

**Faculty of Science**

**SHREE RAMKRISHNA INSTITUTE OF COMPUTER EDUCATION AND APPLIED SCIENCES, SURAT**

**M.Sc. Microbiology**

Syllabus

(Effective from 2021)

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| **M.Sc. Microbiology** | |
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**A. About M.Sc. Microbiology Programme**

The M.Sc. Microbiology programme offered by Sarvajanik University is of two years’duration and is divided into four semesters. The various courses of the programme are designed to include classroom teaching and lectures, laboratory work, project work, viva, seminars, assignments and field trips. Three categories of courses are being offered in this programme: Core courses, Skill enhancement courses and Elective course. A separate research-based course that leads to a dissertation is also one of the Core Courses offer in the final semester. The student presents his/ her research orally at the end of the semester, and this is coupled to a *viva-voce*. This not only equips the student for a career in research/ industry, but also fosters self-confidence and self-reliance in the student as he/she learns to work and think independently. Thirty percent of the total marks for each course will be awarded through Internal Assessment. Particular emphasis is laid on the practical aspects of the field. Students are taught how to plan experiments, perform them carefully, analyze the data accurately, and present the results both, qualitatively and quantitatively.

**B. Programme Objective**

Through the stimulus of scholarly progression and intellectual development the programme aims to equip students with excellence in education and skills, thus enabling the student to pursue a career of his/her choice.

By cultivating talents and promoting all round personality development through multi-dimensional education a spirit of self-confidence and self-reliance will be infused in the student.

The student will be instilled with values of professional ethics and be made ready to contribute to society as responsible individuals.

**C. Eligibility**

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|    | A candidate must have passed Bachelor’s degree in Microbiology / Medical  Technology/Biotechnology/Environmental Science / Industrial Microbiology  /Bioscience / General Science/ Life-Science / Botany/Plant Science/Zoology/Animal  Science/ Biology /Agriculture/Fisheries/Forestry /others.  The candidate who has passed equivalent exam from other subjects or boards need to  avail eligibility certificate for this programme from the Board of Equivalence (BoE)  of the Sarvajanik University. |

**D. M.Sc. Microbiology Course Structure**



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| --- | --- | --- | --- | --- | --- | --- |
| **Sem** | **Course Type** | **Course Code** | **Paper Title** | **Hours/Week** | | **Credi t** |
| **Th** | **Pr** |
| 1 | Core  course | DSC-1 | Principles of Microbiology &Microbial Diversity | 4 | 4 | 4+2 |
| DSC-2 | Agriculture & Environmental Microbiology | 4 | 4 | 4+2 |
| SEC | SEC-1 | Molecular biology & Genetic Engineering | 4 | 4 | 4+2 |
| Elective | DSE-1 |  | 4 | 4 | 4+2 |
| 2 | Core  course | DSC-3 | Microbial Physiology & Metabolism | 4 | 4 | 4+2 |
| DSC-4 | Immunology and molecular pathogenesis | 4 | 4 | 4+2 |
| SEC | SEC-2 | Instrumentation and analytical techniques | 4 | 4 | 4+2 |
| Elective | DSE-2 |  | 4 | 4 | 4+2 |
| 3 | Core  course | DSC-5 | Economic Microbiology | 4 | 4 | 4+2 |
| DSC-6 | Enzyme Technology & Protein Engineering | 4 | 4 | 4+2 |
| SEC | SEC-3 | Pharmaceutical Microbiology & Drug Development | 4 | 4 | 4+2 |
| Elective | DSE-3 |  | 4 | 4 | 4+2 |
| 4 | Core  course | DSC-7 | Dissertation | 32 | | 16 |
| DSC-8 | Seminar Presentation | 4 |
| DSC-9 | Review of published research paper/Article | 4 |
| Total Credit | | | | | | 96 |
| **Note:** DSC – Discipline Specific Core, DSE - – Discipline Specific Elective, SEC - Skill Enhancement Course | | | | | | |

