. Gupta)


(S.V.S. Rana)


(P.K. Singh)


(P. J. John)


(Sandeep Mittal)


(Yeshvandra Verma)

PROGRAMME OUTCOMES (PO's)

In view of the increasing demand of competent Toxicologists, this four semester (two year) degree program has been designed to train the student with different fields of Toxicology as Environmental toxicology, Forensic Toxicology, Applied Toxicology, Occupational and Industrial Toxicology and Regulatory Toxicology. In all the semesters, the students also have the option to elect an open elective course provided/offered by the University in various departments. Besides two Electives, the student will also have a choice of two optional open electives which he can study in any of the regular Departments of University Campus. The course contents are designed in such a way that the student may either pursue his career as an academician/researcher in government organizations or regulatory agencies in India and abroad. There are various industries in private sector viz pharmaceutical industry, food industry, environmental pollution control agencies/departments quality control industries, regulatory agencies who are always in demand of toxicologists.

PROGRAMME SPECIFIC OUTCOMES (PSO's)

Toxicology as a regular course at CCS University, Meerut was established in 2004 with the support from University Grants Commission, New Delhi. Foundation of the course was supported by CCS University, Meerut. About 200 students so far have attended the course and many of them hold important positions in India and overseas. Toxicology is the science of chemical safety. Aim and mission of Toxicology is to identify potential harmful effects of chemical compounds to humans, animals and the environment and to provide for their prevention and treatment. Appropriate experimentation and expert judgment allows to minimize the probability of the occurrence of adverse effects, which in the past have sometimes been of catastrophic dimension. Toxicology is a multidisciplinary science based upon physiology, biochemistry, molecular biology, chemistry, pharmacology, pathology, epidemiology and several others.

It is expected that a student after successfully completing the programme (M.Sc. Toxicology) would be equipped to dwell deeper to generate knowledge as researcher, understand the advances in toxicological techniques and application and the knowledge based decision making. This program has a strong theoretical and practical focus with an emphasis on applications, directly related to employment of the students. The students who undergo this program are able to understand the challenges, problems & issues pertaining to analyze policies and programs of government and to develop appropriate practical skills suitable for medical/ industrial needs as well as NGOs, employment opportunities. The students of Toxicology can participate and succeed in competitive examinations namely; Academician, State Government Services, UGC-JRF/NET etc. and he or she can also pursue higher research degrees i.e. PhD in Toxicology. On the successful completion of the Program, the student should be able to bear the skills to the analysis of a wide range of theoretical and applied aspects in Toxicology and to the understanding of solution of many problems in medical science, pharmacological science, food science and health. This program will employment opportunities in India and abroad.

Course Outcome:

In view of the increasing demand of competent toxicologists, this four semester (two year) course of M.Sc. (Toxicology) has been designed to train the students in applied aspects of toxicology. The course contents are designed in such a way that the student may either pursue his career as an academician and researcher to secure jobs in pharmaceutical industry, food industry, agricultural sector, environmental pollution control departments and quality control industries etc. We aim to give a significant level of theoretical and practical understanding of each course. After theoretical/practical aspects, students go to 4-6 month summer training in national laboratories of repute or in other research institutes engaged in high quality research in toxicology or in industries based on toxicology. Course wise outcome is as follows:

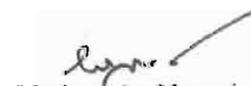

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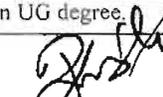

(Yeshvardra Verma)

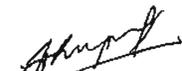
Course- 1

Programme/Class: B.Sc. in Research or Hounors/M.Sc.	Year: Fourth	Semester: VII
Subject: Toxicology		
Course Code: CH-1582	Course Title: Principles of Toxicology	(Theory/Practical)
Course outcomes: At the end of this course the student will be able to: understand the different principles of toxicology, different chemicals properties and toxicity, poisons, toxicity mechanisms, their prevention aspects, case studies etc.		
Credits: 4		Course: Compulsory
Max. Marks: as per university rules		Min. Passing Marks: as per university rule
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4.5-6-10		
Unit	Topics	No. of Lectures Total(60)
I	(a) Introduction, definition, brief history, scope and sub-divisions of toxicology (b) Classification of toxins, natural toxins, animal toxins, plant toxins, food toxins, genetic poisons and chemical toxins	15
II	(a) Basic concepts- Dose and dose response relationship, types of toxic effects (allergic reactions, idiosyncratic reactions, reversible and irreversible effects, acute toxicity, sub acute toxicity, sub chronic effects and chronic effects) (b) Factors affecting toxicity- Species and strain, age, sex, nutritional status, hormones, circadian rhythms and environmental factors	15
III	Absorption and distribution of toxins, portals of entry- Skin, gastrointestinal tract, gills and respiratory system	15
IV	(a) Concept of toxicokinetics and toxicodynamics (b) ADME, bioaccumulation, biotransformation and biomagnifications, antagonism, synergism	15
Suggested Readings: 1. Casarett & Doull's Toxicology- The basic science of poisons by Curtis Klaassen, McGraw Hill 2. Selective Toxicity, Albert A., Methuen, London 3. Environmental Pollution-Health and Toxicology by Rana, S.V.S. Narosa Publishing House, Delhi 4. Food and Nutrition toxicology by Stanley T. Omaye, CRC Press 5. Principles of toxicology, Chichester Weinheim, New York 6. Principles of Biochemical Toxicology By John Timbrell, Taylor and Francis 7. Dictionary of toxicology by E.Hodgson , M.Roe , Academic Press 8. Handbook of Toxicology, by Derelanko, CRC Press		
Suggested Continuous Evaluation Methods: Written assignment/Presentation/Term Paper/Seminar/Quizes		
Course prerequisites: To study this course, a student must have had the subject Bio group in UG degree.		

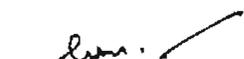

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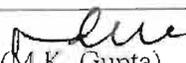

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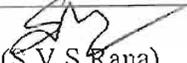

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Programme/Class: B.Sc. in Research or Hounors/M.Sc.	Year: Fourth	Semester: VII
Subject: Toxicology		
Course Code: CH-1583	Course Title: Environmental Toxicology	(Theory/Practical)
Course outcomes: At the end of this course the student will be able to: understand the different chemicals of domestic, industrial and agricultural practices their environmental persistence, biomagnifications in ecosystems, ecotoxicology. This course includes different types of pollutions as Air, water, soil, radioactive pollution, Bio medical wastes. Different waste decomposing techniques etc.		
Credits: 4		Course: Compulsory
Max. Marks: as per university rule		Min. Passing Marks: as per university rule
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4.5-6-10		
Unit	Topics	No. of Lectures Total (60)
I	(a) Ecotoxicological episodes, entry, fate, movement of pollutants in ecosystems, scientific approach to ecotoxicology (b) Air pollution- Classification and properties of air pollutants, Behaviour and fate of air pollutants, photochemical smog, acid rain, health effects of air pollutants in man.	15
II	(a) Water pollution- Origin of Wastewater, Types of water pollution (domestic, Industrial, agricultural, solid waste, thermal and oil pollution). (b) Toxic water pollutants and their health effects, ground water pollution, health effects of marine pollution, case studies.	15
III	(a) Radioactive pollution- Sources of radioactive pollution, health effects of radiation, famous incidents of radioactive pollution (b) Solid waste pollution, Classification of solid waste, E-waste, biomedical waste, Public health aspects of solid waste pollution	15
IV	(a) Soil and land pollution- Soil acidification, Salinization, sodification, industrial soil pollution, soil pollution by petro-products (b) Noise pollution- Sources of noise pollution, domestic noise pollution, traffic noise, other sources of noise pollution, and health effects of noise pollution	15
Suggested Readings:		
<ol style="list-style-type: none"> General and applied Toxicology by Ballantyne, T. Marrs, T. Syversen (Volume-II), Macmillan, UK Fundamentals of Ecotoxicology by Nowman and Michael, CRC Press, Tylore & Francis Groups Environmental toxicology by J. Rose., Gordon and Breach Science Publishers. Environmental Pollution, health and Toxicology by Rana, S.V.S., Narosa, New Delhi Environmental toxicology and Chemistry by D.G. Crosby, Oxford university Press, UK Environmental Toxicology: Biological and health effects by Yu Ming Ho et al, CRC Press. 		
Suggested Continuous Evaluation Methods: Written assignment/Presentation/Term Paper/Seminar/Quizes		
Course prerequisites: To study this course, a student must have had the subject bio group in UG degree.		

