

Math 223APPLIED MATHEMATICS

Total Contact Hours		T	P	C
Theory	96 Hours	3	0	3

Pre-requisite: Must have completed Mathematics I.

AIMSThe students will be able to:

1. Solve problems of Calculus and Analytic Geometry.
2. Develop mathematical skill, attitudes and logical perception in the use of mathematical instruments.
3. Apply principles of Differential Calculus to work out rate measures, velocity, acceleration, maxima & minima values
4. Use Principles of Integral Calculus to compute areas & volumes.
5. Acquire proficiency in solving technological problems with mathematical clarity and insight.

COURSE CONTENTS

- 1. FUNCTIONS & LIMITS. 6 Hours**
 - 1.1 Constant & Variable Quantities
 - 1.2 Functions & their classification
 - 1.3 The concept of Limit
 - 1.4 Limit of a Function
 - 1.5 Fundamental Theorems on Limit
 - 1.6 Some important Limits
 - 1.7 Problems
- 2. DIFFERENTIATION 6 Hours**
 - 2.1 Increments
 - 2.2 Differential Coefficient or Derivative
 - 2.3 Differentiation ab-initio or by first Principle
 - 2.4 Geometrical Interpretation of Differential Coefficient
 - 2.5 Differential Coefficient of X^n , $(ax + b)^n$
 - 2.6 Three important rules
 - 2.7 Problems
- 3. DIFFERENTIATION OF ALGEBRAIC FUNCTIONS 9 Hours**
 - 3.1 Explicit Functions
 - 3.2 Implicit Functions
 - 3.3 Parametric forms

3.4	Problems	
4.	DIFFERENTIATION OF TRIGONOMETRIC FUNCTIONS	6 Hours
4.1	Differential Coefficient of $\sin x$, $\cos x$, $\tan x$ from first principle.	
4.3	Differentiation of inverse Trigonometric functions.	
4.4	Problems.	
5.	DIFFERENTIATIONS OF LOGARITHMIC & EXPONENTIAL FUNCTIONS	6 Hours
5.1	Differentiation of $\ln x$	
5.2	Differentiation of $\log a^x$	
5.3	Differentiation of a^x	
5.4	Differentiation of e^x	
5.5	Problems	
6.	RATE OF CHANGE OF VARIABLES.	6 Hours
6.1	Increasing and decreasing functions	
6.2	Maxima and Minima values	
6.3	Criteria for maximum & minimum values	
6.4	Methods of finding maxima & minima	
6.5	Problems	
7.	INTEGRATION	9 Hours
7.1	Concept	
7.2	Fundamental Formulas	
7.3	Important Rules	
7.4	Problems	
8.	METHODS OF INTEGRATION	9 Hours
8.1	Integration by substitution	
8.2	Integration by parts	
8.3	Problems	
9.	DEFINITE INTEGRALS	6 Hours
9.1	Properties	
9.2	Application to area	
9.3	Problems	
10.	DIFFERENTIAL EQUATIONS	6 Hours
10.1	Introduction	
10.2	Degree and Order	

- 10.3 First order differential equation
- 10.4 Solution
- 10.5 Problems

11. PLANE ANALYTIC GEOMETRY & STRAIGHT LINE 6 Hours

- 11.1 Coordinate System
- 11.2 Distance Formula
- 11.3 The Ratio Formula
- 11.4 Inclination and slope of a line
- 11.5 The slope Formula
- 11.6 Problems

12. EQUATIONS OF STRAIGHT LINE 6 Hours

- 12.1 Some important Forms
- 12.2 General Form
- 12.3 Angle Formula
- 12.4 Parallelism & Perpendicularity
- 12.5 Problems

13. EQUATIONS OF CIRCLE 6 Hours

- 13.1 Standard form of Equation
- 13.2 Central form of Equation
- 13.3 General form of Equation
- 13.4 Radius & Coordinates of the centre
- 13.5 Problems

14. STATISTICS 9 Hours

- 14.1 Concept of mean, median and mode
- 14.2 Standard deviation
- 14.3 Laws of probability
- 14.4 Problems

REFERENCE BOOKS

1. Thomas Finny- Calculus and Analytic Geometry
2. Ghulam Yasin Minhas - Technical Mathematics Vol - II, Ilmi Kitab Khana, Lahore.
3. Prof. Riaz Ali Khan- Polytechnic Mathematic Series Vol I & II, Majeed Sons, Faisalabad
4. Prof. Sana Ullah Bhatti - Calculus and Analytic Geometry, Punjab Text Book Board, Lahore.

Math-223 APPLIED MATHEMATICS

INSTRUCTIONAL OBJECTIVES

1. USE THE CONCEPT OF FUNCTIONS AND THEIR LIMITS IN SOLVING SIMPLE PROBLEMS.

- 1.1 Define a function.
- 1.2 List all type of functions.
- 1.3 Explain the concept of limit and limit of a function.
- 1.4 Explain fundamental theorems on limits.
- 1.5 Derive some important limits.
- 1.6 solve problems on limits.

2. UNDERSTAND THE CONCEPT OF DIFFERENTIAL COEFFICIENT

- 2.1 Derive mathematical expression for a differential coefficient.
- 2.2 Explain geometrical interpretation of differential coefficient.
- 2.3 Differentiate a constant, a constant associated with a variable and the sum of finite number of functions.
- 2.4 Solve related problems.

3. USE RULES OF DIFFERENTIATION TO SOLVE PROBLEMS OF ALGEBRAIC FUNCTIONS.

- 3.1 Differentiate ab-initio x^n and $(ax+b)^n$.
- 3.2 Derive product, quotient and chain rules.
- 3.3 Find derivatives of implicit functions and explicit functions.
- 3.4 Differentiate parametric forms, functions w.r.t another function and by rationalization.
- 3.5 Solve problems using these formulas.

4. USE RULES OF DIFFERENTIATION TO SOLVE PROBLEMS INVOLVING TRIGONOMETRIC FUNCTIONS.

- 4.1 Differentiate from first principle $\sin x, \cos x, \tan x$.
- 4.2 Derive formula Derivatives of $\sec x, \operatorname{cosec} x, \cot x$.
- 4.3 Find differential coefficients of inverse trigonometric functions
- 4.3 Solve problems based on these formulas.

5. USE RULES OF DIFFERENTIATION TO LOGARITHMIC AND EXPONENTIAL FUNCTIONS.

- 5.1 Derive formulas for differential coefficient of Logarithmic and exponential functions.
- 5.2 Solve problems using these formulas.

6. UNDERSTAND RATE OF CHANGE OF ONE VARIABLE WITH RESPECT TO ANOTHER.

- 6.1 Derive formula for velocity, acceleration and slope of a line.
- 6.2 Define an increasing and a decreasing function, maxima and minima values, point of inflexion.
- 6.3 Explain criteria for maxima and minima values of a function.
- 6.4 Solve problems involving rate of change of variables.

7. USE RULES OF INTEGRATION IN SOLVING RELEVANT PROBLEMS.

- 7.1 Explain the concept of integration.
- 7.2 State basic theorems of integration.
- 7.3 List some important rules of integration.
- 7.4 Derive fundamental formulas of integration.
- 7.5 Solve problems of integration based on these rules/formulas.

8. UNDERSTAND DIFFERENT METHODS OF INTEGRATION

- 8.1 List standard formulas of Integration.
- 8.2 Integrate a function by substitution method.
- 8.3 Find integrals by the method of integration by parts.
- 8.4 Solve problems using these methods.

9. UNDERSTAND METHODS OF SOLVING DEFINITE INTEGRALS.

- 9.1 Define definite integral.
- 9.2 List properties of definite integrals.
- 9.3 Find areas under the curves using definite integrals.
- 9.4 Solve problems of definite integrals.

10. USE DIFFERENT METHODS OF INTEGRATION TO SOLVE DIFFERENTIAL EQUATIONS

- 10.1 Define a differential equation, its degree and order
- 10.2 Explain method of separation of variables to solve differential equation of first order and first degree.
- 10.3 Solve differential equations of first order and first degree

11. UNDERSTAND THE CONCEPT OF PLANE ANALYTIC GEOMETRY.

- 11.1 Explain the rectangular coordinate system.
- 11.2 Locate points in different quadrants.
- 11.3 Derive distance formula.
- 11.4 Prove section formulas.
- 11.5 Derive Slope Formula
- 11.6 Solve problem using these formulas.

12. USE EQUATIONS OF STRAIGHT LINE IN SOLVING PROBLEMS.

- 12.1 Define a straight line.
- 12.2 Write general form of equation of a straight line.
- 12.3 Derive slope intercept and intercept forms of equations of a

straight line.

- 12.4 Derive expression for angle between two straight lines.
- 12.5 Derive conditions of perpendicularity and parallelism of two straight lines.
- 12.6 Solve problems involving these equations/formulas.

13. SOLVE TECHNOLOGICAL PROBLEMS USING EQUATIONS OF CIRCLE.

- 13.1 Define a circle.
- 13.2 Describe standard, central and general forms of the equation of a circle.
- 13.3 Convert general form to the central form of equation of a circle.
- 13.4 Derive formula for the radius and the coordinates of the center of a circle from the general form.
- 13.5 Derive equation of the circle passing through three given points.
- 13.6 Solve problems involving these equations.

14. UNDERSTAND THE BASIC CONCEPT OF STATISTICS.

- 14.1 Define mean, median and mode
- 14.2 Explain standard deviation
- 14.3 State laws of probability
- 14.4 Calculate the above mentioned quantities using the proper formula.

Mgm-211 BUSINESS COMMUNICATION

T	P	C
1	0	1

Total contact hours

Theory 32 Hrs.

Prerequisites:The students shall already be familiar with the language concerned.

AIMSThe course has been designed to enable the students to.

1. Develop communication skills.
2. Understand basic principles of good and effective business writing in commercial and industrial fields.
3. Develop knowledge and skill to write technical report with confidence and accuracy.

COURSE CONTENTS

- 1. COMMUNICATION PROCESS. 6 Hours**
 - 1.1 Purposes of communication
 - 1.2 Communication process
 - 1.3 Distortions in communication
 - 1.4 Consolidation of communique
 - 1.5 Communication flow
 - 1.6 Communication for self development

- 2. ORAL COMMUNICATION SKILLS. 6 Hours**
 - 2.1 Significance of speaking.
 - 2.2 Verbal and non-verbal messages.
 - 2.3 Strategic steps of speaking.
 - 2.4 Characteristics of effective oral messages.
 - 2.5 Communication Trafficking.
 - 2.6 Oral presentation.

- 3. QUESTIONING SKILLS. 3 Hours**
 - 3.1 Nature of question.
 - 3.2 Types of questions.
 - 3.3 Characteristics of a good question.
 - 3.4 Questioning strategy

- 4. LISTENING SKILLS. 5 Hours**
 - 4.1 Principles of active listening.

- 4.2 Skills of active listening.
- 4.3 Barriers to listening.
- 4.4 Reasons of poor listening.
- 4.5 Giving Feedback.

- 5. INTERVIEWING SKILLS. 3 Hours**
 - 5.1 Significance of interviews.
 - 5.2 Characteristics of interviews.
 - 5.3 Activities in an interviewing situation
 - 5.4 Types of interviews.
 - 5.5 Interviewing strategy.

- 6. REPORT WRITING. 3 Hours**
 - 6.1 Goals of report writing
 - 6.2 Report format.
 - 6.3 Types of reports.
 - 6.4 Report writing strategy.

- 7. READING COMPREHENSION. 2 Hours**
 - 7.1 Reading problems.
 - 7.2 Four Reading skills.

- 8. GROUP COMMUNICATION. 4 Hours**
 - 8.1 Purposes of conducting meetings.
 - 8.2 Planning a meeting.
 - 8.3 Types of meetings.
 - 8.4 Selection f a group for meeting.
 - 8.5 Group leadership skills.
 - 8.6 Running a successful meeting.
 - 8.7 Active participation techniques.