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| **Semester** | **DSE (Any one to be opt)** |
| 1 | |  |  | | --- | --- | | 1.  2.  3.  4. | Food Chemistry  Energy and Environment  Laboratory safety and management Bioethics & Biosafety | |
| 2 | |  |  | | --- | --- | | 1.  2.  3.  4. | Forensic Chemistry & Toxicology Bioinformatics & Other “OMICS”IPR  Biostatistics. | |
| 3 | |  |  | | --- | --- | | 1.  2.  3.  4. | Forensic biology and DNA typing Research Methodology  Bioentrepreneurship  Application of Green Chemistry | |

**E. Evaluation Scheme**



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| **M.Sc. Microbiology** | | | | | |
| **Evaluation** | **Criteria** | **Theory** | **Practical** | **Dissertation** | **Seminar/ Review of published research**  **paper** |
| Internal | Continuous &  Comprehensive  Evaluation (CCE) | 40 | 60 | 140 | 60 |
| Attendance | 10 | 10 | 10 | 10 |
| Assignment | 20 | ---- | ---- | ---- |
| Internal Practical Test and Viva – Voce / | ---- | 70 | ---- | ---- |
|  | Internal assessment | ---- | ---- | 50 | 30 |
| External | External Evaluation | 30 | 60 | 100 | 50 |
| Total | | 100 | 200 | 300 | 150 |



**F. Syllabus**   
 **Semester 2**   
 **Microbial Physiology and Metabolism**

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| **Name of faculty:** Science | **Department:** Microbiology | |
| **Program:** M.Sc Microbiology Sem-II | **Type:** DSC-3 | |
| **Subject:** Microbial Physiology and Metabolism | | |
| **Credit:** 4+2 | | **Total learning hours:** 60 |
| **Course description:**  Microbial Physiology is a concentrated course with the goal of integrating microbial biochemistry and physiology to enhance the understanding of the microbial cell and the diverse nature of various life processes, which provides opportunity to re-address the learning about general scientific conceptions. This course will attempt learning to provide a balance central metabolism,energy conservation and integration of metabolic events. | | |
| **Student learning outcome:**   |  |  | | --- | --- | |    | Students will learn about various events in the subject of microbial physiology and metabolism. Along with microbial transport of molecules and various metabolic pathways They will also learn working of metabolic potential of micro-organisms  After completing this course, students will have the clear understanding about microbial physiology and metabolism with enhance ability to solve metabolic and physiological issues. | | | |

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| **Unit-1: Energy Metabolism and Transport of Molecules** | | **(Duration: 08 Hrs)** |
| 1.1 | Properties of biomolecules and foundations of life |
| 1.2 Thermodynamics  1.3 Transport of molecules  1.4 Role of ATP & ATP Synthase complex | |

**Unit-2: Metabolism of Carbohydrate**   
2.1 Glycolysis & Gluconeogenesis   
2.2 Pentose Phosphate pathway   
2.3 Citric acid cycle   
2.4 Glyoxylate cycle   
2.5 Photorespiration and C4& CAM pathways

**Unit-3: Metabolism of Lipids**   
3.1 Lipid digestion, Absorption and Transport 3.2 Fatty acid oxidation and Ketone Bodies 3.3 Biosynthesis of Fatty Acid

**(Duration: 08 Hrs)**

**(Duration: 08 Hrs)**

3.4 Regulation of Fatty acid Metabolism

**Unit-4: Metabolism of Amino acid and Protein** 4.1 Metabolic fate of amino group   
4.2 Nitrogen Excretion and Urea cycle   
4.3 Catabolism of amino acids   
4.4 Protein metabolism



**(Duration: 8 Hrs)**

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| **Unit-5: Metabolism of Nucleotide**  5.1 de novo pathway  5.2 Salvage pathway degradation of Nucleotide 5.3 Ribonucleotide reductase  **Unit-6: Oxidative Phosphorylation**  6.1 Electron Transfer reaction in mitochondria 6.2 ATP synthesis  6.3 Regulation of oxidative Phosphorylation  **Unit-7: Photosynthesis**  7.1 General features of photophosphorylation 7.2 Light driven electron flow  7.3 ATP Synthesis by photophosphorylation 7.4 The evolution of oxygenic photosynthesis | **(Duration: 8 Hrs)**  **(Duration: 8 Hrs)**  **(Duration: 8 Hrs)** |