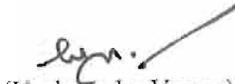

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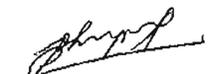
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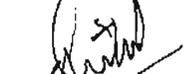
Programme/Class: B.Sc. in Research or Hounors/M.Sc.	Year: Fourth	Semester: VII
Subject: Toxicology		
Course Code: CH-1584	Course Title: Systemic Toxicology	(Theory/Practical)
<p>Course outcomes: At the end of this course the student will be able to: understand the body systems against toxic occupational, industrial and domestic chemicals, poisons, environmental pollutants. Body defends itself and performs the function of detoxification by vital organs of Respiratory, circulatory, digestive and excretory systems.</p>		
Credits: Marks	Course: Compulsory	
Max. Marks: as per university rule	Min. Passing Marks: as per university rule	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4.5-6-10		
Unit	Topics	No. of Lectures Total (60)
I	(a) Cutaneous toxicity- Skin as a barrier against toxins, dermatitis (irritant dermatitis, allergic dermatitis, chemical burns), pigmentary disturbances, phototoxicity, skin cancer by radiation, arsenic and PAH (b) Pulmonary toxicity- Mechanisms of lung injury, mechanism of gaseous exchange in lungs, oxidative burdoon, agents that cause lung injury, acute and chronic responses during lung injury (airway reactivity, pulmonary edema, fibrosis, emphysema, asthma and lung cancer.	15
II	(a) Hepatototoxicity- mechanisms of liver injury, case studies pertaining to carbon tetrachloride and acetaminophen, types of liver injury (fatty liver, cholestasis, bile duct damage, sinusoidal damage, liver cell death- necrosis and cirrhosis, Liver tumors) (a) Renal toxicity- mechanisms of renal injury, specific nephrotoxins (heavy metals, halogenated hydrocarbons, therapeutic agents), nephropathy.	15
III	(a) Neurotoxicity- neurotoxins, neuropathy by methyl mercury, axonopathy by carbon disulfide and myleinopathy by lead, neurotoxicity by nicotine, cocaine and amphetamines. (b) Cardiotoxicity- cardiotoxins (alcohol, centrally acting drugs, steroids and solvents), disturbances in cardiac functions, and general mechanisms of cardiotoxicity.	15
IV	(a) Reproductive toxicity- Gonadotoxic agents, mechanisms of reproductive toxicity, effects of toxins on spermatogenesis and oogenesis, gonadal tumorogenesis. (b) Endocrinal toxicity- endocrine toxins and mechanisms of their toxicity in pituitary, thyroid, adrenal endocrinal disruption by bisphenol A.	15
<p>Suggested Readings:</p> <ol style="list-style-type: none"> 1. General and applied Toxicology by Ballantyne, T. Marrs, T. Syversen (Volume-II), Macmillan, UK 2. Comprehensive Toxicology. Vol.6-II (In Sipes, I.G., McQueen, C.A. and Gandolfi, A.J., Pergamon Press Oxford. 3. Toxicology by Hans Marquardt et al. Academic Press. 4. Toxicology of Skin by Maiback, Taylor and Francis, informa healthcare 5. Dermatotoxicology by H. Zhai and H.I. Maibach, CRC Press 6. General Applied and Systems Toxicology, Wiley Science 7. Hepatototoxicity: The adverse effects of drugs and other chemicals on the liver by Hyman J. Zimmerman, Lippincott Williams and Wilkins 8. Endocrine and Hormonal Toxicology by P.W. Harvey 9. Endocrinal disruptors by Naz, R.K., CRC Press 		
<p>Suggested Continuous Evaluation Methods: Written assignment/Presentation/Term Paper/Seminar/Quizes</p>		
<p>Course prerequisites: To study this course, a student must have had the subject Bio group, in UG degree.</p>		

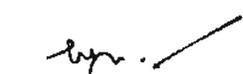

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Programme/Class: B.Sc. in Research or Hounors/M.Sc.	Year: Fourth	Semester: VII
Subject: Toxicology		
Course Code: CH-1585	Course Title: Cell and Molecular Toxicology	(Theory/Practical)
Course outcomes: At the end of this course the student will be able to: understand the knowledge about cellular and molecular toxicity. The chemicals which cause toxicity in genetic material of cell and affect gene expression.		
Credits: 4	Course: Compulsory	
Max. Marks: as per university rules	Min. Passing Marks: as per university rule	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4.5-6-10		
Unit	Topics	No. of Lectures Total (60)
I	Effects of toxins on plasma membrane, passive transport, active transport, diffusion, membrane fluidity.	15
II	(a) Effects of toxins on endoplasmic reticulum- ER enzymes, effects of toxins on ER enzymes/proteins (b) Effects of toxins on mitochondria- mitochondrial membrane permeability, electron transport disturbances, oxidative injury to mitochondria, Apoptosis	15
III	(a) Apoptosis, DNA fragmentation, caspases (b) Effects of toxins on Microsomes and peroxisomes- Microsomal induction by chemicals (alcohol, PB), peroxisomal proliferation by toxins, microsomal enzymes, peroxisomal enzymes and their role in cell injury / death	15
IV	Effects of toxins on cytoskeleton-Effects of toxins on actin filaments (microfilaments), intermediate filaments, cilia & flagella.	15
Suggested Readings:		
<ol style="list-style-type: none"> 1. Cell and molecular biology: Concepts and experiments by G.Karp, Wiley 2. Molecular biology of the cell by B. Alberts , A.Johnson et al., Garland Science, T&F Group 3. General and applied Toxicology by Ballantyne, T. Marrs, T. Syversen (Volume-II),Macmillan, UK 4. Handbook of Toxicological pathology by W.M. Haschek, C.G. Rousseaux, M.A. Walling.,(Volume-I), Academic Press 		
Suggested Continuous Evaluation Methods: Written assignment/Presentation/Term Paper/Seminar/Quizes		
Course prerequisites: To study this course, a student must have had the subject bio group in UG degree.		