RECOMMENDED BOOKS

1. Sh. Ata-ur-Rehman Effective Business Communication & Report Writing.
2. Ulman J.N. Could JR. Technical Reporting.

Mgm-211 BUSINESS COMMUNICATION.

INSTRUCTIONAL OBJECTIVES

1.UNDERSTAND THE COMMUNICATION PROCESS.

- 1.1 State the benefits of two way communication.
- 1.2 Describe a model of communication process.
- 1.3 Explain the major communication methods used in organization.
- 1.4 Identify the barriers to communication and methods of overcoming these barriers.
- 1.5 Identify misconceptions about communication.

2. UNDERSTAND THE PROCESS OF ORAL.

- 2.1 Identify speaking situations with other peoples.
- 2.2 Identify the strategy steps of speaking.
- 2.3 Identify the characteristics of effective speaking.
- 2.4 State the principles of one-way communication.
- 2.5 State the principles of two-way communication.
- 2.6 Identify the elements of oral presentation skills.
- 2.7 Determine the impact of non-verbal communication on oral communication.

3.DETERMINE THE USES OF QUESTIONING SKILLS TO GATHER AND CLARIFY INFORMATION IN THE ORAL COMMUNICATION PROCESS.

- 3.1 Identify different types of questions.
- 3.2 Determine the purpose of each type of question and its application.
- 3.3 Identify the hazards to be avoided when asking questions.
- 3.4 Demonstrate questioning skills.

4.DEMONSTRATE THE USE OF ACTIVE LISTENING SKILL IN THE ORAL COMMUNICATION PROCESS.

- 4.1 State the principles of active listening.
- 4.2 Identify skills of active listening.
- 4.3 Identify barriers to active listening.
- 4.4 State the benefits of active listening.
- 4.5 Demonstrate listening skills.
- 4.6 Explain the importance of giving and receiving feed back.

5.Determine the appropriate interview type for the specific work-related situation and conduct a work-related interview.

- 5.1 State the significance of interviews.
- 5.2 State the characteristics of interviews.
- 5.3 Explain the activities in an interviewing situation.
- 5.4 Describe the types of interviews.

- 5.5 Explain the interviewing strategy.
- 5.6 Prepare instrument for a structured interview.

6. PREPARE A REPORT OUT-LINE, BASED ON SUBJECT MATTER AND AUDIENCE.

- 6.1 Identify the different types of reports.
- 6.2 Determine when to use an informal or formal report presentation.
- 6.3 Identify the stages of planning a report.
- 6.4 Identify the parts of a report and choose the parts appropriate for each type of report.
- 6.5 Draft a report outline.

7. DEMONSTRATE READING COMPREHENSION.

- 7.1 Identify major reading problems.
- 7.2 Identify basic reading skills.
- 7.3 State methods of previewing written material.
- 7.4 Identify methods of concentration when reading.
- 7.5 Demonstrate reading comprehension.

8. UNDERSTAND THE PRINCIPLES OF GROUP COMMUNICATIONS.

- 8.1 State the purpose and characteristics of major types of meeting.
- 8.2 Explain responsibilities of a meeting/committee.
- 8.3 Identify problems likely to be faced at meeting and means to overcome these problems.
- 8.4 Distinguish between content and process at meetings.
- 8.5 Explain the key characteristics of a good group facilitator.

Mgm 221 BUSINESS MANAGEMENT AND INDUSTRIAL ECONOMICS

Total Contact Hours

Theory	32	T	P	C
Practical	0	1	0	1

AIMS The students will be able to develop management skills, get acquainted the learner with the principles of management and economic relations and develop commercial/economic approach to solve the problems in the industrial set-up.

COURSE CONTENTS

- 1. ECONOMICS** **2 Hours**
 - 1.1 Definition: Adam Smith, Alfred Marshall, Prof. Robins.
 - 1.2 Nature and scope
 - 1.3 Importance for technicians.

- 2. BASIC CONCEPTS OF ECONOMICS** **1 Hour**
 - 2.1 Utility
 - 2.2 Income
 - 2.3 Wealth
 - 2.4 Saving
 - 2.5 Investment
 - 2.6 Value.

- 3. DEMAND AND SUPPLY.** **2 Hours**
 - 3.1 Definition of demand.
 - 3.2 Law of demand.
 - 3.3 Definition of supply.
 - 3.4 Law of supply.

- 4. FACTORS OF PRODUCTION.** **2 Hours**
 - 4.1 Land
 - 4.2 Labour
 - 4.3 Capital
 - 4.4 Organization.

- 5. BUSINESS ORGANIZATION.** **3 Hours**
 - 5.1 Sole proprietorship.
 - 5.2 Partnership
 - 5.3 Joint stock company.

6. ENTERPRENEURIAL SKILLS	4 Hours
6.1 Preparing, planning, establishing, managing, operating and evaluating relevant resources in small business.	
6.2 Business opportunities, goal setting.	
6.3 Organizing, evaluating and analyzing opportunity and risk tasks.	
7. SCALE OF PRODUCTION.	2 Hours
7.1 Meaning and its determination.	
7.2 Large scale production.	
7.3 Small scale production.	
8. ECONOMIC SYSTEM	3 Hours
8.1 Free economic system.	
8.2 Centrally planned economy.	
8.3 Mixed economic system.	
9. MONEY.	1 Hour
9.1 Barter system and its inconveniences.	
9.2 Definition of money and its functions.	
10. BANK.	1 Hour
10.1 Definition	
10.2 Functions of a commercial bank.	
10.3 Central bank and its functions.	
11. CHEQUE	1 Hour
11.1 Definition	
11.2 Characteristics and kinds of cheque.	
11.3 Dishonour of cheque.	
12. FINANCIAL INSTITUTIONS	2 Hours
12.1 IMF	
12.2 IDBP	
12.3 PIDC	
13. TRADE UNION	2 Hours
13.1 Introduction and brief history.	
13.2 Objectives, merits and demerits.	
13.3 Problems of industrial labour.	
14. INTERNATIONAL TRADE.	2 Hours
14.1 Introduction	

- 14.2 Advantages and disadvantages.
- 15. MANAGEMENT 1 Hour**
- 15.1 Meaning
- 15.2 Functions
- 16. ADVERTISEMENT 2 Hours**
- 16.1 The concept, benefits and draw-backs.
- 16.2 Principal media used in business world.
- 17. ECONOMY OF PAKISTAN 1 Hour**
- 17.1 Introduction
- 17.2 Economic problems and remedies.

BOOKS RECOMMENDED

- 1.Nisar-ud-Din, Business Organization, Aziz Publisher, Lahore
- 2.M. Saeed Nasir,Introduction to Business, Ilmi Kitab Khana, Lahore.
3. S.M. Akhtar, An Introduction to Modern Economics, United Limited, Lahore.

INSTRUCTIONAL OBJECTIVES

1.UNDERSTAND THE IMPORTANCE OF ECONOMICS.

- 1.1 State definition of economics given by Adam Smith, Alfred Marshall and Professor Robins.
- 1.2 Explain nature and scope of economics.
- 1.3 Describe importance of study of economics for technicians.

2.UNDERSTAND BASIC TERMS USED IN ECONOMICS.

- 2.1 Define basic terms, utility, income, wealth, saving, investment and value.
- 2.2 Explain the basic terms with examples

3. UNDERSTAND LAW OF DEMAND AND LAW OF SUPPLY.

- 3.1 Define Demand.
- 3.2 Explain law of demand with the help of schedule and diagram.
- 3.3 State assumptions and limitation of law of demand.
- 3.4 Define Supply.
- 3.5 Explain law of Supply with the help of schedule and diagram.
- 3.6 State assumptions and limitation of law of supply.

4.UNDERSTAND THE FACTORS OF PRODUCTION

- 4.1 Define the four factors of production.
- 4.2 Explain labour and its features.
- 4.3 Describe capital and its peculiarities.

5. UNDERSTAND FORMS OF BUSINESS ORGANIZATION.

- 5.1 Describe sole proprietorship, its merits and demerits.
- 5.2 Explain partnership, its advantages and disadvantages.
- 5.3 Describe joint stock company, its merits and demerits.
- 5.4 Distinguish public limited company and private limited company.

6.UNDERSTAND ENTREPRENEURIAL SKILLS

- 6.1 Explain preparing, planning, establishing and managing small business set up
- 6.2 Explain evaluating all relevant resources
- 6.3 Describe organizing analyzing and innovation of risk of task

7. UNDERSTAND SCALE OF PRODUCTION.

- 7.1 Explain scale of production and its determination.
- 7.2 Describe large scale production and its merits.
- 7.3 Explain small scale of production and its advantages and disadvantages.

8. UNDERSTAND DIFFERENT ECONOMIC SYSTEMS.

- 8.1 Describe free economic system and its characteristics.
- 8.2 Explain centrally planned economic system, its merits and demerits.

- 8.3 State mixed economic system and its features.
- 9. UNDERSTAND WHAT IS MONEY**
- 9.1 Define money
- 9.2 Explain barter system and its inconveniences.
- 9.3 Explain functions of money.
- 10. UNDERSTAND BANK AND ITS FUNCTIONS.**
- 10.1 Define bank.
- 10.2 Describe commercial bank and its functions.
- 10.3 State central bank and its functions.
- 11. UNDERSTAND CHEQUE AND DISHONOR OF CHEQUE.**
- 11.1 Define cheque.
- 11.2 Enlist the characteristics of cheque.
- 11.3 Identify the kinds of cheque.
- 11.4 Describe the causes of dishonor of a cheque.
- 12. UNDERSTAND FINANCIAL INSTITUTIONS.**
- 12.1 Explain IMF and its objectives.
- 12.2 Explain organisational set up and objectives of IDBP.
- 12.3 Explain organisational set up and objectives of PIDC.
- 13. UNDERSTAND TRADE UNION, ITS BACKGROUND AND FUNCTIONS.**
- 13.1 Describe brief history of trade union.
- 13.2 State functions of trade union.
- 13.3 Explain objectives, merits and demerits of trade unions.
- 13.4 Enlist problems of industrial labour.
- 14. UNDERSTAND INTERNATIONAL TRADE.**
- 14.1 Explain international trade.
- 14.2 Enlist its merits and demerits.
- 15. UNDERSTAND MANAGEMENT**
- 15.1 Explain meaning of management.
- 15.2 Describe functions of management.
- 15.3 Identify the problems of business management.
- 16. UNDERSTAND ADVERTISEMENT.**
- 16.1 Explain the concept of advertisement.
- 16.2 Enlist benefits and drawbacks of advertisement.
- 16.3 Describe principal media of advertisement used in business world.
- 17. UNDERSTAND THE ECONOMIC PROBLEMS OF PAKISTAN.**
- 17.1 Describe economy of Pakistan.

- 17.2 Explain economic problems of Pakistan
- 17.3 Explain remedial measures for economic problems of Pakistan.
measure.

Total contact hours:

Theory 64

Practical 192

OBJECTIVES.

1. Understand the basic principles of organic chemistry.
2. Apply basic principle of organic chemistry in the laboratory work.

COURSE CONTENTS.

1. DEFINITION OF ORGANIC CHEMISTRY AND DIFFERENCE BETWEEN ORGANIC AND IN-ORGANIC COMPOUNDS WITH EXAMPLES.

- 1.1 Source of organic compounds and applications
- 1.2 Classification of organic compounds with their general formula and functional groups.

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2. TYPES OF ORGANIC REACTION.

- 2.1
 - i) Substitution reactions with examples.
 - ii) Addition reaction with examples.
- 2.2 Elimination reaction with examples.
Rearrangements reactions with examples.

3. ISOMERISM DEFINITION AND TYPES.

- 3.1 Types of Isomerism with examples.
- 3.2 Hydrocarbons - Definition and classification with examples and general formula.
- 3.3 Homologous Series.
- 3.4 Nomenclature of organic compounds according to IUPAC system
- 3.5 Nomenclature of various organic compounds according to IUPAC system.

4. ALKANE, METHOD OF PREPARATION

- 4.1 General chemical properties (Reaction) of alkane.

5. ALKENES, METHODS OF PREPARATION.

- 5.1 General chemical properties of alkenes.

