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| **Name of faculty:** Science | **Department:** Biotechnology |
| **Program:** M.Sc. Biotechnology | **Type:** Theory + Practical |
| **Subject:** DSC-3 Agriculture Biotechnology | **Semester:** 8 |
| **Credit:** 04 + 02 | **Total learning hours:** 60 |

**Course description:**
The course will provide a firm idea regarding History of agriculture in India and globally. Further the course aims to expose students to the basic scientific evidence and technical aspects of the different disciplines of agricultural biotechnology and its modern applications. It clarifies major scientific, ecological and sociological aspects of biotechnology in agriculture and food production.

Student learning outcome: After completion of the course:

- Students will understand basic concepts, principles and processes in agriculture biotechnology.
- Students will acquire knowledge about the range of approaches to manipulate and improve overall crop yield and survival ability in plants
- Students will demonstrate the ability to develop, interpret, and critically evaluate modern approaches to scientific investigation in the field of plant sciences
- Students shall be able to evaluate and apply effective technologies in genetics and molecular biology for crop improvement.
- Analyse the complex problems of agriculture and address issues through use of modern tools and techniques in biotechnology

**Unit 1 Introduction and History of Agriculture (5 hours)**
1.1 Brief history of agriculture and present agricultural research systems of India
1.2 National Agricultural Research Systems (NARS) and Regional Agricultural Research Institutions
1.3 Global agricultural research system: Need, Scope & Opportunities, Consultative Group on International Agricultural Research (CGIAR) system
1.4 Other International Centres, Site for International fellowship for scientific mobility

**Unit 2 Gene transfer in plants (7 hours)**
3.1 Physical Modes of Gene transfer
3.2 Screenable and selectable markers
3.3 Chloroplast transformation: Advantages and success
3.4 Methods for developing marker free transgenics

**Unit 3 Agrobacterium Biology and transformation (7 hours)**
2.1 Agrobacterium plant interaction, Opines and their significance
2.2 Disarming the Ti plasmid, T-DNA transfer, Issues with Monocot transformation
2.3 Vectors for plant transformation: cointegrate and binary vectors
2.4 *In-planta* transformation and its application

**Unit 4: Stress physiology and biochemical aspect of biotic stress (10 hours)**
4.1 Biotic stress: coat protein mediated and nucleocapsid mediated viral resistance
4.2 Fungal diseases: chitinase, 1-3 beta-glucanase, PR proteins
4.3 Insect pests resistance: Bt genes, Non-Bt like protease inhibitors, alpha amylase inhibitors
4.4 Herbicide resistance: Phosphinothricin, glyphosate, sulfonylurea, atrazine

**Unit 5: Molecular and biochemical aspect of abiotic stress (8 hours)**
5.1 Abiotic stress: Physiological and molecular responses of plants against abiotic stresses
5.2 Flooding and submergence tolerance, Hypoxia and Anoxia
5.3 Extended shelf life of fruits and flowers: use of ACC synthase, Polygalacturanase, ACC oxidase
5.4 Male sterile lines: bar and barnase system

**Unit 6: Molecular markers and innovative approaches of plant breeding (8 hours)**
6.1 Principles and applications of molecular markers: RFLP, RAPD, AFLP, SSR, and SNPs
6.2 Mapping populations- Back Cross, F2, NILs, RILs, NAM
6.3 Development of SCAR, SSR, ISSR, CAPS and SNP markers
6.3 Marker Assisted Selection, QTL mapping, Basics of Genome wide association studies

**UNIT 7: Genetic engineering approaches for Crop Improvement (8 hours)**
7.1 Enhancing photosynthetic, nutrient use efficiencies of plants
7.2 Quality improvement: Seed storage proteins; heterologous protein production
7.3 Heterosis and Apomixis
7.4 Food and feed safety issues associated with transgenic crops

**Unit 8: Agricultural Entrepreneurship: Biofertilizer and Mushroom Biology (7 hours)**
8.1 Microbes as biofertilizer, Biofertilizers vs Chemical fertilizers; Nitrogen fixers types and examples
8.2 Phosphate solubilizers, mycorrhizae and their applications, Biofertilizer Entrepreneurship
8.3 Medicinal and Nutritional value of mushrooms, Mushroom cultivation and Post-Harvest Technology
8.4 Economics and Entrepreneurship in mushroom cultivation.

