Name of faculty: Science	**Department:** Biotechnology
Program: M.Sc. Genetics	**Type:** Theory + Practical
Subject: DSC-4 Genomics	**Semester:**2
Credit: 04 + 02	**Total learning hours:** 60

Pre-requisites: Knowledge about:

- Gene Expression and Regulation
- Molecular Biology Techniques

Course description:

The goal of this course is to deliver information about genomics starting with other than chromosomal form of inheritance, 'OMICS' technology ways and modes to study genomes, various projects undergoing for genomic studies and applications of genomics.

Student learning outcome:

On completion of course students will be able to:

- Understand techniques for sequencing and mapping of the genome.
- Get acquainted with different global genomic projects ongoing for developing understanding of and about genome and their implications that can be applied at par to human welfare.
- Explain the influence of the genome on functioning at organism/cell/organelle levels.
- Understand applications of genomics in disease and reforms in nutrition.

Unit-1: Introduction: (5 h)

1.1. Extra Chromosomal DNA and Inheritance
1.2. Defining Omics
1.3. Classification of Omics
1.4. General applications of "OMICS"

Unit-2: Genomes: (8h)

2.1 Prokaryotic Genomes (Physical and Genetic features)
2.2 Eukaryotic Organelle Genomes
2.3 Viral Genomes and Mobile Genetic Elements

Unit-3: Genome Mapping-I (Genetic Mapping): (8 h)

2.1 DNA Markers for Genetic Mapping (For Checking Polymorphisms)
2.2 Linkage Analysis
2.3 Gene Mapping in Humans
2.4 Genetic Mapping in Bacteria

Unit-4: Genome Mapping-II (Physical Mapping): (7 h)

4.1 Restriction Mapping

4.2 FISH
4.3 STS Mapping

Unit-5: Genome Sequencing Projects: (8 h)
5.1 Human Genome Project
5.2 Human Microbiome Project
5.3 The Cancer Genome Atlas Programme and Pan Cancer Project(TCGA and Pan Cancer project)
5.4 GOLD

Unit-6: Comparative Genomics: (7 h)
6.1 Comparative Genomics of Bacteria
6.2 Comparative Genomics of Organelles
6.3 Comparative Genomics of Eukaryotes

Unit-7: Functional Genomics: (8 h)
7.1. Annotation of Gene Location in Genome Sequence (Location of Gene Through Inspection, Experimental Techniques for Gene Location)
7.2. Determining the Function of Individual Gene (Through Computer Analysis,Through Experimental Analysis, Other Methods for Deciphering Function of Gene)
7.3. Case study: Gene Function Annotation Studies in *Saccharomyces cerevisiae*
7.4. Forward and Reverse Genetics

Unit-8: Applicative Genomics: (9 h)
8.1. Pharmacogenomics:(Human Genome and SNPs, SNP and Set of Human Diseases, SNP and Drug Response in Humans)
8.2. QSAR Drug Discovery
8.3. Nutrigenomics:(Gene-Environment Interactions and Diet, Genetic Variations and Impact on Plasma Lipoprotein, Nutrigenomics in Cancer)
8.4. Environmental Case Study: Genomic Diversity and Global Warming

References:

- Primrose, S. B., Twyman, R. M., (2006). *Principles of Gene Manipulation and Genomics*. Malden, MA: Blackwell Pub ISBN:1-4051-3544-1
- Campbell, A. M., & Heyer, L. J. (2003). *Discovering Genomics, Proteomics, and Bioinformatics*. San Francisco: Benjamin Cummings. ISBN:0-8053-4722-4
- Brown, T. A. (2006). *Genomes* (3rd Ed.). New York: Garland Science Pub.ISBN:0 8153 4138 5
- Barh D., Khan I. A., Sarwar M. - (2015)Applied Molecular Biotechnology _ The Next Generation of Genetic Engineering-CRC Press_Taylor & Francis ISBN:978-1-4987-1483-9
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- Jim Kaput, Raymond L. Rodriguez, (2006) Nutritional Genomics Discovering the Path to Personalized Nutrition John Wiley & Sons. ISBN:978-0-47l-68319-3

Reference Research Papers:

- Hutter, C., & Zenklusen, J. C. (2018). The cancer genome atlas: creating lasting value beyond its data. *Cell*, *173*(2), 283-285.
- Weinstein, J. N., Collisson, E. A., Mills, G. B., Shaw, K. R. M., Ozenberger, B. A., Ellrott, K., ... & Stuart, J. M. (2013). The cancer genome atlas pan-cancer analysis project. *Nature genetics*, *45*(10), 1113-1120.
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- Peterson, J., Garges, S., Giovanni, M., McInnes, P., Wang, L., Schloss, J. A., ... & NIH HMP Working Group. (2009). The NIH human microbiome project. *Genome research*, *19*(12), 2317-2323.
- Turnbaugh, P. J., Ley, R. E., Hamady, M., Fraser-Liggett, C. M., Knight, R., & Gordon, J. I. (2007). The human microbiome project. *Nature*, *449*(7164), 804-810.

Practicals:

1. Retrieval of data from databases:
    - Nucleic acid sequence retrieval
    - Cancer related data from TCGA
2. Hybridization of DNA. (Southern Hybridization)
3. To study Restriction Fragment Length polymorphism.

Name of faculty: Science	**Department:** Biotechnology
Program: M.Sc. Genetics	**Type:** Theory + Practical
Subject: DSC-3 Modern RNA Biology	**Semester:** 2
Credit: 04 + 02	**Total learning hours:** 60

Pre-requisites: Knowledge about:

- Gene Expression and Regulation
- Molecular Biology Techniques

Course description:

RNA till now thought of having role in just protein synthesis, now stands in separate status as its regulatory role was deciphered. Thus, came in picture the modern RNA world explicit from the conventional RNA world. From that discovery and to date there have been variant applications devised using RNA, be it treatment or manipulation of gene. This course aims at explaining the modifications in RNA and its role and implicative studies for human welfare in the modern world of therapeutics. Students will gain insight on the various aspects of RNA being involved in regulation of life processes and mal functioning of which can lead to dire consequences. Also the course will teach the applications of RNA in gene manipulation and therapy.

Student learning outcome:

On completion of course students will be able to:

- Know the RNA world as it has transformed its existence in today's world through RNA World Hypothesis.
- Understand the aspects of RNA for gene silencing and related manipulations and their applications.
- Explain the interactions of RNA with nucleic acids and proteins leading to their functional role in biological systems.
- Get acquainted with RNA and its relevance with cancer, thus learn and apply the RNA based technologies in prognosis and treatment of cancer.
- Learn about the various vast modern day applications of RNA therapeutics.

Unit-1 Introduction and History: (5 h)

1.1. RNA at Origin
1.2. RNA World Hypothesis
1.3. Primordial RNA World
1.4. Modern RNA World

Unit-2 Transcriptomics: (8 h)

2.1 RNA Content of the Cell
2.2 RNA and Transcriptome
2.3 RNAseq Transcriptomics

2.4 Study and Analysis of Transcriptome
2.5 Applications of Transcriptome

Unit 3 Gene Silencing: (8 h)
3.1. CRISPR/CAS System
3.2. Features of RNA silencing
3.3. RNAi techniques (RNAi shuttles, Small Non Coding RNAs for Targeted Gene Silencing, Delivering RNAi to Nervous System, RNAi and HIV Treatment)
3.4. miRNome Profiling Through Microarrays
3.5. RIP Chip for Detection of miRNA Targets

Unit-4 RNA-RNA Interactions and RNA Protein Interactions Studies: (8 h)
4.1 MARIO Technology
4.2 Aptamers and SELEX
4.3 RAID
4.4 RNA Binding Proteins (RBPs)-Human RBPs, Their Targets, RBPs and Diseases
4.5 Telomere RNA and RNPs

Unit-5 RNAi Reversal and Implications of RNA Secondary Structures: (8 h)
5.1 RNAi Suppression
5.2 siRNA Triggered Cytotoxicity
5.3 RNAi and Retrotransposons
5.4 RNA G-Quadruplexes and Their Biological Functions

Unit-6 RNA Exosomes: (8 h)
6.1 Discovering Exosomes
6.2 Structure of RNA Exosomes
6.3 Archael Exosome
6.4 Eukaryotic Exosome
6.5 Human Exosome and Disease

Unit-7 RNA and Cancer: (7 h)
7.1. mRNA localization and cancer
7.2. lncRNAs and cancer
7.3. Antisense RNA mediated tumor suppression
7.4. RNA vaccines for Cancer
7.5. lncRNA and cancer therapy (ciRS-7)

