

*Diploma in Chemical Lab Technician  
Session 2022-23*

# **FACULTY OF SCIENCES**

## **SYLLABUS**

**FOR**

**Diploma  
in  
Chemical Lab Technician (DCLT)  
(Semester I-II)  
Session: 2022-23 Onwards**



**KHALSA COLLEGE  
AMRITSAR**  
*(An Autonomous College)*

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**Diploma in Chemical Lab Technician**  
**Session 2022-23**

<b>COURSE NAME:</b>	Diploma in Chemical Lab Technician
<b>COURSE CODE:</b>	DCLT

**PROGRAMME OBJECTIVE:**

The objective of the programme is to develop educationally and professionally skilled staff for working as Lab assistant/Lab Technician in various Educational Institutes, Analytical Labs for handling of chemicals, glassware and operating various Laboratory instruments

**PROGRAMME OUTCOMES**

<b>PO1</b>	Developing a understanding in the safe handling of chemical.
<b>PO2</b>	Expertise in the Conduct of chemical labs.
<b>PO3</b>	Developing a understanding in the handling, working and maintenance of the lab instruments.
<b>PO4</b>	Recognizing the needs of lab staff with thinking rationally about how to develop environmentally friendly labs.
<b>PO5</b>	Understanding the safety signs mentioned on the chemicals containers and their disposal.

**PROGRAMME SPECIFIC OUTCOMES**

<b>PSO1</b>	Learning about the safety feature of the chemicals and instrument handling
<b>PSO2</b>	Learning about the preparation of solutions and reagents for the labs, qualitative and quantitative analysis
<b>PSO3</b>	Learning about the working and maintenance of instruments used in chemical lab data record, store record, preparation of solution And purification techniques
<b>PSO4</b>	Learning about the general chemistry and formulae, signs and other features of chemistry labs, operation of instruments like pH-meter, conductivitymeter, polarimeter, Abbe's refractometer, rotator evaporator, colorimeter, spectrophotometer
<b>PSO5</b>	Learning about the various techniques like filtration, crystallization, chromatography, volumetric analysis, gravimetric analysis, electro-analytical, spectroscopic analysis and chromatography

**Eligibility:** The Eligibility of Diploma is that the candidates must have **+2 in any stream (with 50% marks)**

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**Scheme of Courses**

**Course Duration 1 Year**

<b>Semester-I</b>					
<b>Course Code</b>	<b>Course Title</b>	<b>Teaching Hours/Week</b>	<b>Internal Assessment</b>	<b>Max. Marks</b>	<b>Total Marks</b>
DCLT 111	Chemical Lab Safety and Management	Th = 4 Pr = 6	Th = 15 Pr = 10	Th = 45 Pr = 30	Th = 60 Pr = 40
DCLT 112	Basic Laboratory Techniques-I	Th = 4 Pr = 6	Th = 15 Pr = 10	Th = 45 Pr = 30	Th = 60 Pr = 40
		<b>TOTAL MARKS</b>			<b>200</b>
<b>Semester-II</b>					
DCLT 121	Basic Laboratory Techniques-II	Th = 4 Pr = 6	Th = 15 Pr = 10	Th = 45 Pr = 30	Th = 60 Pr = 40
DCLT 122	Analytical - Physical and Spectrometry Method	Th = 4 Pr = 6	Th = 15 Pr = 10	Th = 45 Pr = 30	Th = 60 Pr = 40
		<b>TOTAL MARKS</b>			<b>200</b>

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**Chemical Lab Safety and Management**

Code: DCLT 111

Time: Th =3 Hrs., Pr = 3Hrs.

M.M: 100

Credit Hours (per week): 4

Theory Marks: 60 (45+15 IA)

Credit Hours (per week): 6

Practical Marks: 40 (30 + 10 IA)

**INSTRUCTIONS FOR PAPER SETTERS AND CANDIDATES:**

**(A) Theory Paper**

- I. Examiner will make five sections of paper namely Section-I, II, III IV and V
- II. Examiner will set total of NINE questions comprising ONE compulsory question of short answer type covering whole syllabi and TWO questions from each unit.
- III. Section-I will consist of ten MCQ (Multiple Choice Question) questions carrying 2 Mark each.
- IV. Section-II, III IV and V of paper will consist of EIGHT questions in total having TWO questions from each unit of the syllabus and each question carry 10 Marks.
- V. The students are required to attempt FIVE questions in all, taking ONE Compulsory question of section-I and ONE question from each section i.e. II, III IV and V.
- VI. Section II, III IV and V of question paper should be from Unit I, II, III and IV respectively of syllabus

**(B) Practical Paper**

I. Examiner will check the proficiency of the candidate in Lab handling, Instrument handling, and other lab activities by assigning two practical to each candidate from the syllabus and students needs to complete the task assigned within three hours of exam.

