SARVAJANIK UNIVERSITY

INCLUSIVE | INTEGRATED | INNOVATIVE

creating an enlightened society...

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
Contact: 7228018498, 728018499. Email: info@srki.ac.in

M.Sc. Medical Laboratory Technology	
No.	**Contents**
A	**About M.Sc. Medical Laboratory TechnologyProgramme**
B	**Programme Objective**
C	**Eligibility**
D	**Course Structure**
E	**Evaluation Scheme**
F	**Syllabus**

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 3

Elements of Immunology

Name of faculty: Science	**Department:** Microbiology
Program: M. Sc. Medical Laboratory Technology Sem-III	**Type:** DSC-5
Subject: Elements of Immunology	
Credit: 4+2	**Total learning hours:** 60
Course description: TheAdvances in Immunology course has been designed to convey basic information about immune system development. Also included humoral and cell mediated immunity, antigen & antibody in detail. Topics included like Ag-Ab reactions will help the students to know latest diagnostic methods.Also included immunization and autoimmunity topic to broaden the perspective of the subject.	
Student learning outcome: • Analyze various serum samples, for estimation of different components which are the cause of the immune disease or are the diagnostic/prognostic markers. • Gain information about pathogenicity and infection. • Know about various immunodeficiency disorders like- Hypersensitivity and autoimmunity.	

Unit-1:Immunity **(Duration: 08 Hrs)**

1.1 Classification of immunity
1.2 Cell mediated immunity and Humoral immunity
1.3 Cells of immune system: T cell, B cell, Phagocytic cell

Unit-2:Antigen **(Duration: 06 Hrs)**

2.1 Definition, Properties and Characteristics of antigen
2.2 Classification of antigens.
2.3 Types of Antigen- Haptens and Epitopes

Unit-3:Antibody- Immunoglobulin **(Duration: 08 Hrs)**

3.1 Definition and Characteristics of antibody
3.2 Properties and Structure of antibody
3.3Types of antibody
3.4 Monoclonal Antibodies and their production

Unit-4: Complement **(Duration: 06 Hrs)**

4.1Components of complement
4.2Activation of Various Pathways

4.3 Biological functions of complement system.

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

5.1 Introduction and classification of Hypersensitivity
5.2 Anaphylactic reaction
5.3 Cytotoxic reaction
5.4 Immune complex mediated reaction
5.5 Delayed hypersensitivity

Unit-6:Autoimmunity **(Duration: 06 Hrs)**

6.1Mechanisms of auto immunity
6.2 Classifications of auto immune disorders

Unit-7: Vaccines **(Duration: 08 Hrs)**

7.1 Introduction & types of vaccine.
7.2 Vaccination Schedule in India

Unit-8:Antigen-Antibody Reaction **(Duration: 10 Hrs)**

8.1 Mechanism and Factors affecting antigen –antibody reactions.
8.2 Principle, procedure and applications of various antigen antibody reactions: Precipitation; Agglutination; Fluorescent – antibody technique; RIA; Enzyme Linkedimmunosorbent assay (ELISA); Complement fixation test; Immunochromatograghy
8.3 Advanced Diagnostic techniques: Blotting Techniques and Nucleic acid Amplification Test (NAT).

Reference Book:

- Ananthnarayan R. and JayramPaniker C.K. Text book of Medical Microbiology,5thEdn. Orient Longman, Madras. (ISBN: 9788173718892)
- Owen, Judith A., PuntStanford, Sharon A., Jones, Patricia P., Kuby Immunology.,7th ed. Macmillan Higher education Pub. (ISBN: 9781464189784)
- P.B. Godkar,(2014), Textbook of Medical Laboratory Technology, 3rd ed., Bhalani Publishing House, Mumbai, India. (ISBN: 9789381496190)

Further Reading:

- RoittI.M.,Essential Immunology, 6th Edn. ELBS, London (ISBN: 9780865427297)
- Talwar G. P., A Hand book of Practical Immunology,1stEdn. Vikas Publishing House. (ISBN: 9788123900186)

List of Practical

1) ICT/Dot immunoassay/ Flow through assay for HIV Ab
2) ICT/Dot immunoassay/ Flow through assay for HBs Ag
3) ICT/Dot immunoassay/ Flow through assay for HCV Ab

4) Slide / Tube/ Strip test for typhoid
5) Slide test for syphilisforSyphilis
6) Strip test for Pregnancy
7) Latex test for C-Reactive protein
8) Latex test for Rheumatoid arthritis
9) Latex test for Anti StreptolysinO(ASO).

