SARVAJANIK UNIVERSITY

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Faculty of Science

SHREE RAMKRISHNA INSTITUTE OF COMPUTER EDUCATION AND APPLIED SCIENCES, SURAT

M.Sc. Medical Laboratory Technology

Syllabus

(Effective from 2021)

M.T.B College Campus, B/h P.T.Science College, Opp. Chowpati,
Athwalines, Surat-395001 Gujarat, India
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M.Sc. Medical Laboratory Technology	
No.	**Contents**
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A. About M.Sc. Medical Laboratory TechnologyProgramme

The M.Sc. Medical Laboratory Technology 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.Particular emphasis is laid on the practical aspects of the field. Students can pursue their careeras Academics, R & D Laboratories, Health care set up, corporate organization, Industries & Independent practice.

B. Programme Objective

- The student will be instilled with values of professional ethics and be made ready to contribute to society as responsible individuals.
- Students learn theories and principles of Medical Laboratory science and Technology and. demonstrate the ability to plan and effect the change in laboratory practice and health care delivery system.
- Programme aims to equip students to Setup and manage specialized clinical laboratories and to deliver better health care System to the public and practice as Specialized Technologists in the concerned subject.

C. Eligibility

- A candidate must have passed the Bachelor's degree in Microbiology / Medical Technology /Biotechnology /Environmental Science/Industrial Microbiology /Bioscience/ General Science/ Life-Science / Botany/Plant Science/Zoology/Animal Science/ Biology /Chemistry (with Biology) /Agriculture /Fisheries /Forestry /B.Pharm/ B.Sc. Nursing/ others or B.Physio/ M.B.B.S/ BDS/ BAMS/ BHMS

- 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. Medical Laboratory TechnologyCourse Structure

Sem	Course Type	Course Code	Paper Title	Hour/Week		Credit
				Th	Pr	
1	Core course	DSC-1	Principles of Clinical Bacteriology, Virology & Mycology	4	4	4+2
		DSC-2	Clinical Pathology	4	4	4+2
	SEC	SEC-1	Histopathology &Parasitology	4	4	4+2
	Elective	DSE-1		4	4	4+2
2	Core course	DSC-3	Clinical Biochemistry	4	4	4+2
		DSC-4	Haematology & Blood Transfusion	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	Elements of Immunology	4	4	4+2
		DSC-6	Diagnostic Microbiology & Molecular Techniques	4	4	4+2
	SEC	SEC-3	Clinical Laboratory Management	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						

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

E. Evaluation Scheme

M.Sc. Medical Laboratory Technology					
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

Clinical Biochemistry

Name of faculty: Science	**Department:** Microbiology
Program: M. Sc. Medical Laboratory Technology Sem-II	**Type:**DSC-3
Subject: Clinical Biochemistry	
Credit: 4+2	**Total learning hours:** 60
Course description: The main aim of the subject is to inform the knowledge about carbohydrates, proteins and lipids.Also add the understanding of enzymes, hormones and vitamins.The information regarding various function tests will enhance the depth of subject.	
Student learning outcome: • Demonstrate theory and practical skills to analyze various clinical patients' samples • Able to estimate different components which are the cause of the disease or are the diagnostic/prognostic markers. • Understand the basic information about various clinically important enzymes • Learn special biochemical investigations e.g. LFT, RFT, etc.	

Unit-1:Carbohydrates (Duration: 08 Hrs)

1.1 Definition, Classification, Functions, Digestion & absorption of Carbohydrates.
1.2 Regulation of blood glucose & its importance,
1.3Hyperglycemia, Hypoglycemia
1.4 Diabetes & Glycosylated Hb.
1.5 Blood Glucose estimation & Glucose Tolerance Test

Unit-2:Plasma Proteins (Duration: 08 Hrs)

2.1 Definition, Classification, Functions of Plasma Proteins
2.2 Plasma Proteins estimations.
2.3 Clinical significance plasma protein; Bence-Jones' Proteins and Cryoglobulins

Unit-3:Lipids and Lipoproteins (Duration: 08 Hrs)

3.1 Lipid: Definition, Classification, Functions, Essential Fatty Acids
3.2 Important Lipid Profile Tests- cholesterol, triglyceride, Lipoproteins, phospholipids and its significance in various disorders.