II The split of the marks will be as under:

Write up = 15 Marks, Performance = 15Marks, Note Book = 06 marks, Viva-voce = 04 Marks

**COURSE OBJECTIVES**

*To introduce good Lab Practices, Lab Safety, Lab maintenance, Stock maintenance, Record and data handling and some general terms related to chemistry labs.*

**COURSE CONTENTS**

Theory

UNIT-I

Good lab practices

General Safety, Safe Handling of Chemicals and Glass wares, working in BioSafety areas,

Hazards associated with chemicals and chemical waste, Personal protection and protective

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clothing for handling of potentially hazardous chemicals, Fire prevention and fire control in chemical industries, waste disposal and management.

UNIT-II

**Maintenance of Lab**

Method of storing chemicals, reading of labels (storage code e.g. general, flammable, health hazard, oxidizing agent, corrosive, purity grade, alternate names for the chemical, solvents and glassware, common apparatus used in chemistry lab.

UNIT-III

Maintenance of Data & Records - MS Office, Chem Office, ChemDraw, For search of Literature – Scifinder. Procedures and maintenance of stock, purchase and distribution of registers, proper recordkeeping and documentation. PowerPoint presentations. Idea of ISO 9000 and BIS systems and its importance in maintaining qualities.

UNIT-IV

**General Chemistry I**

Concept of atom, molecule, element and compound; Symbol of an element; valency; Chemical name of compounds, formulae of radicals and formulae of compounds. Balancing of simple chemical equations. Relative Atomic Masses (atomic weights) and Relative Molecular Masses (molecular weights), the Periodic Table, chemical bonding and molecular structure.

## Practical

1. Label the lab chemicals and store them properly
2. Maintaining a laboratory notebook.
3. Cleaning of glassware
4. Measuring volume of liquids  
Using Graduated Cylinder, Using Burette, Using Pipette, Using Measuring Flask
5. Weighing Techniques with Analytical Balance, Weight Box Including Fractional Weights and Riders. Setting of a Chemical Balance and Weighing
6. Solvent drying and concentration
7. Lighting and controlling Bunsen burners
8. Careful transfer of solutions without loss of material
9. Use Scifinder for searching for a particular chemical and literature.
10. Sets up laboratory equipment and instruments, such as Hot air oven, gas cylinders, Incubator, pH meter, water bath, centrifuge, Refrigerator, Balance, water condenser,
11. Detect the elements, functional group, Melting point, Boiling point,
12. Calculation of weight, volume or density and percent yield of a chemical reaction
13. Determination of Melting Point of Naphthalene, Cinnamic acid, Benzoic acid, Salicylic acid, Urea, Acetanilide
14. Determination of Boiling Point of Ethanol, Cyclohexane, Benzene, Toluene

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**COURSE OUTOCMES:**

<b>S. No.</b>	<b>On completing the course, student will be able to</b>	<b>PSOs addressed</b>	<b>Cognitive levels</b>
<b>CO1</b>	Learn about lab safety in terms of glassware, handling of chemicals, personal safety and waste management	1	R, U, Ap
<b>CO2</b>	Maintenance of lab, storing chemicals, glass apparatus, learning alternate names of chemicals	2	R, U, Ap
<b>CO3</b>	Maintenance of data and record by using various softwares, ISO and BIS standards	2	R, U
<b>CO4</b>	Learning general terminology related to elements like atomic number , atomic weight, equations etc	4	R, U, Ap
<b>CO5</b>	Maintain the Purchase, stock, distribution registers, Labelling of chemicals , glassware cleansing, use of glassware for various measurements, detection and characterisation of chemicals through practicals.	3	R, U, Ap

**BOOKS RECOMMENDED:**

1. Laboratory Waste Management: A Guidebook by ACS Task Force on Laboratory Waste Management, ACS Miscellaneous, 1994
2. Margaret-Ann Armour, Hazardous Laboratory Chemicals Disposal Guide, 2nd Edition, 1996
3. Svehla, G: Vogel's qualitative inorganic analysis, 7th Edition, Prentice Hall, 1996
4. Vogel , A.I., Tatchell, A.R., Furnis , B.S., Hannaford , A.J., Smith, P.W.G., Vogel's Practical Organic Chemistry, 5th edition, Pearson education Ltd, 199