Unit-8 RNA Therapeutics: (8 h)
8.1. Antisense Drugs: Molecular Mechanisms of Antisense Drugs
8.2. Drugging pre-mRNA (Exon Skipping, Exon Inclusion)
8.3. LNA-Diagnostic Agent and PNA-Antisense Agent
8.4. Respiratorable Antisense Oligonucleotides
8.5. RNA Vaccines

Reference:

- Crooke S., (2001) Antisense Drug Technology: Principle, Strategies and Applications, Taylor & Francis group.ISBN:978-0-8493-8796-8

- Erdmann V. & Barciszewski J., (2010) RNA Technologies and Their Applications, Springer.ISBN:978-3-642-12167-8
- Jensen T., (2010) RNA Exosome , Springer.ISBN: 978-1-4419-7840-0
- Harper S., (2011) RNA Interference Techniques Humana Press, Springer. ISBN:978-1-61779-113-0
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- Bot A., et al., (2011) Cancer Vaccines From Research to Clinical Practice, Informa Healthcare ISBN:978-1-84184-829-7

Reference Articles:

- Zhang, X., Wu, D., Chen, L., Li, X., Yang, J., Fan, D., ... & Wang, D. (2014). RAID: a comprehensive resource for human RNA-associated (RNA–RNA/RNA–protein) interaction. rna, 20(7), 989-993.
- Yi, Y., Zhao, Y., Li, C., Zhang, L., Huang, H., Li, Y., ... & Wang, D. (2017). RAID v2. 0: an updated resource of RNA-associated interactions across organisms. Nucleic acids research, 45(D1), D115-D118.
- Nguyen, T. C., Cao, X., Yu, P., Xiao, S., Lu, J., Biase, F. H., ... & Zhong, S. (2016). Mapping RNA–RNA interactome and RNA structure in vivo by MARIO. Nature communications, 7(1), 1-12.
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- Ulmer, J. B., Mason, P. W., Geall, A., & Mandl, C. W. (2012). RNA-based vaccines. Vaccine, 30(30), 4414-4418.

Practicals:

1. To isolate RNA from Bacteria/ Plant cells/ animal cells and characterize through UV-Spectrophotometry and Agarose Gel Electrophoresis.
2. Estimation of RNA through colorimetric assay.
3. Study of RNA-RNA and RNA-protein interactions through RAID.
4. Demonstration of Northern Blotting.

Name of faculty: Science	**Department:** Chemistry
Program: M.Sc.	**Type:** Theory + Practical
Subject : SEC-2 Instrumentation and Analytical Techniques	**Semester-**2
Credit: 04 + 02	**Total learning hours:** 60
Course description: This Course Paper proposes to teach about Principle, Instrumentation and Applications of various spectroscopy and chromatographic techniques, advanced instrumentation techniques, chemical sensors and biosensors.	
Student learning outcome: At the end of the course students will be able to... Learn ● The History, origin, laws, principles, theories, instrumental set up, its' working mechanism, various components and it's working pattern, procedure of analysis and applications in the various field of analysis about: ● Visible Spectroscopy ● Atomic Absorption Spectrometry ● Optical Emission Spectrometry ● Advanced Instrumentation Techniques ● Gas Chromatography ● High Performance Liquid Chromatography ● Ion Exchange and Ion Exclusion Chromatography ● Chemical Sensors and Biosensors	

Unit 1. Visible Spectroscopy **06 Hours**

1.1 Characteristics of electromagnetic spectrum
1.2 Origin of spectra and electronics transitions
1.3 Laws of absorption of radiation - Lambert & Beer's law and its deviation
1.4 The architecture of a spectrophotometer
1.5 Calibration curve and standard addition method - multi component analysis
1.6 Applications of UV-visible spectroscopy

Unit 2. Atomic Absorption Spectrometry **08 Hours**

2.1 The history & principle of atomic absorption spectroscopy
2.2 AAS – Instrumentation
2.2.1 Radiation sources: line & continuum
2.2.2 Atomization techniques: FAAS & GFAAS
2.2.3 Wavelength selector: monochromator
2.2.4 Detectors: PMT
2.2.5 Single & double beam AAS
2.5 Applications of atomic absorption spectrometry

Unit 3. Optical Emission Spectrometry **08 Hours**

3.1 Introduction and principle
3.2 Atomic spectroscopic sources
3.3 Inductively coupled plasma - the discharge
3.4 ICP-OES Instrumentation
3.4.1 Nebulizers
3.4.2 Spray Chambers
3.4.3 Sample introduction systems

