

# Master of Science - Applied Chemistry

## Syllabus - First Semester

### COMPUTER PROGRAMMING USING C LANGUAGE

Course Code: CHY4103

Credit Units: 2

#### Course Objective:

This course aims to introduce the students with Computer Programming Concepts, taking C language as the medium with examples emphasized from chemistry. The course lays emphasis on foundations & basic principles of Computer Programming. The language is introduced in a structural manner, beginning with the simple constructs and working up to more complex issues, for example, pointers and dynamic data structures, file manipulations etc

#### Course Contents:

##### MODULE I: Introduction

Introduction to computer, Data Representation: number systems, character representation codes, binary, octal, hexadecimal and their interconversions. Binary arithmetic, floating point arithmetic, signed and unsigned numbers, memory storage unit.

##### MODULE II: Programming in C

History of C, Introduction of C, Basic structure of C program, Concept of variables, constants and data types in C, Operators and expressions: Introduction, arithmetic, relational, Logical, Assignment, Increment and decrement operator, Conditional, bitwise operators, Expressions, Operator precedence and associativity. Managing Input and output Operation.

##### MODULE III: Fundamental Features in C

C Statements, conditional executing using if, else, nesting of if, switch and break Concepts of loops, example of loops in C using for, while and do-while, continue and break.

##### MODULE IV: Arrays and Functions

One dimensional arrays and example of iterative programs using arrays, 2-D arrays and its use in matrix computations. Concept of Sub-programming, functions, example of user defined functions. Function prototype, Return values and their types, calling function, function argument, function with variable number of argument.

##### MODULE V: Advanced features in C

Pointers, relationship between arrays and pointers argument passing using pointers, Array of pointers. Passing arrays as arguments, Strings and C string library. Structure and Union, Defining C structures, giving values to members, Array of structure.

#### Examination Scheme:

Components	CT	HA	S/V/Q	ATTD	EE
Weightage(%)	15	5	5	5	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

**Text & References:**

1. Fundamentals of Computer: V. Rajaraman (Prentice Hall)
2. "ANSI C" by E Balagurusamy
3. YashwantKanetkar, "Let us C", BPB Publications, 2<sup>nd</sup> Edition, 2001.
4. Computers in Chemistry: K.V. Raman (Tata McGraw Hill)

# PHYSICAL CHEMISTRY LAB

Course Code: CHY4105

Credit Units 02

## List of Experiments (Minimum 10 Experiments to be performed)

### Phase Equilibria:

- 1 Determination of mutual solubility curve of Phenol and water and hence the consolute point.
2. To determine the distribution coefficient of  $I_2$  between two immiscible solvents ( $CCl_4$  and  $H_2O$ ).

### Chemical Kinetics:

- 3 To study kinetically the alkaline hydrolysis of ethyl acetate.
- 4 To study the kinetics of reaction between  $K_2S_2O_8$  and KI.
  - a. Determination of the rate constant and order of reaction.
  - b. To study the influence of ionic strength on the rate constant.
- 5 Determination of the effects of change of temperature, change of concentration of reactant and catalyst and ionic strength of the media on the velocity constant of hydrolysis of an ester or ionic reaction.
- 6 Determination of the rate constant for the oxidation of iodide ions by hydrogen peroxide studying the kinetics as an iodine clock reaction.

### Electrochemistry:

7. Determination of the velocity constant, order of the reaction and energy of activation for saponification of ethyl acetate by sodium hydroxide conductometrically.
8. Determination of solubility and solubility product of sparingly soluble salts (e.g.,  $PbSO_4$ ,  $BaSO_4$ ) conductometrically.
9. Determination of the strength of strong and weak acids in a given mixture conductometrically.

### Potentiometry:

- 10 Determination of the strength of strong and weak acids in a given mixture using a potentiometer/pH meter.
11. Acid base titration in a non-aqueous media using a pH meter.

### Colligative Properties

1. Determination of depression in Freezing point of solutions.
2. Determination of elevation in boiling point of solutions.

### Adsorption

Determine the adsorption isotherms of acetic acid from aqueous solutions by charcoal and verify Freundlich adsorption isotherm.

### Examination Scheme:

A				EE	
A	PR	LR	V	PR	V
5	10	10	5	35	35

Note: IA –Internal Assessment, EE- External Exam, PR- Performance, LR – Lab Record, V – Viva.