**Unit-8: Integration of metabolism** 8.1 Metabolism in starvation   
8.2 Hemoglobin metabolism

**(Duration: 4 Hrs)**

**Reference Book:**  
 Berg , Jeremy M, Tymoczko, JohnL., Stever, Lubert Biochemistry 6th edition Published by W.H Freemaan. (2006) ISBN 0716787245  
 Donald J Voet Judith G Voet, Charlotte W. Pratt. Principles of Biochemistry 3rd Edition John Wiley & Sons, Inc (2008).ISBN-13 978-0470-23396-2S  
 Michael M.Cox,David L. Nelson. Lehninger Principles of Biochemistry 5th Edition .W.H. Freeman and Company (2008) ISBN 978-0-230-22699-9  
 Pankaja Naik Biochemistry 4th edition Jaypee The Health Sciences publisher (2016) ISBN 978-93-5152-989-7  
 Robert K Murray,Daryl K Granner, Victor W Rodwekk Harpers Illustrated Biochemistry. 27th Edition Mc Graw Hill (2006). ISBN 007-125301-7(India )

**Further Reading:**  
 Denise R Ferrier Lippincott Illustrated Reviews Biochemistry Wolters Kluwer India Pvt Ltd (2020). ISBN 978-9389859751



J.L.Jain , Sunjay Jain, Nitin Jain Fundamentals of Biochemistry S.Chand Publishing ( 1979). 9788121924535  
U. Satyanarayana, U Chakrapani Biochemistry 5th edition Elesvier (2020) ISBN 978- 8131262535   
 **List of Practical**

1) Estimation of DNA by DPA and RNA by orcinol method.

2) Estimation of lipid by Bligh and Dyer’s/ van Handel’s method.

3) Electrophoretic separation of protein by PAGE: SDS & Native 4) Isolation of respiratory deficient mutant by UV radiation in yeast cell. 5) Study of chemical mutagenesis in *E. coli.*

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| **Immunology and Molecular Pathogenesis** |  |

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| **Name of faculty:** Science | **Department:** Microbiology | |
| **Program:** M.Sc. Microbiology Sem-II | **Type:** DSC-4 | |
| **Subject:** Immunology and Molecular Pathogenesis | | |
| **Credit: 4+2** | | **Total learning hours:**60 |
| **Course description:**  This course is the preamble of novel approach of the immune response, molecular mechanisms of disease/infections consequences. It also emphasizes on pathogenic strategies, immune modulation and its combat mechanisms. It is the enrichment of knowledge towards the mechanisms of pathogenesis and molecular approaches, particularly toward host – parasite interactions | | |
| **Student learning outcome:**   |  |  | | --- | --- | |    | Students understanding will enriched about the immune resistance and related cells, tissues and organs participation  Students will be benefited by understanding the concept of host-parasite interactions at molecular level and thereby various immune responses to invaders  Students will be conceptualized about the Immunodeficiency, Transplantation Immunology and Immunotherapy | | | |

**Unit-1: Introduction to the Immune system**  **(Duration: 8 Hrs)**  1.1 Properties and overview of Immune response   
 1.2 Innate Immunity   
 1.2.1 Features of Innate Immune Recognition   
 1.2.2 Components of Innate Immune System   
 1.2.3 Role of Innate Immunity   
 1.3 Cells and Tissues of the Adaptive Immune System   
 1.3.1 Cells of the Adaptive Immune system   
 1.3.2 Anatomy and functions of Lymphoid tissues   
 1.3.3 Pathway and mechanisms of Lymphocyte Recirculation and Homing

**Unit-2: Effector Mechanisms of Immune Responses**  **(Duration: 6 Hrs)**  2.1 Cytokines regulate Innate Immunity   
 2.2 Cytokines regulate Adaptive Immunity   
 2.3 Cytokines that stimulate Haematopoiesis

**Unit-3: Immune response to Invaders** 3.1 Immune response to Bacteria 3.2 Immune response to Fungi   
3.3 Immune response to Virus

