Chemistry Lab Standard Operations and Safety Measures

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Chemistry Lab Operations and Safety Measures	2	0	0	2	XIIth Pass with Science	NIL

Learning Objectives

- To cultivate efficient working skills among the students to work in a chemistry laboratory
- To create a trained workforce which can responsibly learn imbibe and explore verticals on structured knowledge safely.
- To make students aware of different chemicals and their properties being used in the chemistry laboratory.

Learning outcomes

After studying this course, the student will be:

- Able to design and implement safe working practices in chemistry laboratory.
- Able to safely handle different glass apparatus
- Able to handle the chemicals and equipment safely and properly.
- Able to design working protocols related to various methods and instruments in chemistry laboratory.

SYLLABUS

Practicals/ Hands-on Training: (60 hours)

Part A: Safety Measures

1) Design an illustrative chart exhibiting creativity at transaction of Do's and Don'ts instructions for working in a chemistry laboratory.
2) i. Carry out Classification and labeling of the given set of chemicals based upon Globally Harmonized System.
   ii. Carry out detailed survey of the Chemical Abstract Service (CAS) Registry Number and identify the given set of CAS RN and explain the different sections of CAS RN.
3) Carry out preparation of the indicative MSDS (Material Safety Data Sheet) of given set of chemicals as per Standard MSDS format.
4) Design an illustrative chart exhibiting creativity at transaction of Common Safety Symbols along with its description. Associate appropriate safety symbol with each of the given set of chemicals.

5) Draw and elucidate the National Fire Protection Association Hazard Labels.

6) i. Identify and enlist the Incompatible Chemicals from a given set of chemicals available in the laboratory.
   ii. Carry out investigations on Labeling and storage of Chemical in laboratory.

7) i. On the basis of MSDS analysis, identify the required storage conditions for the given set of chemicals.
   ii. Describe procedure for the storage, maintenance and handling of compressed gas cylinders.

   iii. Explore guidelines for the Storage of shelf chemicals and reagents.

8) i. Carry out a brief review of common pathways by which working Chemicals can enter the Body.
   ii. Carry out a detailed study of the Limits of Exposure of given Chemicals.

9) i. Classify the Hazard based on storage, handling, and disposal of chemicals.
   ii. Identification and describe handling protocols for Substances with Greater Hazardous Nature.

10) Carry out detailed investigations on procedural protocols for safe Disposal of Chemicals.
11) i. Carry out study on recommended Safety and Emergency Equipment essential for the safe practices in a Chemistry Laboratory.
   ii. Study the guidelines in the Event of a Chemical Accident or Spill.

12) i. Write detailed description on Fire Safety in the laboratory.
   ii. Carry out investigations of the data regarding Institute Safety Policies: Safety Audits / Inspections.

Part B: Chemistry Lab Standard Operations

1) Carry out exploration on Holding, Handling and use of Common Laboratory Apparatus as per given list of laboratory apparatus (Appendix A).
2) Carry out investigations of various types of apparatus in labs based on material they are made of such as Pyrex Glass (borosilicate Glass) Apparatus, Fused Silica Apparatus: Corning Vycor Glass, Porcelain apparatus, Plastic Apparatus, Metal Apparatus.
3) Understanding the protocol of Cleaning and drying and polishing of Glassware apparatus.
4) Carry out detailed investigations on Identification, diagrammatic representation, set up of Apparatus assemblies and details exploration on operational procedural protocols for glassware apparatus with Interchangeable ground glass joints: Typical Assemblies.
5) i. Carry out calibration of Volumetric/ Graduated Glassware Apparatus along with description on Temperature Standards.
   ii. Carry out Calibration of thermometers.

6) i. Carry out exploration and investigations of working protocol for various heating equipment in laboratory: Burners, Hot Plates, Electrical Heating Mantles, Electric Oven,

Microwave Oven, Muffle Furnace, Infrared lamps, Crucible and Beaker Tongs and Emersion heaters.

ii. Carry out exploration and investigations of working protocol for various Stirring apparatus in laboratory: Stirring rods; Policeman, Boiling rods, Use of Mechanical agitation-Magnetic Stirrer and Mechanical Shaker.

iii. Carefully analyze the Glass, Cork and Rubber Stoppers and investigate their preparation and appropriate applications.