3.4.4 Optics and the spectrometer
3.4.5 Emission detectors
3.5 Applications of ICP-OES

Unit 4. Advanced Instrumentation Techniques **06 Hours**

4.1 Principle, Instrumental set up & Applications of Non dispersive IR (gas analyzer)
4.2 Modern elemental analyzer
4.3 Total organic carbon analyzer
4.4 Mossbauer Spectroscopy
4.5 Turbidimetry
4.6 Nephelometry

Unit 5.	**Gas Chromatography**	**08 Hours**
5.1	Introduction of chromatography and principle of separation	
5.2	Classification -GSC and GLC & its applications	
5.3	Components of instruments: carrier gas, sample injection system, stationary and mobile phase	
5.4	Columns - packed column and capillary column - WCOT, SCOT, PLOT	
5.5	Detectors - FID, TCD, ECD, ASD	
5.6	Principle and applications of GC-HS, GC-MS	
Unit 6.	**High Performance Liquid Chromatography**	**08 Hours**
6.1	Introduction, principle and types of HPLC	
6.2	Components of instruments: pumps high pressure, pneumatic, syringe, reciprocating, hydraulic	
6.3	Sample injection system	
6.4	Column	
6.5	Detector: ultraviolet light absorption, refractive index, evaporative light scattering	
6.6	Selective applications in separation and estimations	
6.7	Principle and applications of LC-MS	
Unit 7.	**Ion Exchange and Ion Exclusion Chromatography**	**08 Hours**
7.1	Ion exchangers – types, characteristics and properties	
7.2	Ion exchange equilibrium and factors affecting it	
7.3	Instrumental set up of IEC- columns and detector	
7.4	Principle, procedure and applications of IEC	
7.5	Principle, working procedure and applications of Ion Exclusion Chromatography:	
7.5.1	Gel Permeation Chromatography	
7.5.2	Ion Exclusion Technique	
7.5.3	Inorganic Molecular Sieves	
Unit 8.	**Chemical Sensors and Biosensors**	**08 Hours**
8.1	Definition and classification of sensors, Signal and noise	
8.2	Efficiency of sensors, sensitivity and limit of detection	
8.3	Principle and applications of	
8.3.1	Electrochemical sensors	
8.3.1.1	Coulometry & Potentiometry	

8.3.1.2 Conductometry & Amperometry
8.3.1.3 Polarography & Voltammetry
8.3.2 Solid state electrode & Mass sensitive sensors
8.3.3 Optical sensors & Thermal sensors
8.3.4 Biosensors & Biocatalytic biosensors

References

- Engineering Chemistry, P.C. Jain & Monica Jain, 17th Edition, Reprint 2011, Dhanpatrai Publishing Company (P) Ltd.
- Handbook of Analytical Instrument, R.S. Khandpur,2nd Edition, Reprint 2009, Tata McGraw Hill Publishers.
- Instrumental Methods of Chemical Analysis(Analytical Chemistry) , H. Kaur, 8th Edition, 2012, Pragati Prakashan.
- Basic Concepts of Analytical Chemistry, S.M. Khopkar, 3rd Edition, Reprint 2009, New Age International (P) Limited, Publishers.
- Analytical Instrumentation Handbook, Ewing's , Edited by Jack Cazes, 3rd Edition, 2005, Marcel Dekker Publisher.
- Instrumental Methods of Analysis, H.H.Willard, L.L.Meritt, J.A. Dean and F.A. Settle, 7th Edition,1986, CBS Publishers.
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- Instrumental Analysis, D.A. Skoog, D.M. West, F.J. Holler and S.R. Crouch, 11th Edition, Reprint 2012, Cengage Learning.
- BIOS-Instant Notes-Analytical Chemistry, D. Kealey, P.J. Haines, 2002, Viva Books (P) Ltd.
- Analytical Instrumentation, Bela G. Liptak, 1st Edition,1994, 1st Indian Reprint, 2012, Chilton Book Company.