**(Duration: 6 Hrs)**

3.4 Immune response to Parasites



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| **Unit-4: Primary Immunodeficiency: I**  4.1 Combined immune deficiencies disrupt adaptive immunity 4.2 B-cell immune deficiencies  4.3 Complement deficiencies  **Unit-5: Secondary Immunodeficiency: II**  5.1 HIV/AIDS  5.2 Pathogenesis of HIV infections and AIDS 5.3 Clinical Features of HIV Disease  5.4 Immune Response to HIV  5.5 Vaccine Development  **Unit-6: Transplantation Immunology and Immunotherapy** 6.1 Immune Response to Allograft  6.2 Effector mechanisms to Allograft Rejection  6.3 Prevention and treatment of Allograft Rejection  6.4 Xenogeneic and Bone marrow transplantation  6.5 Immunotherapy  **Unit-7: Pathogenic Strategies and Immune Response**  7.1 Induction of immunological tolerance  7.2 Immunosuppression  7.3 Absence of suitable target for the immune response 7.4 Induction of inappropriate antibody and T cell responses 7.5 Antibodies mapped by soluble microbial antigens  7.6 Local intemperance with immune responsiveness  7.7 Antigenic Variation | **(Duration: 6 Hrs)**  **(Duration: 6 Hrs)**  **(Duration: 10 Hrs)**  **(Duration:10 Hrs)** |

**Unit-8: Mechanisms of Cell and Tissue Damage** 8.1 Infection with no cell or tissue damage 8.2 Direct damage by microorganisms   
8.3 Microbial Toxins   
8.4 Immunopathology   
8.5 Other indirect mechanisms of damage

**(Duration: 8 Hrs.)**

**Reference Book:**  
 Abbas A K et al (2007). Cellular and Molecular Immunology, 6th Ed,Elsevier: *ISBN*: 9781437715286  
 Mims, C. A. et al (2000).MIMS’ Molecular pathogenesis of Infectious Disease, 5th Ed. Academic Press: ISBN: 9780123977816.

Owen et al (2013). Kuby Immunology, 7rth Edi., W. H. Freeman, : ISBN: 9781429219198



Paul W E. (2008), Fundamental Immunology, 7th Ed., Wolters Kluwer: ISBN: 9781451117837

**Further Reading:**  
 Peter J Delvis et al (2017). Roitt's Essential Immunology, 13thEdi., Wiley-Blackwell, ISBN: 978-1118415771  
 Willium B. Coleman & Gregory J Tsongalis, Molecular Pathology: The Molecular Basis of Human Disease, 2ndEdi., Academic Press. ISBN: 978-0128027615

**List of P[r](https://www.amazon.in/Roitt%E2%80%B2s-Essential-Immunology-Essentials-Delves/dp/1118415779/ref=zg_bs_4149595031_10?_encoding=UTF8&psc=1&refRID=W4Z23VGYJHGKF5QBNC1T)actical**

1) ELISA detection of anti-HIV sera   
2) ELISA detection of HBsAg   
3) To study pathogenicity of *Stphylococcus aureus* by coagulase test. 4) To study immunoprecipitation reaction.

5) Ouchterlony double diffusion technique.

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| **Instrumentation and Analytical Techniques** |  |

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| **Name of faculty:** Science | | **Department:**Chemistry |
| **Program:** M.Sc. Sem-II | | **Type:** SEC-2 |
| **Subject:** Instrumentation and Analytical Techniques | | |
| **Credit: 4+2** | **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 | | | |

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| **Unit 1: Visible Spectroscopy** | | | **(Duration: 06 Hrs)** |
| 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** | | | **(Duration: 08 Hrs)** |
| 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 | | | |

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| **Unit 3: Optical Emission Spectrometry** | | | **(Duration: 08 Hrs)** |
| 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** | | | **(Duration: 06 Hrs)** |
| Principle, Instrumental set up & Applications of 4.1 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 Naphelometry | | | |
| **Unit 5:** | **Gas Chromatography** | | **(Duration: 08 Hrs)** |
| 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** | | **(Duration: 08 Hrs)** |
| 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: ultra violet 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** | | **(Duration: 08 Hrs)** |