Unit-4:Clinical Enzymes (Duration: 08 Hrs)

4.1 Definition, Classification, Factors affecting enzyme activity, Isoenzymes and Coenzymes.
4.2 Clinical Enzymology: Therapeutic, diagnostic and analytical uses of enzymes
4.3 Estimation Methods and Diagnostic Importance of Enzymes &Isoenzymes:

Phosphatases; Transaminases; Lactate Dehydrogenases; Creatine Kinase; Amylase; Lipase; Gama GlutamylTransferase

Unit-5: Hormones **(Duration: 08 Hrs)**

5.1 Types and biochemical functions.
5.2 Thyroid and parathyroid hormones
5.3 Determination of T3, T4, TSH.

Unit-6: Function Tests **(Duration: 08 Hrs)**

6.1 Liver Function Tests
6.2 Renal Function Tests
6.3 Cardiac Function Tests

Unit-7: Electrolytes and Minerals **(Duration: 06 Hrs)**

7.1 Introduction of electrolytes
7.2 Minerals and Electrolytes determination and clinical Significance: Sodium; Potassium; Chloride; Calcium; Phosphorus; Iron & TIBC

Unit-8:Vitamins **(Duration: 06 Hrs)**

8.1 Brief Classification and Clinical Significance
8.2 Determination of Vitamin B12 and D3.

Reference Book:

- Chatterjee M. N. and Shinde R. 2007. *Textbook of Medical Biochemistry*, 8th ed., Jaypee Brothers Publishers.(ISBN: 9789350254844)
- Godkar P. B. (2014). Textbook of Medical Laboratory Technology, 3rd ed., Bhalani Publishing house. (ISBN: 9789381496190)
- Ochei J. &Kolhatkar A. (2000), *Medical Laboratory Science: Theory & Practice,* Tata McGraw Hill Pub. (ISBN: 9780074632239)
- Satyanarayan, U. Chakrapani, Biochemistry, 3rd edition, Books & Allied Pvt Ltd Kolkatta(ISBN: 9788187134800)

Further Reading:

- Harold Varley, (1990), *Practical Clinical Biochemistry*, Indian Edition, Anold Heinemann. (ISBN: 9780433338062)
- Vasudevan D. &Sreekumari S. (2005). *Textbook of Biochemistry*; 4th ed, Jaypee Publishers.(ISBN: 9789389034981)
- Wilson K. & Walker J., *Practical Biochemistry: Principles & Technique,* 5 ed., Cambridge University Press. (ISBN: 9780521799652)

List of Practical

1) Blood Glucose/Sugar estimation and GTT.
2) Blood Cholesterol – Free & Total HDL Cholesterol, LDL Cholesterol.

3) Serum Triglyceride
4) Serum Total Protein and Serum Albumin and A/G ratio
5) Micro albumin test
6) Blood/Urine Urea.
7) Blood /Urine Creatinine.
8) Blood /urine Uric Acid
9) Serum Calcium / Ionized Calcium
10) Serum Phosphorus
11) Serum potassium
12) Serum Sodium
13) Serum Chloride
14) Serum Iron, and TIBC (Total Iron Binding Capacity)
15) Serum Bilirubin.
16) Serum Alkaline Phosphatase.
17) Serum Acid Phosphatase.
18) S.G.O.T
19) S.G.P.T.
20) Serum Amylase.
21) Serum Lipase

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Haematology & Blood Transfusion