**References:**

1. A.Finlay and J.A.Kitchener, "Practical Physical Chemistry, Longman
2. F.Daniels and J.H.Mathews, "Experimental Physical Chemistry", Longman
3. H.H.Willard, L.L.Merritt and J.A.Dean, "Instrumental Methods of Analysis", Affiliated East-West Press
4. D.P.Shoemaker and C.W.Garland, "Experimental Physical Chemistry", McGraw-Hill
5. A.I.Vogel, "A Textbook of Quantitative Inorganic Chemistry", Longman
6. J.B.Yadav, "Advanced Practical Chemistry", Goel Publishing House
7. J.J.Lingane, "Electroanalytical Chemistry", Interscience
8. L.Meites, H.C.Thomas and R.P.Bauman, "Advanced Analytical Chemistry McGraw Hill.

## COMPUTER PROGRAMMING USING C LANGUAGE LAB

Course Code: CHY4107

Credit Units: 01

### List of Experiments (Any 10 Experiments are to be performed)

- C program to calculate percentage of marks obtained.
- C program involving all the operations of a Calculator using Switch / if - else if – else.
- C program to find the largest and smallest among three entered numbers.
- C program to calculate Factorial of a number using for loop.
- C program to find different patterns using for nested for loop.
- C program to search an element from the given array.
- C program to add/Subtract elements of a 2-D matrices.
- C program using different string functions.
- C programs including user defined function calls to find sum of two numbers.
- C programs including user defined function calls to calculate table of a number.
- C programs involving pointers, and solving various problems with the help of those.
- C program using structure to make a record of students having different parameters (Name , age , sex , course , roll no)

### Examination Scheme:

IA				EE	
A	PR	LR	V	PR	V
5	10	10	5	35	35

Note: IA –Internal Assessment, EE- External Exam, PR- Performance, LR – Lab Record, V – Viva.

### Text & References:

- 1.Fundamentals of Computer : V. Rajaraman (Prentice Hall)
- 2.“ANSI C” by E Balagurusamy
- 3.YashwantKanetkar, “Let us C”, BPB Publications, 2<sup>nd</sup> Edition, 2001.
- 4.Computers in Chemistry : K.V. Raman (Tata Mc Graw Hill)

## SEMINAR

**Course Code: CHY4108**

**Credit Units: 01**

### Objectives

A seminar is primarily an activity based academic event that is organized to provide the students a one to one and hands on experience on any aspect of their learning for research based activity. Prereq., graduate standing in chemistry/ biochemistry/ Forensic Sciences on consent of instructor. Seminar to acquaint new graduate students with departmental research (This one will be running through out first semesters on every Monday any Lecture, where normally Ph.D students /internal Faculties /external speakers will give talk on their research or other topic of their specialization).

The trainer has to make sure that the aspect covered are practically practiced by the participants. The evaluation will be done by Board of examiners comprising of the faculties.

### Major Themes for Seminar

The seminar may be conducted on any of the following major themes:

- Nuclear Chemistry
- Modern trend in Inorganic Chemistry
- Modern trend in Organic Chemistry
- Modern trend in Physical Chemistry
- Nanotechnology and its application
- Polymer Chemistry
- Pharmaceuticals
- Food Technology
- Agriculture Chemistry
- Computational Chemistry
- Green Chemistry
- Any other relevant topics

These themes are merely indicative and other recent and relevant topics of study may be included.

### Evaluation Scheme:

Attendance	Active Participation	Multiple Choice Questions/ Quiz	Solving the case/ Assignment/ Write up	Total
10	30	30	30	100

# Syllabus - Second Semester

## ANALYTICAL CHEMISTRY

Course Code: CHY4201

Credit Units:04

### MODULE I: WET CHEMICAL METHODS OF ANALYSIS

Volumetric analysis –neutralization, precipitation, complexometric and redox titrations- theoretical titrations curves - theory of indicators; Gravimetric analysis, volatilization and precipitation methods- homogeneous precipitation; Colorimetric analysis - principles and applications- estimation of iron and nickel.

### MODULE II: SPECTRAL METHODS

Molecular and atomic spectroscopy - interaction of electromagnetic radiation with matter – Beer-Lambert law - UV/Visible absorption spectroscopy- photometric titrations, IR absorption spectroscopy; Fluorescence, phosphorescence and chemiluminescence methods; NMR spectroscopy, Atomic spectroscopy – atomic absorption spectrometry; Emission spectroscopy - flame photometry and ICP-AES; atomic fluorescence spectroscopy; Principles, instrumentation and analytical applications of spectral methods.

### MODULE III: ELECTROANALYTICAL TECHNIQUES

Conductometry, and high frequency titrations; Potentiometry, pH-metry, Ion selective electrodes; Electrogravimetry and coulometry; Voltammetry –polarography, amperometric titrations and anodic stripping voltammetry; principles, practice and applications.

### MODULE IV: SEPARATION TECHNIQUES

Solvent extraction and Ion exchange techniques – principles and applications; Chromatographic techniques – adsorption chromatography, thin layer chromatography, gas chromatography, high performance chromatography, size exclusion chromatography; Supercritical fluid chromatography.

### Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	15	5	5	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

### Book Suggested:

- D.A.Skoog, D.M.West, F.J. Holler and S.R.Crouch, “ Fundamentals of Analytical Chemistry”, 8th Edn., - Thomson Brooks/Cole Pub. (2005).
- J.Mendham, R.C.Denney, J.D. Barnes and M.J.K.Thomas, “Vogel’s Text book of quantitative chemical analysis”, 6th Edn., Pearson Education (2008).
- F.W. Fifield and D.Kealey, “ Principles and Practice of Analytical Chemistry, 1<sup>st</sup> Indian Reprint, Blackwell Pub. (2004).
- H.H Willard, L.L Merritt, J.A Dean, and F.A Settle, “ Instrumental Methods of Analysis”, 7th Edn., -CBS Pub (2004).
- G. D.Christian, “Analytical Chemistry”, 6th Edn., John Wiley Press (2006).
- K.A. Rubison and J.F. Rubison, “ Contemporary Instrumental Analysis, Printice Hall, Inc. (2000).
- A.K.Srivastva& P.C. Jain,” Instrument approach to chemical analysis” 4<sup>th</sup>edition,S.Chand& Company(2012)
- C.L.Wilson and D.W.Wilson, “Comprehensive Analytical Chemistry”, Dan van Nostrand 9. J.G.Dick, “Analytical Chemistry, McGraw Hill

# INDUSTRIAL CHEMISTRY

Course Code: CHY4202

Credit Units: 03

## MODULE I: GLASS INDUSTRY

Introduction, classification of glass, basic raw materials of glass, manufacturing processes including chemical reactions, some special glasses: optical glass, coloured glass, fibre glass, laminate glass, safety glass, photosensitive glass, photochromatic glass, lead glass, borosilicate glass and glass wool.

## MODULE II: CEMENT INDUSTRY

Types of cement, manufacture of Portland cement, composition, setting and hardening of cement, Mortars and concrete, gypsum, plaster of paris, estimation of silica, alumina, calcium oxide and sulphates in Portland cement.

## MODULE III: SOAPS AND SYNTHETIC DETERGENTS

Manufacture of detergent, types of detergents, anionic, cationic, nonionic and amphoteric detergents, manufacture of soap, Liquid soap.

## MODULE IV: HOMOGENEOUS AND HETEROGENEOUS CATALYSIS and CATALYTIC PROCESSES

Conversion, selectivity, contact time, time on stream, Kinetics of heterogeneous catalysis, adsorption, phase transfer catalysis, super acid catalysis, intramolecular catalysis, enzyme catalysis, semi-conductor catalysis and photocatalysis. Promoters, stabilizers, catalyst deactivation by poisoning, fouling and sintering, Cracking, reforming, alkylation, isomerization, hydrogenation/dehydrogenation, dehydrocyclisation, dehydrosulphurization, hydrocracking, oxidation, metathesis, carbonylation, polymerization, synthetic fuels, hydrogen generation.

### Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	15	5	5	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

### BOOKS SUGGESTED:

- Jens Hagen, Industrial catalysis, 2nd Edition, Wiley-VCH Verlag GmbH & Co., (2006).
- Herman Pines, The chemistry of catalytic hydrocarbon conversions, Academic Press, New York (1981).
- R. Pearce and W.R. Patterson, Catalysis and chemical processes, Leonard Hill, London (1981).
- Charles, N. Satterfield, Heterogeneous catalysis in industrial practice, 2nd Edn. Mc.Graw Hill, International Edition, Singapore (1993).
- Catalytic Chemistry, Bruce-gates, John Wiley & Sons
- Organic Chemistry Vol.2 IL Finar 5th Edn. Longmans 1975
- Dryden's outlines of Chemical Technology 2nd Edn., edited and revised by M.Gopala Rao, Marshall sitting – EastWest Press, 1973.
- Chemical Process Industries 3 Edn., R Norries Shreve, Mc Graw Hill 1967.
- Chemistry of Engg Materials by CV Agarwal.
- Applied Chemistry for Engineer's by Diamond
- Industrial Chemistry by BK Sharma, Goel Publishing house Meerut.



# ANALYTICAL CHEMISTRY LAB

Course Code:CHY4206

Credit Units:02

## Minimum 8experiments to be performed

### Chromatography

1. Estimation of zinc and magnesium in the given mixture solution against EDTA(Disodium salt ) solution
2. Thin-layer chromatography-separation of nickel, manganese, cobalt and zinc.
3. Separation and identification of the sugars present in the given mixture of glucose, fructose and sucrose by paper chromatography and determination of R<sub>f</sub> values.

