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	
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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 1

Principles of Clinical Bacteriology, Virology & Mycology

Name of faculty: Science	**Department:** Microbiology
Program: M. Sc. Medical Laboratory Technology Sem-I	**Type:**DSC-1
Subject: Principles of Clinical Bacteriology, Virology & Mycology	
Credit: 4+2	**Total learning hours:** 60
Course description: This course has been prepared to instruct basic and medically relevant information on the microbes, viruses and fungi.The microbial structure, growth and development, methods and role of sterilization in the context of study of microbes are included. It includes preservation and maintenance of pure cultures. It also covers basic principles of viral and fungal classification, structures, clinical diseases and laboratory diagnostic methods.	
Student learning outcome: • Demonstrate theory and practical skills in microscopy and their handling techniques and staining procedures • Understand the basic microbial structure and function and study the comparative characteristics of prokaryotes and eukaryotes • Know various Culture media and their applications and also understand various physical and chemical means of sterilization • Know microbial techniques for isolation of pure cultures of bacteria and suitable drug for treatment. • Know viruses with their structure, lab. Diagnosis and preventive measures. • Explain fungi including their morphology and different techniques of lab. Diagnosis. • Discuss various viral and fungal diseases of human.	

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

1.1 Evolution and History of microbiology

1.2 Classification of microorganisms, General characteristics of prokaryotes & eukaryotes

1.3 Introduction to Bacterial cell structures

Unit-2: Microscopy (Duration: 08 Hrs)

2.1 Types of microscopes: Principles & Components of- Light microscope; DGI; Fluorescent; Phase contrast

2.2 Electron microscope: Transmission/ Scanning

2.3 Importance and applications of dyes, stains, fixatives, mordent and intensifiers.

Unit-3: Pure Cultures and Cultural Characteristics (Duration: 08 Hrs)

3.1 Methods of isolation of pure culture

3.2Methods of cultivation: Broth, slant and Stab
3.3 Bacteriological media
3.4 Maintenance and preservation of pure culture

Unit-4: Sterilization and Disinfection **(Duration: 08 Hrs)**

4.1 Introduction and Definition
4.2 Physical and Chemical Methods
4.3 Ideal characteristics and mode of action of disinfectants.

Unit-5: General Properties of Viruses **(Duration: 08 Hrs)**

5.1Structure of viruses
5.2Replication of viruses
5.3 Cultivation of viruses
5.4 Detection of viral growth in cell culture

Unit-6: Diseases caused, Lab Diagnosis and Prevention of- **(Duration: 06 Hrs)**

6.1Human immunodeficiency viruses
6.2Chikunguinea
6.3Hepatitis viruses
6.4 Dengue

Unit-7: General Properties of Fungi **(Duration: 06 Hrs)**

7.1 The morphology of fungi
7.2Classification of fungi
7.3 Specimen collection & diagnostic methods of fungal infection

Unit-8: Morphology, Diseases caused and Lab Diagnosis of- **(Duration: 08 Hrs)**

8.1 Cutaneous Mycosis
8.2 Sub cutaneous Mycosis
8.3 Systemic Mycosis
8.4 Opportunistic fungal infections

Reference Book:

- Ananthnarayan R. and JayramPaniker C.K. Text book of Medical Microbiology,5thEdn. Orient Longman, Madras. (ISBN: 9788173718892)
- Cheesbrough Monica ,District laboratory practice in tropical countries VOL-1 & 2, , Cambridge University Press.(ISBN: 9780521665476)
- Prescott M,Harley John P., Microbiology, 8th edition, Lansing, Donald A. Klein, McGraw Hill. (ISBN: 9780077467890)
- 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)
- Modi H.A., Elementary Microbiology, Fundamentals of Microbiology,Vol-1,Akta Prakashan, Nadiad(ISBN: 9789350701010)

Further Reading:

- P.B. Godkar, 2014, Textbook of Medical Laboratory Technology, 3rd ed., Bhalani Publishing House, Mumbai, India. (ISBN: 9789381496190)
- Subhash Chandra Parija, A text book of Microbiology and immunology, 2nd Edition, ELSEVIER, a division of Reed Elsevier India Private Ltd.(ISBN: 9788131236246)