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| 7.1  7.2  7.3  7.4  7.5  **Unit 8:** 8.1 8.2 8.3 | Ion exchangers – types, characteristics and properties  Ion exchange equilibrium and factors affecting it  Instrumental set up of IEC- columns and detector  Principle, procedure and applications of IEC  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 | |
| **Chemical Sensors and Biosensors** | | **(Duration: 08 Hrs)** |
| Definition and classification of sensors, Signal and noise Efficiency of sensors, sensitivity and limit of detection Principle and applications of  8.3.1 Electrochemical sensors  8.3.1.1 Coulometry & Potentiometry  8.3.1.2 Conductimetry & 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 | | |

**Reference Book:**

Engineering Chemistry, P.C. Jain & Monica Jain, 17th Edition, Reprint 2011, Dhanpatrai Publishing Company (P) Ltd. ( ISBN: 9789352167203)  
Handbook of Analytical Instrument, R.S. Khandpur,2nd Edition, Reprint 2009, Tata McGraw Hill Publishers. . ( ISBN: 9780070604605)  
Instrumental Methods of Chemical Analysis(Analytical Chemistry) , H. Kaur, 8th Edition, 2012, Pragati Prakashan.( ISBN: 9789387151673)  
Basic Concepts of Analytical Chemistry, S.M. Khopkar, 3rd Edition, Reprint 2009, New Age International (P) Limited, Publishers.( *ISBN*: 9781906574000)  
Analytical Instrumentation Handbook, Ewing’s , Edited by Jack Cazes, 3rd Edition, 2005, Marcel Dekker Publisher. (ISBN : 9780429121432)  
Instrumental Methods of Analysis, H.H.Willard, L.L.Meritt, J.A. Dean and F.A. Settle, 7th Edition,1986, CBS Publishers. (ISBN : 9788123909431)  
Instrumental methods of analysis, B.K. Sharma, 24th Edition, 2005, Go Publishing House. (ISBN : 9788182836730)  
Instrumental Analysis, D.A. Skoog, D.M. West, F.J. Holler and S.R. Crouch,11th Edition, Reprint 2012, Cengage Learning. (ISBN- 9781305577213)  
BIOS-Instant Notes-Analytical Chemistry, D. Kealey, P.J. Haines, 2002, Viva Books (P) Ltd. (ISBN-9781859961896)  
Analytical Instrumentation, Bela G. Liptak, 1stEdition,1994, 1stIndian Reprint, 2012, Chilton Book Company. (ISBN-9780801983979)

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| **List of Practical** |  |

1) Determination of Phenol in water sample by Spectrophotometer. 2) Determination of COD in water sample by Spectrophotometer. 3) Estimation of Sugar in natural sample by Spectrophotometer.

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| **Forensic Chemistry & Toxicology** |  |

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| **Name of faculty: Science** | | **Department:**Chemistry |
| **Program:** M.Sc. Sem-II | | **Type:** DSE-2 |
| **Subject: Forensic Chemistry & Toxicology** | | |
| **Credit:** 04(T) + 02 (P) | **Total learning hours:**60 | |
| **Course description:** This course paper intends to deal aboutthe ForensicToxicology, thebranch 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. | | |

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| **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; 6thEdition., 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. 10. Analytical Methods in Human Toxicology, Part II, Curry, 1986.

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, 23rdEdition, 2017, published by APHA, AWWA, WEF.

2. Official Methods of Analysis, Dr. William Harwitz, Dr. George W Latimer, 18thEdition, 2005, published by Association of Officiating Analytical Chemists (AOAC).

3. Analytical Techniques in Agriculture, Biotechnology and Environmental Engineerin; A. Nag; 1stEdition, 2006, Prentice Hall of India.

4. Laboratory Manual in Biochemistry – J. Jayaraman, 2011, New Age Publication. 5. Analytical Chemistry, H. Kaur, 1stEdition, 2013, Pragati Prakashan.