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**DCLT-112: Basic Laboratory Techniques-I**

**Time: Th =3 Hrs., Pr = 3Hrs.**

**M.M: 100**

**Credit Hours (per week): 4**

**Theory Marks: 60 (45+15 IA)**

**Credit Hours (per week): 6**

**Practical Marks: 40 (30 + 10 IA)**

**INSTRUCTIONS FOR PAPER SETTERS AND CANDIDATES:**

**(A) Theory Paper**

- I. Examiner will make five sections of paper namely Section-I, II, III IV and V
- II. Examiner will set total of NINE questions comprising ONE compulsory question of short answer type covering whole syllabi and TWO questions from each unit.
- III. Section-I will consist of ten MCQ (Multiple Choice Question) questions carrying 2 Mark each.
- IV. Section-II, III IV and V of paper will consist of EIGHT questions in total having TWO questions from each unit of the syllabus and each question carry 10 Marks.
- V. The students are required to attempt FIVE questions in all, taking ONE Compulsory question of section-I and ONE question from each section i.e. II, III IV and V.
- VI. Section II, III IV and V of question paper should be from Unit I, II, III and IV respectively of syllabus

**(B) Practical Paper**

- I. Examiner will check the proficiency of the candidate in Lab handling, Instrument handling, and other lab activities by assigning two practical to each candidate from the syllabus and students needs to complete the task assigned within three hours of exam.
- II The split of the marks will be as under:  
Write up = 15 Marks, Performance = 15Marks, Note Book = 06 marks, Viva-voce = 04 Marks

**COURSE OBJECTIVES**

*To introduce good Lab Practices, Lab Safety, Lab maintenance, Stock maintenance, Record and data handling and some general terms related to chemistry labs.*

**COURSE CONTENTS**

**Theory**

UNIT-I

UNIT-I

Chemical & physical changes, proper use of the analytical balance, Weighing and measuring of salts and chemicals, correct pipetting and volume-transfer techniques, and wet chemistry techniques. filtration, refluxing, precipitation, recrystallization

UNIT-II

**Volumetric Analysis:** Acid ,base, salt, Atomic Weight, Molecular Weight, Equivalent Weight, Normality, Molarity, Molality, ppm, ppb, density, Specific gravity, Weight - volume

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relationship Preparation of solutions of solids, liquids, volatile, non-volatile, etc. substances.  
Preparation of standard & primary standard solutions.

**. UNIT-III**

**Introduction to organic chemistry Lab:** Purification & separation of liquid mixture by distillation, Thin Layer Chromatography (TLC): Separation of different sample mixture on thin layer chromatography and calculation of retention factor ( $R_f$ ), Work up of reactions using separatory funnel,

**UNIT-IV**

**Introduction of basic instrumental techniques:** the use and maintenance of analytical balance, potentiometers, pH meters, conductivity meters, Strength of acids and bases in aqueous solution in terms of  $K_a$ ,  $K_b$ ; the pH scale, the pOH,  $pK_w$ ,  $pK_a$ ,  $pK_b$ , etc. Hydrolysis of salts, pH of solutions of salts of strong acid – weak base, weak acid – strong base, weak acid–weak base

## Practical

1. Preparation of standard solutions and determination of the concentration and percentage purity of  
0.1 M NaOH, 0.1 N Hypo solution, 0.1 M Oxalic acid, 0.5 N potassium dichromate solution
- 0.2
2. Preparation of dilute solutions of known concentration of sulphuric acid, hydrochloric acid and nitric acid. (Dilution should be carried out strictly under the supervision of a teacher).
3. Neutralization titrations of NaOH vs. HCl
4. Determine the pH of a given solution by using a pH meter.
5. Determination of Heat of neutralization of Strong acid-strong base calorimetrically
6. Determination of Heat of neutralization of Strong acid-strong base conductometrically
7. Prepare the Ethylene diamine tetra acetic acid (EDTA) solution & indicator and titration with EDTA.
8. Determination of optical rotation of sugar solution using polarimeter
9. Water analysis 1.Hardness 2.Chloride 3.Total dissolved solid (TDS) 4. Alkalinity
10. Concentration of samples using rotary evaporator
11. Technique of purification :distillation, recrystallization, chromatography

### **COURSE OUTCOMES:**

S. No.	On completing the course, student will be able to	PSOs addressed	Cognitive levels
CO1	Use of balance, pipette, burette, filtration, crystallization, refluxing etc.	1, 4	R, U, Ap
CO2	Acid, base, volumetric analysis, molecular weight, primary and secondary standard solutions	2, 3, 4	R, U, Ap, An