List of Practical

1) Study of Compound Microscope.
2) Examination of living Bacteria.
   a) Hanging – drop technique.
3) Differential Staining
   a) The Gram Stain
   b) The Acid fast Staining.
4) Special Staining
   a) The Spirocheate Stain
   b) The Metachromatic Granules Stain.
   c) The spore Stain
   d) The Capsule Stain
5) Study of some important biochemical reactions.
   a) Indole Test.
   b) Methyl red Test.
   c) V.P. Test.
   d) Citrate Utilization Test.
   e) H2S Production (2% peptone)
   f) Study of TSI slants with different
   g) Fermentation of Sugars
   h) Test for enzyme activity-Oxidase, Catalase, Coagulase, Urease,
6) Preparation of media, pH adjustment and preparation of buffers
   (A) Bacteriological Media
   a) Nutrient agar
   b) MacConkey' agar
   c) EMB agar
   d) Wilson & Blair's agar for Salmonella sp.
   e) CLED medium for Urinary Tract Infection.
   f) King's medium for Pseudomonas sp.
   g) Manitol salt agar for *Staphylococcus* sp.

   (B) Mycological Media
   a) Glucose Yeast Extract agar.
   b) Sabouraud's agar
7) Demonstration of common fungi - Penicillin, Aspergillus, Rhizopus, Mucar, Yeast.

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Clinical Pathology

Name of faculty: Science	**Department:** Microbiology
Program: M. Sc. Medical Laboratory Technology Sem-I	**Type:**DSC-2
Subject: Clinical Pathology	
Credit: 4+2	**Total learning hours:** 60
Course description: The Clinical Pathology course has been prepared to inform anatomy, physiology, formation and collection of various clinical samples (urine, stool, semen, sputum etc.).Also routine analysis of various clinical samples is included to expand the view of the subject.	
Student learning outcome: ● Learn anatomy and physiology of various organs. ● The training in this subject enables the students to carry out routine clinical laboratory investigation (urine, stool, sputum etc.). ● The candidates are made to learn collection of clinical samples and their processing with basic technique and recording of data.	

Unit-1: Urine Analysis **(Duration: 10 Hrs)**

1.1 Anatomy and Physiology of Urine formation.
1.2 Composition, Collection, Preservation & Transportation of Urine.
1.3 Routine Examination Physical, Chemical & Microscopic.
1.4 Reagent Strip Method.

Unit-2:Stool Analysis **(Duration: 08 Hrs)**

2.1Collection, Preservation & Transportation of Stool.
2.2 Routine Examination Physical, Chemical & Microscopic.
2.3 Correlation and significance in various diseases.

Unit-3: Cerebrospinal Fluid Analysis **(Duration: 08 Hrs)**

3.1 Anatomy and physiology of meninges.
3.2 Formation &Composition of CSF.
3.3 Collection, Preservation & Transportation of C.S.F.
3.4 Physical, Chemical & Microscopic Examination.
3.5 Correlation of Abnormal C.S.F. findings in various diseases.

Unit-4: Sputum Analysis **(Duration: 08 Hrs)**

4.1 Anatomy and Physiology of Respiratory system.
4.2 Collection, Preservation & Transportation of sputum.
4.3 Physical, Microscopic & Bacteriological Examination.

Unit-5: Semen Analysis **(Duration: 08 Hrs)**

5.1 Anatomy & Physiology of Male Reproductive System.

5.2 Formation & Collection of semen.
5.3 Physical, Chemical & Microscopic Examination as per WHO Recommendation.

Unit-6: Gastric Analysis (Duration: 06 Hrs)

6.1 Anatomy and Physiology of Stomach.
6.2 Collection, Preservation, Transportation & analysis.

Unit-7: Body Fluid Analysis: 1 (Duration: 06 Hrs)

Anatomy, Physiology, Formation, Indications, Collection and Routine Examination of:

7.1Pleural fluid
7.2 Peritoneal fluid

Unit-8: Body Fluid Analysis: 2(Duration: 06 Hrs)

Anatomy, Physiology, Formation, Indications, Collection and Routine Examination of:

8.1 Pericardial fluid
8.2 Synovial fluid

Reference Book:

- Mohan H. (2005). *Textbook of Pathology*, 5th ed., Jaypee Brothers (ISBN: 9788180613685)
- Ochei J. &Kolhatkar A. (2000), *Medical Laboratory Science: Theory & Practice*, Tata McGraw Hill Pub. (ISBN: 9780074632239)
- P.B. Godkar, (2014), Textbook of Medical Laboratory Technology, 3rd ed., Bhalani Publishing House, Mumbai, India. (ISBN: 9789381496190)