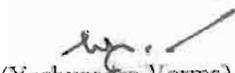

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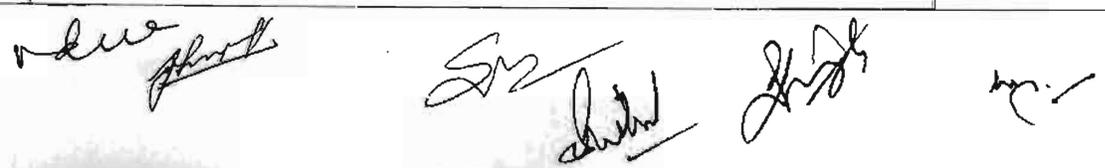

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Practical

Programme/Class: B.Sc. in Research or Honours/M.Sc.		Year: Fourth	Semester: VII
Subject: Toxicology			
Course Code: CH-1587	Course Title: Practical (as per based on all theory papers)		(Practical)
Course outcomes: At the end of this course the student will be able to: understand the knowledge about different poisonous animals and toxic chemicals which cause toxicity in humans and animals.			
Credits: 4		Course: Compulsory	
Max. Marks: as per university rules		Min. Passing Marks: as per university rule	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4.5-6-10			
	Topics		No. of Practical Hours
1	Qualitative Tests for the following drugs/ chemicals in suitable samples: (i) Salicylic acid (ii) Trichloro compounds including chloral hydrate, chloroform, dichlorophenazone, trichloroethylene (iii) Paracetamol/acetaminophen (iv) Imipramine (v) Iron (ferric/ ferrous)		10
2	Environmental analysis: (i) Testing of polluted water for the following parameters: Conductivity, pH, Temperature, Turbidity (ii) Determination of noise level (iii) Determination of light intensity (iv) Determination of RSPM		10
3	Blood/ Urine analysis: (i) Urine analysis for specific gravity (ii) Urine analysis for uric acid (iii) Urine analysis for creatinine (iv) Blood analysis for glucose (v) Blood analysis for haemoglobin		10
4	Instrument Demonstration: pH meter, Colorimeter, Noise level meter, Refractometer, Water analyzer, Sound meter, Lux meter, Haemometer, Micropipette, High volume air sampler		10
	Spotting: Based on all theory papers (i) Histological/ Histopathological slides of mammals: T.S. of Liver, Kidney, Lung, Adrenal gland, Ovary, Testis, Stomach, Skin, Thyroid gland, Pancreas, Blood, Trachea Sting of honey bee/ wasp Liver (Necrosis), Liver (Apoptosis) Testis (Necrosis), Ovary (Apoptosis) (ii) Ultrastructure of cell organelles: Mitochondria, Golgi bodies, Nucleus, Nucleolus, RER, SER, Vesicles (iii) Poisonous animals/ specimens: Sting Ray, Lion fish, Zebra fish, Puffer fish, Physalia, Metridium, Aurelia, Cucumeria (Sea Cucumber), Cobra (Naja Naja), Viper, Heloderma (Gila monster), Octopus, Spider Crab, Neries, Scolopendra, Wasp, Ticks & Mites, Millipede, Scorpion, Coleoptera		10
6	Neurotoxicity		10



7	Viva – voce	
8	Practical Records of the Semester	

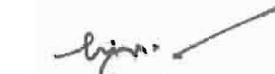

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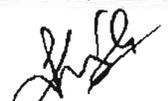

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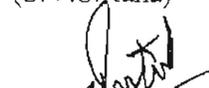
Programme/Class: M.Sc.		Year: Fourth	Semester: VIII
Subject: Toxicology			
Course Code: CH-2582		Course Title: Immunotoxicology	(Theory/Practical)
Course outcomes: At the end of this course the student will be able to: understand the knowledge of immune system of body and effects of chemicals and poisons on immune system.			
Credits: 4		Course: Compulsory	
Max. Marks: as per university rules		Min. Passing Marks: as per university rule	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4.5-6-10			
Unit	Topics		No. of Lectures Total (60)
I	(a)	The immune system (i) – innate immunity, components of immune system (NK, PMN, Macrophage), soluble factors, acute phase proteins and complements	15
	(b)	The immune system (ii) - Acquired- general aspects, cellular components –APCs, T-cells, B- cells, Humoral and cell mediated immunity.	
II	(a)	Structure and functions of primary and secondary lymphoid organs (bone marrow, thymus, spleen), immunoglobulins.	15
	(b)	Leukocyte toxicity- Components of leukocytes, toxic effects on granulocytes, neutropenia, human leukemia, leukemogenic agents and mechanism of toxic leukemogenesis.	
III	(a)	Immunotoxicity- Immunomodulation by xenobiotics.	15
	(b)	immunosuppression, examples of immunosuppression- tobacco smoke and UV- radiation. Immunotoxicity of lead and TCDD. Immune mediated diseases (hypersensitivity and autoimmunity).	
IV	(a)	Animal models in immunotoxicology, immunotoxicity testing,	15
	(b)	Evaluation of mechanisms of action of immunotoxicants, health effects and test guidelines.	
Suggested Readings: <ol style="list-style-type: none"> Blood: Principles and practice of hematology, by Handlin, R.I., Lux, S.E., and Stossel, T.P., Lippincott Williams and Wilkins, Philadelphia Toxicology of hematopoietic system & Tox. of Immune system, Vol.4 &5. by Bloom, J.C. (In Sipes, I.G., McQueen, C.A. and Gandolfi, A.J., Comprehensive Toxicology. Pergamon Press Oxford. Fundamental Immunology by Paul, W.E., Reven Press New York Toxicology of immune system, Vol. 5. by Lawrence, In Sipes, I.G., McQueen, C.A. and Gandolfi, A.J., Comprehensive Toxicology. Pergamon Press Oxford. Methods in immunotoxicology by Burlson Gary, Wiley. Liss Mechanistic toxicology by Boelsterli, Urs A. Boelsterli, CRC Press. Immunology, the immune system in health and diseases by C.A. Janeway, Garland publishing, London 			
Suggested Continuous Evaluation Methods: Written assignment/Presentation/Term Paper/Seminar/Quizes			
Course prerequisites: To study this course, a student must have had the subject bio group in UG degree.			

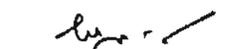

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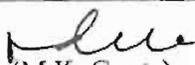

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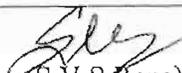

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Programme/Class: M.Sc.	Year: Fourth	Semester: VIII
Subject: Toxicology		
Course Code: CH-2583	Course Title: Biochemical Toxicology	(Theory/Practical)
Course outcomes: At the end of this course the student will be able to: understand the knowledge of effects of chemicals, xenobiotics and poisons on biochemical system of body and essential biochemical of body as carbohydrate, protein and fats.		
Credits: 4		Course: Compulsory
Max. Marks: as per university rules		Min. Passing Marks: as per university rule
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4.5-6-10		
Unit	Topics	No. of Lectures Total (60)
I	(a) Mechanism of Toxicity- Biotransformation of xenobiotics, phase-I reactions (hydrolysis, reduction, oxidation), activation of xenobiotics by CYP450, (b) Phase –II reactions (glucuronidation, methylation, acetylation, amino acid conjugation, glutathione conjugation) and Phase –III reactions- transport mechanisms	15
II	(a) Lipid peroxidation - Introduction of LPO, Types of reactive species, mechanism of free radical generation, the role of super oxide anion, hydrogen peroxide, hydroxyl and nitric oxides. (b) Oxidative stress- Definition, toxicological consequences of oxidative stress, oxidative damage to proteins, DNA and lipids. Oxidative stress and disease.	15
III	(a) Antioxidative defence mechanisms- Enzymatic antioxidants (Superoxide dismutase, glutathione peroxidase, catalase) (b) non-enzymatic antioxidants (Vitamin E, Selenium, GSH)	15
IV	(a) Disturbances in calcium homeostasis and cell injury, xenobiotic induced alterations in intracellular calcium distribution, toxicological consequences of increased intracellular calcium concentrations. (b) Energy disturbances- disruption in cellular energy production, mitochondrial targets, protonophoric and uncoupling activity of xenobiotics, inhibition of NADPH production, inhibition of electron transport.	15
Suggested Readings:		
<ol style="list-style-type: none"> Principles of biochemical toxicology by John Timbrell, CRC Press. A text book of modern Toxicology By Ernest Hodgson, Wiley. Introduction to biochemical toxicology by E. Hodgson and R.C.Smart, A John Wiley & Sons, Inc. Publication. Comprehensive Toxicology. Biotransformation. Vol.3. In Sipes, I.G., McQueen, C.A. and Gandolfi, A.J., Pergamon Press Oxford. Casarett & Doull's Toxicology- The basic science of poisons by Curtis Klaassen, McGraw Hill Principles and methods of toxicology by Wallace A. Hayes, CRC Press, Taylor and Francis group. Cytochromes P450: Metabolic and toxicological aspects by Ioannides Costas, CRC Press. 		
Suggested Continuous Evaluation Methods: Written assignment/Presentation/Term Paper/Seminar/Quizes		
Course prerequisites: To study this course, a student must have had the subject Bio group in UG degree.		