****

Diagnostic Microbiology& Molecular Techniques

Name of faculty: Science	**Department:** Microbiology
Program: M. Sc. Medical Laboratory Technology Sem-III	**Type:**DSC-6
Subject: Diagnostic Microbiology & Molecular Techniques	
Credit: 4+2	**Total learning hours:** 60
Course description: The main aim of the subject is to inform the awareness of pathogenic microbes regarding their morphology, cultural characteristics, disease production and laboratory diagnosis.The consciousness regarding recent advances and automation will improve the strength of subject.	
Student learning outcome: • Acquire detail information about human pathogenic microbes. • Expand knowledge of cultivation of pathogenic microbes and their identification through various methods. • Gain information about advanced methods for microbial detection and recent advances. • Know about collection, preservation, transport, processing and disposal of various clinical samples.	

Unit-1:Morphology, Cultural Characteristics, Antigenic structures, Pathogenesis (in brief), Laboratory Diagnosis of following bacteria:(Duration: 08 Hrs)

1.1 Staphylococcus
1.2Streptococcus
1.3 Corynebacterium
1.4 Neisseria

Unit-2:Morphology, Cultural Characteristics, Antigenic structures, Pathogenesis (in brief), Laboratory Diagnosis of following bacteria: (Duration: 08 Hrs)

2.1 Mycobacterium
2.2 Bacillus
2.3 Clostridium
2.4 Spirochetes

Unit-3:Morphology, Cultural Characteristics, Antigenic structures, Pathogenesis (in brief), Laboratory Diagnosis of following bacteria: (Duration: 08 Hrs)

3.1 Enterobacteriaceae
3.2 Salmonella
3.4 Vibrio
3.5 Pseudomonas

Unit-4: Laboratory Diagnosis of Infectious Diseases (Duration: 06 Hrs)

Collection, preservation, transport, processing and disposal of following clinical samples for culture:

4.1 Blood
4.2Throat
4.3 Sputum
4.4Pus

Unit-5: Laboratory Diagnosis of Infectious Diseases (Duration: 06 Hrs)

Collection, preservation, transport, processing and disposal of following clinical samples for culture:

5.1 Urine
5.2 Stool
5.3 C.S.F
5.4 Other body fluids

Unit-6: Automation in Microbiology and Antibiotic Sensitivity Test(Duration: 06 Hrs)

6.1 BACTEK
6.2 VITEK
6.3 Antibiotic susceptibility test by disk diffusion technique

Unit 7 Gene Cloning Strategies and PCR Techniques (Duration: 08 Hrs)

7.1 Joining of DNA fragment
7.2 Introduction of DNA in host cell
7.3 Construction of Genomic and cDNA library
7.4 Techniques for selection, screening and characterization of transformants
7.5 Isolation and amplification of specific nucleic acid sequences
7.6 PCR, RT PCR and qRT PCR variant of PCR, Factors affecting PCR amplification.