Name of faculty: Science	**Department:** Microbiology
Program: M.Sc.	**Type:** Theory + Practical
Subject: DSE-2 Bioinformatics & Other "OMICS"	**Semester-**2
Credit: 04 + 02	**Total learning hours:** 60
Course description: The paper mainly emphasizes on study concept development and application of omics and Bioinformatics. The objective of the paper is to introduce students to the rapidly evolving field of bioinformatics. Explain the different NGS study designs, outline the application areas of comparative genomics and proteomics. Describe some relevant databases, sequence alignment methods and various bioinformatics application.	
Student learning outcome: After learning this course students will be able to understand. ● Concept, Mechanism and application genomics, Proteomics and metagenomics ● Students will utilize the available biological database, online resources and tools. ● Students will be able to understand and perform the bimolecular structure visualization, sequences alignment, modelling and drug discovery.	

Unit-1: Genomics (Duration: 08 Hrs)

1.1 Introduction to Genomics: Structural, Functional and Comparative
1.2 Next Generation Sequencing Technologies
1.3 Genome Mapping
1.4 Genome Assembling and annotation

Unit-2: Proteomics (Duration:08 Hrs)

2.1 Genomics to Proteomics: the way forward
2.2 Interaction Proteomics: Methods of Protein-Protein Interaction
2.3 Wet lab Techniques for proteomics data generation: 2-D Differencial gel electrophoresis, Protein Microarray and its Application, Types and Manufacture of protein chip.
2.4 Application of Proteomics.

Unit-3: System Biology (Duration: 07 Hrs)

3.1 Systems biology: Understanding of Biological Systems
3.2 Microbial Metabolomics
3.3 Mass Spectrometry-Based Microbial Metabolomics: Techniques, Analysis, and Applications.
3.4 Concept of Synthetic biology

Unit-4: Other omics (Duration: 07 Hrs)

4.1 Metagenomics: Fundamental concepts, library construction and screening methods

4.2 Mining Metagenomes for Novel Bioactive Molecules

4.3 Transcriptomics: RNA level Gene Expression: DNA Micro array Technology and its Application, Printing Technologies

4.4 Concepts of Culturomics, Metatranscriptomics and Metaproteomics

Unit-5: Major Bioinformatics Resources (Duration:08 Hrs)

5.1 Databases in Bioinformatics

5.2 Sequence databases: NCBI, DDBJ, EMBL, PIR, Swissprot

5.3 3D Structure and classification Database : PDB, MMDB, CDD, E-MSD, 3-D Genomics, CATH, SCOP,InterPro, Prosite, Pfam, ProDom.

5.4 Database Searches: Keyword-based searches using tools like ENTREZ and SRS

5.5 Sequence-based searches: BLAST and FASTA

Unit-6: Sequence Alignment (Duration:08 Hrs)

6.1 Sequence Analysis, Basic concepts: Sequence similarity, identity and Homology, Scoring Matrix.

6.2 Pairwise and Multiple sequence alignments

6.3 Molecular Phylogenetics

6.4 Phylogenetic Tree Construction Methods and Programs

Unit-7: Comparison of protein 3D structures (Duration: 07 Hrs)

7.1 Protein primary structure analysis and prediction.

7.2 Secondary structure prediction: Algorithms viz. Chou Fasman, GOR methods

7.3 Tertiary Structure prediction: Fundamentals of the methods for 3D structure prediction

7.4 Homology/comparative Modeling, fold recognition, threading approaches, and *ab initio* structure prediction methods

Unit-8: Bioinformatics Application (Duration:07 Hrs)

1.1 Bioinformatics Application in drug design: Chemical databases like NCI /PUBCHEM.

1.2 Fundamentals of Receptor-ligand interactions.

1.3 Structure-based drug design:

1.4 Ligand based drug design: Structure Activity Relationship – QSARs & Pharmacophore etc.

1.5 *In silico* predictions of drug activity and ADMET.

References:

Low, L. W. Y., & Tammi, M. T. (Eds.). (2017). Bioinformatics: A Practical Handbook of Next Generation Sequencing and Its Applications. # N/A.

Primrose, S. B., & Twyman, R. (2013). Principles of gene manipulation and genomics. John Wiley & Sons.