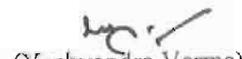

(M.K. Gupta)


(S.V.S. Rana)


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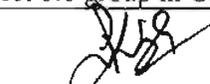

(Sandeep Mittal)


(Yeshvandra Verma)

Programme/Class: M.Sc.	Year: Fourth	Semester: VIII
Subject: Toxicology		
Course Code: CH-2584	Course Title: Chemical Carcinogenesis	(Theory/Practical)
Course outcomes: At the end of this course the student will be able to: understand the chemicals which cause mutation in gene expression which ultimately lead to cancer in different organs.		
Credits: 4	Course: Compulsory	
Max. Marks: as per university rules	Min. Passing Marks: as per university rule	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4.5-6-10		
Unit	Topics	No. of Lectures Total (60)
I	(a) General characteristics of carcinogens, history of chemical carcinogens, organic and inorganic carcinogens, hormonal carcinogens, direct acting carcinogens, procarcinogens, co- carcinogens, epigenetic carcinogens. (b) Introduction to genetic toxicology, mutagenesis and oncogenesis. Chromosomal aberrations, mutation in somatic and germ cells. Oncogenes, tumor suppressor genes.	15
II	(a) Biochemical mechanisms of chemical carcinogenesis- Metabolism of chemical carcinogens, free radicals and chemical carcinogenesis, formation of macromolecular adducts by chemical carcinogens, radiation and carcinogenesis (b) Molecular mechanisms of chemical carcinogenesis- Formation of DNA adduct, DNA damage, repair and disrepair, stages of carcinogenesis (Initiation, promotion, progression), Miller and Miller theory.	15
III	(a) Oncogenes- Viral and cellular oncogenes, oncogene activation by retrovirus, oncogene activation by leukemia virus, target oncogenes in chemical carcinogenesis (b) Organic carcinogens- Polycyclic hydrocarbons, polycyclic aromatic hydrocarbons, alkylating agents, N-Nitroso compounds, mechanism of their toxicity.	15
IV	(a) Inorganic carcinogens- arsenic, asbestos, chromium and nickel, mechanisms of their carcinogenesis. (b) Assay of carcinogenesis- short term bioassay, long term assay, chromosomal aberration test, micronuclei test, Ames test, Gene mutation assay, Use of transgenic animals in carcinogenesis testing.	15
Suggested Readings:		
<ol style="list-style-type: none"> 1. Comprehensive Toxicology by Charlene A. Mc Queen, Chemical Carcinogens & anticarcinogens, Volume-12, Pergamon Press Oxford. 2. Advances in modern toxicology, Mutagenesis (Volume- 5) by E.G. Flamm, M.A.Mehlman, Gary F.W., John Wiley and Sons Inc. 3. Toxicology by Hans Marquardt et al. Academic Press. 4. Chemical induction of cancer, by Arcos, J.C., Argus, M.F., and Wolf, G., (Vol.1) 5. The molecular basis of cancer by Mendelsohn and others, Saunders, Philadelphia (Elsevier) 6. Handbook of Toxicological pathology by W.M. Haschek, C.G. Rousseaux, M.A. Walling., (Volume-2), Academic Press 7. Mycotoxins and N-Nitroso compounds: Environmental risk (Volume-I) by R.C.Shank, CRC press 		
Suggested Continuous Evaluation Methods: Written assignment/Presentation/Term Paper/Seminar/Quizes		
Course prerequisites: To study this course, a student must have had the subject bio group in UG degree.		

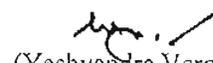

(M.K. Gupta)


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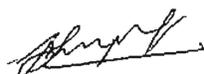
Course - 8

Programme/Class: M.Sc.	Year: Fifth	Semester: VIII
Subject: Toxicology		
Course Code: CH-2585	Course Title: Occupational and Industrial Toxicology	(Theory/Practical)
Course outcomes: At the end of this course the student will be able to: understand the chemicals of different occupations and practices. There are manufacturing of various chemicals in different industries and their exposure in workers and other non target humans and animals.		
Credits: 4		Course: Compulsory
Max. Marks: as per university rules		Min. Passing Marks: as per university rule
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4.5-6-10		
Unit	Topics	No. of Lectures Total (60)
I	(a) Occupational hazards- Physical hazards, Chemical hazards, Biological hazards, Mechanical hazards, psychosocial hazards (b) Occupational diseases- Pneumoconiosis, silicosis, asbestosis, anthracosis, byssinosis, bagassosis, Farmers' lung	15
II	Occupational Cancers- Skin cancer, Lung cancer, Bladder cancer, Leukemia	15
III	(a) Prevention of occupational diseases- Medical measures, Engineering measures, Legislative measures, Occupational health in India (b) Industrial toxicology- History and basic features with case studies	15
IV	Monitoring & management of occupational & industrial toxicants	15
Suggested Readings:		
<ol style="list-style-type: none"> Toxicology and risk assessment by A.M. Fan and L.W.Chang, Pan Stanford Fundamentals of industrial hygiene by H. Plogg, A. Barbara et al., National Safety council Industrial chemical exposure: Guidelines for Biological monitoring by R.R. Lauwerys and P.Hoet., CRC Press. Risk assessment of chemicals: An introduction by Leeuwen, C.J. Van; Vermeire, T.G., Springer. Environmental Pollution-Health and Toxicology by Rana, S.V.S. Narosa Publishing House, Delhi General and applied Toxicology by Ballantyne, T. Marrs, T. Syversen (Volume-III), Macmillan, UK 		
Suggested Continuous Evaluation Methods: Written assignment/Presentation/Term Paper/Seminar/Quizes		
Course prerequisites: To study this course, a student must have had the subject bio group in UG degree.		