6. ALKYNES, METHODS OF PREPARATION.

- 6.1 General chemical properties of alkynes.

7. ALKYL HALIDES, TYPES OF ALKYL HALIDES.

- 7.1 Method of preparation.
- 7.2 General chemical properties of RX
- 7.3 Organometallic compounds, Definition preparation of Rmgx (Grignard reagent)
- 7.4 Properties (chemical & physical) of Rmgx
- 7.5 Properties of Rmgx.

- 8 ALCONALS, CLASSIFICATION, GENERAL METHODS OF**
8.1 Preparation of alcohol.
8.2 General reaction of alcohol.
- 9 ETHER, METHODS OF PREPARATION.**
9.1 Properties of Ether (chemical reaction).
- 10 ALDEHYDE, DEFINITION.**
10.1 Preparation of aldehyde.
10.2 Chemical properties of aldehyde.
- 11 KETONE, DEFINITION.**
11.1 Preparation of ketone.
11.2 Chemical properties of ketone.
- 12 CARBOXYLIC ACIDS, DEFINITION.**
12.1 Classification
12.2 Preparation of Carboxylic acid.
12.3 General Chemical properties of Carboxylic acid.
- 13. DERIVATIVES OF CARBOXYLIC ACIDS.**
13.1 Preparation of acid chlorides along with chemical properties.
13.2 General methods of preparation of acid an-hydrides.
13.3 Chemical properties of acid an-hydrides.
- 14 GENERAL METHODS OF PREPARATION OF AMIDE.**
14.1 Chemical properties.
- 15 GENERAL METHODS OF PREPARATION OF ESTER.**
15.1 Chemical properties of esters.
- 16 AMINES, DEFINITION AND CLASSIFICATION.**
16.1 Preparation of all types of amines.
16.2 General reaction of Amines.
- 17 AROMATIC HYDRO CARBONS, CLASSIFICATION.**
17.1 Methods of preparation of Benzene.
17.2 Chemical properties of Benzene.
- 18 PHENOLS, THEIR CLASSIFICATION.**
18.1 General methods of preparation.
18.2 General reaction of phenols.
- 19 CARBOHYDRATES, CLASSIFICATION.**
19.1 Preparation of glucose.

- 19.2 Reaction of glucose.
- 19.3 Fructose, methods of preparation and reaction of fructose.
- 19.4 Comparison between glucose and fructose.

20 PROTEINS AND THEIR CLASSIFICATION

- 20.1 Chemical composition, molecular shape.
- 20.2 Chemical properties and colour reaction of proteins.

21 NATURAL PRODUCTS LIKE "VITAMINS" A, B, C, D "ENZYMES"

22 ALKALOIDS LIKE "PIPERINE", "NICOTINE", "QUININE"

RECOMMENDED BOOKS

- 1 Manual on Organic Chemistry -I,II (Polytechnic manual series)
- 2 Chemistry part -II (for f.sc students) by Dr.KMibne Rasa, Dr M.A. Afzal
- 3 Organic Chemistry for B.Sc students by B.S Bahl

CHT 244 ORGANIC CHEMISTRY

INSTRUCTIONAL OBJECTIVES.

- 1. INTRODUCTION OF ORGANIC CHEMISTRY**
 - 1.1 Student will be able to understand organic chemistry. 2.HRS
 - 1.1.1 Define organic chemistry
 - 1.1.2 Differentiate between organic and inorganic compounds
 - 1.1.3 Give the application of organic chemistry daily life
 - 1.2 Understand the general formula and functional groups of organic compounds 2 Hrs
 - 1.2.1 Give general classification of organic compounds
 - 1.2.2 Write general formula for each class of organic compounds
 - 1.2.3 Write the functional group for each class of organic compounds
- 2. TYPES OF ORGANIC REACTIONS** 4. HRS
 - 2.1 Understand the types of organic reactions
 - 2.1.1 Enlist the types of organic reactions
 - 2.1.2 Explain substitution reaction
 - 2.1.3 Explain addition reaction
 - 2.1.4 Explain Elimination reaction
 - 2.1.5 Explain rearrangement reaction
 - 2.1.6 Give examples of different types of reaction
- 3. ISOMERISM** 2. HRS
 - 3.1 Understand isomerism
 - 3.1.1 Define isomerism
 - 3.1.2 Give types of isomerism in organic compounds
 - 3.1.3 Explain different isomeric forms
 - 3.1.4 Give examples of different isomeric forms
- 4. HYDROCARBONS** 4. HRS
 - 4.1 Understand the Hydrocarbons
 - 4.1.1 Define hydrocarbon
 - 4.1.2 Give classification of hydrocarbons
 - 4.1.3 Write general formula for hydrocarbons
 - 4.1.4 Explain homologous series
 - 4.2 Understand the Nomenclature of organic compounds 2. HRS
 - 4.2.1 Explain conventional method of naming organic compounds
 - 4.2.2 Explain IUPAC system for naming organic compounds
 - 4.2.3 Write names of organic compounds according IUPAC system
 - 4.3 Understand the concept of alkanes 3. HRS
 - 4.3.1 Define alkanes
 - 4.3.2 Write general formula for alkanes and alkyl Radicals
 - 4.3.3 Name alkanes and alkyl radicals
 - 4.3.4 Explain general methods of preparation of alkanes

- 4.3.5 Explain general properties of alkanes
- 4.4 Understand the concept of alkenes 3. HRS
- 4.4.1 Define alkenes
- 4.4.2 Name alkenes
- 4.4.3 Explain general methods of preparation of alkenes
- 4.4.5 Enlist the uses of ethere
- 4.5 Understand the concept of alkynes 3. HRS
- 4.5.1 Define alkynes
- 4.5.2 Enlist different types of alkynes
- 4.5.3 Explain the methods of preparation of acetylene
- 4.5.4 Explain the properties of acetylene
- 4.5.5 Give the uses of C_2H_2
- 5. ALKYL HALIDES**
- 5.1 Understand the concept of alkyl halides 2. HRS
- 5.1.1 Define alkyl halide
- 5.1.2 Give the type of alkyl halides
- 5.1.3 Name different alkyl halides
- 5.1.4 Explain general methods of preparation of Alkyl Halides
- 5.1.5 Explain general properties of Alkyl Halides
- 5.1.6 Enlist uses of Alkyl Halides
- 6. ORGANOMETALIC COMPOUNDS**
- 6.1 Understand the concept of organometallic compounds 2. HRS
- 6.1.1 Define organometallic compounds
- 6.1.2 Explain the methods of preparation of Grignard Reagent (R-Mg-X)
- 6.1.3 Explain the properties of R-MG-X
- 7. ALCOHOLS**
- 7.1 Understand the concept of alcohols 2. HRS
- 7.1.1 Define alcohol
- 7.1.2 Give classification of alcohols
- 7.1.3 Explain general methods of preparation of alcohols
- 7.1.4 Explain general properties of alcohols
- 7.1.5 Explain the methods of preparation of ethylalcohol
- 7.1.6 Enlist the uses of ethyl alcohol
- 8. ETHERS**
- 8.1 Understand the concept of ethers. 2. HRS
- 8.1.1 Define ether
- 8.1.2 Give general formula of ethers
- 8.1.3 Explain general methods of preparation of ethers.
- 8.1.4 Explain general properties of ethers.
- 9. ALDEHYDES.**
- 9.1 Understand the concept of aldehydes.
- 9.1.1 Define aldehyde
- 9.1.2 Name different aldehydes.

- 9.1.3 Explain general methods of preparation of aldehydes.
- 9.1.4 Explain general properties of aldehydes.
- 9.1.5 Enlist the uses of aldehydes.

- 10. KETONES** 2. HRS
- 10.1 Understand the concept of ketones.
 - 10.1.1 Define ketone
 - 10.1.2 Name different
 - 10.1.3 Explain methods of preparation of acetone
 - 10.1.4 Explain the properties of acetone
 - 10.1.5 Enlist the uses of acetone
- 11. CARBOXYLIC ACIDS** 3. HRS
- 11.1 Understand the concept of carboxylic acids
 - 11.1.2 Name different carboxylic acids
 - 11.1.3 Give the types of carboxylic acids
 - 11.1.4 Explain the general methods of preparation of mono carboxylic acids
 - 11.1.5 Explain the properties of mono carboxylic acids
 - 11.1.6 Enlist the uses of carboxylic acids
- 12. ACID DERIVATIVES** 3. HRS
- 12.1 Understand the concept acid chlorides
 - 12.1.1 Define acid chlorides
 - 12.1.2 Name acid chlorides
 - 12.1.3 Explain general methods of preparation of acid chlorides
 - 12.1.4 Explain general properties of acid chlorides
 - 12.2 Understand the concept of acid anhydrides 3. HRS
 - 12.2.1 Define acid anhydride
 - 12.2.2 Name acid anhydride
 - 12.2.3 Give general methods of preparation of acetic anhydride
 - 12.2.4 Give properties of acetic anhydride
 - 12.2.5 Enlist the uses of acetic anhydride
 - 12.3 Understand the concept of acid amide 2. HRS
 - 12.3.1 Define acidamide
 - 12.3.2 Name acid amides
 - 12.3.3 Explain general methods of preparation of acidamides
 - 12.3.4 Explain the properties of acid amides
- 13. ESTERS** 2. HRS
- 13.1 Understand the concept of esters
 - 13.1.1 Define esters
 - 13.1.2 Name esters
 - 13.1.3 Give general methods of preparation of esters
 - 13.1.4 Give general properties of esters
- 14. AMINES** 3. HRS
- 14.1 Understand the concept of amines
 - 14.1.1 Define amine
 - 14.1.2 Give classification of amines
 - 14.1.3 Name different types of amines

- 14.1.4 Explain the method of preparation of primary amines
- 14.1.5 Explain the method of preparation of secondary amine
 - Explain the method of preparation of tertiary amine
 - Explain the general properties of amines

15 AROMATIC HYDROCARBONS

- 15.1 Understand the concept of aromatic hydrocarbons 3. HRS
 - 15.1.1 Define aromatic hydrocarbons
 - 15.1.2 Differentiate between open chain (aliphatic) and closed chain (aromatic) compounds
 - 15.1.3 Give classification of aromatic compounds
 - 15.1.4 Explain the nomenclature of aromatic compounds
 - 15.1.5 Explain the methods of preparation of benzene
 - 15.1.6 Explain the properties of benzene
- 15.2 Understand the concept of phenol 2. HRS
 - 15.2.1 Define phenol
 - 15.2.2 Explain the nomenclature of phenol
 - 15.2.3 Explain general methods of preparation of phenol
 - 15.2.4 Explain general properties of phenols

16 CARBOHYDRATES

- 16.1 Understand carbohydrates 3. HRS
 - 16.1.1 Define carbohydrate
 - 16.1.2 Give classification of carbohydrates
 - 16.1.3 Write structure formula of glucose and fructose
 - 16.1.4 Explain the method of preparation of glucose
 - 16.1.5 Explain the properties of glucose
 - 16.1.6 Explain the method of preparation of fructose
 - 16.1.7 Explain the properties of fructose
 - 16.1.8 Give comparison between glucose and fructose

17 PROTEINS

- 17.1 Understand the concept of proteins 3. HRS
 - 17.1.1 Define protein
 - Give classification of proteins
 - Explain general properties of proteins

LIST OF PRACTICALS.

1. Detection of Sulphur, Nitrogen and halogens in the organic compounds.
2. Preparation and properties of methane.
3. Preparation and properties of Acetylene.
4. Preparation of iodoform from alconal
5. Preparation and properties of Acetic acid.
6. Preparation of Acetamide.
7. Preparation of Ethyle ether.
8. Preparation of Nitrobenzene.
9. Preparation of Acetone.
10. Chemical test of aldehyde.
11. Chemical test of Ketone.
12. Preparation of Urea from Ammonium cyanate
13. Preparation of oxalic acid from cane sugar.
14. Preparation of Acetadehyde.
15. Preparation and properties of methyl orange.
16. Preparation of aqueous fermic acid.
17. Preparation of Acetic Anhydride.
18. Preparation of Acetylene chloride.
19. Preparation of Ethyl Amine
20. Preparation of Ethyle benzene
21. Color reactions of protiens
22. Preparation of Ethyl bromide
23. Preparation of Ethyl Acetate
24. Preparation of chloroform from Acetone.
25. Determination of Amino Acids in Proteins.
26. Preparation of Aniline
27. Purification of organic substance by Scxhlet apparatus.
28. Reaction and test of Saccharide.