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| **Bioinformatics & Other “OMICS”** |  |

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| **Name of faculty:** Science | **Department:**Microbiology | |
| **Program:** M.Sc. Microbiology Sem-II | **Type:** DSE-2 | |
| **Subject:** Bioinformatics & Other “OMICS” | | |
| **Credit:** 04+02 | | **Totallearning hours:**60 |
| **Course description:** The paper mainly emphasizes on study conceptdevelopment 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 coursestudentswillbe able to understand.   Concept, Mechanism and application genomics, Proteomics and metagenomics   Student will be utilized the available biological database, online resources and tools.   Student will be able to understand and perform the bimolecular structure visualization,  sequences alignment, modelling and drug discovery. | | |

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| **Unit-1:**   1.1 1.2 1.3 1.4 **Unit-2:**   2.1 2.2 2.3 | **Genomics** | **(Duration: 08 Hrs)** |
| Introduction to Genomics: Structural, Functional and Comparative Next Generation Sequencing Technologies  Genome Mapping  Genome Assembling and annotation | |
| **Proteomics** | **(Duration:08 Hrs)** |
| Genomics to Proteomics: the way forward  Interaction Proteomics: Methods of Protein-Protein Interaction  Wet lab Techniques for proteomics data generation: 2-D Differencial gel | |

electrophoresis, Protein Microarray and its Application, Types and

Manufacture of protein chip, MALDI-ToF.

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| **Unit-3:** | 2.4 | Application of Proteomics. | |
| 3.1 | **System Biology** | **(Duration: 07 Hrs)** |
| Systems biology: Understanding of Biological Systems | |
| 3.2 | Microbial Metabolomics | |
| 3.3 | Mass Spectrometry-Based Microbial Metabolomics: Techniques, Analysis, | |

and Applications.

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| **Unit-4:** | 3.4 |  | |
| Concept of Synthetic biology | |
| 4.1 | **Other omics** | **(Duration: 07 Hrs)** |
| 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

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| **Unit-5:** | 4.4 | Concepts of Culturomics, Metatranscriptomics and Metaproteomics | |
| 5.1 | **Major Bioinformatics Resources** | **(Duration:08 Hrs)** |
| 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

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| **Unit-6:** | 5.5 | Sequence-based searches: BLAST and FASTA | |
| 6.1 | **Sequence Alignment** | **(Duration:08 Hrs)** |
| Sequence Analysis, Basic concepts: Sequence similarity, identity and | |

Homology, Scoring Matrix.

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| **Unit-7:** | 6.2 | Pairwise and Multiple sequence alignments | |
| 6.3 | Molecular Phylogenetics | |
| 6.4 | Phylogenetic Tree Construction Methods and Programs | |
| 7.1 | **Comparison of protein 3D structures** | **(Duration: 07 Hrs)** |
| 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

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| **Unit-8:** | 1.1 | **Bioinformatics Application** | **(Duration:07 Hrs)** |
| Bioinformatics Application in drug design: Chemical databases like NCI | |

/PUBCHEM.

1.2 Fundamentals of Receptor-ligand interactions.

1.3 Structure-based drug design:

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| 1.4 | Ligand based drug design: Structure Activity Relationship – QSARs |

&Pharmacophore etc.

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

**Reference Book:**

 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.

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| --- | --- | --- | --- | --- | --- | --- | --- |
|  | 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.

**List of Practical**   
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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| **Intellectual Property Rights** |  |

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| **Name of Faculty: Science** | **Department:**Environmental Science |
| **Program:** M. Sc. Sem-II | **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

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| **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** 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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| |  |  | | --- | --- | | **Biostatistics** |  |  |  |  | | --- | --- | | **Name of faculty: Sciences** | **Department: Microbiology** | | **Program:** M.Sc. Microbiology Sem-II | **Type:** DSE-2 | | **Subject:** Biostatistics | | | **Credit:** 04+02 | **Total learning hours:** 60 | | **Course description:**  The course deals with the application of statistical principles to uncover biological phenomena. It also deals with statistical concepts and terminology and basic analytic techniques. The course also explain the use of computer tools and software to solve statistical data. | | | **Student learning outcome: By the end of the course, student will;**   Recognize the importance of data, data collection methods   Able to express data by suitable type of graphs and diagram   Able to perform various statistical tests to get inference from data sets.   Able to calculate measures of central tendency and dispersion of data.   Able to perform students t-test, chi-square test, and ANOVA   Understand about software packages and computer tool to analyse data. | | | |
| **Unit-1: Introduction to Biostatistics and Data collection** | **(Duration: 08 Hrs)** |