(M.K. Gupta)


(S.V.S. Rana)


(P.K. Singh)


(P. J. John)


(Sandeep Mittal)


(Yeshvandra Verma)

Practical

Programme/Class: B.Sc. in Research or Hounors/M.Sc.		Year: Fourth	Semester: VIII
Subject: Toxicology			
Course Code: CH-2586		Course Title: Practical (as per based on all theory papers)	(Practical)
Course outcomes: At the end of this course the student will be able to: understand the knowledge about different poisonous animals and toxic chemicals which cause toxicity in humans and animals.			
Credits: 4		Course: Compulsory	
Max. Marks: as per university rules		Min. Passing Marks: as per university rule	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4.5-6-10			
	Topics		No. of Practical Hours
1	Care and maintenance of laboratory animals (Rat/Rabbit): a. Knowledge about different laboratory animals b. Food and water supply to laboratory animals c. Breeding of laboratory animals d. Collection of urine samples e. Collection of faeces f. Dose administration by different routes		10
2	Visceral organs of laboratory animals.		10
3	Qualitative analysis of blood for the following: a. Stained preparation of the blood film b. Determination of ESR/PCV/MCV/MCH/MCHC in rats/rabbit/men. c. Determination of haemin crystals in man/animals d. Determination of blood group in man		10
4	Separation of the following by centrifugation: a. Serum b. Supernatant		10
5	Quantitative analysis of serum for the following using commercial kits: a. ALT b. AST c. Alkaline phosphatase d. Acid phosphatase e. Bilirubin f. Serum protein g. Tissue protein h. LDH i. Calcium		10
6	Qualitative analysis of serum for the following: a. Separation of amino acids by paper electrophoresis b. Separation of solvents/pesticides by paper chromatography		10
7	Genotoxic/cytogenetic risk assessment (MN/ nuclear anomalies/ chromosomal aberration).		10

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8	Identification of the following slides: (Spotting) Spleen, Monocytes, Intestinal carcinoma, Thymus, Promyelocyte Breast cancer, Lymph glands, Macrophage, Eosinophilia, Apoptosis/Apoptotic bodies, AIDS Virus, Neutrophils, Human blood Prostate cancer, Anaemia, Bone marrow, Liver abscess, Leukocytes, Leukemia, Stomach carcinoma, Ovarian cancer, Lymphocytes, Megakaryocytes	10
9	Determination of Lipid peroxidation in liver/kidney/lungs in xenobiotics exposed subjects.	10
10	Viva Voce	
11	Practical record of the semester	

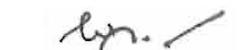

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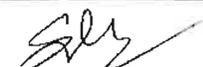

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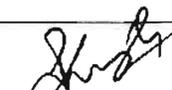

(Yeshvandra Verma)

Course -9

Programme/Class: M.Sc.		Year: Fifth	Semester: IX
Subject: Toxicology			
Course Code: CH-3582		Course Title: Toxicology of Heavy Metals	(Theory/Practical)
Course outcomes: At the end of this course the student will be able to: understand the knowledge of heavy metals like arsenic, lead, mercury, cadmium and copper Toxicity in various practices of human life, animals and environment.			
Credits: 4		Course: Compulsory	
Max. Marks: as per university rules		Min. Passing Marks: as per university rule	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4.5-6-10			
Unit	Topics		No. of Lectures Total (60)
I	(a)	Introduction to bioinorganic chemistry, general idea about trace elements, role of trace elements in human nutrition, nutritive elements, toxic elements.	15
	(b)	Toxicity of essential trace elements- toxicity of iodine, iron, copper, zinc, molybdenum,	
II	(a)	Heavy metals & their toxicity (lead, cadmium, mercury and arsenic)	15
	(b)	Heavy metals & carcinogenesis (Nickel and chromium).	
III	(a)	Immunotoxicity of metals- Immunosuppression and hypersensitive reactions, immunosuppression by metals, mechanisms of immunotoxicity, hypersensitivity reactions by heavy metals viz. chromium, mercury and nickel.	15
	(b)	Reproductive and developmental toxicity of metals – male reproductive toxicity, female reproductive toxicity and developmental effects of metals with special reference to lead, mercury and cadmium.	
IV	Ecotoxicology of metals- Sources of emission, biogeochemical transport, uptake, storage, Ecosystem effects of heavy metals viz. cadmium and mercury on ecosystem.		15
Suggested Readings:			
<ol style="list-style-type: none"> 1. Handbook on the Toxicology of metals, by Nordberg, G.F., Fowler, B.A., Nordberg, M and Friberg, L.T., Academic Press, London 2. Toxicology by Hans Marquardt et al. Academic Press. 3. Trace elements in human health and disease by Ananda S. Prasad and D.Oberleas, Academic Press. 4. Trace elements in human and animal nutrition by E.J.Underwood, Academic Press 5. Handbook of Human Toxicity by Edward J. Massaro, CRC Press 6. Chromium: Metabolism and toxicity by Desmond Burrows, CRC Press. 			
Suggested Continuous Evaluation Methods: Written assignment/Presentation/Term Paper/Seminar/Quizzes			
Course prerequisites: To study this course, a student must have had the subject bio group in UG degree.			

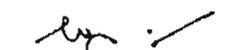

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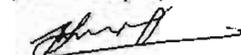

(P.J. John)


(Sandeep Mittal)


(Yeshvandra Verma)

Programme/Class: M.Sc.		Year: Fifth	Semester: IX
Subject: Toxicology			
Course Code: CH-3583		Course Title: Toxicology of Pesticides	(Theory/Practical)
Course outcomes: At the end of this course the student will be able to: understand about the various types of pesticides and insecticides. It provides the knowledge of pesticides of ancient time to modern time as inorganic pesticides to organic pesticides.			
Credits: 4		Course: Compulsory	
Max. Marks: as per university rules		Min. Passing Marks: as per university rule	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4.5-6-10			
Unit	Topics		No. of Lectures Total (60)
I	(a) Introduction to pesticides, classification of pesticides (Organochlorines, Organophosphates, Carbamates, Pyrethroids) (b) Generation of pesticides, chemistry of pesticides, uses and exposure to pesticides.		15
II	(a) Toxicity of organochlorine compounds – DDT, lindane, endrin and chlordecone, mechanism and organ toxicity, case studies (b) Toxicity of organophosphates- Parathion, malathion and dichlorvos, mechanism and organ toxicity, case studies.		15
III	(a) Toxicity of carbamates - Aldicarb, carbaryl, methiocarb, (b) Toxicity of Pyrethroids synthetic pyrethroids, pyrethrin, mechanism and organ toxicity, case studies.		15
IV	(a) Toxicity of herbicides – Paraquat, fungicide- hexachlorobenzene and organomercurials, fumigants- phosphine and ethylene, mechanism and organ toxicity, case studies. (b) Movement of pesticides in the animal & plant system- suitable examples of aquatic toxicity, wild life toxicity, poultry and birds, introduction to biopesticides.		15
Suggested Readings:			
<ol style="list-style-type: none"> 1. Pesticides studied in Man by Hayes, W.J.Jr. Williams and Wilkins, Baltimore, Md. 2. IARC Monograph on the evaluation of carcinogenic risk of chemicals to man. Some Organochlorine pesticides, Lyon, France. 3. IARC Monograph on the evaluation of carcinogenic risk of chemicals to man. Some carbamates, thiocarbamates and carbazines, Lyon, France. 4. IARC Monograph on the evaluation of carcinogenic risk of chemicals to man. Some fumigants, herbicides and industrial chemicals, Lyon, France. 5. Toxicology of organophosphate and carbamate compounds by Gupta, R.C., Elsevier 6. Insecticides: Toxicology and uses by H.C.L.Gupta., Agrotech Publishing Academy (India) 7. Toxicology by Hans Marquardt et al. Academic Press. 			
Suggested Continuous Evaluation Methods: Written assignment/Presentation/Term Paper/Seminar/Quizes			
Course prerequisites: To study this course, a student must have had the subject bio group in UG degree.			