### Physical Analytical Chemistry Section

1. To verify Beer-Lambert's Law for potassium permanganate solution and hence to determine the molar extinction coefficient and unknown concentration of given sample colorimetrically

### Organic Analytical Chemistry

2. To verify the Beer-Lamberts Law and determine the concentration of given dye solution colorimetrically.
3. To estimate the amount of D-glucose in given solution colorimetrically.

### Quantitative Analysis

4. Determination of the percentage or number of hydroxyl groups in an organic compound by acetylation method.
5. Estimation of amines/phenols using bromate bromide solution/or acetylation method.
6. Determination of Iodine and Saponification values of an oil sample.
7. To determine the acid value of given oil

### Examination Scheme:

IA				EE	
A	PR	LR	V	PR	V
5	10	10	5	35	35

Note: IA –Internal Assessment, EE- External Exam, PR- Performance, LR – Lab Record, V – Viva.

### Reference Books

- C.L.Wilson and D.W.Wilson, "Comprehensive Analytical Chemistry", Dan van Nostrand
- J.G.Dick, "Analytical Chemistry, McGraw Hill
- D.A.Skoog and D.M.West, "Analytical Chemistry – An Introduction", Reinholdt. ( practical Book)
- I.M.Kolthoff, V.J.Elving and Sandell, "Treatise on Analytical Chemistry", Interscience.(practical Book)

# INDUSTRIAL CHEMISTRY LAB

Course Code:CHY4207

Credit Units:01

Minimum 10 experiments to be performed

## A. Analysis of cement

## B. Analysis of polymers

1. Determination of Acid Values of plastic material.
2. Determination of Saponification value of plastic material.
3. Determination Iodine value of a plastic material.
4. Determination of hydroxyl Value of plastic material.
5. Determination of Carbonyl Value of plastic material.
6. Determination of Molecular Weight of a polymer.
7. Determination of Capacity of cation exchange resin.
8. Determination Capacity of an anion exchange resin.

## C. Preparation of polymers

9. Preparation of Urea Formaldehyde resin.
10. Preparation of Phenol Formaldehyde resin.
11. To synthesize and hydrolyse Nylon 6:6 in the laboratory

## D. Water Analysis

11. Total dissolved solids
12. Carbonate and non-carbonate hardness by EDTA
13. Dissolved oxygen, BOD, COD
14. Turbidity

## Examination Scheme:

IA				EE	
A	PR	LR	V	PR	V
5	10	10	5	35	35

Note: IA –Internal Assessment, EE- External Exam, PR- Performance, LR – Lab Record, V – Viva.

# INORGANIC CHEMISTRY LAB

Course Code:CHY4208

Credit Units:02

Minimum 10 experiments to be performed

## MODULE-I: QUANTITATIVE INORGANIC ANALYSIS & SPECTROPHOTOMETRIC DETERMINATION

Ores analysis (oxides and carbonate ores or any other)

Nickel/molybdenum/tungston/vanadium/uranium by extractive spectrophotometric method. (Any other experiments may be added) (Dry Lab)

## MODULE-II: ESTIMATION OF INDUSTRIAL PRODUCTS

Active CaO in lime

Chlorine in bleaching powder

Lead content in red lead

## MODULE-III: PREPARATION OF TYPICAL INORGANIC COMPLEXES

Preparation of selected inorganic compounds and their study by IR, electronic spectra, Mossbauer. ESR and magnetic susceptibility measurements. Handling of air and moisture sensitive compounds involving vacuum lines. Selection can be made from the following:

1. Trialkoxyboanes- IR and NMR spectra.
2. Preparation of Tin (IV) chloride
3. Sodium tetrathionate  $\text{Na}_2\text{S}_4\text{O}_6$ .
4. Determination of Cr (III) complexes.  $[\text{Cr}(\text{H}_2\text{O})_6]\text{NO}_3 \cdot 3\text{HO}$ ,  $[\text{Cr}(\text{H}_2\text{O})_4\text{Cl}_2]\text{Cl} \cdot 2\text{H}_2\text{O}$ ,  $[\text{Cr}(\text{en})_3]\text{Cl}_3$ ,  $\text{Cr}(\text{acac})_3$ . Inorg.synths., 1972, 13, 184.
5. Preparation of Fe(II) chloride (use it as Friedel-Craft chlorination source) J. Org. Chem.,1978, 43, 2423; J. Chem. Edu., 1984, 61, 645; 1986, 63, 361.
6. Reaction of Cr(III) with a multidentate ligand; a kinetics experiment (visible spectra Cr-EDTA complex) J.A.C.S., 1953, 75, 6570.
7. Preparation and use of Ferrocene. J. Chem. Edu. 1966, 43, 73; 1976, 53, 730.