Twyman, R., & George, A. (2013). Principles of proteomics. Garland Science.
Baidoo, E. E. (Ed.). (2019). Microbial Metabolomics: Methods and Protocols. Humana Press.
Xiong, J. (2006). Essential bioinformatics. Cambridge University Press.
Kitano, H. (2001). Foundations of systems biology. The MIT Press Cambridge, Massachusetts London, England.
Camilla Benedetti, (2014) Metagenomics methods, applications and perspectives, Nova Publisher.
Kalia, V. C., Shouche, Y., Purohit, H. J., & Rahi, P. (Eds.). (2017). Mining of microbial wealth and metagenomics. Springer Singapore.
Ghosh, Z., & Mallick, B. (2008). Bioinformatics: principles and applications. Oxford University Press.
Rastogi, S. C., Rastogi, P., & Mendiratta, N. (2008). Bioinformatics Methods And Applications: Genomics Proteomics And Drug Discovery 3Rd Ed. PHI Learning Pvt. Ltd.

Further Reading:

Ouellette, B. F., & Baxevanis, A. (Eds.). (2001). Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins. John Wiley.
Pevsner, J. (2015). Bioinformatics and functional genomics. John Wiley & Sons.
Humphery-Smith, I., & Hecker, M. (Eds.). (2006). Microbial proteomics: functional biology of whole organisms (Vol. 48). John Wiley & Sons.
Orengo, C., Jones, D., & Thornton, J. (Eds.). (2003). Bioinformatics: genes, proteins and computers. Taylor & Francis.
Lesk, A. M. (2017). Introduction to genomics. Oxford University Press.
Mount, D. W., & Mount, D. W. (2001). Bioinformatics: sequence and genome analysis (Vol. 1). Cold Spring Harbor, NY: Cold spring harbor laboratory press.
Janitz, M. (Ed.). (2011). Next-generation genome sequencing: towards personalized medicine. John Wiley & Sons.

Practicals:

1) Biological databases search and Retrieval of Data.
2) Pair-wise and multiple sequence alignment
3) Perform the phylogenetic analysis using Clustal Omega
4) ORF Finding
5) Primer designing
6) Protein structure prediction
7) Homology Modeling

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Name of faculty: Dr. Hemangi Desai	**Department:** Chemistry
Program: M.Sc. Organic Chemistry	**Type:** Theory
Semester: II	
Subject: DSE-II- Forensic Chemistry & Toxicology	
Credit: 04(T) + 02 (P)	**Total learning hours:** 60
Course description: This course paper intends to deal about the Forensic Toxicology, the branch of science that applies the principles and knowledge of toxicology to issues and problems in the field of law. To achieve this, techniques of analytical chemistry are combined with principles of toxicology to address issues related to the toxic effects of substances on humans that are germane to judicial proceedings. Analytical chemistry deals with the techniques and methods for determining the identity and relative amounts of unknown components in a sample of matter.	
Student learning outcome: At the end of the course students will be able to learn... • Forensic chemistry and its scope, • Examination of petroleum products, fires, explosives, • Types of forensic toxicology, analysis, extraction, isolation and clean up procedures, • Forensic examination of metallic poison and various organic-toxic compounds.	

Unit 1: Forensic Chemistry and its Scope **(16 hrs)**

1.1 Analysis of beverages:
Alcohol and Non- alcoholic, country made liquor, illicit liquor

1.2 Drugs of abuse: Introduction, Classification, Narcotic drugs & Psychotropic substances, drugs of abuse in sports.

1.3 Brief Introduction to Drugs and cosmetic act, Excise Act, NDPS Act

1.4 Analysis of Gold and Other metals in cheating cases.

Unit 2: Examination of Petroleum Products **(14 hrs)**

2.1 Distillation & Fractionation, various fraction and their commercial uses.

2.2 Standard methods of analysis of petroleum products for adulteration

2.3 Trap cases: purpose, examination of chemicals used in trap case

2.4 Cement: Composition, types and Forensic analysis, Mortar & Concrete

Unit 3: Fires **(13 hrs)**

1.1.1 Nature and Chemistry of fire, Classification

1.2 Igniters of fires, Phases of fires, Main types of fires

1.3 Examination of scene of fires

1.4 Arson: Relevant IPC sections, Motives, Analysis of Accelerants

Unit 4: Explosives **(14 hrs)**

4.1 Classification, Comparison & characterization of explosives

4.2 Military & Commercial explosives

4.3 Qualitative determination: Detection of Explosophores (anions), Detection of Black powder, Nitrocellulose and Dynamite,

4.4 Quantitative determination

Unit 5: Forensic Toxicology **(14 hrs)**

5.1 Introduction, concept and Significance

5.2 Poisons: Definition, Classification of poisons

5.3 Types of poisoning sign and symptoms of poisoning

5.4 Mode of action, factors modifying the action of poisons

5.5 Toxicological exhibits in fatal and survival cases

5.6 Preservation Treatment in cases of poisoning

5.7 Analysis report

Unit 6: Extraction, Isolation and Clean-up procedures (15 hrs)