(M.K. Gupta)


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(Sandeep Mittal)


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(Yeshvandra Verma)

Course -11

Programme/Class: M.Sc.	Year: Fifth	Semester: IX
Subject: Toxicology		
Course Code: CH-3584	Course Title: Toxicology of Organic Solvents	(Theory/Practical)
<p>Course outcomes: This paper gives information about some organic solvents used in various industries. Especially organic solvents used in paint industry, cosmetic industry and petroleum products etc. The toxicity of solvent chemicals and their adverse effects on animals humans and environmental systems.</p>		
Credits: 4		Course Compulsory
Max. Marks: as per university rules		Min. Passing Marks: as per university rules
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4.5-6-10		
Unit	Topics	No. of Lectures Total (60)
I	(a) General properties of solvents, industrial and commercial uses of solvents, general toxicity (neurotoxicity, hepatotoxicity, renal toxicity and behavioural toxicity) of solvents with examples.	15
	(b) Metabolism of organic solvents, generation of reactive intermediates and reactive oxygen species.	
II	(a) Toxicity of aliphatic solvents- carbon tetrachloride, chloroform, trichloroethylene, tetrachloroethylene.	15
	(b) Toxicity of aromatic hydrocarbons- benzene, toluene, xylene, styrene.	
III	(a) Toxicity of alcohols- ethyl alcohol, methyl alcohol, isopropyl alcohol	15
	(b) Toxicity of food additives- polycyclic hydrocarbons, heterocyclic amines, synthetic carcinogens, nitrosamines.	
IV	(a) Hematototoxicity, haematopoietic effects, leukemogenic and clastogenic effects of organic solvents.	15
	(b) Biological monitoring of organic solvents, methods of monitoring with case studies, concept of biomarkers	
<p>Suggested Readings:</p> <ol style="list-style-type: none"> 1. Food and Nutrition toxicology by Stanley T. Omaye, CRC Press 2. Toxicity and metabolism of industrial solvents by Ethel Browning, Elsevier. 3. Toxicology by Hans Marquardt et al. Academic Press. 4. Environmental monitoring by G.B. Wiersma, CRC Press 		
Suggested Continuous Evaluation Methods: Written assignment/Presentation/Term Paper/Seminar/Quizes		
Course prerequisites: To study this course, a student must have had the subject bio group in UG degree.		

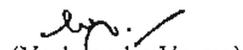

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(Yeshvandra Verma)

Programme/Class: M.Sc.	Year: Fifth	Semester: IX
Subject: Toxicology		
Course Code: CH-3585	Course Title: Regulatory Toxicology	(Theory/Practical)
Course outcomes: At the end of this course the student will be able to: understand the regulatory aspects of different agencies of international and national levels. These agency regulate the uses and their toxicity aspect of different chemicals.		
Credits: 4		Course: Compulsory
Max. Marks: as per university rules		Min. Passing Marks: as per university rules
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4.5-6-10		
Unit	Topics	No. of Lectures Total (60)
I	(a) Introduction to Regulatory institutions- FDA, EPA, WHO, IARC, OSHA, ACGIH, UNEP. (b) Programs for regulating chemical hazards- FDA, human drugs, medical devices, cosmetics, pesticides, industrial chemicals.	15
II	(a) Regulation of water pollution- EPA, SDWA, DOEn, CPCB, Legal aspects of Water pollution control in India. (b) Regulation of air pollutants- Clean air act, Air pollution control in India.	15
III	(a) Regulation of consumer products- consumer product safety commission, FHSA (b) FDA and EPA testing standards for food, water, pesticides and industrial chemicals. Food, drug and cosmetic Act.	15
IV	(a) Interagency testing criteria- NTP, EPA, CPSC. (b) Animal welfare requirements- AWA, CPCSEA, APHIS, Public health service policy, GLP.	15
Suggested Readings:		
<ol style="list-style-type: none"> 1. Regulatory Toxicology by Renuka Sengupta, Narosa Publishing House, Delhi 2. Fundamental Toxicology by J.H. Duffus and H.G.J. Worth, RSC Publishing 3. Toxicology by Hans Marquardt et al. Academic Press. 4. General and applied Toxicology by Ballantyne, T. Marrs, T. Syversen (Volume-III), Macmillan, UK 5. Food and Nutrition toxicology by Stanley T. Omaye, CRC Press 6. Handbook of Environmental (Laws, Acts, guidelines, compliances and standards) –Volume-2 by R.K. Trivedy, BS Publications, Hyderabad. 7. Handbook of toxicology by M.J. Derelanko and M.A. Hollinger, CRC Press 		
Suggested Continuous Evaluation Methods: Written assignment/Presentation/Term Paper/Seminar/Quizes		
Course prerequisites: To study this course, a student must have had the subject bio group in UG degree.		

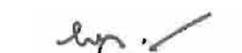

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Practical

Programme/Class: M.Sc.		Year: Fifth	Semester: IX
Subject: Toxicology			
Course Code: CH-3586		Course Title: Practical (as per based on all theory papers)	(Practical)
Course outcomes: At the end of this course the student will be able to: understand the knowledge about different poisonous animals and toxic chemicals which cause toxicity in humans and animals			
Credits: 4		Course: Compulsory	
Max. Marks: as per university rules		Min. Passing Marks: as per university rule	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4.5-6-10			
	Topics		No. of Practical Hours
1	Qualitative tests: Pb, Cd, Fe, Hg, F, As, Cr		10
2	Semi quantitative tests: Nitrate/ Phosphates/ Sulphate		10
3	Quantitative Tests: (i) Determination of Na/K in serum by Flame Photometry (ii) Determination of Ca/Fe/F/I by Colorimetry (iii) Determination of Pb/Cd/Cu/Cr by AAS (iv) Determination of mercury by mercury analyzer (v) Determination of cholinesterase activity in serum		10
4	Bacteria, formaldehyde, urea and detergent in milk & starch/boric acid in cheese		10
5	Determination of Organo phosphate compounds.		10
6	Biometry of fish		10
7	Chromatography- a. Preparation of TLC plates. b. Separation of different solvents/pesticides by TLC		10
8	Estimation of protein/DNA damage using electrophoretic techniques		10
9	Spotting: Slides/ Photographs: Minamata disease, Goitre, Cretinism, Dental Fluorosis, Skeleton Fluorosis, Exophthalmia, Black foot disease, Itai – Itai disease, Thyroid, Genu Valgum, Haemochromatosis, Keshan disease, Hydrocephalus, Allergic Dermatitis, Irritant Dermatitis, Nickel Allergy, Structure of Skin, Thioacetamide induce liver necrosis, CCl ₄ induced liver necrosis, Benzene induced liver necrosis, Parenchymal degeneration in liver, TCE induced liver damage, T.S. of Liver (Hg), T.S. of Liver (Cd), T.S. of Liver (Pb), T.S. of Kidney (Hg), T.S. of Kidney (Cd), T.S. of		10

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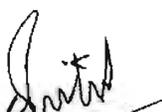
	Kidney (Pb), T.S. of Testis (Cd), T.S. Thyroid (Normal/ Goiter) Hazard Symbols: Explosive, Flammable, Gasses under Pressure, Corrosive, Toxic, Dangerous for environment, Oxidizing, Health Hazard	
10	Viva – Voce	
11	Practical record of the semester	

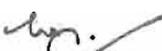
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(Sandeep Mittal)


(Yeshvandra Verma)

