Title of Vocational Programme: **Laboratory Techniques in Chemistry (LTC)**

VOC108

Faculty: **Science**

Department: **Chemistry**

Course Learning Outcomes:

This vocational course is intended for students aspiring for employment as laboratory technicians in school or college laboratories. At present, no academic programme is available in our University to train students for the laboratory techniques through the regular chemistry curriculum. This vocational programme has been designed to train laboratory supporting staff in appropriate procedures for organizing and maintaining school/college (degree, agricultural, engineering etc.) chemistry laboratories.

The broad objectives of this programme are to:

*Familiarize the learners with the basic facilities available in school and college level chemistry laboratories;

*Impart knowledge of the basics of organization and management of laboratories;

*Train the learners in the operation and maintenance of chemicals and simple apparatus used in laboratories;

*Enable them to develop skills in common laboratory techniques;

*Train them in the procedures of procurement and storage of laboratory equipment , apparatus , glass wares and chemicals ;

*Enable them to adopt appropriate disposal procedures and safety methods suitable for laboratories.

The aim of this vocational programme is to train the prospective Laboratory Technicians / Assistants to work in a chemistry laboratory, especially at the School or College level, more efficiently and productively.

Therefore, after studying the course as per the following syllabus, learners will be able to

*Identify the glass wares /apparatus/equipment/Chemicals used in a typical chemistry laboratory;

*Understand the basic working principles ;

* prepare solutions of required concentrations and common laboratory reagents;

*learn how to use them for setting up experiments;

*check the purity of a substance with the help of various chromatographic techniques;

*describe the hazards –Fire hazards, Chemical hazards and Gas hazards in a laboratory, and the precautions to be taken there of;

*use the computer for proper organization and management of science laboratories and

*adopt proper safety measures when working in a chemistry laboratory.

Credits: 3			**Programme: Vocational**
Max. Marks: 100			**Min. Passing Marks: 33**
Department Name: Chemistry			**Course Code: LTC**
Duration of Programme: 2 semester			
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 1-0-2			
	Unit	**Topics**	**No. of Lectures**
SEM 1	**I (Theory)**	**Introduction to Chemistry Laboratory: (05 Hours)** What is laboratory,General instruction for safe working in chemical laboratories., Lab design,, Storage, Ventilation, Lighting, Fume cupboard, Arrangement of store, Safety provisions, Organization of practical work, Maintenance of laboratory, equipments, apparatus . Cleaning of laboratories and preparation room.	**15**

		Introduction and use of laboratoryapparatus : (04 Hours) **Basic Apparatus**, Glass apparatus- Beaker, Test tube, boiling tube, funnel, separating funnel, filtration flask, round bottom flask, flat bottom flask, conical flask, condenser or Liebig condenser,petridish, desicator, watch glass etc.**Measuring Apparatus** - measuring cylinder, burette, pipette, Volumetric flask, Double-Pan Analytical Balance, Single-Pan Balance/Electrical analytical Balance etc.**Miscellaneous apparatus**:-Buchner funnel, Bunsen burner, burette stand, retert clamp, china dish/evaporating basin, wiregauze, cork borers, filterpumps, crucible, Mohr clip, pipe clay triangle, pestle and mortar,sprit lamp, spatulas , Thermometer, pH meter/pH paper etc.**Apparatus for Heating**: Bunsen burner,Water Bath, Oil Bath ,Hot Plate ,Heating Mantle etc.**Laboratory Centrifuge**:Advantages and Disadvantages of Centrifuge Handling and storage of Glass Apparatus, Kipp's apparatus, Hot air oven **SOLUTIONS AND THEIR PREPARATION: (06 Hours)** Water as a Solvent ,Types of Water , Solutions, Components of a Solution ,Types of Solution Solubility , Concentration of Solutions ,Percentage ,Molarity ,Normality, Molality in ppm .Calculation of Masses and Volumes for Preparation of Solutions Solids ,Liquids. More Concentrated Solutions, Accuracy and Precision of Measurements of Solution , Methods of Preparation of Solutions , Bench Reagents and Standard Solutions	
	II (Practical)	Experiment 1: Handling Common Laboratory Equipment Experiment 2: Cork boring Experiment 3: Calibration of Volumetric Glassware EXPERIMENT 4: Weighing an Object Using Analytical Balance EXPERIMENT 5: Preparation of Solutions and Reagents EXPERIMENT 6: Preparation of Buffer Solutions and Determination of their pH Values EXPERIMENT 7: Preparation of some organic compound and Determination of their Boiling Point and Melting point Activity: Activity 1: Cleaning of laboratories and preparation room. Activity 2: Classification of apparatus in store. Activity 3: Cleaning of glassware. Activity 4 : Organization of practical work. Activity 5: A brief report on Safety provisions in laboratories.	
SEM 2	**Unit**	Topics	**No. of Lectures**
	I (Theory)	**COMMON LABORATORY TECHNIQUES (05 Hours)** Refluxing :Apparatus with Interchangeable Ground Glass ,Joints (Quick fit) , Filtration : Techniques and Filter Media ,Filter Paper ,A Simple Filtration ,Recrystallization and Determination of Melting Point ,Choice of Solvent and Precautions with Flammable Solvents, , , Distillation and Determination of Boiling Point **Chromatography :(01 Hours)** Classification and Applications of Chromatography	**15**