**References and Textbooks:**


1. Adrian Slater, Nigel Scott and Mark Fowler, Plant Biotechnology: The genetic manipulation of plants, 2nd Edition, Oxford University Press, 2003
2. Introduction to Plant Biotechnology. 2nd edition. By H. S. Chawla. Oxford & IBH publishing Co. Pvt. Ltd. New Delhi.
3. Plant Biotechnology and Genetics: Principles, Techniques and Applications, Edited by C. Neal Stewart JR. John Wiley and Sons Publications 2008
4. Marker Assisted Plant Breeding: Principles and practices, B.D Singh and A.K Singh, Springer 2015

5. Plant Biotechnology Vol-I, Plant Genetic Engineering, Edited by Don Grierson, Blackie Academic and Professional 1991
6. Salisbury,P.B. & Ross,C.W.(1992).Plant Physiology.Wadsworth Publishing,California.
7. Lincoln Taiz and Eduardo Zaiger (4th Edition), Plant Physiology, Sinqaur Associates Inc. Publishers.
8. Krishnamoorthy, 1999. Hand Book of Mushroom Cultivation. TNAU Publications, Coimbatore, TN, India.
9. Biswas, S, Datta, M and Nagachan, S.V. 2012. Mushrooms- A manual for cultivation. PHI Learning Private Limited, New Delhi
10. SubbaRao, N. S., 1998, Biofertilizers in agriculture and forestry. India Book House Ltd. New Delhi.

**Practicals**

1. Quantitative analysis of important phytochemicals from suitable plant sources (any three).
2. Determination if in-vitro antioxidant activity using DPPH assay
3. Estimation of antioxidant enzymes namely Ascorbate peroxidase, Superoxide dismutase, Catalase from plant leaf

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| **Name of the Faculty: Science** | **Department: Biotechnology** |
| **Program:** M.Sc. Biotechnology | **Type:** Theory + Practical |
| **Subject:** DSC-4 Aquaculture Technology | **Semester-**8 |
| **Credit:** 04 + 02 | **Total Learning Hours:** 60 |
| **Course Description:** This course exposes students to the fields, applications of Aquaculture by providing fundamental knowledge about the subject & prepares them for its practical execution. | |
| **Student Learning Outcome:** After completion of the course student will<br>1) know the applications, importance, global scenario, challenges & different areas of aquaculture.<br>2) be able to apply the learnt skills in small scale entrepreneurship or start a business.<br>3) be able to do research in irrelevant areas of aquaculture.<br>4) be prepared for QA/ QC jobs in aquaculture related companies, food processing industries. | |

**Unit -1 Introduction (05 hours)**
1.1 Definitions & History
1.2 Objectives & Advantages of Aquaculture
1.3 Role of Biotechnology in Aquaculture
1.4 Status of Aquaculture- Global & Indian Scenario
1.5 Impact of Aquaculture

**Unit- 2 Types of Culture Systems & Different Culture Practices (06 hours)**
2.1 Cage & Tank Culture
2.2 Recirculating & Raceway systems
2.3 Monoculture
2.4 Polyculture
2.5Intensification of Culture

**Unit-3 Diseases in Aquaculture (09 hours)**
3.1 Immunology & defence mechanism in fin & shell fishes
3.2 Types of diseases (Nutritional, Protozoal, Fungal, Bacterial, Viral)
3.3 Diagnostic tools
3.4 Management, Treatment & Prevention
3.5 Vaccines

**Unit-4 Feed Formulation in Aquaculture (08 hours)**
4.1 Importance of Feed/ Nutrition
4.2 Types of Food & feedstuffs
4.3 Feed Formulation tools & techniques
4.4 Feed development Process
4.5 Food supplements, Prebiotics, Probiotics & Synbiotics