( Any five preparations)

## MODULE-IV: QUALITATIVE INORGANIC SEMI-MICRO ANALYSIS

Detection of atleast four cations (2 common and 2 uncommon) in a mixture of salts.

### Examination Scheme:

IA				EE	
A	PR	LR	V	PR	V
5	10	10	5	35	35

Note: IA –Internal Assessment, EE- External Exam, PR- Performance, LR – Lab Record, V – Viva.

### REFERENCES (Inorganic Chemistry Lab)

- G.H.Jeffery, J.Bassett, J.Mendham and R.C.Denney Vogel's Text book of quantitatives chemical analysis, ELBS 5th Edn. Longman, SingapoorePublishers,Singapore, 1996.
- R. Mukhopodhyay, P.Chatterjee, " Advanced practical Chemistry"
- Dinesh Sharma, " A hand book of Analytical Inorganic chemistry", First Published(2004)
- I.M.Kolthoff, E.B.Sandell et.al. Quantitative chemical analysis, CHYmillan, Madras 1980.

- A Text book of quantitative Inorganic Analysis – A. I. Vogel
- Standard methods of Chemical Analysis F.J. Welcher
- Experimental Inorganic Chemistry – W. G. Palmer.
- Manual on Water and Waste Water Analysis, NEERI- Nagpur D.S. Ramteke and C. A. Moghe
- Inorganic synthesis- King.
- Synthetic Inorganic Chemistry- W. L. Jolly
- EDTA Titrations – F. Laschka

## TERM PAPER

Course Code: CHY4210

Credit Units: 01

### Objectives

The objective of this course is to judge the understanding as well as application of the knowledge gained by the students. The aim of the term paper is to provide the students with an opportunity to further enhance their knowledge in a sector of their choice by undertaking a significant practical unit of examining and analyzing various aspects of Chemistry & its application at a level commensurate with the learning outcomes of the various courses taken up them in the ongoing semester.

A term paper is primarily a record of intelligent reading in several sources on a particular subject. The students will choose the topic at the beginning of the session in consultation with the faculty assigned.

### Guidelines:

1. The term paper will be related to the contemporary research issue and the topic will be given by the department.
2. The presentation of the term paper is scheduled to be held before the commencement of Semester examinations.
3. The paper will carry 100 marks that will be marked on the basis of understanding and organization of content based on the literature review. The Bibliography shall form an important part of the paper.
4. Examples of a few broad areas for term paper (List is indicative, not exhaustive)
  - Inorganic chemistry
  - Organic chemistry
  - Physical chemistry
  - Green chemistry
  - Agriculture chemistry

### Evaluation Scheme

Organisation and relevance of content	Literature Review	Bibliography	Presentation	Total
30	30	20	20	100

## SEMINAR

**Course Code: CHY4210**

**Credit Units: 01**

### Objectives

A seminar is primarily an activity based academic event that is organized to provide the students a one to one and hands on experience on any aspect of their learning for research based activity. Prereq., graduate standing in chemistry/ biochemistry/ Forensic Sciences on consent of instructor. Seminar to acquaint new graduate students with departmental research (This one was for second semester students to attained and fourth semester students had to present on one selected topic of their choice or Ph.d. students/ internal faculties /external speaker will give talk).

The trainer has to make sure that the aspect covered are practically practiced by the participants. The evaluation will be done by Board of examiners comprising of the faculties. This one will be one time event in one semester.

### Major Themes for Seminar

The seminar may be conducted on any of the following major themes:

- Nuclear Chemistry
- Modern trend in Inorganic Chemistry
- Modern trend in Organic Chemistry
- Modern trend in Physical Chemistry
- Nanotechnology and its application
- Polymer Chemistry
- Pharmaceuticals
- Food Technology
- Agriculture Chemistry
- Computational Chemistry
- Green Chemistry
- Any other relevant topics
- Research topics of students

These themes are merely indicative and other recent and relevant topics of study may be included.

### Evaluation Scheme:

Attendance	Active Participation	Multiple Choice Questions/ Quiz	Solving the case/ Assignment/ Write up	Total
10	30	30	30	100

# WORKSHOP

**Course Code: CHY4210**

**Credit Units: 01**

## **Objectives**

A workshop is primarily an activity based academic event that is organized to provide the students a one to one and hands on experience on any aspect of their learning. The communication in a workshop has to be necessarily two way. The trainer has to make sure that the aspect covered are practically practiced by the participants. The student will choose the option of workshop from amongst their concentration electives. The evaluation will be done by Board of examiners comprising of the faculties.