Unit 8 Applications of Recombinant DNA Technology (Duration: 10Hrs)

8.1 DNA Fingerprinting & DNA Forensics
8.2 Gene Therapy
8.3 Recombinant products: hormones and vaccines
8.4 Transgenesis in plants Gene transfer to plants, Plants as bioreactor
8.5 Transgenic animals: Retroviral vector method, Cre-*lox P* recombination system
8.6 Safety regulations related to genetic engineering

Reference Book:

- Ananthnarayan R. and JayramPaniker C.K. Text book of Medical Microbiology,5thEdn. Orient Longman, Madras. (ISBN: 9788173718892)
- CheesbroughMonica,District laboratory practice in tropical countries VOL-1 & 2, Cambridge University Press. (ISBN: 9780521665476)
- Mackie and McCartney Medical Microbiology. A Guide to Laboratory Diagnosis and control of Infection.13th ed., J.P.Duguid, B.P.Marmion and R.H.A.Swain, the English Language Book Society and Churchil Company. (ISBN: 9780443017872)
- P.B. Godkar, 2014, Textbook of Medical Laboratory Technology, 3rd ed., BhalaniPublishing House, Mumbai, India. (ISBN: 9789381496190)

- SmitaRastogi and Neelam Pathak, (2009) Genetic Engineering, Oxford University Press; Illustrated edition. (ISBN: 0195696573)
- Watson, J. D. (2004). Molecular biology of the gene. Pearson Education India, (ISBN: 9332585474)
- Glick, B. R., & Patten, C. L. (2017). Molecular biotechnology: principles and applications of recombinant DNA (Vol. 34). John Wiley & Sons, (ISBN: 1555812244)

Further Reading:

- Elmer W Koneman et al, Introduction to Diagnostic Microbiology, Philadelphia, J B Lippincott Company.(ISBN: 9780781730143)
- Danial Greenwood et al, medical Microbiology, A guide to Microbial Infections, Pathogenesis, Immunity, Laboratory Diagnosis and control, London, Churchill Livingstone. (ISBN: 9780702071997)

List of Practical

1) Pure culture study of the following cultures and their antibiotic susceptibility:
   a) *Bacillus cereus*
   b) *Staphylococcus aureus*
   c) *Escherichia coli*
   d) *Klebsiellamobillis*
   e) *Klebseillapneumoniae*
   f) *Proteus vulgaris*
   g) *Salmonella typhi / paratyphi A / paratyphi B*
   h) *Pseudomonas aeruginosa*
2) Isolation of Genomic DNA from bacteria and fungi.
3) RFLP
4) DNA amplification by PCR

****

SARVAJANIK UNIVERSITY

Clinical Laboratory Management

Name of faculty: Science	**Department:** Microbiology
Program: M. Sc. Medical Laboratory Technology Sem-III	**Type:** SEC-3
Subject: Clinical Laboratory Management	
Credit: 4+2	**Total learning hours:** 60
Course description: The main objective of this paper is to build the capacity of lab managers to enable them to manage their lab services efficiently and effectively using fundamentals of management. Also included topics like automation and quality control to enhance the knowledge in this field.	
Student learning outcome: • The students will understand various lab operations, costing, investment analysis and these will equip them with better decision-making skills in delivering good quality services. • Also know basics of service quality, efficiencies and professionalism in lab management • Understand standards of laboratory practice.	

Unit-1:Introduction to Clinical Laboratory Management(Duration: 08 Hrs)

1.1 Definition and General Principles
1.2 Concepts and function of Management
1.3 Role of Laboratory in Health Care and Training of Laboratory Personnel
1.4 Code of Conduct

Unit-2: Good Laboratory Practice (GLP) (Duration: 08 Hrs)

2.1 Introduction to Basics of GLP and Accreditation
2.2 Aims of GLP and Accreditation
2.3 Advantages of Accreditation

Unit-3: Safety in the Laboratory (Duration: 06 Hrs)

3.1 Awareness/Safety in a clinical laboratory
3.2 General safety precautions
3.3 Source of Laboratory Hazards
3.4Preventing Laboratory Infection

Unit-4:Laboratory Policies(Duration: 08 Hrs)

4.1 Definition and Purpose
4.2 Laboratory Hours and Emergency Work
4.3 Range of Tests to be Performed and Referral of Specimens
4.4 Work Load Capacity of the Laboratory

Unit-5: Management of Laboratory Resources (Duration: 06 Hrs)

5.1 Collection of Specimens and delivery of Reports

5.2 Reporting of Results and Record Keeping
5.3 Management of Time and Space
5.4 Management of Equipment and Supplies

Unit-6: Laboratory Instruments (Duration: 08 Hrs)