7) i. Carry out detailed investigations of Heating and Cooling Bath, and determine their working ranges and working protocols.
ii. Explore and differentiate between different forms of water for Laboratory Use: Distilled (Grade I to III), De-ionized and tap water, and carry out conductance measurement /other analytical investigations for the differentiation purpose.

8) i. Differentiate among Various types of Filter Paper and explore their applications.
ii. Preparation of a fluted filter paper and its advantages.

iii. Classification of reagents as AR/ GR grade.

9) i. Care and Use of Analytical Balance: Mass and Weight, Two-Pan Balance and Electronic Balance.
ii. Carry out Calibration of weighing balances and accuracy in measurement.

10) Introduction to Chromatographic adsorption: Paper and Thin Layer Chromatography. Preparation of Thin Layer Chromatography (TLC) Plates.

11) i. Use of melting point apparatus. Experimental determination of the melting point using various methods.
ii. Experimental determination of the boiling point using various methods.

12) To Purify given organic solvents.
13) i. Hand on training for working with typical assemblies of apparatus for distillation and refluxing.
ii. Assessment of Fire hazards attending the distillation of inflammable solvents.

14) i. Purification of given solid organic compounds by crystallisation method.
ii. Recrystallization of given non-volatile organic solids and outline the Difficulties encountered in recrystallization process.

15) Removal of traces of colouring matter and use of decolourising carbon.
16) i. Carry out exploration and investigations of working and working protocol for Filtration Apparatus: Filtration with suction.
ii. Explore and imbibe knowledge about types of Vacuum Pump; Water and Oil Pump and their applications.

17) Investigate Conventions for Drying of the recrystallized material.
18) i. Introduction to Gas absorption traps and their importance.
ii. Recrystallization in an atmosphere of inert gas.

19) i. Performing Evaporation of the solvent in the laboratory.
ii. Preparation of anhydrous liquids or solutions of organic compounds in organic solvents.

20) i. Various procedures for the precipitation and washing of the precipitates.
ii. Application of various methods and instruments for drying of solid organic compounds.

21) i. Incineration of Filter paper with precipitate.
ii. Differentiate between various types of centrifugation methods, principle, uses and application of centrifugation method.

iii. Calculation of yields for different chemical processes.

22) In-depth Understanding and Preparation of Chemical Laboratory Reagents.
23) Explore methodologies of Preparation and Storage of Standard Solutions.

Important Instruction Note on working approach:

A minimum of 5 exercises from Part A and 10 exercises from Part B is required to be discussed/performed/investigate. Moreover, exercises related to MSDS, CASRN safety symbols identification is required to be performed mandatorily.

Mandatory exercises:

Part A Exercise No.: 2, 3, 4, 5 and 9

Part B Exercise No.: 1 to 10.

The exercises mentioned above will be performed by the student strictly in accordance with the instructions received and only under the supervision of the teacher concerned.

Essential Readings:

1. Skoog D.A., West D.M., Holler F.J., Stanley R.C., **Fundamentals of analytical chemistry**, 9th Edition, Cengage Learning.
2. Mendham, J.; Denney, R.C.; Barnes, J.D.; Thomas, M.J.K. (2007), **Vogel's Quantitative Chemical Analysis**, 6th Edition, Prentice Hall.
3. Furniss, B. S; Hannaford, A. J.; Smith, Peter W. G.; Tatchell, A. R; **Vogel's Text Book of Practical Organic Chemistry**, 5th Edition, Longman Scientific and Technical, Longman Group Ltd.
4. Garland, C. W.; Nibler, J. W.; Shoemaker, D. P. (2003), **Experiments in Physical Chemistry**, 8th Edition, McGraw-Hill, New York.
5. https://iupac.org/
6. https://edu.rsc.org/resources/practical/experiments

Examination scheme and mode:

Evaluation scheme and mode will be as per the guidelines notified by the University of Delhi.