Further Reading:

- Kawthalkar S M, Essential of Clinical Pathology,2nd ed., Jaypee Brothers. (ISBN: 9789386150691)
- Mukharjee K.L. (1999), *Medical Laboratory Technology*, Vol II, 2nd ed.,Tata MacGraw Hill. (ISBN: 9789352606818)
- Sood R. (1994) *Medical Laboratory Technology*, 4th ed., Jaypee Brothers. (ISBN: 9788180615917)

List of Practical

1) Routine Urine Analysis: Physical, Chemical, Microscopic examination. & Reagent Strip Method
2) Routine Stool Analysis: Physical, Chemical, Microscopic examination.
3) Routine Cerebrospinal Fluid Analysis: Physical, Chemical, Microscopic examination.
4) Routine Sputum examination: Physical, Microscopic
5) Routine Semen Analysis: Physical, Chemical, Microscopic examination.
6) Routine Peritoneal fluid Analysis: Physical, Chemical, Microscopic examination.
7) Routine Pleural fluid Analysis: Physical, Chemical, Microscopic examination.
8) Routine Pericardial fluid Analysis: Physical, Chemical, Microscopic examination.
9) Routine Synovial fluid Analysis: Physical, Chemical, Microscopic examination.

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Histopathology & Parasitology

Name of faculty: Science	**Department:** Microbiology
Program: M. Sc. Medical Laboratory Technology Sem-I	**Type:**SEC-1
Subject: Histopathology & Parasitology	
Credit: 4+2	**Total learning hours:** 60
Course description: The main purpose of the subject is to update the knowledge about the habitat, morphology, life cycle of parasite in human body and to impart knowledge about its diagnosis in laboratory. Histopathology and cytopathology techniques are included to widen the view of the subject.	
Student learning outcome: • Knowaboutidentification of various parasitic pathogens. • Recognize different parasite using different procedures with special reference to their habitat, morphology, life cycle and their isolation, identification for diagnostic purpose. • Learn collection of histopathological samples and their processing with basic technique and recording of data.	

Unit-1:General Parasitology **(Duration: 08 Hrs)**

1.1General characteristics and Classification of Parasite
1.2 Types of Parasite and Host
1.3 Host –Parasite Relationship and Mode of transmission
1.4 Classification of Protozoa &Helminthes.

Unit-2:Protozoa-I **(Duration: 08 Hrs)**

Introduction, classification & study of individual Protozoa:

2.1*Entamoebahistolytica*
2.2*Trichomonasvaginalis*
2.3*Toxoplasma gondii*

Unit-3:Protozoa-II **(Duration: 08 Hrs)**

Introduction, classification & study of individual Protozoa:

3.1*Leishmaniadonovani*
3.2*Giardia lamblia*
3.3*Plasmodium falciparum & Plasmodium vivax*

Unit-4:Cestodes **(Duration: 08 Hrs)**

Introduction, classification & study of individual Cestodes:

4.1 General characteristics of Cestodes
4.2*Taeniasaginata*
4.3*Taeniasolium*
4.4*Echinococcusgranulosus*

Unit-5:Trematodes **(Duration: 06 Hrs)**

Introduction, classification & study of individual Trematodes:

5.1 General characteristics of Trematodes
5.2*Schistosomahaematobium*
5.3 *Schistosomamansoni*
5.4*Schistosomajaponicum*

Unit-6:Nematodes-I **(Duration: 08 Hrs)**

Introduction, classification & study of individual Intestinal Nematodes:

6.1*Trichuristrichiura*
6.2*Anchylostomaduodenale*
6.3*Enterobiusvermicularis*
6.4*Ascarislumbricoides*

Unit-7: Nematodes-II **(Duration: 04 Hrs)**

Introduction, classification & study of individual Somatic Nematodes:

7.1*Wuchereriabancrofti*
7.2*Brugiyamalayi*

Unit-8: Histopathology Techniques **(Duration: 10 Hrs)**

8.1 Types of fixatives uses and Decalcification
8.2 Basic concept of tissue processing and automated tissue processing
8.3 Microtomy& Types of Microtome
8.4 Routine& Special stains, Museum- Technique & Specimen preservation
8.5 FNAC

Reference Book:

- Arora D.R. and Arora B. (2004). *Medical Parasitology*, 2nd ed., CBC Publishers & Distributors Pvt Ltd. (ISBN: 9788123911878)
- Chatterjee K.D. (2009). *Parasitology: Protozoology and Helthminthology in Relation to Clinical Medicine*, 13th ed., CBC Publishers & Distributors Pvt Ltd (ISBN: 9788123918105)
- Mohan H. (2005). *Textbook of Pathology*, 5th ed., Jaypee Brothers (ISBN: 9788180613685)
- Ochei J. &Kolhatkar A. (2000), *Medical Laboratory Science: Theory & Practice*, Tata McGraw Hill Pub. (ISBN: 9780074632239)
- P.B. Godkar, (2014), Textbook of Medical Laboratory Technology, 3rd ed., Bhalani Publishing House, Mumbai, India. (ISBN: 9789381496190)

Further Reading:

- Chakraborty P. *Text book of Medical Parasitology*, 2nd ed., JP (ISBN: 9789352550418)
- Ichhpujani RL and Bhatia Rajesh. *Medical parasitology*.3rd ed., JP (ISBN: 9789350250457)
- Kawthalkar S M, Essential of Clinical Pathology,2nd ed., Jaypee Brothers. (ISBN: 9789386150691)

- Sood R. (1994) *Medical Laboratory Technology*, 4th ed., Jaypee Brothers. (ISBN: 9788180615917)

List of Practical

1) Routine stool examination for detection of intestinal parasites with concentration methods:
   a) Saline preparation
   b) Iodine preparation
   c) Floatation method
   d) Centrifugation method
2) Identification of adult worms, Tapeworm segments, ova, cysts and larvae of parasite from charts/photographs/models/slides
3) Malarial Parasite Microscopy:
   a) Preparation of thin and thick blood smears
   b) Staining of smears
   c) Examination of smears for malarial parasites (*P. Vivax*and*P. falciparum*)
   d) Demonstration of various stages of life cycle of malarial parasites in stainedslides
4) Malaria Rapid diagnostic test (RDT/ICT)
5) Test for Filarial parasite: (slide/demonstration)
6) Cutting, Fixation and processing of tissues (Demonstration).
   Staining – (a) Haematoxylin and Eosin for paraffin sections.
   (b) PAP Stain for cytology.

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Food Chemistry

Name of faculty: Science	**Department:** Chemistry
Program: M. Sc.Sem-I	**Type:**DSE-1
Subject: Food Chemistry	
Credit: 04(T) + 02 (P)	**Total learning hours:** 60

Course description:

This course presents concise and relevant information on the composition of foods and the reactions they undergo during processing and storage. The course will deal with the chemistry of the principal components of foods, their properties and interactions. This will provide basic information regarding the food analysis also.

Student learning outcome:

At the end of the course students will be able to:

- Explain the importance of water for stability and quality of foods.
- Understand the relationship between nutrition and human well being
- Know the major and minor components of foods
- Know composition and properties of food
- Explain the basic structures of food constituents
- Understand the basic chemical reaction food constituents undergo during processing
- Identify additives added to foods for different purposes

Unit 1 Water in Food **(06 Hrs)**

1.1 Moisture in foods, definition of water in food, Water as a nutrient

1.2 Types of water and their specific function

1.1 Sorption phenomenon

1.2 Water activity and food stability

1.3 Water activity and packaging

1.6 Water activity and spoilage

Unit 2 Carbohydrates **(10 Hrs)**

2.1 Definition, classification and physical properties

2.2 Nutritive roles of carbohydrate

2.3 Sweetness of sugars, relation of structure to sweetness

2.4 Important carbohydrates in food

(glucose, sucrose, starch, agar, glycogen, cellulose, pectin, gums and resins)

2.5 Carbohydrates: digestion, absorption, metabolism (glycolysis, citric acid cycle, glycogenesis, Glycogenolysis, Gluconeogenesis, hexose monophosphate pathway)

2.6 Retro gradation and staling

2.7 Modified celluloses and starches

2.8 Pectic substances and dietary fibre

2.9 Nonenzymatic browning and Mailard reaction

Unit 3 Lipids **(08 Hrs)**

3.1 Characteristics and classification

3.2 Physical properties-melting point, softening point, specific gravity, refractive index, smoke, flash and fire point, turbidity point

3.1 Chemical properties- reichertmeissel value, polenske value, iodine value, peroxide value, saponification value

3.4 Effect of frying on fats

3.5 Changes in fats and oils- rancidity, lipolysis, flavor reversion

3.6 Auto-oxidation, factor affecting rate of oxidation and its prevention, Methods of measuring lipid oxidation- solid fat index, peroxide value, thiobarbituric acid test, anisidine value, Kreis test, oxirane test