Principle, Component, Operations, Maintenance and Applications of -

6.1 Balance
6.2 PH Meter
6.3 Centrifuge
6.4 Colorimeter
6.5 Spectrophotometer
6.6 Flame Photometer

Unit-7:Automation (Duration: 06 Hrs)

7.1 Types of Biochemistry Analyzer: Continuous Flow Analysers; Discrete Chemistry Analysers; Centrifugal Analysers; Dry Chemistry Analysers
7.2 Advantages and Disadvantages of Automation

Unit-8:Quality Control (Duration: 10 Hrs)

8.1 Analytical Variables: Accuracy, Precision and Reliability; Standard and Control; Sensitivity and Specificity; Types of Error; Mean, Standard Deviation, Co-Efficient of Variation and Central Tendency
8.2 Internal and External Quality Control
8.3 Preparation of Quality Control Charts: Levy-Jenning Chart and Gaussian Curve; Cusum Chart
8.4WestguardMultirule Charts

Reference Book:

- Bishop(2013),Clinical Chemistry,7th edition, Wiley Publications (ISBN: 978145111868)
- Henry's Clinical Diagnosis and Management by Laboratory Methods,(2011),22nd edition, Elsevier (ISBN: 9780323673204)
- P.B. Godkar, (2014), Textbook of Medical Laboratory Technology, 3rd ed., Bhalani Publishing House, Mumbai, India. (ISBN: 9789381496190)

Further Reading:

- Ochei J. &Kolhatkar A.(2000), *Medical Laboratory Science: Theory & Practice*, Tata McGraw Hill Pub. (ISBN: 9780074632239)
- Teitz,(2007),Fundamentals of Clinical Chemistry,6th edition, Elsevier Publications (ISBN: 9780323530446)

List of Practical

1) Clinical laboratory training and its report submission includes:
   – Observation of routine analysis and laboratory procedure.
   – Understanding of Good Laboratory Practice.
   – Understanding of accreditation process

****

Forensic Biology and DNA Typing

Name of faculty: Science	**Department:** Biotechnology
Program: M.Sc. Sem-III	**Type:** DSE-3
Subject: Forensic Biology and DNA Typing	
Credit: 04	**Total learning hours: 60**

Course description:

The course provides the basic knowledge about Forensic Science and its applications. Specifically, this course covers biological and molecular aspects and information used for forensic studies and to solve the crimes. The techniques used for identification and characterization of culprits or victims through diverse biological evidences are included in this course.

Student learning outcome:

On completion of course students will be able to:

- Learn the basics of forensic biology.
- Understand the collection, identification and applications of various biological evidence for solving crimes.
- Learn basic biology of DNA and its principles.
- Apply the techniques for DNA typing for forensics.

Unit-1: Basics of Forensics: (4 h)

1.1. Introduction to Forensics and its branches
1.2. Forensic biology: A subdiscipline of Forensics
1.3. History of Forensic Biology
1.4. Laboratory Services: Forensics

Unit-2: Biological Sources as Forensic Indicators: (8 h)

2.1. The Decay process of Biological Sources
2.2. Body fluids and waste products
2.2.1. Blood and Cells; Blood Typing (bloodstain pattern analysis)
2.2.2. Saliva and Semen
2.2.3. Faeces, urine and vomitus
2.3. Hair
2.4. Bone
2.5. Wounds

Unit-3: Crime Scene Investigation and Analysis of Biological Evidence: (8 h)

3.1. Protection and documentation of crime scene
3.2. Recognition and collection of biological evidence
3.3. Packaging and transportation of biological evidence
3.4. Identification and characterization of biological evidence
3.5. Crime scene reconstruction and reporting results

Unit-4: Organisms in Forensics: (9 h)