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<b>CO3</b>	Thin layer chromatography and its use for the identification and purification of chemicals.	3, 5	R, U, Ap, An
<b>CO4</b>	Use pH meter, potentiometer and conductivity meter	4	R, U, Ap, An
<b>CO5</b>	Preparation of solution, dilution of solutions, practical handling of polarimeter, rotary-evaporator, colorimeter etc.	4, 5	R, U, Ap, An

**BOOKS RECOMMENDED:**

1. Svehla, G: Vogel's qualitative inorganic analysis, 7th Edition, Prentice Hall, 1996
2. Gordon, A. J; Ford, R. A. The Chemist's Companion: A Handbook of Practical Data, Techniques, and References, Wiley-interscience, 1972.
3. Hein, M; Peisen, J.P, Miner, R. L, Foundations of College Chemistry in the Laboratory, John Wiley and Sons, 2011
4. Vogel, A. I, Elementary Practical Organic Chemistry: Small Scale Preparations Part 1, 2nd edition, 2010

## **Diploma in Chemical Lab Technician**

**Session 2022-23**

**Semester-II**

### **DCLT 121: Basic Laboratory Techniques-II**

**Time: Th =3 Hrs., Pr = 3Hrs.**

**M.M: 100**

**Credit Hours (per week): 4**

**Theory Marks: 60 (45+15 IA)**

**Credit Hours (per week): 6**

**Practical Marks: 40 (30 + 10 IA)**

### **INSTRUCTIONS FOR PAPER SETTERS AND CANDIDATES:**

#### **(A) Theory Paper**

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### **COURSE OBJECTIVES**

*To introduce good Lab Practices, Lab Safety, Lab maintenance, Stock maintenance, Record and data handling and some general terms related to chemistry labs.*

### **COURSE CONTENTS**

#### Theory

##### **UNIT I**

General purification techniques Purification of solid organic compounds, recrystallisation, use of miscible solvents, use of drying agents and their properties, sublimation. Purification of liquids. Experimental techniques of distillation, fractional distillation, distillation under reduced pressure. Extraction, use of immiscible solvents, solvent extraction. Chemical methods of purification and test of purity

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UNIT II

**Chromatography:** Classification of chromatography methods, principles of differential migration adsorption phenomenon, Nature of adsorbents, Stationary and mobile Phases, Separation technique. Applications solvent systems, R<sub>f</sub> values, factors affecting R<sub>f</sub> values.

UNIT III

**Thin layer Chromatography (TLC):** Advantages. Principles, factors affecting R<sub>f</sub> values. Experimental procedures. Adsorbents and solvents. Preparation of plates. Development of the chromatogram. Detection of the spots. Applications.

UNIT IV

**Titrimetric Methods of Analysis:** General principle. Types of titrations. Requirements for titrimetric analysis. Concentration systems: Molarity, formality, normality, wt% ppm, milliequivalents and millimoles-problems. Primary and secondary standards, criteria for primary standards, preparation of standard solutions, standardization of solutions. Limitation of volumetric analysis, endpoint and equivalence point, Neutralisation-titration curve, theory of indicators, choice of indicators. Use of phenolphthalein and methyl orange

## Practical

1. Separation of o & p nitrophenol by column chromatography, and comparison of their R<sub>f</sub> values.
2. Detection of nitrogen, sulphur and halogens in an organic compound.
3. Synthesis and characterization of Acetanilide from aniline.
4. Synthesis and characterization of Phenytoin drug.
5. Green Chemistry Experiment: Preparation of benzoic acid from Benzyl-using green approach.
6. Synthesis and Analysis (a) Preparation of Sodium trioxalatoferrate (III) (b) Preparation of Ni-DMG Complex
7. Crystallisation of benzoic acid and acetanilide and determination of melting points of the crystalline materials
8. Distillation of carbon tetrachloride and Determination of its boiling point
9. Synthesis of important reagents used in chemistry laboratory: Ammoniacal silver nitrate, Aqua Regia, Fehlings solution, Molischs reagent, Picric acid

S. No.	On completing the course, student will be able to	PSOs addressed	Cognitive levels
CO1	Learn various purification techniques used in general chemical labs.	3, 5	R, U, Ap
CO2	Chromatography and related terms like stationary phase, mobile phase, R <sub>f</sub> value.	5	R, U, Ap
CO3	Detection of spots and development of TLC	3, 5	R, U, Ap, An