3.7 Technology of edible fats and oils- Refining, Hydrogenation and Interesterification

Unit 4 Proteins **(08 Hrs)**

4.1 Protein classification and structure

4.2 Nature of food proteins (plant and animal proteins)

4.3 Denaturation of protein and its implications

4.4 Functional properties of proteins (organoleptic, solubility, viscosity, binding gelation/ texturization , emulsification , foaming)

4.5 Supplementary value of food proteins

4.6 Modification of food protein in processing and storage and its implications

4.7 Reaction of protein in food (Reaction with lipids, sulphites enzymatic hydrolysis, plastein reaction)

Unit 5 Minerals **(04 Hrs)**

5.1 Mineral functions, sources

5.2 Solubility and bioavailability of minerals

5.3 Nutritional aspects of minerals

5.4 Fortification: Iron sources used in fortification

Unit 6 Vitamin **(06 Hrs)**

6.1 Classification, stability, toxicity and sources

6.2 Distribution in foods, loss during processing

6.3 Mechanism of degradation

6.4 Functions and deficiency diseases caused by following vitamins:

6.4.1 Fats soluble vitamins – Vitamin A, D, E and K

6.4.2 Water soluble vitamins – Vitamin C and B-complex

Unit 7 Food additives **(08 Hrs)**

7.1 Definition, need and classification of food additives

7.2 Permitted food additives and their role

7.2.1 Preservatives-Natural and Artificial (Class-I and class-II preservatives)

7.2.2 Antioxidants, Chelating agents, Colouring agents

7.2.3 Curing agents, Emulsions

7.2.4 Flavors and flavor enhancers

7.2.5 Non-nutritive sweeteners

7.2.6 pH control agents

7.2.7 Stabilizer and thickeners

7.2.8 Humectants, Anti-caking agents

7.2.9 Firming agent, Clarifying agent, Flour bleaching agents

Unit 8 Food Analysis **(10 Hrs)**

8.1 Analysis of Chemical Additives in foods

8.1.1 Division of colour additives

8.1.2 Chromatographic identification of colours, quantitative estimation of added dyes in foods (Titanium Trichloride Method)

8.2 Chemical preservatives and synthetic sweetening agents (Organic-ether extractable and non- ether extractable)

8.2.1 Analysis of SO_2& Sodium Benzoate (Chemical Methods), Sorbic Acid (Chromatography)

8.3 Types of Antioxidants used in Foods

8.3.1 Analysis of ButylatedHydroxy Toluene (BHT) (Spectrophotometry)

8.4 Moisture analysis in food

8.5 Common adulterants in food

8.6 Pesticide analysis of food products

Reference:

1. Fennema's food chemistry, Damodaran, S., Parkin, K. L., &Fennema, O. R., 2007, CRC press.
2. Food science, Potter, N. N., & Hotchkiss, J. H., 2012, Springer Science & Business Media.
3. Principles of food chemistry, DeMan, J. M., Finley, J. W., Hurst, W. J., & Lee, C. Y. 2018, Springer.
4. Food chemistry, Aurand, L. W., Woods, A. E., & Wells, M. R., 1987, Springer, Dordrecht.
5. Food Chemistry, Meyer, L. H., 1982, AVI Publising Company.
6. Foods facts and principles, N. ShakuntalaManay, M. ShdaksharaSwamy, 2008, New age International Publisher, New Delhi.
7. Introduction to Chemical Analysis of Foods, S. Suzanna & Nielsen, CBS Publishers & Distributor.
8. Food chemistry, Belitz, H. D., Grosch, W., &Schieberle, P., 2004, Springer, Berlin, Heidelberg.

Laboratory Practical

1. Separation of Amino Acids using Thin Layer Chromatography.
2. Estimation of Vitamin C by Iodometric Titration.
3. Preparation of Lineweaver Burk Plot for Amylaze Enzyme.
4. Qualitative Analysis of Carbohydrates.
5. Determination of pH, Turbidity and TDS of water sample.
6. Determination of D.O. and Conductivity of water sample.
7. Preparation of p-Nitro Chloro benzene from Acetanilide.
8. Preparation of Eosin from Phthalic Acid.
9. Determination of Zn^{+2}/ Cu^{+2} by Complexometric titration.
10. Gravimetric estimation of Ni as Ni (Dimethyl Glyoxime)$_2$ /Ba as $BaSO_4$.
11. Determination of COD of water sample by redox titration.