## **Major Themes for Workshop**

The workshop may be conducted on any of the following major themes:

- Nuclear Chemistry
- Modern trend in Inorganic Chemistry
- Modern trend in Organic Chemistry
- Modern trend in Physical Chemistry
- Nanotechnology and its application
- Polymer Chemistry
- Pharmaceuticals
- Food Technology
- Agriculture Chemistry
- Computational Chemistry
- Green Chemistry
- Any other relevant topics

These themes are merely indicative and other recent and relevant topics of study may be included.

## **Guidelines for Workshop**

The procedure for earning credits from workshop consists of the following steps:

- Relevant study material and references will be provided by the trainer in advance.
- The participants are expected to explore the topic in advance and take active part in the discussions held
- Attending and Participating in all activities of the workshop
- Group Activities have to be undertaken by students as guided by the trainer.
- Evaluation of workshop activities would be done through test and quiz at the end of the workshop.
- Submitting a write up of at least 500 words about the learning outcome from the workshop.

## **Methodology**

The methodology followed at the workshop could be based on any one or more of the following methods:

- Case Study
- Simulation
- Quiz
- Quality analysis& characterization
- Identification and preparation of materials

**Evaluation Scheme:**

<b>Attendance</b>	<b>Active Participation</b>	<b>Multiple Choice Questions/ Quiz</b>	<b>Solving the case/ Assignment/ Write up</b>	<b>Total</b>
<b>10</b>	<b>30</b>	<b>30</b>	<b>30</b>	<b>100</b>



# Syllabus - Third Semester

## INSTRUMENTAL METHODS OF ANALYSIS

Course Code: CHY4301

Credit Units: 03

**Course Objective:** The curriculum is developed to help the students to understand the basic theory & applications of various sophisticated instruments. The instrumental analysis course aims to provide students with an understanding of the functioning and applications of these instruments in our day to day life. It covers the basic principles of theory, its operation and their applications in chemistry, physics, biology, nanotechnology, material science and materials chemistry. Recent advances in the characterization of nanomaterials will also include in the course. The course is further enhanced with invited lectures on recent developments and applications in characterization of nanomaterials.

### Course Contents:

#### MODULE I: MICROSCOPIC TECHNIQUES

Microscopic techniques, Transmission electron microscopy, Scanning electron microscopy, high resolution scanning electron microscopy, high resolution transmission electron microscopy, Selected Area Electron Diffraction Pattern, Chromatographic techniques in combination with Mass Spectrometer (GC-MS, LC-MS etc) and their applications in various fields such as chemistry, biology, medicine, nanotechnology etc

#### MODULE II: ANALYTICAL TECHNIQUES

Thermal Analysis (DSC, TGA, DTA etc). Applications of XRD measurements, Calculation of particle size from XRD measurements using Debye Scherer formula. Applications of spectroscopic techniques in chemistry, biology, nanotechnology, nanomedicine etc.

#### MODULE III: MAGNETIC MEASUREMENTS

Magnetic property of materials using Vibrating Sample Magnetometer, Hysteresis loop, Remnant magnetization, Coercivity, Saturation Magnetization etc. Principle and Applications of CHNS analyzer. Applications of VSM, and CHNS analyzer

#### MODULE IV: DYNAMIC LIGHT SCATTERING (PCS)

Theory of Dynamic Light Scattering (PCS). Hydrodynamic Diameter, Number average diameter, volume average diameter, Intensity average diameter. Applications of dynamic light scattering in synthesis of nanomaterials, chemistry, biology and nanomedicine.

### Examination Scheme:

Components	CT	HA	S/V/Q	ATTD	EE
Weightage(%)	15	5	5	5	70

### Text and References

- Fundamentals of Analytical Chemistry (with CD-ROM and InfoTrac) by Douglas A. Skoog, Donald M. West, F. James Holler, Stanley R. Crouch, Hardcover: 992 pages, Publisher: Brooks Cole
- Dean's Analytical Chemistry Handbook by Pradyot Patnaik, Hardcover: 1280 pages, Publisher: McGraw-Hill Professional

- Quantitative Chemical Analysis, Sixth Edition by Daniel C. Harris, Hardcover: 928 pages, Publisher: W. H. Freeman
- Analytical Chemistry by Gary D. Christian, Hardcover: 848 pages Publisher: Wiley; 6th edition
- Comprehensive Medicinal Chemistry by Hansh C, Vol IV, Elsevier Pergamon.
- Medicinal Chemistry-A Biochemical Approach by Nogrady T, Oxford University Press New York, Oxford.

# DRUGS AND DYES

**Course Code: CHY4304      Credit Units: 03**

**Course Objective:** At the end of this course students must acquire a good knowledge about the various drugs their active constituents, their pharmacological actions and therapeutic uses. Beside drugs they will learn about various dyes used in day to day life, their properties and applications.