4.1. Microbes (Bacteria, Viruses, Protist And Fungi)
4.2. Plants
4.2.1. Wood and illegal trade in protected plants
4.2.2. Pollen and spores
4.2.3. Fruit, seeds and leaves
4.2.4. Secondary metabolites as drugs and poison
4.3. Invertebrates (forensic indicators and forensic information obtained-calculating death time)
4.4. Vertebrates
4.5. Collection of plant and animal material for forensic studies

Unit-5: Basics of DNA Biology: (6 h)

5.1. Basic DNA principles and structure of DNA
5.2. Chromosome, genes
5.3. DNA Polymorphisms
5.4. DNA Markers
5.5. Designating chromosomal locations

Unit-6: DNA typing: (8 h)

6.1. Introduction to DNA analysis
6.2. Historical methods for DNA typing
6.3. Sources for DNA
6.4. Sampling, collection, storage and transportation of DNA evidence
6.5. Dealing with Degraded DNA, Low copy Number DNA and Mixture of DNA samples

Unit-7: Techniques for DNA typing: (10 h)

7.1. Extraction of DNA
7.2. Quantitation and analysis of DNA evidence
7.3. Amplification of DNA
7.4. Separation and detection of DNA
7.5. STR markers and genotyping (general STR and Y-chromosome)
7.6. SNPs and other polymorphisms
7.7. VNTRs profiling

Unit-8: Applications of DNA Typing in Forensics: (7 h)

8.1. Sex chromosome haplotyping and gender identification
8.2. Mitochondrial DNA profiling (Tzar Nicholas II case)

8.3. Parentage identification
8.4. Disaster victim identification
8.5. Wildlife Crime and Forensics

References:

- Li R.,(2015) Forensic Biology (2nd Edition), CRC Press ISBN:978-1-4398-8972-5
- Butler J., (2010) Fundamentals of Forensic DNA Typing, Elsevier ISBN:9780123749994
- Gunn A., (2006) Essential Forensic Biology, John Wiley & Sons Ltd.ISBN:978-0470758038
- Jamieson A. & Bader S., (2016) A Guide to Forensic DNA Profiling, John Wiley & Sons Ltd.ISBN:978-1118751527

Practical:

1. Extraction and characterization (spectrophotometric and gel electrophoresis) of DNA from hair/nail clipping. Or To study DNA extraction through InstaDNA card.
2. Demonstration of Crime scene investigation. Or To identify unknown remains through mitochondrial DNA study (Demonstration and theoretical case study)
3. To study diatoms for identification of location, time of year and habitat of crime involving drowning.
4. To identify blood stain through presumptive tests (Hydrogen Peroxide test/Kastle-Meyer Test).

Reference for Practical:

1. Walker P. & Wood E., (2010) Facts on File Science Experiments Forensic Science Experiments, Infobase Publishing ISBN:978-0816078042

Research Methodology

Name of faculty: Science	**Department:** Microbiology
Program: M.Sc. Microbiology Sem-III	**Type:**DSE-3
Subject: Research Methodology	
Credit: 04	**Total learning hours:** 60

Course description:
The learning objective of the paper will enrich the students with basic principle of research methodology which help the students to learn essential steps involved in research methodology like Review of literature, Construction of hypothesis, Data collection, Report writing and Research publication.

Student learning outcome:

- Student will learn about objective and types of research.
- Student will understand important steps involved in research
- Student will learn about writing a research proposal and report and how to do citation

Unit-1: Introduction to research methodology **(Duration: 07 Hrs)**

1.1 Definition of Research
1.2 Objectives of research
1.3 Types of research.
1.4 The research process

Unit-2: Important steps of research **(Duration: 08 Hrs)**

3.1 Reviewing the literature
3.2 Formulating a research problem
3.3 Identifying variables: What is variables?, Types of variablesConstructing hypothesis
3.4 Types of measurement scale
3.5 Data collection

Unit-3: Constructing Hypothesis **(Duration: 07 Hrs)**

3.1 Defination of Hypothesis
3.2 The function of Hypothesis
3.3 Testing of a hypothesis
3.4 Characteristics of hypothesis
3.5 Types of hypothesis