12. Analysis of fats/oils – Any two of the following:

Acid value, Iodine number, Reichert Meissel number and Saponification value of fats

13. Determination of riboflavin from curry leaves (fluorimetric method).
14. Determination of salt content in commercial table butter.
15. Determination of Moisture in food sample.

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. Manual of analysis of fruits and vegetable products, Central food technological research institute, Mysore, S. Ranganna, 1977, Tata McGraw Hill publishing company Ltd, New Delhi.
6. Biochemical Methods, S. Sadasivam, and A. Manikam, 2nd Edition, 1996, New Age International(p) Ltd. Publishers and Tamil Nadu Agricultural University (Coimbatore).
7. Laboratory techniques in food analysis, D. Pearson, 1973, John Wiley & Sons, New York.
8. Analytical Chemistry, H. Kaur, 1st Edition, 2013, PragatiPrakashan.

Energy and Environment

Course Title	Energy and Environment
Course credit	04+02
Course Hrs	60
Course Objective	The students are expected to understand the importance of energy conservation and become capable to identify the technologies for effective utilization of renewable energy sources.
Course Objective	After learning the subject, students will be able to understand, • Importance of renewable energy sources. • Application of different renewable energy sources. • Impact of energy on ecology, society and environment. • Energy Policy of India and our energy future. • The need, importance and scope of non-conventional and alternative energy.
Course content	**Unit-1: Introduction:** Energy, Units of energy, Law of conservation of energy, Scenario of renewable and non-renewable energy sources, Needs of renewable energy, advantages and limitations of renewable energy, present energy scenario of conventional and RE sources. **Unit-2: Solar Energy:** Sun as source of energy: solar energy potential in India, National solar mission, solar radiation and its spectral characteristics, solar radiation outside the Earth's atmosphere and at the Earth's surface, flat plate and concentrating collectors, solar thermal power generation, fundamentals of solar photo voltaic conversion. **Unit-3: Wind Energy:** Wind power and its sources, modern wind energy-modern wind turbines, wind energy estimation, types of wind energy systems, site selection, details of wind turbine generator. **Unit-4: Bio Energy:** Types of biogas plants, biogas generation, factors affecting biogas generation, advantages and disadvantages of biomass energy, biomass

	gasification, types of gasification. **Unit-5: Ocean thermal energy:** Ocean thermal energy conversion principal, energy from tides, tidal power plants, single and double basin plants, site requirements, advantages and limitations. **Unit-6: Energy, environment and society:** Impact of energy use on the environment, fossil fuel burning and related issues of air pollution, global warming, greenhouse effect, nuclear energy and related issues of radioactive waste, social inequalities related to energy production, distribution and use. **Unit-7: Energy, ecology and environment:** Energy -production, transformation and utilization, associated environmental impacts: Nuclear accidents, pollution, construction of dams, over consumption of energy and its impact on the environment, economy and global change. **Unit-8: Energy policy and our energy future:** Energy statistics in India and world, importance of energy conservation, India's Energy Strategy(National Energy Policy), energy audit definition, energy management system, types of energy audit, Fuel and energy substitution in future.
Reference Books	1. Solar Energy: Principles of Thermal collection and storage, S.P.Sukhatme and J.K.Nayak, McGraw-Hill Education. 2. Elliott, D. 1997. Sustainable Technology, Energy, Society and Environment. New York, Routledge Press. 3. Sathyajith Mathew.2006.Wind energy: fundamental, resources analysis and economics. Springer Berlin Heidelberg, The Netherland ISBN: 139783540309055. 4. M.V.R. Koteswara. Rao, "Energy Resources: Conventional & Non-conventional" BSP Publications,2006. 5. Craig. J.R.,Vaughan, D.J.,Skinner.B.J.1996. Resources of the Earth: Origin, use and environmental impact.(2nd edition). Prentice hall, New Jersey.

	6. Godfrey Boyle, "Renewable Energy Power for A Sustainable Future," Oxford University Press.
Practical/ Demonstration of Equipments	1. Determination of calorific value by Bomb Calorimeter. 2. Solar radiation measurement methods using Pyrheliometer and Pyranometer. 3. VI – characteristics of solar PV system 4. VI – characteristics of Thermister.