6.1 Non-volatile organic poison

6.2 Stas-otto, Dovbriey Nickolls (Ammonium sulphate) method, acid digest and Valov(Tungstate) methods, Solid phase micro extraction techniques, Solvent extraction methods

6.3 Volatile Poisons: Industrial solvent acid and basic Distillation

6.4 Toxic Cations: Dry Ashing and Wet digestion process

6.5 Toxic Anions: Dialysis method total alcoholic extract

Unit 7: General Study and Analysis (13 hrs)

7.1 Barbiturates, methaqualone, Hydro morphine, Methadone, Meprobamate, Mescaline, Amphetamines, LDS, Heroin, Cannabinoids, Phinothiazines

7.2 Insecticides: Types, General methods for their analysis

7.3 Alkaloids: Definition, classification, Isolation and General characterization.

7.4 Analysis of Ethyl Alcohol in blood and urine, illicit liquor, Methanol, Acetone, Chloroform, Phenol

7.5 Snake venoms and Poisons, Irrespirable gases

7.6 Vegetable poisons, Opium, Abrus, Cynanogenetic glycosides, Dhatura, Marking nuts, Nux-vomica, Oleander and Aconite

7.7 Forensic Pharmacological studies:
Absorption, Distribution, Metabolism, Pathways of drug metabolism

Unit 8: Forensic Examination of Metallic Poisons (14 hrs)

8.1 Absorption, Distribution, Metabolism, Pathways of metallic poison metabolism: Arsenic, Mercury, Lead, Bismuth, Copper, Aluminium, Iron, Barium, Zinc.

References:

1. Vogel's Textbook of Quantitative Chemical Analysis, Maudham Bassett et.al; 6th Edition, 2004, Longman Essex.
2. Organic Chemistry Vol. II, I. L. Finar, Pearson Education, Singapore.
3. Organic Chemistry, R.T. Morrison, R.N. Boyd; 6th Edition., 2003, Prentice Hall, New Delhi.
4. Vogel Textbook of Practical Organic Chemistry, Brean S. Furniss et. al; 1998, Addison Wesley Longman, Edinburg.
5. Medicinal Chemistry, A. Burger, Vol. II, 1970, Wiley Interscience, NY.
6. D. A. Skoog, D.M. West, F.J. Holler; Analytical Chemistry – An Introduction, 7th Edition, 2000, Saunders College Pub. Philadelphia, USA.
7. Working Procedure Manual – Chemistry, Explosives and Narcotics, 2000, BPR&D Pub. 11. Official and standardized Methods of Analysis, C.A. Watson, 1994, Royal Society of Chemistry, UK.
8. Modi's Medical Jurisprudence & Toxicology, 1988, M. M. Trirathi Press Ltd. Allahabd.
9. Forensic Science Hand Book, Vol I, II and III, Saferstein, R., 1982, Pretince Hall, NI.
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11. Poison Detection in Human Organs Curry, A.S., 1976.
12. Forensic Science, Handbook, Vol. I, II & III, Saferstien, Prentice Hall Inc, USA.
13. Encyclopedia of Forensic Sciences Vol. I, II and III, J. A. Siegel, P.J Saukko, 2000, Acad. Press.

Laboratory Practical

1. Estimation of mixture (Acid + Amide)
2. Estimation of mixture (Acid + Ester)
3. Organic synthesis of Paracetamol.
4. Organic synthesis of 6 - methyluracil.
5. Organic synthesis of Acridone.
6. Organic synthesis of Methyl Orange.
7. Determination of Phenol in water sample by Spectrophotometer.
8. Determination of COD in water sample by Spectrophotometer.
9. Estimation of Sugar in natural sample by Spectrophotometer.
10. Identification of salts and metals by simple colour test and group analysis.
11. Identification of different vegetable poison by colour test, chromatography etc.
12. Identification of insecticides and pesticides by TLC/ colour test.