Course -13

Programme/Class: M.Sc.	Year: Fifth	Semester: X
Subject: Toxicology		
Course Code: CH-4582	Course Title: Tools and Techniques in Toxicology	(Theory/Practical)
Course outcomes: This course provides the knowledge of instruments and techniques used in these all courses of toxicological sciences.		
Credits: 4		Course: Compulsory
Max. Marks: as per university rule		Min. Passing Marks: as per university rules
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4.5-6-10		
Unit	Topics	No. of Lectures Total (60)
I	(a) Laboratory animals- Animal environment, Animal husbandry, Animal care & maintenance, accreditation, CPCSEA. (b) Histopathology- Fixation, dehydration, clearing, embedding, microtomy and staining methods	15
II	(a) Microscopy- Light microscopy, Interference microscopy, Polarization microscopy, Electron microscopy, Confocal microscopy (b) Centrifugation- Principles of centrifugation, Types of centrifuges, ultracentrifugation, Applications of centrifugation	15
III	(a) Spectrophotometry- Beer-Lambert relationship, Instrumentation, Applications of spectrophotometry, Atomic absorption spectrophotometry (b) Chromatography- Adsorption chromatography, thin layer chromatography, Paper chromatography, High performance liquid chromatography (HPLC), Gas-liquid chromatography	15
IV	(a) Electrophoresis- Introduction to electrophoresis, Instrumentation, Electrophoresis of proteins, Electrophoresis of enzymes, Isoelectric focusing, Isotachopheresis, Southern, northern & western blotting (b) Radiological techniques- Radioimmuno assay (RIA), ELISA- competitive ELISA, indirect ELISA, sandwich ELISA, applications of ELISA	15
Suggested Readings: <ol style="list-style-type: none"> Handbook of laboratory Animal Science by Jann Hau, Gerald, L., Van Hoosier., CRC Press Fundamentals of analytical toxicology by R.J. Flanagan, A. Taylor et al., Wiley- Interscience Analytical toxicology for clinical, forensic and pharmaceutical chemists by Brandenberger H., R.A.A. Maes., Walter de Gruyter, NY/London Biotechniques: Theory and Practice by Rana, S.V.S., Rastogi Publications, Meerut 		
Suggested Continuous Evaluation Methods: Written assignment/Presentation/Term Paper/Seminar/Quizes		
Course prerequisites: To study this course, a student must have had the subject bio group in UG degree.		

(M.K. Gupta)

(S.V.S.Rana)

(P.K. Singh)

(P. J. John)

(Sandeep Mittal)

(Yeshvandra Verma)

Programme/Class: M.Sc.	Year: Fifth	Semester: X
Subject: Toxicology		
Course Code: CH-4583	Course Title: Applied Toxicology	(Theory/Practical)
Course outcomes: At the end of this course the student will be able to: understand the knowledge of instruments and techniques used in these all courses of toxicological sciences.		
Credits: 4	Course: Compulsory	
Max. Marks: as per university rule	Min. Passing Marks: as per university rules	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4.5-6-10		
Unit	Topics	No. of Lectures Total (60)
I	(a) Food Toxicology- Toxic ingredients and contaminants of food, Toxicity of dietary supplements, toxins in fish, shell fish and marine food. Analysis of food toxins	15
	(b) Cosmetic toxicology- Toxicity of shampoos, conditioners, bleachers, dyes, allergic and respiratory disorders	
II	Medical Toxicology- Mission of medical toxicology, Comparative toxicology, Human risk assessment, Toxicological database	15
III	Clinical toxicology- Introduction to drug schedule, History of the poisoned patient, physical examination, laboratory, evaluation, radiographic examination, Prevention of poison absorption, enhancement of excretion of the poison, Use of antidotes in poisoning.	15
IV	(a) Veterinary toxicology- Common causes of toxicity in dogs, cats, horses and poultry, by herbicides, house hold chemicals, heavy metals, mycotoxins, blue green algae and toxic plants	15
	(b) Nanotoxicology- Types of engineered nanoparticles and basic concepts of their toxicity	
Suggested Readings:		
1. Chemical warfare agents, Toxicology and treatment by Timothy C. Marrs, Wiley.		
2. Medical Toxicology, by Dart, Richard C, Lippencot Williams and Wilkins.		
3. The clinical Toxicology, By RTI international		
4. General and applied Toxicology by Ballantyne, T. Marrs, T. Syversen (Volume-II), Macmillan, UK		
5. General and applied Toxicology by Ballantyne, T. Marrs, T. Syversen (Volume-III), Macmillan, UK		
6. Food and Nutrition toxicology by Stanley T. Omaye, CRC Press		
Suggested Continuous Evaluation Methods: Written assignment/Presentation/Term Paper/Seminar/Quizes		
Course prerequisites: To study this course, a student must have had the subject bio group in UG degree.		

(M.K. Gupta)

(S.V.S.Rana)

(P.K. Singh)

(S. Singh)

(Sandeep Mittal)

(Yeshvandra Verma)

Programme/Class: M.Sc.		Year: Fifth	Semester: X
Subject: Toxicology			
Course Code: CH-4584	Course Title: Forensic Toxicology		(Theory/Practical)
Course outcomes: At the end of this course the student will be able to: understand the knowledge of instruments and techniques used in these all courses of toxicological sciences.			
Credits: 4		Course: Compulsory	
Max. Marks: as per university rule		Min. Passing Marks: as per university rules	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4.5-6-10			
Unit	Topics		No. of Lectures Total (60)
I	(a) Historical account of forensic toxicology, Forensic examination of biological fluids, stains and other materials-different blood groups, DNA profiling/finger printing, disputed paternity and maternity. (b) Identification of blood stains, semen, saliva, urine, faecal matter, milk, hair.		15
II	(a) Common Household poisons –Mineral acids and caustic alkalis, organic acids (oxalic acid, carbolic acid), vegetable acid poisons (hydrocyanic acid and cyanides) (b) Specific vegetables poisons - <i>Ricinus communis</i> , <i>Croton tiglium</i> , <i>Abrus Precatorius</i> , <i>Ergot</i> , <i>Capsicum</i> , <i>Calotropis</i> , <i>Plumbago</i> .		15
III	(a) Specific animal poisons-cantharides, snakes, scorpions, insects (b) Mechanical poisons – Powdered glass		15
IV	Sedatives and hypnotics (Chloral hydrate & Barbiturates), organophosphorus compounds (malathion, diazinon), chlorinated compounds (DDT), aluminium phosphide, deliriant poisons (datura, cannabis), spinal poisons (strychnos nux vomica), cardiac poisons (nerium odorum, aconite, nicotine, digitalis), asphyxiants (carbon monoxide, carbon dioxide, hydrogen sulphide, war gases.		15
Suggested Readings:			
<ol style="list-style-type: none"> 1. Principles of Forensic Toxicology, by Levine Barry, AACC Press. 2. The Essentials of forensic medicine and toxicology by Dr. K.S.Narayan and Dr. O.P. Murty., Publisher: J.P.Medical publishers, India 3. Parikh's text book of medical jurisprudence, forensic medicine and toxicology by C.K.Parikh., CBS Publ., New Delhi. 4. Concise text book for medicine and toxicology by R.K.Sharma, Elsevier. 5. Hair analysis in clinical and forensic toxicology by Kintz et al., Elsevier 6. Hair in toxicology: An important Bio-monitor by Tobin Desmond J. RSC Publishing 			
Suggested Continuous Evaluation Methods: Written assignment/Presentation/Term Paper/Seminar/Quizes			
Course prerequisites: To study this course, a student must have had the subject bio group in UG degree.			