Laboratory safety and Management

Name of Faculty: Science	**Department:**Environmental Science
Program:M. Sc.	**Type of Subject:**Theory
Subject: Laboratory safety and Management	
Semester-1 (DSE)	

Student Learning Outcomes (SLOs):

- Be aware of the factors that can lead to an accident.
- Discuss toxicology, industrial hygiene, source models, dispersion models, , fires and fire prevention, explosions and explosion prevention, electrostatics, pressure relief systems, runaway reactions, and risk analysis as they apply to chemical process safety, and be able to solve corresponding problems.
- Discuss the nature of the accident process and methods used in accident investigation, inherently safer design strategies, and the various strategies and governmental regulations relevant to process safety management.

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

1. Industrial Hygiene & Chemical Safety - M.H.Fulekar: I. K.International Publishing House,New Delhi.

2. Industrial Hygiene Reference And Study Guide- Allan K. Fleeger, Dean Lillquist, AIHA,01-May-2006

3. Personal Protective Equipment -Guide to Ports/Dock Workers - M.H.Fulekar : Governmentof India's Publication

4. Fundamentals of Industrial Hygiene-Barbara A. Plog, Patricia J. Quinlan, National SafetyCouncil Press, 2002

5. Occupational safety management and engineering, Willie Hammer, Dennis Price, PrenticeHall, 2001

6. Industrial Safety and Health Management, C. Ray Asfahl, David W. Rieske, Prentice Hall,31-Jul-2009

7. Fundamentals of Occupational Safety and Health, Mark A. Friend, James P. Kohn,Government Institutes, 16-Aug-2010

8. Handbook of occupational safety and health, Louis J. DiBerardinis, John Wiley, 1999

9. Occupational Hygiene. Blackwell Science, Harrington, J.M. & K. Gardiner.1995, Oxford.

10. Industrial Hygiene Evaluation Methods. Micheal S. Bisesi. CRC Press, 28-Aug-2003

Unit-1: Introduction of Industrial Hygiene (7 Lecture)

1.1 Definition, scope and applications

1.2 Occupational Environmental Stress: Physical & Chemical

1.3 Airborne chemicals: Dust or aerosols (respirable and non respirable, inhalable and total dust), gases, fumes, vapours, mist and smoke.

1.4 Concept of threshold limiting values

UNIT-2: Biosafety (7 Lecture)

2.1 Introduction; Historical Backround

2.2 Introduction to Biological Safety Cabinets and types

2.3 Primary Containment for Biohazards and Biosafety Levels of Specific Microorganisms

2.4 Recommended Biosafety Levels for Infectious Agents and Infected Animals

UNIT-3 Safety Precautions (7 Lecture)

3.1 Precautions: Process and operations involving explosives, flammables, toxic substances, dusts, vapors, cloud formation & combating.

3.2 Safety precautions for transportation for hazardous chemicals; Handling and storage of hazardous chemicals.

3.3 Respiratory personal protective equipment (RPPE) & non respiratory personal protective equipment (NRPPE): head protection , ear protection , face and eye protection , hand protection, foot protection and body protection.

UNIT-4 Fire and Explosion (7 Lecture)

4.1 Fire phenomena, classification of fire and extinguishers.

4.2 Statutory and other standards.

4.3 Fire prevention & protection system.

4.4 Explosion phenomena, explosion control devices, fire awareness.

UNIT-5 Electrical Safety:(7 Lecture)

5.1 Electricity and Hazardous, Indian standards.

5.2 Effects of electrical parameters on human body.

5.3 Safety measures for electric works.

UNIT-6 Noise and Vibration: (7 Lecture)

6.1 Noise: generation, types and permissible limit

6.2 measurement and evaluation of noise

6.3 control methods: control of source, isolation, sound proofing and practicing aspects of control of noise

6.4 vibration: generation, types and control

Unit-7 Hazards & Risk identification, Assessment and control techniques:(7 Lecture)

7.1 Hazards, Risks & detection techniques, Preliminary hazard analysis(PHA) & hazard analysis(HAZAN)

7.2 Failure mode effect analysis(FMEA), Hazard and operability(HAZOP) study.

7.3 Hazard ranking (DOW & MOND index), Fault tree analysis, Event tree analysis(ETA)

7.4 Major accident hazard control, onsite and off-site emergency plans.

Unit-8 Storage hazards **(7 lecture)**

8.1 safety measures for storage of flammable liquids/solvents, acid and alkali, chlorine and ammonia

8.2 safety of storing gas cylinders, color coding, marking and ensuring safe connection of cylinder

8.3 design of storage shed or go-down, retention basin, catch pot or dump vessel. Safe placement of containers.