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	chromatogram		
<b>CO4</b>	Concepts involved in volumetric analysis like indicator , end point, preparation of primary and secondary standard solutions and their standardization.	3, 4	R, U, Ap, An
<b>CO5</b>	Qualitative and quantitative analysis of some organic chemicals and preparation of some important reagents.	3	R, U, Ap, An

**BOOKS RECOMMENDED:**

1. Holler, F. J; Crouch, S. R; West, D. M; Skoog, D. A; Fundamentals of Analytical Chemistry, Cengage, 9 th edition, 2014
2. Bard, A. J.; Faulkner, L. R.; Electrochemical Methods: Fundamentals and Applications, Wiley, 2nd edition, 2000.
3. Halpern, A. M.; McBane, G. C. Experimental Physical Chemistry: A Laboratory edition, 2006.
4. Findlay, A; Practical Physical Chemistry, Nabu Press, 2012

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**DCLT 122: Analytical - Physical and Spectrometry Method**

**Time: Th =3 Hrs., Pr = 3Hrs.**

**M.M: 100**

**Credit Hours (per week): 4**

**Theory Marks: 60 (45+15 IA)**

**Credit Hours (per week): 6**

**Practical Marks: 40 (30 + 10 IA)**

**INSTRUCTIONS FOR PAPER SETTERS AND CANDIDATES:**

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Write up = 15 Marks, Performance = 15Marks, Note Book = 06 marks, Viva-voce = 04 Marks

**COURSE OBJECTIVES**

*To introduce good Lab Practices, Lab Safety, Lab maintenance, Stock maintenance, Record and data handling and some general terms related to chemistry labs.*

**COURSE CONTENTS**

Theory

**UNIT-I**

Introduction to the theory and problem solving methods involved in various advanced instrumentation techniques such as UV-Vis, IR, NMR spectroscopies, Mass Spectrometry, Spectrophotometry.

**Colorimetry and Spectrophotometry:** Theory of colorimetry and spectrophotometry. Beer-Lambert's law instrumentation and applications of colorimetry and spectrophotometry.

**UNIT-II**

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**Ultraviolet absorption spectroscopy:** Absorption laws. Concept of molar absorptivity, energy level, types of electronic excitations, Frank-Condon principle, concept of chromophore and auxochrome. Bathochromic, hypsochromic, hyperchromic and hypochromic shifts.

**UNIT-III**

**IR spectroscopy:** Principle & applications. Interpretation of some simple spectras.

**Mass spectrometry:** Principle and instrumentation of mass spectrometer, Interpretation of some simple spectras.

**UNIT-IV**

**Nuclear Magnetic Resonance Spectroscopy:** Origin of spectra, instrumentation, solvents, nuclear shielding and desheilding, chemical shift spin-spin splitting, coupling constants, interpretation of NMR spectra.

## Practicals

Introduction of instrumental techniques and hands on experience rotary evaporator, spectroscopic instruments such as UV-Vis, IR and Fluorescence.

**IR Spectral Analysis of the following functional groups** with examples a) Hydroxyl groups b) Carbonyl groups c) Amino groups d) Aromatic groups

**UV – Vis Spectroscopy:** Determine the percentage composition of different sample components

S. No.	On completing the course, student will be able to	PSOs addressed	Cognitive levels
CO1	Concepts, working and used of colorimeter for the analytical purposes.	5	R, U, Ap, An
CO2	Ultraviolet spectrum and factors affecting the spectral peaks	4	R, U, Ap, An
CO3	Principle and use of IR and mass spectroscopy and their related terms	5	R, U, Ap, An
CO4	Nuclear magnetic spectroscopy and terminology involved in it.	5	R, U, Ap, An
CO5	Application of spectroscopic techniques like UV-Visible, IR, NMR and Mass spectroscopy for the	5	R, U, Ap, An

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	qualitative and quantitative analysis		
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**BOOKS RECOMMENDED:**

1. F. James Holler, Stanley R Crouch, Donald M. West, Douglas A. Skoog, Fundamentals of Analytical Chemistry, Cengage, 9 th edition, 2014
2. Vogel , A.I., Tatchell, A.R., Furnis , B.S., Hannaford , A.J., Smith, P.W.G Vogel's Practical Organic Chemistry, 5th edition, Pearson education Ltd, 1996.
3. Pavia, Lampman and Kriz, Introduction to Spectroscopy, Brooks/Cole Pubs Co, 5th edition, 2015
4. Rouessac, F; Rouessac, A; Chemical Analysis: Modern Instrumental Methods and Techniques, Wiley-Blackwell, 2000