Unit-4: Research design **(Duration: 07 Hrs)**

4.1Need for a research design
4.2 Important concept relating to research design

4.3 Basic principles of experimental designs
4.4 Important experimental designs

Unit-5: Data collection & preparation process (Duration: 08 Hrs)

5.1 Collection of primary data
5.2 Collection of secondary data
5.3 Selection of appropriate method for data collection
5.4 Data preparation process

Unit-6: Literature citation (Duration: 08 Hrs)

5.5 Different systems of citing references
5.6 Citation in text
5.7 Placement of reference section
5.8 Format of reference section

Unit-7: Research Report – Tables & Figures (Duration: 07 Hrs)

6.1 Introduction and placement of tables
6.2 Format of table
6.3 Introduction and placement of figures
6.4 Numbering & caption of figures
6.5 Preparation of statistical diagrams, photographs &microphotograps

Unit-8: Writing a Research proposal & report (Duration: 08 Hrs)

5.1 Contents of research proposal
5.2 Components of research report
5.3 Research report - Formatting& typing
5.4 Plagiarism

Reference Book:

- Gurumani N. (2011) Research Methodology For Biological Sciences, MJP Publishers, Chennai (ISBN: 978-81-8094-016-0)
- Kumar, R. (2005). *A Step-by-step Guide for Beginners*. Sage Publications. (ISBN: 9788132106487)
- Kothari, C. R. (2004). *Research methodology: Methods and techniques*. New Age International. (ISBN: 978-81-224-2488-1)

Further Reading:

- Singh, Y. K. (2015) Fundamental of Research Methodology and Statistic New Age International (P) Ltd., Publishers - New Delhi (ISBN: 978-81-224-2418-8)

SARVAJANIK UNIVERSITY

List of Practical

1) Searching of scientific journals & resources
2) Preparation of graphs and tables to present the scientific data
3) Online grammar checking in scientific writing
4) References management by online tools
5) Plagiarisms checking

****

Bioentrepreneurship

Name of Faculty: Science	**Department:** Biotechnology
Program: M.Sc. Sem-III	**Type:** DSE-3
Subject: Bioentrepreneurship	
Credit: 04	**Total Learning Hours:** 60
Course Description: This course introduces students to basic concepts of Bio- Entrepreneurship. It will also inculcate the importance, need & applications of these areas. This course will prepare the students for becoming an entrepreneur.	
Student Learning Outcome: After completion of the course, students will be: 1)Student will be able to appreciate the importance of Bio-Entrepreneurship 2)Student will be able to exposed to different concepts needed for practical execution when they work as Entrepreneur 3) Student will gain skills useful for becoming an entrepreneur	

Unit 1 Introduction to Entrepreneurship (08 Hours)

1.1 Definitions & Concepts -Entrepreneur, Entrepreneurship, MSMEs, Enterprise &Startups

1.2 Process of Entrepreneurship

1.3 Competencies & Skills/ Qualities of an Entrepreneur

1.4 Types of Entrepreneurs & Enterprise

1.5 Advantages & Disadvantages of Entrepreneurship

Unit 2 Biotechnology Entrepreneurship (09 Hours)

2.1 Concept of Biotechnology Entrepreneurship

2.2 Significance of the Biotechnology Entrepreneur

2.3 Biotechnology entrepreneurship versus general entrepreneurship

2.4 Essential biotechnology entrepreneurial characteristics

2.5 Backgrounds of biotechnology entrepreneurs

2.6 Fuel, Feed and Heal the world through Biotechnology Entrepreneurship: Industrial and Environmental Biotechnology, Food and Agricultural Biotechnology, Health Biotechnology.