Practicals:

1. Preparation of Material Safety Data Sheet for some common chemicals.
2. To neutralize the given sample using NaOH / HCL/ CaCO3
3. Determination of CO2 from the atmosphere by volumetric method in a workplace Environment.
4. Estimate Noise Levels at different locations.

SARVAJANIK UNIVERSITY

Bioethics & Biosafety

Name of Faculty: Science	**Department:** Biotechnology
Program: M. Sc. Sem-I	**Type:** DSE-1
Subject: Bioethics & Biosafety	
Credit: 04	**Total Learning Hours:** 60
Course Description: This course introduces students to basic concepts of Bioethics & Biosafety. It will also inculcate the importance, need & applications of these areas in the students of any applied science branch. It will provide information about rules, regulations, laws, acts & protocols regarding bioethics & biosafety to be followed in different fields of science.	
Student Learning Outcome: After completion of the course, students will be: 1)Student will be able to appreciate the importance of Bioethics & Biosafety 2)Student will be able to implement necessary bioethics rules & regulations wherever needed in practice 3) Student will be able to identify the need of safety & will to execute it in practical life.	

Unit 1 Introduction (07 Hours)

1.1 History & Definitions of Ethics & bioethics

1.2 History & Definitions of Safety & Biosafety

1.3 Applications of Bioethics

1.4 Applications of Biosafety

1.5 Environment Ethics

Unit 2 Ethical, Legal, Social Issues – I (09 Hours)

2.1 Prenatal Diagnosis & Genetic manipulation

2.2 Biotechnology

2.3 Genetically modified Organism: Foods & Crops

2.4 Stem Cell Research

2.5 Organ transplantation & Xenotransplantation

Unit 3 Ethical, Legal, Social Issues – Ii (09 Hours)

3.1 Biodiversity & Resource management

3.2 Human & animal Cloning

3.3 Animal Testing & Animals in Research

3.4 Testing of Drugs on Human Volunteers

3.5 Assisted Reproductive Technologies (ART)

Unit 4 Hazardous Materials – Handling & Disposal (07 Hours)

4.1 Hazards & Biohazards (biological agents) with their types/ categories

4.2 Disposal of chemical wastes & hazardous wastes

4.3 Material Safety Datasheet (MSDs)

4.4 Controlling the exposure to hazardous substances

4.5 Duties, immunization & first aid of employees

Unit 5 Risk Assessment & Containment (07 Hours)

5.1 Risk Assessment

5.2 Containment Levels

5.3 Containment in Animal lab

5.4 Containment in Plant tissue culture Lab

5.5 Containment in Microbiological lab

Unit 6 Biosafety (07 Hours)

6.1 Risk Assessment of Planned introduction & Biotechnology products

6.2 Planned introduction & Field trials of GM plants

6.3 Planned introduction of GE organisms

6.4 Biosafety during industrial production

6.5 Risk & Safety management in ART & stem cell research

Unit 7 Regulations & Guidelines – I (07 Hours)

7.1 NIH guidelines

7.2 ICH International Community Harmonization guidelines

7.3 Regulatory Framework for GE Plants in India

7.4 Indian Biosafety guidelines

7.5 Laboratory Biosafety Manual of WHO

Unit 8 Regulations & Guidelines – Ii (07 Hours)

8.1 Cartagena Protocol

8.2 ART regulation Bill

8.3 National Regulatory Bodies for Biosafety in India

8.4 Ethical Guidelines for Biomedical research involving human subjects

8.5 National Guidelines for Stem Cell Research

Reference Books

- Bioethics & Biosafety by M K Sateesh, I K International Pub. Ltd
- Biotechnology Expanding Horizons by B D Singh, Kalyani Pub.

Web Resources

- Biosafety resource book by FAO http://www.fao.org/3/i1905e/i1905e00.htm
- Biosafety Manual by WHO https://www.who.int/csr/resources/publications/biosafety/Biosafety7.pdf
- ICMR Bioethics Unit https://ethics.ncdirindia.org/

Practical

1) Case study on Bioethics

2) Project on Analysis of Biosafety measures / First aid of any Institute/lab/ Industrial unit

3) Visit to an industry to study safety measures