## **Course Content:**

### **MODULE-I: INTRODUCTION TO DRUGS**

Definition of drug (WHO), classification of drugs, nomenclature of drugs, stereochemical aspects of drugs, definitions of terms commonly used in the chemistry of drugs, routes of drug administration and different dosage forms and applications

### **MODULE-II: MECHANISM OF ACTION, STRUCTURE AND SYNTHESIS OF DRUGS**

Sulphonamides : Sulphathiazole, Sulphadiazine(any two)  
Antiseptics : Iodoform, Dettol  
Antileprotic drugs : Dapsone (DDS), Acedapsone (DADDS)  
Anticancer agents : Alkylating agents  
CardiovascularDrugs : Amyl nitrate, Methyldopa  
Antipyretics&Analgesics: Novalgin, Paracetamol  
Antimalarials :Chloroquine ,Primaquine,Mepacrine  
Anti diabetic : Tolbutamide  
Antitubercular : p-amino salicylic acid, Ethambutol

### **MODULE-III: INTRODUCTION TO DYES**

Historical development of synthetic Dyes - Introduction, Nomenclature, classification based on structure & mode of applications of fibres.Structural features of a dye (chromophores and auxochromes), bathochromic and hypsochromic effects, diazotisation and coupling, colour and chemical constitution (Witt's theory, Armstrong theory and Modern theory). Dye intermediates- unit, batch & continuous process in the preparation of dye intermediates,

### **MODULE-IV: STRUCTURE AND PREPARATION OF DYES**

Nitro Dyes : Picric acid, Martius yellow, Naphthol yellow S  
Nitroso Dyes : Fast green O, Naphthol green Y  
Azo Dyes : Methyl orange, Methyl red, Congo Red  
Phthaleins : Phenolphthalein  
Phthalocyanines: Copper phthalocyanine  
Xanthenes : Fluorescein, Eosin, Mercurochrome  
Rhodamines : Rhodamine B  
Thiazine Dyes : Methylene blue  
Cyanine Dyes : Quinoline blue  
Antraquinone Dyes: Alizarin  
Indigoids : Indigo (Indigotin)  
Thioindigos : Thioindigo  
Azine Dyes : Safranine T

Action of light on dyes and dyed fibres, Factors affecting fastness of dyed fibres General consideration, fluorescence, phototropy, mechanism of fading.

**Examination Scheme:**

Components	CT	HA	S/V/Q	ATTD	EE
Weightage(%)	15	5	5	5	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, ATTD: Attendance EE: End Semester Examination

**Text & References:**

- The Organic Chemistry of Drug Synthesis, Vol. 1,2,3,4 by Lednicer Daniel, 1st edition, John Wiley & Sons INC.
- Exploring QSAR Vol; I Fundamentals and Applications in Chemistry and Biology by CHansh and A Leo Vol. II: hydrophobic, Electronic and Steric Constants by C Hansh, A Leo and D Hockman ACS Book Catalog.
- Foye's Principles of Medicinal Chemistry by Foye, 6th edition, Lippincott William Wilkins.
- Comprehensive Medicinal Chemistry by Hansh C, Vol IV, Elsevier Pergamon.
- Quantitative Drug Design- A Critical Introduction by Martin YC, Marcel Dekker Inc. New York.
- Medicinal Chemistry-A Biochemical Approach by Nogrady T, Oxford University Press New York, Oxford.
- Computer Aided Drug Design, by Pops and Perruns, Academic Press, NY
- Burger's Medicinal Chemistry by Wolff ME, John Wiley & Sons, New York.
- Introduction to Medicinal Chemistry' – How Drugs Act and Why by Alex Gringauz, Willey-VCH Publication 1997.
- Drug Design by Bothara KG & Kulkarni VM, 3rd edition, NiraliPrakashan.
- An Introduction to Drug Design by SN Pandeya & IR Dimmock, 1st edition, New Age International Publishers.
- Structure based Drug Design by Veerapandian, 1st edition, Taylor & Francis New York, London.
- Holtje. Sippl., Rognan and Folkers, Molecular Modeling.
- P.K. Larsen, Tommy and U.Madsen, textbook of Drug Design and Discovery.

# NATURAL PRODUCTS CHEMISTRY

Course Code: CHY4305

CreditUnits:03

**Course Objective:** The main idea of this course is to give the students a brief idea of natural product chemistry, which includes the study of Vitamins, alkaloids, terpenes and steroids etc. These play a key role in our day to day life. The course covers the importance of these naturally occurring materials and their applications in chemistry, biology and medicine. The course will also include the invited lectures on recent advances in natural product chemistry and it gives a reasonable good overview of the naturally occurring chemicals and their important reactions, their applications etc.