NOTE:- (Each experiment will be conducted in two consecutive periods)

OBJECTIVES.

1. Understand manufacturing procedure employed by modern chemical industries.
2. Understand the operation of the equipment necessary to carry out the chemical reaction on industrial scale.
3. Prepare the flow sheet diagram of chemical Industries.
4. To present each chemical industry from the view point of statistics of production, consumption and location in Pakistan.

COURSE CONTENTS.

1. INTRODUCTION (INDUSTRIAL CHEMICAL PROCESS)

- 1.1 Unit operation and unit process, examples Batch process, continuous process.
- 1.2 Flow charts.

2 SOFT WATER, HARD WATER, CHEMICALS RESPONSIBLE FOR THE HARDNESS OF WATER.

- 2.1 Water conditioning
Softening, purification and clarification (definition)
- 2.2 Ion method
- 2.3 Sodium cation exchange process
- 2.4 Mixed bed resins.
- 2.5 Hydrogen cation exchange process
- 2.6 Soda lime process (cold soda lime, Hot soda lime process)
- 2.7 Deaeration of water and its importance.
- 2.8 Demineralization and desalting of water.

3 CHLORO ALKALI INDUSTRIES.

- 3.1 Introduction
- 3.2 Manufacture of Soda ash, Raw material, Treatment of raw materials
- 3.3 Flow chart of Solvay process
- 3.4 Unit operations and unit processes.
- 3.5 Manufacture of Sodium Bicarbonate.
- 3.6 Flow sheet, unit operations and processes.
- 3.7 Uses of Sodium carbonate and Sodium bicarbonate.
- 3.8 Manufacture of caustic soda by electrolysis of NaCl, Pretreatment of NaCl solution.
- 3.9 Diaphragm cell method.
- 3.10 Mercury cell method
- 3.11 Membrane cell method.
- 3.12 Comparison of the three cell methods.
- 3.13 By-products of caustic soda manufacture.
- 3.14 Uses of chlorine and Hydrogen.
- 3.15 Manufacture of bleaching Powder.

- 3.16 Manufacture of Calcium hypochlorite.
 - 3.17 Manufacture of Sodium hypochlorite
 - 3.18 Manufacture of HCl as the by-products of chlor-alkali industry
 - 3.19 Unit operation and unit process involved.
 - 3.20 Uses of HCl
- 4 **SULPHURIC ACID.****
- 4.1 Formula, uses and importance in industrial developments
 - 4.2 Raw materials
 - 4.3 Brief introduction of Lead Chamber Process.
 - 4.4 Manufacture by contact process. Flow sheet.
 - 4.5 Unit operation and unit process.
 - 4.6 Treatment of vent gas of contact process
 - 4.7 Energy requirements
- 5 **AMMONIA****
- 5.1 Ammonia, uses, economics.
 - 5.2 Manufacture of Ammonia from Natural gas.
 - 5.3 Steam natural gas reforming, Primary reforming, Secondary reforming.
 - 5.4 Shift conversion.
 - 5.5 CO₂ absorption and separation
 - 5.6 Removal of Carbon monoxide.
 - 5.7 Compression of N₂ and H₂
 - 5.8 Ammonia synthesis, Ammonia converter (equipment)
 - 5.9 Flow chart
 - 5.10 Unit operation and unit process.
 - 5.11 Liquification of Ammonia.
 - 5.12 Storage of Ammonia
 - 5.13 Manufacture of Nitric Acid from Ammonia, flow sheet
 - 5.14 Unit operation and unit process.
- 6 **AMMONIA NITRATE.****
- 6.1 Manufacture of Ammonium Nitrate, Raw material, Flow sheet
 - 6.2 Unit operation and unit processes
 - 6.3 Uses of Ammonium Nitrate, storage.
- 7 **MANUFACTURE OF UREA****
- 7.1 Formula uses, Raw material.
 - 7.2 Flow sheet, Multi-sheet compression.
 - 7.3 Unit operation and unit process.
 - 7.4 Prilling Tower and Prilling of Urea.
- 8 **MANUFACTURE OF AMMONIUM SULPHATE****
- 8.1 Uses, Raw material
 - 8.2 Flow sheet
 - 8.3 Unit operation and unit process.

- 9 PHOSPHATE FERTILIZERS.**
- 9.1 MAP, DAP formula, uses.
 - 9.2 Raw materials, Processing of phosphate rock
 - 9.3 Flow diagram
 - 9.4 Unit operation and unit process.
- 10 PORTLAND CEMENT**
- 10.1 Types of portland cement
 - 10.2 Raw material
 - 10.3 Manufacture method, Dry process, wet process
 - 10.4 Flow sheet (wet process)
 - 10.5 Unit operation and unit process.
 - 10.6 Kilra (living and heating zones) reactions.
 - 10.7 Setting and Harding of cement
 - 10.8 Energy requirement of wet and dry process
 - 10.9 Slag cement.
- 11 LIME**
- 11.1 Lime, formula, uses.
 - 11.2 Calculation of lime stone, unit operation and unit process.
 - 11.3 Slacked lime manufacture.
- 12 GYPSUM**
- 12.1 Formula, uses, processing of Rock
 - 12.2 Calculation of gypsum, chemical reaction.
 - 12.3 Uses of plaster of paris.
 - 12.4 Harding of plaster
- 13 PETROLEUM INDUSTRY, INTRODUCTION.**
- 13.1 Constituents of petroleum
 - 13.2 Natural gas.
 - 13.3 Liquified Petroleum gas (LPG)
- 14 REFINING OF PETROLEUM**
- 14.1 Products of refining
 - 14.2 Conversion process, cracking or pyrolysis
 - 14.3 Reforming, catalytic reforming
 - 14.4 Polymerization
 - 14.5 Alkylation.
 - 14.6 Isomenization.

RECOMMANDED BOOK

Chemical process Industries by Shreve

INSTRUCTIONAL OBJECTIVES.

1. INTRODUCTION

- 1.1 understand unit process
 - 1.1.1 Define unit process
 - 1.1.2 Give examples of nit process
 - 1.1.3 Distinguish unit operation and unit process
 - 1.1.4 Explain continuous process with examdples.
 - 1.1.5 Explain batch process with examples
- 1.2 Understand flow charts
 - 1.2.1 Name types of flow charts.
 - 1.2.2 Distinguish between block diagram and symbolic diagram.
 - 1.2.3 Read different flow charts.

2. WATER

- 2.1 Understand water conditioning
 - 2.1.1 Enlist impurities of water.
 - 2.1.2 Name salts responsible for water hardness
 - 8 2.1.3 Give water softening methods.
 - 2.1.4 Explain water purification
 - 2.1.5 Describe clarifications
- 2.2 Understand Ion exchange methods
 - 2.2.1 Enlist rasins used for ion exchange method
 - 2.2.2 Describe ion exchange method
 - 2.2.3 Explain regeneration of resirs
 - 2.2.4 Give reactions involved in ion exchange method.
- 2.3 Understand sodium cation exchange
 - 2.3.1 Enlist uses of soft water.
 - 2.3.2 Describe water softening by sodium cation exchange process
- 2.4 Understand mixed bad resins.
 - 2.4.1 Name mixed bed resins
 - 2.4.2 Explain mixed bed resins refining of water.
- 2.5 Understand hydrogen cation exchange process
 - 2.5.1 Give formula of hydrogen cation exchange
 - 2.5.2 Draw flow sheet diagram for hydrogen-cation exchange process.
 - 2.5.3 Explain hydrogen cation exchange process
- 2.6 Understand soda lime process and phosphate conditioning
 - 2.6.1 Describe soda line process
 - 2.6.2 Explain cold soda line process
 - 2.6.3 Explain phosphate conditioning.
- 2.7 Understand de-airation of water.
 - 2.7.1 Define term de-airation
 - 2.7.2 Give the importance of de-airation for boiler water
 - 2.7.3 Explain de-airation methods.
- 2.8 understand demineraization and de-slating
 - 2.8.1 Enlist minerals in water

- 2.8.2 Describe demineralization
- 2.8.3 Explain de-salting.

3. CHLORALKALI INDUSTRIES

- 3.1 Chloralkali industries.
 - 3.1.1 Define chloralkali
 - 3.1.2 Enlist the products of chloralkali industries.
 - 3.1.3 Enlist the chloralkali industries in Pakistan
- 3.2 understand soda ash manufacture
 - 3.2.1 Name the process of soda ash manufacture
 - 3.2.2 Give raw materials used for soda ash manufacture by solvay process
 - 3.2.3 Define brine solution
 - 3.2.4 Explain purification of brine solution
- 3.3 Draw flow sheet.
 - 3.3.1 Draw flow sheet of solvay process for manufacture of soda ash.
 - 3.3.2 Enlist unit operations of soda ash manufacture.
 - 3.3.3 Explain unit process of soda ash manufacture
 - 3.3.4 Give uses of soda ash.
- 3.4 Understand sodium bicarbonate manufacture
 - 3.4.1 Give commercial name of sodium bicarbonate
 - 3.4.2 Give raw material used for sodium bicarbonate manufacture
 - 3.4.3 Draw flow sheet of sodium bicarbonate manufacture
 - 3.4.4 Enlist unit operation and unit processes
 - 3.4.5 Explain unit process of sodium bicarbonate manufacture.
 - 3.4.6 Enlist uses of sodium bicarbonate
- 3.5 Caustic soda manufacture.
 - 3.5.1 Give chemical name of caustic soda
 - 3.5.2 name methods of caustic soda manufacture
 - 3.5.3 Name cells used for caustic soda manufacture
 - 3.5.4 Draw diagram of diaphragm cell
 - 3.5.5 Draw flow sheet for the manufacture of caustic soda using diaphragm cell
 - 3.5.6 Name unit operations for caustic soda manufacture by diaphragm cell
 - 3.5.7 Explain unit processes for caustic soda manufacture by diaphragm cell
 - 3.5.8 Draw diagram of mercury cell
 - 3.5.9 Draw flow sheet for the manufacture of caustic soda by mercury cell
 - 3.5.10 Enlist unit operation for manufacture of caustic soda by mercury cell
 - 3.5.11 Describe unit processes for manufacture of caustic soda by mercury cell
 - 3.5.12 Draw diagram of membrane cell
 - 3.5.13 Draw flow sheet for the manufacture of caustic soda by membrane cell
 - 3.5.14 Name unit operations for the manufacture of caustic soda by membrane cell
 - 3.5.15 Describe unit process for manufacture of caustic soda by mercury cell
 - 3.5.16 Give the comparison of the three cells used for caustic soda manufacture.
 - 3.5.17 Give the by products of caustic soda manufacture.
 - 3.5.18 Illustrate uses of chlorine
 - 3.5.19 Give uses of hydrogen
- 3.6 Understand bleaching powder manufacture
 - 3.6.1 Enlist raw materials for bleaching powder manufacture.
 - 3.6.2 Draw flow sheet for bleaching powder manufacture.
 - 3.6.3 Explain bleaching powder manufacture
 - 3.6.4 Name unit operations of bleaching powder manufacture