Unit 3 Financial Management & Financial Statements (09 hours)

3.1 Approaches to managing capital & cost of capital

3.2 Working capital & cash flow planning

3.3 Financial Planning & Budgets

3.4 Statement showing financial position

3.5 Measuring & reporting financial performance

3.6 Accounting conventions & concepts

Unit 4 Project Management (07 hours)

4.1 Project: Concept & Classification

4.2 Project Formulation

4.3 Project Reporting

4.4 Project Appraisal

Unit 5 Entrepreneurial Planning & HRM (06hours)

5.1 Basic legal forms of organizations

5.2 Company formation,ownership structure & securities

5.3 Human resource & business strategies

5.4 Workforce Planning

5.5 HRM Functions

Unit 6 Case studies of Biotech Entrepreneurs (06 Hours)

6.1 Shantha Biotech: Unleashing Biotechnology in India.

6.2 Aravind Eye Hospital: Making a Dent in Global Blindness.

6.3 Centocor: Diagnostics Company on Monoclonal Antibodies.

6.4 Suguna Poultry Farm Ltd: Hard work, No compromise, No excuse.

6.5 The Surat Transformation: Urban Renewal.

Unit 7 Introduction to IPR (06 Hours)

7.1 History & Definition of IPR

7.2 Forms/ Types of IPR

7.3 Traditional Knowledge, Commercial Exploitation & Protection

7.4 Protection of Biotechnological Inventions

Unit 8 Introduction to Patent (09 Hours)

8.1 Introduction & Types of Patent

8.2 Requirements for Patenting

8.3 Procedure of Patent Application

8.4 Various types of patent applications in India

8.5 Patent Search

References:

- Bioentrepreneurship Development: A Resource Book Prepared by Biotech Consortium India Limited (BCIL), New Delhi Compiled by: Ms.ShreyaSanghvi Malik, Deputy Manager Dr. Shiv Kant Shukla, Deputy General Manage
- Biotechnology Entrepreneurship (2014) Craig Shimasaki, Academic Press, USA.
- Dynamics of Entrepreneurial Development and Management (2005) Vasant Desai, Himalaya Publishing House.
- Making Breakthrough Innovation Happen: How Eleven Indians Pulled of the Impossible (2009) PorusMushi, HarperCollins Publishers India.
- The CII Entrepreneur Hand Book: Practical Advice for Starting a New Business (2010) SushilaRavindranath, Westland Ltd.
- The Game Changers: 20 extraordinary success stories of Entrepreneurs (2013) Y. Modi, R. Kumar & A. Kothari, Random House Publishers India Pvt. Ltd.
- Bioethics & Biosafety by M K Sateesh ,I K International Pub. Ltd
- Biotechnology Expanding Horizons by B D Singh, Kalyani Pub.

Application of Green Chemistry

Name of faculty: Science	**Department:** Chemistry
Program: M.Sc.Sem-III	**Type:**DSE-3
Subject:Application of Green Chemistry	
Credit: 04(T) + 02 (P)	**Total learning hours:** 60

Course description: Students shall be able to understand:

- A functional concept of the field of green chemistry.
- The 12 principles of green chemistry.
- Several real-world examples where organizations used green chemistry to improve the sustainability performance of their products.

How the practice of green chemistry enhances competitiveness, innovation and faster time to market.

Student learning outcome:

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

- Green Chemistry is the design of chemical products and processes that reduce or eliminate the use and generation of hazardous substances.
- This course will present the fundamentals of the 12 principles of green chemistry, and explore relevant examples of their practical use in commercial applications.
- To understand the environmental consequences of chemical manufacturing and illustrate how these may be minimized.

Unit 1 Application of green chemistry in daily life (06 Hours)

1.1 Green Dry cleaning of clothes, Green Bleaching Agents, green detergents, green dyes
1.2 Eco Friendly paints & Waxes
1.3 Putting out Fires in a green way
1.4 Turning turbid water clear in a Green way
1.5 Biodegradable plastics
1.6 Computer chips
1.7 Green drugs
1.8 Solar cell, Solar water heater
1.9 Green building and construction Materials
1.10 Bleaching of paper
1.11 Reusable water Bottle
1.12 Bio Material & Green fuel
1.13 Anti foulants and other green chemicals

Unit 2 Application of green chemistry in pharmaceutical Industry. (12Hours)