1.1 Biostatistics: Definition, Role and Application   
1.2 Biological variations and uncertainties and role of statistics 1.3 Data: Definition   
1.4 Primary and secondary data   
1.5 Data Collection   
1.6 Classification and tabulation of data   
1.7 Frequency Distribution

**Unit-2: Diagrammatic and Graphical Representation of Data**  **(Duration: 07Hrs)**  2.1 Diagrammatic representation of data and its Limitation   
 2.2 Diagrammatic representation of data and its Limitation   
 2.3 Graphical representation of data: Significance and limitation

**Unit-3: Basic Concepts of Population, samples and variables**  **(Duration: 07 Hrs)**

3.1 Population and Samples: Introduction 3.2 Methods of Sampling   
3.3 Sampling errors



3.4 Variables: Introduction, Definition, Types, Measurement and scale of measurements

**Unit-4: Measures of Central Tendency**  **(Duration: 08 Hrs)**  4.1 Average, its function and desirable properties of good measure of tendency 4.2 Arithmetic mean, Median, Mode, Geometric & Harmonic Mean- Calculation techniques, merits and demerits   
 4.3 Relationship between Mean, Median and Mode   
 4.4 Comparison of the mean, median and mode: Advantage and Disadvantages 4.5 Partition Values: Quartiles, Deciles and Percentiles

**Unit-5: Measures of Dispersion**  **(Duration: 07 Hrs)**  5.1 Dispersion: Definition and Need for Measures of Dispersion   
 5.2 Range, Mean deviation, Variance and the standard deviation   
 5.3 Introduction to Skewness   
 5.4 Introduction to Kurtosis

**Unit-6: Correlation and regression analysis**  **(Duration: 08 Hrs)**  6.1 Introduction to Correlation, Correlation and Causation   
 6.2 Types and Methods to study Correlation   
 6.3 Introduction to Regression   
 6.4 Difference between Correlation and regression   
 6.5 Linear regression analysis: Regression line and Equation   
 6.6 Non-Linear and multiple regression

**Unit-7: Tests of significance and ANOVA**  7.1 Statistical Hypotheses

**(Duration: 08 Hrs)**

7.2 Tests of Significance: General procedure and steps, Significance of test, p value 7.3 Normal Curve test, Chi-square test, Students t-test   
7.4 Analysis of Variance (ANOVA)

**Unit-8: Computers in Biostatistics**



**(Duration: 07 Hrs)**

8.1 Computer Software for Statistical operation   
8.2 MS Excel for statistical analysis: Descriptive statistics, t-test, ANOVA 8.3 R in Biostatistics

**Reference Book:**

 Arora, P. N., and P. K. Malhan. Biostatistics. Himalaya Publishing House, 2011. ISBN: 978-93-5024-718-1

 Gurumani, N. An introduction to Biostatistics. 2nd Edition, MJP publisher, 2002. ISBN: 978-81-9094-006-4

 Khan, Irfan A., and Atiya Khanum. Fundamentals of biostatistics. Ukaaz, Third revised edition 2012. ISBN: 81-900441-0-9

 Rao, K. Visweswara. Biostatistics: a manual of statistical methods for use in health, nutrition and anthropology. Jaypee Brothers Medical Publishers (P) Ltd, 2nd edition, 2007. ISBN; 81-8448-055-5

 Rao, PSS Sundar, and J. Richard. Introduction to biostatistics and research methods. 5th Edition, PHI Learning Pvt. Ltd., 2018. ISBN: 978-81-203-4520- 1

**Further Reading:**

 Schmuller, Joseph. Statistical Analysis with Excel For Dummies United Kingdom: Wiley, 2016.

**List of Practical**   
1) Making plain tables in Microsoft Excel   
2) Preparation of basic chart in Microsoft Excel   
3) Finding mean, median and mode by Microsoft Excel.

4) Performance of ANNOVA by Microsoft Excel 5) Performance of students t-test.

6) Performance of chi-square test.

7) Calculation of standard deviation.

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