- 3.6.4 Name unit operations of bleaching powder manufacture.
- 3.6.5 Give uses of bleaching powder manufacture.
- 3.7 Understand calcium hypochlorite manufacture.
 - 3.7.1 Describe raw material for the calcium hypochlorite manufacture
 - 3.7.2 Draw flow sheet for calcium hypochlorite manufacture
 - 3.7.3 Explain calcium hypochlorite manufacture.
 - 3.7.4 Give unit operation for calcium hypochlorite manufacture.
 - 3.7.5 Enlist uses of calcium hypochlorite.
- 3.8 Understand sodium hypochlorite manufacture
 - 3.8.1 Give raw materials for soda hypochlorite manufacture.
 - 3.8.2 Draw flow sheet for the manufacture of sodium hypochlorite
 - 3.8.3 Enlist unit operations for soda hypochlorite manufacture.
 - 3.8.4 Enlist uses of soda hypochlorite.
- 3.9 Understand hydrochloric acid manufacture
 - 3.9.1 Define muriatic acid (HCl)
 - 3.9.2 Enlist methods of manufacture of hydrochloric acid
 - 3.9.3 Draw flow sheet for hydrochloric acid manufacture by synthesis process.
 - 3.9.4 Enlist unit operation for hydrochloric acid manufacture by synthesis
 - 3.9.5 Explain unit process for hydrochloric acid manufacture by synthesis
 - 3.9.6 Enlist uses of hydrochloric acid

4. **SULPHURIC ACID**

- 4.1 understand sulphuric acid manufacture.
 - 4.1.1 Define oil of vitriol (H_2SO_4)
 - 4.1.2 Give formula of Sulphuric Acid
 - 4.1.3 Give formula of Sulphuric Acid
 - 4.1.4 Enlist uses of sulphuric acid
 - 4.1.5 Illustrate importance of sulphuric acid in industrial development
 - 4.1.6 Enlist raw materials for sulphuric acid manufacture
 - 4.1.7 Name methods for sulphuric acid manufacture.
 - 4.1.8 Draw flow sheet diagram for sulphuric acid manufacture by lead chamber process.
 - 4.1.9 Enlist unit operations for lead chamber process
 - 4.1.10 Describe unit process of lead chamber process.
 - 4.1.11 Draw flow sheet for sulphuric acid manufacture by contact process
 - 4.1.12 Enlist unit operation for contact process
 - 4.1.13 Explain unit processes for contact process.
 - 4.1.14 Enlist vent gases of contact process
 - 4.1.15 Illustrate vent gases treatment of contact process.
 - 4.1.16 Give energy requirements for contact process.

5. **AMMONIA**

- 5.1 Understand ammonia and nitric acid manufacture.
 - 5.1.1 Enlist uses of ammonia
 - 5.1.2 Name method used for ammonia manufacture.
 - 5.1.3 Give raw materials for Ammonia manufacture by synthesis process.
 - 5.1.4 Enlist the steps involved in the manufacture of Ammonia from natural gas.
 - 5.1.5 Define reforming of natural gas.
 - 5.1.6 Describe primary reforming
 - 5.1.7 Explain secondary reforming

- 5.1.8 Explain shift conversion
- 5.1.9 Describe carbon di oxide absorption
- 5.1.10 Illustrate separation of carbon di oxide
- 5.1.11 Describe removal of carbon mono oxide before ammonia manufacture.
- 5.1.14 Draw diagram of Ammonia convertor
- 5.1.15 Describe unit process of Ammonia convertor
- 5.1.16 Draw flow sheet for Ammonia manufacture from natural process.
- 5.1.17 Describe unit processes involved in ammonia manufacture.
- 5.1.18 Illustrate liquification of ammonia
- 5.1.19 Describe storage of liquid ammonia
- 5.1.20 Name the method used for the manufacture of nitric acid from ammonia.
- 5.1.21 Draw flow sheet for manufacture of nitric acid from ammonia
- 5.1.22 Explain unit operation involved in nitric acid manufacture.
- 5.1.23 Explain unit processes involved in nitric acid manufacture.

6. AMONIUM NITRATE.

- 6.1 Understand ammonium nitrate manufacture
 - 6.1.1 Describe raw materials for ammonium nitrate manufacture.
 - 6.1.2 Draw flow sheet for ammonium nitrate manufacture.
 - 6.1.3 Enlist unit operations involved in ammonium nitrate manufacture.
 - 6.1.4 Explain unit processes involved in ammonium nitrate manufacture.
 - 6.1.5 Give uses of ammonium nitrate
 - 6.1.6 Explain storage of ammonium nitrate.

7. UREA.

- 7.1 Understand urea manufacture.
 - 7.1.1 Write formula of urea
 - 7.1.2 Enlist uses of urea
 - 7.1.3 Draw flow sheet for urea manufacture
 - 7.1.4 Describe unit operations involved in urea manufacture
 - 7.1.5 Explain unit processes involved in urea manufacture
 - 7.1.6 Explain prilling of urea

8 AMONIUM SULPHATE

- 8.1 Understand ammonium sulphate
 - 8.1.1 Enlist uses of ammonium sulphate
 - 8.1.2 Name raw materials for ammonium sulphate manufacture
 - 8.1.3 Draw flow sheet for ammonium sulphate manufacture
 - 8.1.4 Give unit operations involved in ammonium sulphate manufacture
 - 8.1.5 Describe unit processes involved in ammonium sulphate

9 PHOSPHATE FERTILIZER

- 9.1 Understand mono ammonium phosphate and di-ammonium phosphate
 - 9.1.1 Give formula of monoammonium phosphate
 - 9.1.2 Write formula of diammonium phosphate
 - 9.1.3 Enlist uses of ammonium phosphate
 - 9.1.4 Enlist raw materials of ammonium phosphate
 - 9.1.5 Describe beneficiation of phosphate rock
 - 9.1.6 Draw flow sheet for manufacture of ammonium phosphate
 - 9.1.7 Describe unit operations involved in ammonium phosphate manufacture

9.1.8 Explain unit process involved in ammonium phosphate manufacture

10 PORT LAND CEMENT

- 10.1 Understand portland cement manufacture
 - 10.1.1 Define portland cement
 - 10.1.2 Enlist uses of cement
 - 10.1.3 Enlist raw materials
 - 10.1.4 Name methods of cement manufacture
 - 10.1.5 Draw flow sheet for cement manufacture by dry process
 - 10.1.6 Describe unit operations involved in cement manufacture by dry process
 - 10.1.7 Give different zone in rotary kiln
 - 10.1.8 Enlist unit operation involved in cement manufacture by wet process
 - 10.1.9 Enlist unit operation involved in cement manufacture by semi wet process
 - 10.1.10 Distinguish between rotary kiln for dry process and wet process
 - 10.1.11 Illustrate physical properties of clinkers
 - 10.1.12 Explain briefly the function of gypsum in cement
 - 10.1.13 Describe hardening of cement
 - 10.1.14 Name various types of cement
 - 10.1.15 Describe various type of cement

11 LINE

- 11.1 Understand lime processing
 - 11.1.1 Write formula for lime
 - 11.1.2 Enlist uses of lime
 - 11.1.3 Enlist unit operation involved in lime processing
 - 11.1.4 Describe Unit processes involved in lime processing

12 GYPSUM.

- 12.1 Understand gypsum processing
 - 12.1.1 Write formula of gypsum
 - 12.1.2 Enlist uses of gypsum
 - 12.1.3 Describe calcination of gypsum
 - 12.1.4 Enlist uses of plaster
 - 12.1.5 Describe hardening of plaster

13 PETROLEUM INDUSTRY

- 13.1 Understand petroleum industry, ii) Understand L.P.G.
 - 13.1.1 Enlist constituents of petroleum
 - 13.1.2 Give composition of natural gas
 - 13.1.3 Describe unit operation and unit processes for processing of natural gas
 - 13.1.4 Define L.P.G.
 - 13.1.5 Draw flow sheet for L.P.G manufacture
 - 13.1.6 Explain steps involved in L.P.G. manufacture
 - 13.1.7 Enlist uses of natural gas
 - 13.1.8 Define refining
 - 13.1.9 Explain refining of petroleum
 - 13.1.10 Enlist petroleum refining products

14 UNIT PROCESSES IN PETROLEIUM

- 14.1 Understand unit processes involved in petroleum processing
 - 14.1.1 Explain cracking or pyrolysis
 - 14.1.2 Give examples of pyrolysis
 - 14.1.3 Explain reforming
 - 14.1.4 Explain catalytic reforming
 - 14.1.5 Explain polymerization
 - 14.1.6 Give examples of polymerization
 - 14.1.7 Give examples of alkylation
 - 14.1.8 Explain isomerization
 - 14.1.9 Give examples of isomerization

LIST OF PRACTICALS.

1. Detection of soft and hard water.
2. Determination of hardness of water.
3. Determination of dissolved oxygen in water.
4. Determination of total chlorides in water.
5. Determination of sulphates contents in water.
6. Determination of carbonates in water.
7. Determination of bicarbonates in water.
8. Determination of iron contents in water.
9. Determination of calcium contents in water.
10. Preparation of Ammonium Nitrate in lab.
11. Preparation of Amminium Sulphate in lab.
12. Purification by crystallization.
13. PH value determination.
14. Preparation of lime by the calcination of lime stone
- 15 Preparation of plaster of paris from gypsum.
- 16 Demineralization of water.

COURSE CONTENTS.

1 INTRODUCTION.

- 1.1 Definition Importance in daily life.
 Industrial importance.
- 1.2 Types of analysis, Qualitative analysis, Quantitative analysis, Volumetric analysis, Gravimetric analysis.
- 1.3 Instrumental method of analysis, conventional methods of analysis.

2. SAMPLING.

- 2.1 Sampling techniques for liquid, solid and gas samples.
- 2.2 Storage of sample.

3. ERRORS IN ANALYSIS.

- 3.1 Personal errors.
- 3.2 Determinate errors.
- 3.3 Indeterminate errors.
- 3.4 Detection of errors.

4. ANALYSIS OPERATION.

- 4.1 Weighing of sample.
- 4.2 Volume measurement of sample.
- 4.3 Preparation of sample solution.
- 4.4 Titration.
- 4.5 Precipitation.
- 4.6 Filtration.
- 4.7 Drying
- 4.8 Ignition.

5 PREPARATION OF STANDARD SOLUTION.

- 5.1 Primary standard, secondary standard.
- 5.2 Standard solution.
- 5.3 Methods of expression of concentration.
- 5.4 Equivalent weight, Molecular weight.
- 5.5 Calculation of equivalent weight of acids.
Calculation of equivalent weight of bases.
Calculation of equivalent weight of oxidising compounds.
Calculation of equivalent weight of reducing compounds.
- 5.6 Normal solution and normality
- 5.7 Molar solution and molarity
- 5.8 Molal solution and molality
- 5.9 Preparation of solutions of different normalities.
Preparation of solution of different molalities.

6 MATHEMATICAL CALCULATION FOR THE PREPARATION OF ABOVE SOLUTION INDICATOR.

- 6.1 Internal indicator.

- 6.2 External indicator.
- 6.3 Universal indicator.
- 6.4 Behaviour of different indicators in acidic sols and in basic sols.
- 6.5 Preparation of indicator solution.
(phenolphthalein, methyl orange, methyl red, methyl blue, litmus solution, starch solution, diphenylamine).

7 **VOLUMETRIC ANALYSIS.**

- 7.1 Types of volumetric analysis (on the basis of reagent used).
- 7.2 Acidimetry - alkalimetry.
- 7.3 Redox - titration.
- 7.4 Iodometry.
- 7.5 Iodimetry
- 7.6 Argentometry.
- 7.7 Apparatus for volumetric analysis.
- 7.8 Mathematical calculations based on $N_1V_1 = N_2V_2$ and amount per litre = Normality * eq.wt.

8. **GRAVIMETRIC ANALYSIS.**

- 8.1 Apparatus for gravimetric analysis.
- 8.2 Free water contents, combined water contents (water of crystallization)
- 8.3 Determination of free and combined water gravimetrically.
- 8.4 Desiccants and use of desiccator.
- 8.5 Gravimetric determination of silver.
- 8.6 Gravimetric determination of magnesium.
- 8.7 Gravimetric determination of calcium.
- 8.8 Gravimetric determination of silica.
- 8.9 Gravimetric analysis of cement.

9 **REPORTING OF ANALYSIS RESULTS.**

- Percentage.
- Gram per liter.
- Parts per million (PPM)
- Parts per billion (PPM)

CHT 263 QUANTITATIVE ANALYSIS.