2.1 Green Pharmacy: Principle
2.2 Green Catalyst & Biocatalyst used in pharmaceutical industry.
2.3 Green Solvents and it's categories:
Water, Ionic liquids & Supercritical CO_2, Other Green Solvents
2.4 Solvent free processes,

2.5 Green processes in Pharmaceutical development
2.6 Minimum Pharmacy Waste
2.7 Design pharmaceutical products for degradation
2.8 Green Resources for Drug development through Ethan botany
2.9 Eco friendly Medicinal plants &Ayurvedic preparation

Unit 3 Application of Green chemistry in Agriculture. (10Hours)

3.1 Natural product in plant protection:
3.2 Development of green chemicals for the Agriculture-Minimum Risk Pesticides
3.3 Eco friendly Pesticides & Insecticides
3.4 Renewable Feedstock from Agriculture (Biomass)
3.5 A new Role of Neem Tree in greening the Environment
3.6 Vesicular ArbuscularMycorrhizae in green chemistry.

Unit 4 Application of Green chemistry in Industry (12Hours)

4.1 Food and flavour Industry
4.2 Paper and pulp Industry
4.3 Polymer Industry
4.4 Textile Industry
4.5 Paint Industry: Water Based paints, High solids Paints, low TiO_2 paint
4.6 Tannery Industry
4.7 Rubber Industry

Unit 5 Application of Green chemistry for achieving sustainable development (06 Hours)

5.1 Green chemistry skills
5.2 Environmentally Friendly Technologies
5.3 Renewable feedstock and raw materials,
5.4 Oleochemistry, photochemistry, bio catalysis & biotransformation, sequestration of CO_2, waste biomass as chemical feed stock,
5.5 Biodegradation of biomass to biogas & biodiesels

Unit 6 Application of Green chemistry in analytical chemistry (04Hours)

6.1 Green analytical chemistry
6.2 Electrophoresis
6.3 Micronization in separation Methods
6.4 Greener solvent for separation

Unit 7 Eco friendly technologies for clean world (06Hours)

7.1 Waste: production, problems & prevention
7.2 Environmentally Benign Technologies using green chemistry
7.3 Application of non conventional energy sources
7.4 Microwave induced & Ultrasound assisted green synthesis

Unit 8 Other Applications Of Green Chemistry **(04 Hours)**

8.1 Chemicals from glucose:

8.2 Polysaccharide Polymers

8.3 Application of green chemistry in organic synthesis

8.4 Greener nanoscience

References:

1. V.K. Ahluwalia& M.R. Kidwai: New Trends in Green Chemistry, 2005, Anamalaya Publishers.
2. P.T. Anastas& J.K. Warner: Oxford Green Chemistry- Theory and Practical, 1988, University Press.
3. A.S. Matlack: Introduction to Green Chemistry, 2001, Marcel Dekker.
4. M.C. Cann& M.E. Connely: Real-World Cases in Green Chemistry, 2000, American Chemical Society, Washington.
5. M.A. Ryan & M. Tinnesand, Introduction to Green Chemistry, 2002, American Chemical Society, Washington.

Laboratory Practical

1. Determination of Organic Carbon in soil sample.
2. Determination of Nitrogen in soil sample.
3. Determination of Phosphorous in soil sample.
4. Determination of BOD in industrial wastewater sample.
5. Determination of NOx in Air sample.
6. Determination of SOx in Air sample.
7. Nitration of Salysilic Acid using $Ca(NO_3)_2$ and Acetic Acid.
8. Bromination of Acetanilide using $KBrO_3$ and $(NH_4)_2Ce(NO_3)_6$.
9. Preparation of Schiff Base by Microwave Technique.
10. Determination of Blood Sugar by Folin-Wu method.
11. Determination of Blood Urea by DAM method.
12. Determination of % Purity of Brass Alloy (Copper and Zinc).

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 Engineering, A. Nag, 1st Edition, 2006, Prentice Hall of India Pvt. Ltd.
4. Laboratory Manual on Engineering Chemistry, S.K. Bhasin and Sudha Rani, 3rd Edition, Reprint 2011, DhanpatRai Publishing Company (P) Ltd.