References:

1. Standard Methods for Examination of Water & Wastewater, Andrew D. Eaton, Lenore S. Clesceri, Eugene W. Rice, Arnold Greenberg, 23rd Edition, 2017, published by APHA, AWWA, WEF.
2. Official Methods of Analysis, Dr. William Harwitz, Dr. George W Latimer, 18th Edition, 2005, published by Association of Officiating Analytical Chemists (AOAC).
3. Analytical Techniques in Agriculture, Biotechnology and Environmental Engineerin; A. Nag; 1st Edition, 2006, Prentice Hall of India.
4. Laboratory Manual in Biochemistry – J. Jayaraman, 2011, New Age Publication.
5. Analytical Chemistry, H. Kaur, 1st Edition, 2013, Pragati Prakashan.

Name of faculty: Science	**Department:** Environmental Science
Program: M.Sc.	**Type:** Theory
Subject: DSE-3 Intellectual Property Rights	**Semester:** 3
Credit: 04 + 02	**Total learning hours:** 60

Student learning outcome:

At the end of the course students will be able to...understand about

- The course is designed to provide comprehensive knowledge to the students regarding principles of IPR, concept and theories.
- The course is designed to provide knowledge regarding historical development, procedure for granting patent, infringement.
- The course is designed to provide comprehensive knowledge to the students regarding the effect of IPR especially of patents on emerging issues like public health, climate, Domain Name Disputes and Cyber-squatting, Bio piracy etc. and the ways to tackle this problem,

Unit-1: Introduction to IPR (7 Lecture)

1.1 Introduction, concept and theories
1.2 Kinds of IPR
1.3 Need for private rights versus public interests
1.4 Advantages and disadvantages of IPR

UNIT-2: Criticism and world Scenario (7 Lecture)

2.1 Criticisms of IPR
2.2 Politics of IPR
2.3 Third World Criticisms and Marxist Criticisms
2.4 International Regime relating to IPR, TRIPs and other triaties (WIPO,WTO,GATTS)

UNIT-3 Patent law-1 (7 Lecture)

3.1 Research exemption and historical development in IPR law
3.2 Concepts in IPR: novelty, utility, inventiveness/non-obviousness
3.3 Patent protection: software patent, product, process and microorganisms
3.4 Patent Act-1970-amendments of 1999,2000,2002 and 2005

UNIT-4 Patent law-2 (7 Lecture)

4.1 Rights of patentee
4.2 Procedure for granting a patent and obtaining patent
4.3 grounds for opposition
4.4 Working of patents, compulsory license, acquisition, surrender, revocation and restoration
4.5 Transfer of patent rights.

UNIT-5 Infringement of IPR (7 Lecture)

5.1 Introduction to direct, contributory and induced
5.2 Ingringer and determined
5.3 Official machinery, controller, powers and functions
5.4 Defenses to infringement

UNIT-6 Copyright and law (7 Lecture)
6.1 Copyright and neighboring right : Concept and principles
6.2 Copyright: registrar, procedure, ownership, licence and translation of copyright
6.3 Copyright Act, 1957 and International copyright law
6.4 copyright in computer program, dramatic-musical, literary,special rights, broadcasting and performers.
6.5 Infringement: criteria and importance

Unit-7 Trade mark and TRIPS (7 Lecture)
7.1 Introduction: trade mark and TRIPS
7.2 Registration and procedure of trademark.
7.3 TRIPS Flexibilities and access to medicine
7.4 Infringement of trademark

Unit-8 Emerging Issues and challenges (7 Lecture)
8.1 Public health, Climate change and IPR
8.2 Patents and biotechnology
8.3 Bio piracy
8.4 Domain name disputes and cyber squatting

References and Textbooks:

- D.P. Mittal (Taxman Publication), Indian Patents Law and Procedure
- B.L. Wadera, Patents, trademarks, copyright, Designs and Geographical Judications.
- P. Narayanan (Eastern Law House), Intellectual Property Law
- N.S. Gopalakrishnan & T.G. Agitha, Principles of Intellectual Property (2009), Eastern Book Company, Lucknow
- Ganguli (Tata Megraw), Intellectual Property Rights
- Brinkhof (Edited), Patent Cases, Wolters Kluwer
- Prof. Willem Hoyng & Frank Eijsvogels, Global Patent Litigation, Strategy
- Hilarry Pearson and Clifford Miller, Commercial Exploitation of INtellectual Property

Practicals:
1. Searching of chemical/biological process patent.
2. Searching of trademark in computer/instrumentation .
3. Review the case study of Beyer pharmaceutical/Novartis pharmaceutical .
4. Review the case study of Beyer pharmaceutical/Novartis pharmaceutical.