Name of faculty: Science	**Department:** Microbiology
Program: M. Sc. Medical Laboratory Technology Sem-II	**Type:**DSC-4
Subject: Haematology & Blood Transfusion	
Credit: 4+2	**Total learning hours:** 60
Course description: Haematology section includes various topics like blood formation, knowledge of different types of anaemia and leukaemia.Also include coagulation mechanism and disorder.Blood transfusion has been organised to provide knowledge about screening of donor, blood components and various transfusion reactions.	
Student learning outcome: • Carry out routine clinical laboratory investigation in haematology or related to blood. • Provide technical help for selected sophisticated haematological techniques with adequate knowledge of various principles. • Understand the skill of blood collection from donors and preventive measures against communicable diseases. They should be able to perform different investigations, preservation and interpretation.	

Unit-1: Introduction to Haematology (Duration: 08 Hrs)

1.1 Definition, composition and functions of blood.
1.2 Types of Anticoagulants
1.3 Formation of blood: Erythropoiesis, Leucopoiesis, Thrombopoiesis
1.4 Definition, types and structure of Hb
1.5 Morphology of normal and abnormal Red Blood Cells.

Unit-2:Blood Coagulation (Duration: 08 Hrs)

2.1 Coagulation Factors, Mechanism of Blood Coagulation.
2.2 Coagulation disorders, Haemophilia A& Haemophilia B
2.3 Platelet disorders and Platelet count.
2.4 Various coagulation defect test

Unit-3:Haemoglobinopathiesand Anaemias (Duration: 08 Hrs)

3.1 Haemoglobinopathies: Abnormalities of Haemoglobin Molecule;
Sickle Cell Anaemia & Thalassemia
3.2 Haematocrit: Pack Cell Volume(PCV) and Various Blood indices
3.3 Definition and classification of anaemia; factor causing anaemia
3.4 Iron & B-12 deficiency anaemia; aplastic anaemia & G-6PD deficiency anaemia; Haemolytic anaemia &Sideroblastic anaemia.

Unit-4:Leukaemias, Automation & Quality Control in Haematology
(Duration: 08 Hrs)

4.1 Differential WBC Count: - Normal, abnormal values and physiological variation
4.2 Introduction and general Classification of Leukaemias.

4.3 Acute & Chronic Myeloid Leukaemias.

4.4 Automation in Haematology: Blood cell counter &Coagulometer

4.5 Quality control in Haematology.

Unit-5:Blood Group System –I & II (Duration: 08 Hrs)

5.1 ABO blood Group system, subgroup of ABO, Variants of ABO blood group system.

5.2 Rh blood group system.

5.3 Gel technique for blood grouping and serological Techniques.

5.4 AHG test.

5.5 Other Blood Group systems

Unit-6:Compatibility Testing, Transfusion Reaction and HDN (Duration: 08 Hrs)

6.1 Compatibility testing and special methods of routine and emergency cross match

6.2 Types of Transfusion reaction

6.3 Investigation of Transfusion reaction.

6.4Haemolytic disease of Newborn due to ABO, Rh or Other blood group incompatibility

Unit-7:Blood Collection &Component Preparation (Duration: 06 Hrs)

7.1 Screening of Donor

7.2 Phlebotomy of Blood Donor

7.3 Storage and transportation of blood

7.4 Mandatory screening tests-HIV1&HIV2, HBsAg, HCV, RPR & Malaria.

7.5 Component preparation: Red cell concentrate; Fresh Frozen Plasma; Cryoprecipitate; Platelet concentrate

Unit-8: Automation, Biosafety and Quality Control in Blood Banking (Duration: 06 Hrs)

8.1 Automation in Blood collection

8.2 Automation in blood grouping, Cross matching

8.3 Bio safety and Biomedical waste management

8.4 Quality Control in blood banking

Reference Book:

- Denise Harmening, Modern Blood banking and Transfusion Practices, 6th Edition 2012. (ISBN: 9780803626829)
- Godkar P. B. (2014). Textbook of Medical Laboratory Technology, 3rd ed., Bhalani Publishing house. (ISBN: 9789381496190)
- Mukharjee.L. K , Medical Laboratory Technology,Vol.1-3, 3rd edition, Tata McGraw Hill ISBN: (9789352606825)
- Saran R K., Transfusion Medicine Technical Manual, Ed, 2nd Ed, Directorate General of Health Service (DGHS), Ministry of Health & Family Welfare, 2003.
- Wintrobe's Clinical Haematology, 14th edition, Lippincott Williams & Wilkins (ISBN: 9781496347428)

Further Reading:

- Dacie& Lewis Practical Haematology, 12th edition, Elsevier Publications (ISBN: 9780702066962)
- De Gruchy's Clinical Haematology in Medical Practice, Sixth edition, Wiley Publications (ISBN: 978-8126532438)
- Makroo R.N., Compendium of Transfusion Medicine, Practice of Safe Blood Transfusion (ISBN: 9788190626415)
- SoodRamnik, Text book of Medical Laboratory Technology, 5th edition, Jaypee Publications (ISBN: 9788180615917)
- Technical Manual, American Association of Blood Banks, 1996. (ISBN: 9781563958885)
- Technical Manual, American Association of Blood Banks, 2014(ISBN: 978-1563953156)

List of Practical

HAEMATOLOGY

1) Methods of Blood Collection and Anticoagulants
2) Haemoglobin estimation: Sahli's method and Cyanmethaemoglobin method.
3) Total R.B.C.
4) Total W.B.C. Count.
5) Differential Count.
6) Platelet Count.
7) Reticulocyte Count
8) E.S.R.
9) Packed cell volume/ Determination of Haematocrit.
10) Bleeding time, Whole Blood Coagulation time and Prothrombin time.
11) Sickling test.- Slide Test, DTT

BLOOD BANKING

1) ABO (Forward) and RH grouping by slide method.
2) ABO (Forward) and RH grouping by Tube method.
3) Reverse grouping
4) Direct Antiglobulin Test (DAT)
5) Indirect antiglobulin test (IAT)
6) Tests for Weak D testing by albumin and indirect antiglobulin technique
7) Anti A/ Anti B titre
8) Anti D titration by albumin and indirect antiglobulin technique
9) Cross matching by saline, albumin and IAT
10) Test for HBsAg (Hepatitis B surface Antigen) ELISA.
11) Test for HIV Antibodies (ELISA Test)
12) Visit to a Blood Bank.

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Instrumentation and Analytical Techniques

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	

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
2.3 Applications of atomic absorption spectrometry

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
1.1 Non dispersive IR(gas analyzer)
4.2Modern elemental analyzer
4.3Total organic carbon analyzer
4.4Mossbauer 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: 08Hrs)

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:
7.5.1Gel Permeation Chromatography
7.5.2Ion Exclusion Technique
7.5.3Inorganic Molecular Sieves

Unit 8: Chemical Sensors and Biosensors (Duration: 08 Hrs)

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
8.3.1Electrochemical sensors
8.3.1.1Coulometry&Potentiometry
8.3.1.2Conductimetry&Amperometry
8.3.1.3Polarography& Voltammetry
8.3.2Solid state electrode & Mass sensitive sensors
8.3.3Optical sensors & Thermal sensors
8.3.4Biosensors&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, PragatiPrakashan.(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, 1st Edition,1994, 1st Indian 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

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 about theForensic 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, DovbrieyNickolls (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. Furnisset. 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, 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, PragatiPrakashan.

Bioinformatics & Other "OMICS"

Name of faculty: Science	**Department:** Microbiology
Program: M.Sc. Microbiology Sem-II	**Type:** DSE-2
Subject: Bioinformatics & Other "OMICS"	
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 • 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.	

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:08Hrs)

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, MALDI-ToF.

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:08Hrs)

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:08Hrs)

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:07Hrs)

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.

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.
- 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

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

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 neighboringright : 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.

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 (Duration: 08 Hrs)

7.1 Statistical Hypotheses

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 AtiyaKhanum. 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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