INSTRUCTIONAL OBJECTIVES.

1 INTRODUCTION.

- 1.1 Understand quantitative analysis.
 - 1.1.1 Define quantitative analysis.
 - 1.1.2 Illustrate importance of quantitative analysis.
 - 1.1.3 Distinguish qualitative analysis and quantitative analysis.
 - 1.1.4 Explain volumetric analysis.
 - 1.1.5 Describe gravimetric analysis.
 - 1.1.6 Define instrumental methods of analysis.

2. SOMPLING.

- 2.1 Understand sampling.
 - 2.1.1 Define sampling.
 - 2.1.2 Describe methods of sampling.
 - 2.1.3 Explain sampling of liquids for liquid, solid and gas liquids.
 - 2.1.4 Illustrate storage of samples.

3 ERRORS IN ANALYSIS.

- 3.1 Understand errors in analysis.
 - 3.1.1 Enlist errors in analysis.
 - 3.1.2 Explain personal error.
 - 3.1.3 Describe determinate error.
 - 3.1.4 Illustrate indeterminate error.
 - 3.1.5 Detect different errors.

4 ANALYSIS OPERATION.

- 4.1 Understand analysis operation.
 - 4.1.1 Describe working principle of electric balance.
 - 4.1.2 Explain weighing operation.
 - 4.1.3 illustrate measurement of volume using burette, pipette and measuring flask.
 - 4.1.4 Prepare sample solution.
 - 4.1.5 Explain Titration.
 - 4.1.6 Describe precipitation.
 - 4.1.7 Explain filtration.
 - 4.1.8 Illustrate drying.
 - 4.1.9 Explain ignition.

5 PREPARATION OF STANDARD SOLUTION.

- 5.1 Understand preparation of standard solution.
 - 5.1.1 Define primary standard.
 - 5.1.2 Define secondary standard.
 - 5.1.3 Define equivalent weight.

- 5.1.4 Describe standard solution.
- 5.1.5 Enlist methods of expression of solution concentration.
- 5.1.6 Calculate equivalent weight of different compounds.
- 5.1.7 Explain Normal solution.
- 5.1.8 Explain terms of solution concentration like normality, molarity and formality.
- 5.1.9 Prepare solution of different normalities.
- 5.1.10 Prepare solution of different molarities.
- 5.1.11 Calculate normality and molarity.

6 INDICATOR.

- 6.1 Understand indicator.
 - 6.1.1 Define indicator.
 - 6.1.2 Distinguish internal indicator.
 - 6.1.3 Describe universal indicator.
 - 6.1.4 Illustrate behaviour of different indicators in acidic/basic solutions.
 - 6.1.5 Prepare different indicators (like phenolphthalein, methyl orange, starch, litmus solution and diphenylamine).

7 VOLUMETRIC ANALYSIS.

- 7.1 Understand Volumetric analysis.
 - 7.1.1 Define volumetric analysis.
 - 7.1.2 Enlist type of reagent based volumetric analysis.
 - 7.1.3 Describe acidimetry, alkalimetry.
 - 7.1.4 Explain redox titrations.
 - 7.1.5 Distinguish Iodimetry and iodometry.
 - 7.1.6 Explain argentometry.
 - 7.1.7 Solve problems based on $N_1V_1 = N_2V_2$.
 - 7.1.8 Solve problems based on $\text{Amount/litre} = \text{Normality} \times \text{Equivalent weight}$.

8 GRAVIMETRIC ANALYSIS.

- 8.1 Understand gravimetric analysis.
 - 8.1.1 Define gravimetric analysis.
 - 8.1.2 Describe gravimetric analysis apparatus.
 - 8.1.3 Calculate free water content.
 - 8.1.4 Calculate water of crystallization.
 - 8.1.5 Explain desiccator.
 - 8.1.6 Enlist desiccants.
 - 8.1.7 Determine silver from given sample.
 - 8.1.8 Determine magnesium from given sample.

- 9.1.9 Determine calcium from given sample.
- 9.1.10 Determine silica from given sample.
- 8.1.11 Analyse cement.

9 REPORTING OF ANALYSIS RESULTS.

- 9.1 Know analysis results reporting.
 - 9.1.1 Define percentage.
 - 9.1.2 Define gram per liter.
 - 9.1.3 Describe parts per million.
 - 9.1.4 Tell parts per billion.

CHT 263 QUANTITATIVE ANALYSIS.

LIST OF PRACTICALS.

1. Calibration of
 - i. Burette
 - ii. Measuring cylinder.
 - iii. Measuring flask
 - iv. Pipette.
2. Weighing practice on analytical balance.
3. Weighing practice on digital balance.
4. Preparation of N/10 solution of primary standard Na_2CO_3 , Oxalic Acid)
5. Calculation method for preparation of N/10 (approximate) solution of secondary standard (NaOH , H_2SO_4).
6. Determination of normality of approximately prepared solution by titrating against some standard solution. HCl , H_2SO_4 and Normal solution.
7. Preparation of indicator solution.
 - i. Phenolphthalein solution.
 - ii. Methyl orange solution.
 - iii. Litmus solution.
 - iv. Starch solution.
 - v. Diphenylamine.
8. Determination of equivalent weight of an organic acid (oxalic acid)
9. Determination of acetic acid in vinegar.
10. Determination of alkaline value of soda ash.
11. Determination of percentage of NaOH and Na_2CO_3 in the mixture of two bases.
12. Preparation of (approx) M/20 KMnO_4 solution.
13. Standardizing the M/20 KMnO_4 solution
14. Determination of iron content in iron wire.
15. Determination of Fe^{+2} and Fe^{+3} in the iron salt.
16. Redox titration using external indicator.
17. Redox titration using internal indicator.
18. Standardization of 0.1 N iodine solution with $\text{Na}_2\text{S}_2\text{O}_3$ solution.
19. Standardization of BaS_2O_3 solution versus a known iodine solution.

20. Determination of antimony in antimony salt.
21. Determination of available chlorine in bleaching powder.
22. Determination of chlorine in soluble salt by volhards, method.
23. Estimation of chloride in a given sample of NaCl by AgNO₃ by using Mohr's methods.
24. Gravimetric determination of free water (moisture contents) and combined water (water crystallization)
25. Analysis of cement.
 - i. Determination of percentage loss on ignition.
 - ii. Determination of percentage of total silica.
 - iii. Determination of percentage of insoluble residue.
 - iv. Determination of percentage of moisture contents.
 - v. Determination of percentage of calcium contents.
 - vi. Determination of percentage magnesium contents.
26. Analysis of copper.
27. Analysis of tin
28. Analysis of lead.

CHT 271 SAFETY PRACTICE AND PROCEDURE.

T P C
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OBJECTIVES.

- 1.To acquaint students with causes of accidents in industry and instruct them how to eliminate hazards.
- 2.To train students in a fundamentals of fire protection.
- 3.To introduce students to the fundamentals of first aid.
- 4.To promote in students and understanding of value of plants layout for safe performance.
- 5.To provide the students ready reference of outstanding accepted safe standards, codes and technical aids.

COURSE CONTENTS.

1. Introduction to safety and its place in industry.
2. Accidents and accident costs.
3. Analyzing causes of accidents.
4. Fundamentals of accident prevention.
- 5.Industrial noise nad its controll, illumination for safety and comfort.
6. Industrial negieneand planad sanitation.
7. Personnel protective equipment.
8. Types of firehazards and causes.
9. Fire fighting equipments with identification symbols.
10. Plant layout for fire safety
11. Importance of plant maintenance and house keeping safety.
12. Plant inspection and safety inventory.
13. Accidents and their prevention in:
 - i. Mines Coal and salt mines.
 - ii. Petrolium industry.
 - iii. Paint industry and paint shops.
 - iv. Paper and board mills.
 - v. Prining industry.
 - vi. Food processing industry.
 - vii. Vegitable oil and soap industry.
 - viii Acid industry. (H_2SO_4 , HNO_3 , HCl)
 - ix. Caustic alkali industry.
 - x. Fertilizers (Ammonia, Urea, Nitrate) industry.
14. Plastic and fiber industry.
15. Power plants.
16. Antidotes od different chemicals.
17. First aid, Extended medical services.
18. Employees training in safe practices, methods of promoting safety. With special attention on women and employees.
19. Accident investigation, Record and report.

BOOKS RECOMMENDED.

1. Industrial Accident prevention.

2. Pakistan Labour.

CHT 271 SAFETY PRACTICE AND PROCEDURE

INSTRUCTIONAL OBJECTIVES

1. INTRODUCTION

- 1.1 Understand safety in chemical industry.
- 1.2 Understand philosophy of accidents.
 - 1.1.1 Define accident
 - 1.1.2 Enlist various types of accidents.
 - 1.1.3 Explain accident analysis
 - 1.1.4 Explain master sheet and work sheet of accident analysis.
 - 1.1.5 Name remedial/prevention measures.
 - 1.1.6 Explain facts in selection preventions
 - 1.1.7 Describe causes of attach
 - 1.1.8 Explain preventive measures in chemical industries, like
 - petroleum, paints, paper and board printing industries.
 - Food processing
 - Vegetable oils and Ghee
 - Acid and ackali industry
 - Fertilizers urea, Ammonia Ammonium Nitrate
 - Plastics and Fibre Industry
 - Power plants

2. ACCIDENT COST

- 2.1 Understand Accident cost.
 - 4 Various types of accidents in various chemical industry.
 - 2.1.3 Explain laws of the cost of accidents
 - 2.1.4 Describe location where accident has occurred, like
 - At work place
 - Running machinery
 - Reaction vessab/Roactors
 - 2.1.5 Explain management role of reliance
 - 2.1.6 Differentiate the responsibility of safety engineer and supervisor.
 - 2.1.7 Explain degree of responsibility.
 - 2.1.8 Explain the use of Gloves, Apron, Goggles and masks in health hazardous atmosphere (Antidotes of chemical)
 - 2.1.9 Calculate cost of lost of time of (n) used employee.
 - 2.1.10 Commute in terms of money cost of time lost by other employees who stop work
 - 2.1.11 Calculate the cost of time spent by first aid attendant and hospital department staff.
 - 2.1.12 Explain Insurance rules for various injuries like
 - Loss of nail of a finger
 - Cuts on hands and face
 - Slips and falls
 - Handling of toxic material
 - Miscellaneous operations and calculate compensation medical cost on the vasis of set formula

3. EMPLOYEES TRAINING

- 3.1 Understand training of employees.
 - 3.1.1 Define training and education of an employee.

- 3.2.2 Explain safety educational method
- 3.3.3 Enlist various methods of training and education.
- 3.4.4 Describe planned training with examples.
- 3.5.5 Differentiate between, education training and supervision of an employee.
- 3.6.6 Explain safety organization (Industry) as educational medium to avoid accidents for women workers.

4 ACCIDENT INVESTIGATION RECORD AND REPORT

- 4.1 Understand Accident Investigation terminology and maintain record of reports.
 - 4.1.1 Define accident investigation.
 - 4.1.2 Describe the accident fully, whether the injured person fell or was struck
 - 4.1.3 Narrate various factors of accident
 - 4.1.4 Name the machine, tool, appliance, gas, liquid involved in accident
 - 4.1.5 State of motors, pulley's gears etc.
 - 4.1.6 Enlist total number of such accidents occurred in an year.
 - 4.1.7 Specify remedial measures in the form of a report such as
 - Better illumination needed.
 - Better ventilation.
 - Providing goggles.
 - Enforcing instruction especially to women/men who work on plant operations.
 - 4.1.8 Explain the importance of training of an employee.

5 INDUSTRIAL NOISE AND CONTROL

- 5.1 Understand Industrial noise and control.
 - 5.1.1 Define Industrial noise.
 - 5.1.2 Enlist types of noise with frequency.
 - 5.1.3 Explain the complexity of noise on worker in a chemical industry.
 - 5.1.4 Describe causes of noise.
 - 5.1.5 Explain the relationship of noise to accident and prevention.
 - 5.1.6 Explain noise standards.
 - 5.1.7 Describe medical view point on noise and its control.
 - 5.1.8 Explain control medium of noise.