	CHEMISTRY LABORATORY SAFETY (03 Hours) **Fire Hazards** in the Laboratory ,Causes of Fires ,Classification of Fires , Precautions for Fire Prevention ,Fire Alarms ,Fire Escapes, Fire Extinguishers ,Use of Fire Extinguishers **Chemical Hazards** Classification and Handling of Hazardous Chemicals , Storage of Chemicals , Transfer from Large Containers **Gas Hazards** in the Laboratory How to Make LPG and CNG Safer in the Laboratory Detection and Handling of Gas Leakage Health Hazards of Gases **Use Of Computer In Laboratory : (03 Hours)** Components of a Computer Central Processing Unit Memory Input and Output Devices Overall Functions Data Input Data Processing Data Output, Application Software MS Word, MS Excel, MS PowerPoint ,Internet . **Stock Control:(01 Hours)** Arranging Stock - Locating and Referencing, Shelf Arrangement of Stock; Order Books, Inventory , **FILES AND RECORDS : (02 Hours)** Filing Systems :,Classification of Files ,Filing Methods ,Filing System for Equipments and Chemicals Filing of Printed and Written Material Records : Stock Records , Recording Stock used and Misused, Record of Use of Listed Poisons ,Record of Use of Alcohol, Record of Breakages ,Information about Equipment Serial Numbers Maintenance Record, Miscellaneous Records	
II **(Practical)**	EXPERIMENT 1: Preparation of Hydrogen Sulphide Gas Using a Kipp's Apparatus EXPERIMENT 3: Simple Acid-Base Titration EXPERIMENT 4: Preparation of Distilled/ Deionized Water and Determination of its Conductance EXPERIMENT 5: Purification of Benzoic Acid by Recrystallization EXPERIMENT 6: Preparation of Potash Alum EXPERIMENT 7: Experiments based on Chromatography Activity : Activity 1: Classification of chemicals in store. Activity 2: Classification Hazardous Chemicals Based on the Information Given on the Labels Activity 3: Preparation of Comparative Chart. Activity 4: To Learn the Use of a Carbon Dioxide Fire Extinguisher Activity 5: Preparation of Stock Register on MS-Excel.	

Reference books:

01. Vogels Qualitative Inorganic Analysis, A. I .Vogel , Prentice Hall , 7th Edition.
02. Practical Chemistry, Giri, Bajpai , Pandey ; S. Chand. 2020
03. Lab Manual of Organic Chemistry , R. K. Bansal , New Age, 2009
04. Systemic Practical Chemistry , P. C. Kamboj , Vishal Publishing Co, Jallandhar, 2011
05. Senior Practical Physical Chemistry, B. D. Khosla, R. Chand & Co.
06. Comprehensive Practical Organic Chemistry, V. K. Ahluwalia, & R. Aggarwal , Universities Press
07. Virtual Labs at Amrita Vishwa Vidyapeetham https://vlab.amrita.edu/index.php?sub=2
08. Virtual Labs at Amrita Vishwa Vidyapeetham https://vlab.amrita.edu/index.php?sub=2&brch=191
09. http://www.shl.uiowa.edu/labcert/idnr/2018_lab_symposium/Basic_Lab_Techniques.pdf
10. http://www.chem.uzh.ch/bienz/lecture/gpc/Files/Einl_u_Vers_1.pdf
11. Laboratory Manual, Chemistry Laboratory Techniques
https://ocw.mit.edu/courses/chemistry/5-301-chemistry-laboratory-techniques-january-iap-2012/labs/MIT5_301IAP12_comp_manual.pdf
12. FUNDAMENTALS OF CHEMISTRY – Vol. I - Chemical Laboratory Techniques - Gelosa D. and Sliepcevich A.https://www.eolss.net/sample-chapters/c06/e6-11-02-01.pdf

Suggested Continuous Evaluation Methods:
Theory : 20 marks for Test / Quiz, 05 marks for Class Interaction
Practical: 15 marks for Record File / Assignment, 05 marks for Viva Voce, 05 marks for class interaction.

Eligibility: Pass in 10+2 with Chemistry subjects.

Suggested equivalent online courses:

1. John Dolhun. 5.301 Chemistry Laboratory Techniques. January IAP 2012. Massachusetts Institute of Technology: MIT Open Course Ware, https://ocw.mit.edu. License: Creative Commons BY-NC-SA.
2. https://www.youtube.com/watch?v=ooj3z1gK4Pg&list=PLf8BtxjDOFP17cJkI6II96_JAXBzmbavp
3. https://www.youtube.com/channel/UCY-ANi3wxkUSGhAeI7T0TGw
4. https://www.youtube.com/channel/UCCD7HknuluD1ZC0wsCXUuPQ

Syllabus Developed by-					
Sl.No	**Name**	**Designation**	**Department**	**College/University**	**As**
01	Dr.Dhananjay Singh	Associate Professor	Chemistry	PPN (PG) College,Kanpur	PI
02	Dr.Yashveer Gautam	Assistant Professor	Chemistry	PPN (PG) College,Kanpur	Co-PI

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