(M.K. Gupta)

(P. J. John)

(S.V.S.Rana)

(Sanjeev Mittal)

(P.K. Singh)

(Yeshvandra Verma)

Programme/Class: M.Sc.	Year: Fifth	Semester: X
Subject: Toxicology		
Course Code: CH-4585	Course Title: Experimental Design and Biostatistics	(Theory/Practical)
Course outcomes: At the end of this course the student will be able to: understand the knowledge of instruments and techniques used in these all courses of toxicological sciences.		
Credits: 4		Course: Compulsory
Max. Marks: as per university rule		Min. Passing Marks: as per university rule
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4.5-6-10		
Unit	Topics	No. of Lectures Total (60)
I	(a) Animal bioassays –LDS, ADI & RfD, NOAEL, related laws and regulations, determination of acute toxicity, sub chronic and chronic toxicity. (b) Methods in Bioassay- Current trends, use of Daphnia, Zebra fish and other lower animals in toxicological studies.	15
II	In vitro toxicology Concepts of <i>in vitro</i> toxicology, methods of <i>in vitro</i> toxicology, Cytotoxicity assays (MTT assay, MTS assay, ATP assay, Neutral viability tests). Cell lines used for <i>in vitro</i> toxicology, NTP guidelines for <i>in vitro</i> alternative methods in toxicology.	15
III	(a) Measures of Central tendency- student 't' test , Z-test. (b) Probabilities, Hypothesis testing, Chi square test.	15
IV	Analysis of variance-one way & two way ANOVA, post hoc tests, Duncan's test, William's test.	15
Suggested Readings:		
<ol style="list-style-type: none"> 1. Comprehensive Toxicology. Vol.2. (Toxicological testing and evaluation). Sipes, I.G., McQueen, C.A. and Gandolfi, A.J., Pergamon Press Oxford. 2. General and applied Toxicology by Ballantyne, T. Marrs, T. Syversen (Volume-I), Macmillan, UK 3. Statistical methods in bioinformatics: An Introduction (Statistics for biology and health) by W.J. Ewens and G.R. Grant 4. In vitro Toxicology Systems- Methods in pharmacology and toxicology by Bal-Price, A and Jennigs. P., Humana Press 5. National toxicology program (NTP) 2011. Vision and roadmap for 21st century Toxicology. 6. In vitro Toxicology- A volume in methods in toxicology and pharmacology by Alok Dhawan and Seok, S.K., Academic Press, London & New York 7. Fundamental Toxicology by J.H. Duffus and H.G.J. Worth, RSC Publishing 8. Toxicology by Hans Marquardt et al. Academic Press. 		
Suggested Continuous Evaluation Methods: Written assignment/Presentation/Term Paper/Seminar/Quizes		
Course prerequisites: To study this course, a student must have had the subject bio group in UG degree.		

(M.K. Gupta)

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Practical-

Programme/Class: M.Sc.		Year: Fifth	Semester: X
Subject: Toxicology			
Course Code: CH-4586	Course Title: Practical (as per based on all theory papers)		(Practical)
Credits: 4		Course: Compulsory	
Max. Marks: as per university rules		Min. Passing Marks: as per university rule	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-5-6-10			
	Topics		No. of Practical Hours
1	Finger printing (Thumb impression)		10
2	Microtomy and staining		10
3	In vitro toxicology tests, Cytotoxicity assays.		10
4	Experiments on alternative animal models for toxicity assessment		10
5	Zebra fish embryo assay,		10
6	CAM assay		10
7	Spotting: i. Hairs of different animals Hyena, Lion, Wild dog, Jackal, Neelgai, Bear . ii. Plant toxins- Rhododendron, Mushroom, Marijuana, Aberus precatorius, Croton seeds, Nux Vomica, Dhatura, Tobacco leaves		10
8	1. Forensic analysis of the following using TLC/Spectrophotometrically/GLC- Paracetamol, Sleeping drugs, Mineral acid tests, Sedative plants, Trapping tests, Blood stains test, Mercury, Alcohol, Organophosphates, Organochlorine, Carbamates 2. Dactylography 3. Biostatistics/Bioinformatics exercises using computer with suitable software (internet) as a tool. 4. Instrumentation- HPLC, GLC, Spectrophotometry, PCR, RT-PCR, Lyophilizer		10
9	Viva – Voce		
10	Practical record of the semester		

(M.K. Gupta)

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Course – Minor elective

Programme/Class: M.Sc.	Year: Fourth	Semester: VII
Subject: Toxicology (Minor Elective)		
Course Code:	Course Title: Health and Hygiene	(Theory)
Course outcomes: At the end of this course the student will be able to: understand the knowledge about good and bad habits in daily life of a person and entire community which leads to public and community health. This course provides the good job opportunity in various government and private sector and NGOs.		
Credits: 4	Course: Minor elective	
Max. Marks: as per university rule	Min. Passing Marks: as per university rule	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 6-0-0		
Unit	Topics	No. of Lectures Total (60)
I	Public and community health- Introductory idea, definition and objective of public and community health. Daily nutritional requirements, Nutritional deficiencies.	12
II	Environmental and personal hygiene- introduction, importance and components.	12
III	Food poisoning and toxins- Types, symptoms, treatment of food poisoning, Food toxins.	12
IV	Health destroying social habits- Pan, Supari, Ganja, drinking, smoking, tea coffee (effects and side effects)	12
V	Health laws on food safety and hygiene.	12
Suggested Readings:		
<ol style="list-style-type: none"> 1. Elements of Hygiene and public health by Rai Bahadur Jaisingh P.Modi, Elsevier 2. Introduction to public health by Mary-Jane Schneider, Jones and Barlett learning 3. Fundamental food Microbiology by A.Ray and A.Bhunia, CRC 		
This course can be opted as an elective/ value added course by the students of following subjects: Open for all		
Suggested Continuous Evaluation Methods: Written exam		
Course prerequisites: To study this course, a student must have had not opted (studied) in UG degree.		


(M.K. Gupta)


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(Yeshvandra Verma)

Course –Minor elective

Programme/Class: M.Sc.		Year: Fifth	Semester: IX
Subject: Toxicology (Minor elective)			
Course Code:	Course Title: Forensic Science		(Theory)
<p>Course outcomes: At the end of this course the student will be able to: understand the knowledge about various poisonous chemical toxins and natural plant and animal poisons may be used in various crimes and intentional cases of suicides. This course provides the basics of forensic investigations and possibilities to clear various disputes of paternity and maternity cases. This course provides the jobs in forensic departments of government and allied organizations.</p>			
Credits: 4		Course: Minor elective	
Max. Marks: as per university rule		Min. Passing Marks: as per university rule	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 6-0-0			
Unit	Topics		No. of Lectures Total (60)
I	Definition, History and scope of forensic science. Medico legal aspects		12
II	General idea of samples for forensic studies- blood, hair, saliva, urine, semen and milk, post –mortem examination.		12
III	A brief idea about poisons- Animal poisons, Plant poisons, Metallic and non metallic poisons.		12
IV	Fire arms and injury caused by them. General idea of bombs and explosives.		12
V	Analytical methods- Microscopy, spectrophotometry, chromatography, electrophoresis and their applications in forensic analysis.		12
<p>Suggested Readings:</p> <ol style="list-style-type: none"> 1. The Essentials of forensic medicine and toxicology by Dr. K.S.Narayan and Dr. O.P. Murty., Publisher- J.P.Medical publishers, India 2. Parikh's text book of medical jurisprudence, forensic medicine and toxicology by C.K.Parikh., CBS Publ., New Delhi. 3. Concise text book for medicine and toxicology by R.K.Sharma, Elsevier. 			
This course can be opted as an elective/ value added course by the students of following subjects: Open for all			
Suggested Continuous Evaluation Methods: Written exam:			
Course prerequisites: To study this course, a student must have had not opted (studied) the subject in UG degree.			


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