6 INDUSTRIAL HYGIENE AND PLANT SANITATION

- 6.1 Understand Industrial Hygiene and sanitation.
 - 6.1.1 Define Industrial Hygiene and sanitation.
 - 6.1.2 Name various Hygiene and sanitation methods.
 - 6.1.3 Explain all methods and its effect upon accident prevention.

7 FIRE PREVENTION HAZARDS

- 7.1 Understand fire hazards and prevention.
 - 7.1.1 Define fire hazards.
 - 7.2.2 Enlist types of fires in a chemical Industry.
 - 7.2.3 Name fire fighting and extinguishing equipments.
 - 7.2.4 Explain origin of the fire.
 - 7.2.5 Describe fire resistive designs and construction/equipments.
 - 7.2.6 Explain method of fire prevention.
 - 7.2.7 Explain the use of fire extinguish and the chemicals it contains.
 - 7.2.8 Describe the use of chemical to avoid accidents due to fire.

OBJECTIVES.

1. Understand the scientific methods as applied to the development of the laws of chemistry and physics.
2. Techniques for the control of chemical phenomenon from the study of laws of chemistry and physics.
3. Acquire the techniques used in analytical methods.

COURSE CONTENTS.**1. THERMOCHEMISTRY.**

- 1.1 Introduction.
- 1.2 Exothermic and endothermic reaction.
- 1.3 Heat of Reaction.
- 1.4 Factor affecting heat of reaction
- 1.5 Heat of formation.
- 1.6 Heat of combustion.
- 1.7 Application of heat of combustion.
- 1.8 Heat of Neutralization.
- 1.9 Hess's law of constant heat summation.

2. THERMODYNAMICS.

- 2.1 First law of thermodynamics.
- 2.2 Heat changes at constant pressure and at constant volume.

3. SOLUTION.

- 3.1 Solution, types of solutions.
- 3.2 Concentration.
- 3.3 Normality, Normal solution.
- 3.4 Molarity, Molar solution Molality.
- 3.5 Percentage composition.
- 3.6 Properties of solution.
- 3.7 Electrolytes.
- 3.8 Definition of solubility.
- 3.9 Effect of temperature and pressure on solubility.
- 3.10 Elevation of boiling point and its applications.
- 3.11 Depression of freezing point and its applications.

4. COLLOIDAL STATE.

- 4.1 Preparation of colloidal solutions.
- 4.2 Properties of colloidal solutions.
- 4.3 Application of colloidal chemistry in industry.

5. PHOTOCHEMISTRY.

- 5.1 Sources of photochemical reactions.
- 5.2 Photochemical reaction.

- 5.3 Laws of photochemistry.
- 5.4 Measurement of intensity of Radiation.
- 5.5 Photosensitisation.
- 5.6 Photosynthesis.
- 5.7 Photophysical phenomena.
Luminescence

Phosphorescence.

- 5.8 Application of photochemistry.

6. **ELECTROCHEMISTRY.**

- 6.1 Electrolytes and electrolysis.
- 6.2 Electrolytes and Ohm's Law.
- 6.3 Conductivity of electrolytes.
- 6.4 Faraday's Law of electrolytes.
- 6.5 Effect of dilution on conductivity.
- 6.6 Measurement of conductivity.

7. **RADIOACTIVITY.**

- 7.1 Natural radioactivity.
- 7.2 Artificial radioactivity.
- 7.3 Properties of A-ray.
- 7.4 Properties of B-rays.
- 7.5 Properties of R-rays.
- 7.6 Protons, neutrons and alpha emission
- 7.7 Positrons and other particles discovered.
- 7.8 Detection and measurement of Radioactivity.
- 7.9 Nuclear fission and its application.
- 7.10 Nuclear fusion and its applications.
- 7.11 Radioactive disintegration series.
- 7.12 Isotopes with examples.
- 7.13 Isobars with examples.

8. **CHEMICAL KINETICS.**

- 8.1 Velocity of a chemical reaction.
- 8.2 Reaction rate and velocity constant.
- 8.3 Factors which affect reaction rate

9. **CHEMICAL EQUILIBRIUM.**

- 9.1 Law of mass action.
- 9.2 Equilibrium mixtures and measurement of equilibrium constant.
- 9.3 Hydrolysis of bicarbonates.
- 9.4 Reaction between an organic acid and an alcohol reaction between hydrogen and iodine.
- 9.5 Application of equilibrium constant.
- 9.6 Effect of temperature, pressure, concentration and catalyst.

RECOMMENDED BOOKS.

- 1. Chemistry for Class XI
Published by Punjab Text Book Board, Lahore.
- 2. Essentials of Physical Chemistry by B.S. Bhal, G.D. Tuli.

INSTRUCTIONAL OBJECTIVES.**1. PHYSICAL CHEMISTRY**

- 1.1 Understand chemistry
 - 1.1.1 Define thermo chemistry
 - 1.1.2 Distinguish exothermic and endothermic reactions.
 - 1.1.3 Give examples of exothermic and endothermic reactions.
 - 1.1.4 Explain heat of reaction
 - 1.1.5 Enlist factors affecting heat of reaction
 - 1.1.6 Describe heat of formation
 - 1.1.7 Illustrate heat of combustion
 - 1.1.8 Enlist heat of combustion application
 - 1.1.9 Describe heat of neutralization
 - 1.1.10 State Hess's law of constant heat summation
 - 1.1.11 Solve problems based on Hess's law

2 THERMODYNAMICS

- 2.1 Understand thermodynamics
 - 2.1.1 State first law of thermodynamics
 - 2.1.2 Calculate heat changes at constant volume
 - 2.1.3 Calculate heat change at constant pressure

3 SOLUTION

- 3.1 Understand solution
 - 3.1.1 Define solution
 - 3.1.2 Give examples of types of solution
 - 3.1.3 Define concentration
 - 3.1.4 Explain normality
 - 3.1.5 Describe molarity
 - 3.1.6 Explain percentage composition
 - 3.1.7 Illustrate properties of solution
 - 3.1.8 Explain electrolysis
 - 3.1.9 Define solubility
 - 3.1.10 Describe effect of temperature and pressure on solubility
 - 3.1.11 Explain elevation of boiling point
 - 3.1.12 Enlist elevation of boiling point application
 - 3.1.13 Explain depression of freezing point
 - 3.1.14 Enlist depression of freezing point applications

4 COLLOIDAL STATE

- 4.1 Understand colloidal state
 - 4.1.1 Explain colloidal state
 - 4.1.2 Prepare different colloidal solutions
 - 4.1.3 Describe properties of colloidal solutions
 - 4.1.4 Enlist colloidal chemistry application in industry

5 PHOTO CHEMISTRY

- 5.1 Understand photo chemistry

- 5.1.1 Enlist sources of photo chemical radiations
- 5.1.2 Describe photo chemical reactions
- 5.1.3 State different laws of photo chemistry
- 5.1.4 Enlist different instruments used to measure intensity of radiations
- 5.1.5 Describe photosensitisation
- 5.1.6 Define photo synthesis
- 5.1.7 Define luminescence
- 5.1.8 Explain briefly fluorescence
- 5.1.9 Define phosphorescence
- 5.1.10 Enlist applications of photo chemistry

6 UNDERSTAND ELECTRO CHEMISTRY

- 6.1 Describe electrolytes
- 6.2 State ohm's law
- 6.3 Describe conductivity of electrolytes
- 6.4 State faraday's laws of electrolysis
- 6.5 Explain effect of dilution on conductivity
- 6.6 Enlist instruments used to measure the conductivity

7 UNDERSTAND RADIOACTIVITY

- 7.1 Define natural radioactivity
- 7.2 Define artificial radioactivity
- 7.3 Enlist properties of alpha rays, Beta rays, gamma rays
- 7.4 Describe particles of atom like proton, neutron, positron
- 7.5 Explain the method, for radio activity measurement
- 7.6 Define nuclear fission and nuclear fusion
- 7.7 Enlist nuclear fission and nuclear fusion application
- 7.8 Explain radioactive disintegration series
- 7.9 Give examples of Isobars and Isotopes

8 UNDERSTAND CHEMICAL KINETICS

- 8.1 Calculate velocity of chemical kinetics
- 8.2 Explain reaction rate
- 8.3 Describe velocity constant
- 8.4 Enlist factors which effect reaction rate

9 UNDERSTAND CHEMICAL EQUILIBRIUM

- 9.1.1 State law of mass action
- 9.1.2 Define equilibrium mixtures
- 9.1.3 Measure equilibrium constant
- 9.1.4 Explain hydrolysis of $BiCl_3$
- 9.1.5 Describe reaction between an organic acid and an alcohol
- 9.1.6 Illustrate reaction between hydrogen and Iodine
- 9.1.7 Enlist equilibrium constant application
- 9.1.8 Describe effect of temperature, pressure, concentration and catalyst on equilibrium constant

LIST OF PRACTICALS.

	No. of Practicals.
1. To weigh the chemicals on an analytical balance (use of sensitive analytical balance)	03
2. To determine the melting point of a given organic compounds.	01
3. To determine the boiling point of a given liquid.	01
4. Determine the specific gravity of the given liquid.	02
5. Determine the viscosity by viscometer (ostwalds viscometer)	02
6. Determine of solubility of common salt at room temperature.	01
7. To separate the mixture by sublimation.	02
8. To obtain alcohol from a mixture of alcohol and water by distillation.	02
9. To determine the equivalent weight of magnesium (To verify the law of constant composition)	02
10. Preparation of standard solution of alkalies and acids e.g NaOH, KOH, oxalic acid and succinic acid.	04
11. Prepare approximate solution of H ₂ SO ₄ and determine its exact molarity by titrating it against standard N/10 NaOH.	02
12. Determination of surface tension by stalgo meter.	02
-Determination of surface tension of liquid by using torsion balance.	
-Preparation of colloidal solution and study the properties of colloidal solution.	
-Determination of equilibrium constant and rate of reaction (1st degree reaction and 2nd degree reaction).	
- Preparation of Neon signs.	

OBJECTIVES.

1. Apply the principles of unit operation in chemical engineering.
2. To apply principles of unit operation in the laboratory work.
3. Know the construction and working of chemical process equipment related to different industrial operations, its uses and applications.

COURSE CONTENTS.

1 UNIT OPERATIONS OF CHEMICAL ENGINEERING

- 1.1 Flow of fluids, types of fluids.
 - 1.2 Fluids statics, fluids dynamics.
 - 1.3 Mechanism of fluids flow.
 - 1.4 Reynold's number, significance of Reynold number
 - 1.5 Manometers, types
 - 1.6 'U' tube manometers.
 - 1.7 Inclined and well type manometers.
 - 1.8 Viscosity, units of viscosity.
 - 1.9 Bernouli's theorem.
 - 1.10 Fluids Heads, friction losses
 - 1.11 Friction in pipes, sudden enlargement and contraction losses in fittings
- Module

2. MEASUREMENT OF FLUIDS;

- 2.1 Venturi-meter, orificemeter.
- 2.2 Rotameters, Pitot tubes & weirs.
- 2.3 Displacement meters. (i) Disc meter
- 2.4 (ii) Current meter

3. PUMPS

- 3.1 Pumps types of pumps.
- 3.2 Pump's terminology i.e. capacity velocity head, suction heads and net positive suction Head, cavitation
- 3.3 Centrifugal pumps, types, construction and working
- 3.4 Construction and working of rotary pumps.
- 3.5 Construction and operation of reciprocating pumps i.e. Piston pumps
- 3.6 Plunger Pump, Simplex type, their construction and working principles..
- 3.7 Theory of compression, compressor selection.
- 3.8 Construction and working of reciprocating compressor.
- 3.9 Construction and working of centrifugal compressor.

4. HEAT TRANSFER

- 4.1 Modes of Heat transfer, fourier law.
- 4.2 Thermal conductivity, pipe insulation.