**Unit-5 Aquaculture Biotechnology (09 hours)**
5.1 Molecular genetic tools & applications
5.2 Current techniques of Fish Cytogenetic
5.3 Fish Genome manipulation
5.4 Tissue Culture in Seaweeds & Pearl Oysters

5.5 Transgenic Fish

**Unit-6 Biotechnology in Aquaculture Breeding (08 hours)**
6.1 Fish Hybridization
6.2 Induced Breeding & Hatcheries
6.3 Hormonal manipulation of sex
6.4 r-hormones & growth factors
6.5 Cryopreservation of fish gametes

**Unit-7 Prawn Culture & Processing (07 hours)**
6.1 Prawn culture methods
6.2 Constraints in shrimp & prawn culture
6.3 Harvesting
6.4 Post Harvest Technology
6.5 Processing for preservation

**Unit-8 Algal Biotechnology (08 hours)**
6.1 Economic Importance of Seaweeds & Algae (uses & products)
6.2 Microalgae culture
6.3 SeaWeed Culture
6.4 Algal blooms & Bio fouling
6.5 Bioactive Compounds from algae & Molecular farming

**References & Textbooks**


- Aquaculture Technology & environment by Ujwala Jadhav, PHI Learning Pvt. Ltd.
- Fish Genetics by Sangeeta Malvee, SBS Pub & Dist. Pvt. Ltd
- General & Applied Ichthyology by S k Gupta & P C Gupta, S Chand Pub.
- Algal Culturing Techniques by Rober Anderson, Elsevier


**List of Open Source Software/ Learning Websites**
1) http://eprints.cmfri.org.in/ CMFRI Repository
2) http://www.cmfri.org.in/video-gallery

**Practicals**
1) Proximate Analysis of Fish Feed / Edible fish / Fish – Prawn waste material/ Prawn Feed – Protein, Carbohydrates, Fats, Moisture, Fiber
2) Study of Fish diseases
3) Algal Culture
4) Study of Fish Gill Chromosomes
5) Visit to Aquaculture/ prawn Culture Farm/ Prawn processing unit/ Feed Development plant/ Induced breeding Centre/ Fish Cytogenetic lab (OR) Review Article on recent advances & challenges in Aquaculture technology (OR) one week training/internship at an aquaculture farm/ processing unit / aquaculture related lab

**Reference and Textbooks for Practical:**

- General & Applied Ichthyology by S k Gupta & P C Gupta, S Chand Pub.
- Algal Culturing Techniques by Rober Anderson, Elsevier

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| **Name of faculty:** Science | **Department:** Chemistry |
| **Program:** M.Sc. | **Type:** Theory + Practical |
| **Subject :** SEC-2 Instrumentation and Analytical Techniques | **Semester-**8 |
| **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:**<br>At the end of the course students will be able to... Learn<br>● 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:<br>● Visible Spectroscopy<br>● Atomic Absorption Spectrometry<br>● Optical Emission Spectrometry<br>● Advanced Instrumentation Techniques<br>● Gas Chromatography<br>● High Performance Liquid Chromatography<br>● Ion Exchange and Ion Exclusion Chromatography<br>● 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

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| **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.
- Instrumental methods of analysis, B.K. Sharma, 24th Edition, 2005, Goel Publishing House.
- 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.

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|---|---|
| **Name of Faculty:** Dr. Ratna Trivedi | **Department:** Environmental Science |
| **Program:** M. Sc. | **Type of Subject:** Theory |
| **Subject:** Intellectual Property Rights | |
| **Semester-**3 | |

**Student Learning Outcomes (SLOs):**

- 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,

**References and Textbooks: (With Author, Edition, Publishers, ISBN)**


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


**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 Paten 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

**Practical's:**
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.

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| **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.<br>● Concept, Mechanism and application genomics, Proteomics and metagenomics<br>● Students will utilize the available biological database, online resources and tools.<br>● 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:**<br>At the end of the course students will be able to learn...<br>• Forensic chemistry and its scope,<br>• Examination of petroleum products, fires, explosives,<br>• Types of forensic toxicology, analysis, extraction, isolation and clean up procedures,<br>• 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:**


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## 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.

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