- 4.3 Film Coefficient
- 4.4 Overall heat transfer coefficient.
- 4.5 Factors affecting heat transfer coefficient.
- 4.6 Classification of heat exchange equipments.
- 4.7 Double pipe heat exchanger, shell and tube heat exchanger.
- 4.8 Floating head heat exchangers
- 4.9 Extended surface heat exchangers and condensers.

5. EVAPORATION.

- 5.1 Basic principles of evaporation.
- 5.2 Types of evaporators.
- 5.3 Construction and operation of
 - i) Short tube evaporator
 - ii) Long tube vertical evaporator.
- 5.4 Forced circulation upward flow (climbing film) evaporator.
- 5.6 Constriction and working of.
 - i) Falling film evaporators.
 - ii) Agitated film evaporator.
- 5.7 Evaporator accessories.
- 5.8 Surface condenser, contact condensers.
- 5.9 Multiple evaporators.
- 5.10 Principle economy and capacity.
- 5.11 Effect of boiling point elevation.
- 5.12 Methods of feeding.
- 5.13 Removal of non-condensed gases
- 5.14 Removal of condensates, salt removal

6. EVAPORATOR PROBLEMS

- 6.1 Scale formation and its removal
- 6.2 Steam table and their use, choice of steam pressure
- 6.3 Trouble shootings in operation of evaporators, remedies

RECOMMENDED BOOKS.

- 1. I. M. Coulson and J. H. Richardson Introduction to Chemical Engineering
- 2. A. H. Perry Chemical Engineering Hand Book

INSTRUCTIONAL OBJECTIVES.

1.1 THE STUDENT WILL BE ABLE TO UNDERSTAND THE UNIT OPERATIONS

- 1.1.1 Define unit operation and unit process
- 1.1.2 Give examples of unit operations
- 1.1.3 Give examples of unit process
- 1.1.4 Explain basic laws (law of material balance law of energy balance) of chemical energy
- 1.1.5 Differentiate between steady state and non steady state systems

2.1 UNDERSTAND THE FLUID

- 2.1.1 Define fluid
- 2.1.2 Give types of fluid
- 2.1.3 Differentiate between Newtonian and non Newtonian fluids
- 2.1.4 Give examples of the two types of fluids

2.2 UNDERSTAND THE FLUID PRESSURE

- 2.2.1 Define fluid statics
- 2.2.2 Develop a relationship to calculate the pressure exerted by liquid column

2.3 UNDERSTAND THE MANOMETER

- 2.3.1 Define manometer
- 2.3.2 Give the types of manometers
- 2.3.3 Explain the construction and working of simple manometer (u-tube manometer)
- 2.3.4 Explain the construction and working of differential manometer
- 2.3.5 Explain the construction and working of inclined tube manometer
- 2.3.6 Calculate pressure drop from manometer readings

2.4 UNDERSTAND THE FLUID DYNAMICS

- 2.4.1 Define fluid dynamics
- 2.4.2 Explain the mechanism of fluid flow by Reynold experiment
- 2.4.3 Differentiate between laminar flow and turbulent flow
- 2.4.4 Explain Reynolds number
- 2.4.6 Differentiate between point velocity, maximum velocity and mean velocity of the flowing fluid

2.5 UNDERSTAND THE VISCOSITY

- 2.5.1 Define viscosity
- 2.5.2 Explain the units of viscosity
- 2.5.3 Calculate the viscosity of fluids by using Hagen Poiseuille equation

2.6 UNDERSTAND BERNOULLI'S THEOREM

- 2.6.1 Explain Bernoulli's theorem

- 2.6.2 Develop a mathematical equation for Bernoulli's theorem
- 2.6.3 Explain fluid heads
- 2.6.4 Calculate the H.P. of the pump required to pump the liquid from station A & B, by using Bernoulli's equation

2.7 UNDERSTAND FRICTION LOSSES

- 2.7.1 Enlist different kinds of friction losses
- 2.7.2 Calculate the head loss due to friction in pipes
- 2.7.3 Calculate the head loss due to sudden enlargement
- 2.7.4 Calculate the head loss due to sudden contraction
- 2.7.5 Explain the losses in fittings in terms of equivalent pipe length

2.8 UNDERSTAND THE MEASUREMENT OF DISCHARGE OF FLUIDS

- 2.8.1 Enlist the equipments used for the measurement of flow rate of fluids
- 2.8.2 Explain the construction and working of orifice meter
- 2.8.3 Explain the methods of installation of an orifice meter
- 2.8.4 Explain the construction and working of venturimeter
- 2.8.5 Give comparison between orifice meter and venturimeter
- 2.8.6 Explain the construction and working of pilot tube
- 2.8.7 Explain the construction and working of rotameter
- 2.8.8 Explain the construction and working of weirs

3.1 UNDERSTAND THE TERMINOLOGY OF PUMPS

- 3.1.1 Define pump
- 3.1.2 Define pump capacity
- 3.1.3 Explain suction head
- 3.1.4 Explain net positive suction head
- 3.1.5 Explain discharge head
- 3.1.6 Explain velocity head
- 3.1.7 Explain pump efficiency

3.2 UNDERSTAND THE TYPES OF POSITIVE DISPLACEMENT PUMPS

- 3.2.1 Define positive displacement pump
- 3.2.2 Explain the classification of positive displacement pumps
- 3.2.3 Explain the construction and working of a reciprocating pump (piston pump)
- 3.2.4 Explain the construction and working of a plunger pump
- 3.2.5 Explain the construction and working of diaphragm pump
- 3.2.6 Explain the construction and working of a gear pump
- 3.2.7 Explain the construction and working of cycloidal pump

3.3 UNDERSTAND THE CONSTRUCTION AND WORKING OF DIFFERENT TYPES OF CENTRIFUGAL PUMPS

- 3.3.1 Define centrifugal pump
- 3.3.2 Give the classification of centrifugal pumps
- 3.3.3 Explain the construction and working of a volute pump
- 3.3.4 Explain construction in a c.f pump

- 3.3.5 Explain priming of a c. f pump
- 3.3.6 Explain and thrust in a c. f pump
- 3.3.7 Explain the construction of a turbine pump
- 3.4 UNDERSTAND THE SELECTION METHOD OF A PUMP**
- 3.4.1 Enlist the factors that are to be considered in the selection of a pump
- 3.4.2 Give comparison between centrifugal pump and reciprocating pump
- 3.4.3 Enlist the pump losses
- 4.1 UNDERSTAND THE BLOWERS**
- 4.1.1 Define blower
- 4.1.2 Explain the construction and working of cycloidal blower
- 4.1.3 Explain the construction and working of Nash-Hytor
- 4.1.4 Explain the construction and working of centrifugal blower
- 4.2 UNDERSTAND THE COMPRESSORS**
- 4.2.1 Define compressor
- 4.2.2 Explain the working principle of reciprocating compressor
- 4.2.3 Explain the working principle of centrifugal compressor
- 4.2.4 Enlist the factors one should consider while selecting a compressor
- 5.1 UNDERSTAND MODES OF HEAT TRANSFER**
- 5.1.1 Define heat
- 5.1.2 Enlist modes of heat transfer
- 5.1.3 Explain conduction
- 5.1.4 Explain convection
- 5.1.5 Explain radiation
- 5.1.6 Give examples of the three modes of heat transfer
- 5.2 MAKE CALCULATIONS RELATED TO CONDUCTION**
- 5.2.1 State Fourier's law of heat conduction
- 5.2.2 Give mathematical form of Fourier's law
- 5.2.3 Explain thermal conductivity
- 5.2.4 Give units of thermal conductivity
- 5.2.5 Explain the effect of thermal conductivity
- 5.2.6 Develop a formula to calculate heat flow through compound resistance in flat wall
- 5.2.7 Develop a formula to calculate heat flow through cylindrical wall
- 5.2.8 Calculate heat loss through a flat furnace wall
- 5.2.9 Calculate heat loss through a cylindrical furnace wall
- 5.2.10 Calculate the thickness of insulation layer on a hot pipe
- 5.3 MAKE CALCULATIONS RELATED TO CONVECTION**
- 5.3.1 State Newton's law of heat convection
- 5.3.2 Explain film coefficients
- 5.3.3 Develop an equation for overall heat transfer coefficient by combining film coefficients

- 5.3.4 Give the factors effecting overall heat transfer co-efficient
- 5.3.5 Calculate the overall heat transfer co-efficient when film co-efficients are given

5.4 UNDERSTAND TEMPERATURE DROP IN FLOWING FLUIDS

- 5.4.1 Differentiate between co-current flow and counter current flow
- 5.4.2 Calculate temperature in parallel flow
- 5.4.3 Calculate temperature drop in counter current flows
- 5.4.4 Calculate mean temperature difference
- 5.4.5 Calculate log mean temperature difference

5.5 MAKE CALCULATIONS RELATED TO CONDUCTION

- 5.5.1 State stefan boltzman law of heat radiation
- 5.5.2 Explain black body
- 5.5.3 Explain grey body
- 5.5.4 calculate the heat transference by radiation

5.6 UNDERSTAND HEAT TRANSFER EQUIPMENTS

- 5.6.1 Define heater
- 5.6.2 Define heat exchanger
- 5.6.3 Give the classification of heat exchangers
- 5.6.4 Explain the construction and working of pipe heat exchanger
- 5.6.5 Explain the construction and working of tubular (shell and tube) heat exchanger
- 5.6.6 Explain the construction and working of floating head heat exchanger
- 5.6.7 Explain the finned tubes heater

6.1 UNDERSTAND DIFFERENT TYPES OF EVAPORATORS

- 6.1.1 Define evaporation
- 6.1.2 Enlist types of evaporators
- 6.1.3 Explain construction and working of horizontal tube evaporator
- 6.1.4 Explain construction and working of short tube evaporator
- 6.1.5 Explain construction and working of long tube evaporator
- 6.1.6 Explain construction and working of climbing film evaporator
- 6.1.7 Explain construction and working of falling film evaporator

6.2 UNDERSTAND EVAPORATOR ACCESSORIES

- 6.2.1 Define evaporator accessories
- 6.2.2 Enlist evaporator accessories
- 6.2.3 Enlist different types of condenser
- 6.2.4 Explain the working of a contact condenser
- 6.2.5 Explain the construction and working of a steam ejector
- 6.2.6 Explain the construction and working of an entrainment separator

6.3 UNDERSTAND MULTIPLE EFFECT EVAPORATOR

- 6.3.1 Explain basic principle of multiple effect evaporation
- Explain construction and working of a triple effect evaporator
- Enlist the methods of feeding
- Explain forward feeding method
- Explain backward feeding method
- Explain mixed feeding method
- Explain economy and capacity of a multiple effect evaporator

6.4 MAKE CALCULATIONS RELATED TO EVAPORATOR

- 6.4.1 Explain the use of steam table
- 6.4.2 Calculate the amount of steam required for evaporating a given feed to a desired concentration in a single effect evaporator

6.5 UNDERSTAND THE PROBLEMS OF EVAPORATORS

- 6.5.1 Explain the effect of noncondensed gases and their removal
- Explain scale formation, its effects and removal
- Explain trouble shootings in the operation of evaporator and their remedies

LIST OF PRACTICALS.

1. Introduction to the unit operation laboratory.
2. Study the operating characteristics and performance of a centrifugal type pump. Dismantle and assemble centrifugal pump.
3. Calibrate a storage tank to obtain weight and volume relationship per unit height and study of important values used in chemical industry.
4. Prepare a graph of co-efficient of discharge of an orifice vs Reynold number.
5. Make flow measurement by venturimeter.
6. Measurement of friction in pipes.
7. Determine the efficiency of a boiler.
8. Determine overall heat transfer co-efficient from hot gases and to note the effect of stirring on overall heat transfer co-efficient.
9. Determine the heat losses from a steam pipe and observe the effect of lagging.
9. To determine the overall heat transfer and efficiency of equipment exemplified by the preheater and condenser of a climbing and falling film type evaporator when
 - a) Feed rate is constant.
 - b) Steam pressure is constant.