**Course Content:**

**MODULE I: NATURAL PRODUCTS AND THEIR BIOSYNTHETIC PATHWAYS**

General classification of natural products, their isolation and characterisation and biosynthesis of common plant products; Biosynthesis pathways for natural products using co-enzymes and enzymes; Synthesis of selected natural products based on genetic classification – fatty acid derivatives and related compounds, general biogenesis and synthesis of cis jasmone, methyl jasmonate, prostaglandins, exaltone and muscone.

**MODULE II: VITAMINS**

Vitamins: Classification, occurrence, chemistry of Vitamins A, C and E, structure elucidation and synthesis, deficiency syndromes,

**MODULE III :ALKALOIDS**

Alkaloids, definition, Isolation, Classification (define different categories of alkaloids with specific examples, their medicinal uses, synthesis). Drugs (cocaine, opiates, quinine, vincristine, curare, mescaline, etc.) and toxins (nicotine, lupinines, strychnine, tetrodotoxin, etc.). Introduction, 2. Simple Alkaloids I: Pyrrole Derivatives 3. Simple Alkaloids II: Piperidine Derivatives 4. Aromatic Alkaloids I: Simple Derivatives 5. Aromatic Alkaloids II: More Complex Derivatives 6. The Indole Alkaloids 7. Miscellaneous Alkaloids with Interesting Bioactivities.

**MODULE IV: TERPENES AND STEROIDS**

Classification and biosynthesis of mono-, sesqui-, di- and triterpenoids and steroids. Acetyl CoA, Mevalonic acid, acetoacetyl CoA, squalene to lanosterol, Cholesterol to estradiol, diosgenin and its utility in hormone synthesis.

**MODULE V: GENERAL CHEMISTRY OF THE FOLLOWING COMPOUNDS**

Cholesterol, Artemisinin, Gibberellin A<sub>3</sub>, Azadirachtin.

**Examination Scheme:**

Components	CT	HA	S/V/Q	ATTD	EE
Weightage(%)	15	5	5	5	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, ATTD: Attendance EE: End Semester Examination

**Text and References:**

- K. Nakanashi. Natural Products Chemistry, Vols. I and II, Academic Press, New York and London (1974).
- M. Harmata. Strategies and Tactics in Organic Synthesis 4 & 5, Academic Press (2004)
- T. L. Gilchrist. Heterocyclic Chemistry (2nd edn.), Longman Scientific & Technical Publishers.(1992).
- R. K. Bansal. Heterocyclic Chemistry: Synthesis, Reactions and Mechanisms, Wiley Eastern (1991).

# INDUSTRIAL MANAGEMENT AND SAFETY PROCESSES

**Course Code: CHY4307**

**CreditUnits:03**

**Course Objective:** The curriculum is developed to help the students understand the basic functions & responsibilities of a manager, provide him tools and techniques of managing different activities of the business concerned and to understand & interpret the provisions of some of the important provisions related to patent, trademark etc. It also aims at minimizing the chances of risks, injuries and accidents by implementing risk management techniques and safety management operations, monitoring the operating systems and bolstering the safety measures of an industry in general. With the rise of natural disasters in and around our world, the importance of the safety of human capital, protection of the environment and conservation of existing assets of an industry is increasing, leading to growing relevance of these skills.

## **Course Contents:**

### **MODULE I: BASIC CONCEPTS OF MANAGEMENT FUNCTION OF MANAGEMENT**

Planning, Organizing, Directing, Control, Decision-making, Budgeting, Inventory Management (IM) & Quality Control (QC), Meaning & Importance of Inventory management, Inventory models, Cost consideration, Economic order quantity model.

### **MODULE II :QUALITY MANAGEMENT**

Meaning & definition of Quality-Quality control systems-quality assurance-planning for quality- total quality management (TQM) philosophy-implementation of TQM in service and manufacturing industries-national & international standards.

### **MODULE III: MANUFACTURING MANAGEMENT**

Production planning & control, dynamics of material flow-inventory-bottlenecks and process variability, planning levels and time scales, forecasting-aggregate planning, synchronized manufacturing and theory of constraints-just in time production-shop floor performance monitoring.

### **MODULE IV:SAFETY IN CHEMICAL PROCESS INDUSTRIES**

Safety in industries; need for development; importance safety consciousness in Indian chemical industry; safety programmes, elements of safety programme; effective realization, economic and social benefits.Industrial safety- Chemical process industries; potential hazard; chemical and physical job safety analysis; high pressure; high temperature operation; dangerous and toxic chemicals; highly radioactive materials; safe handling and operation of materials and machineries; planning and layout.

## **Examination Scheme:**

<b>Components</b>	<b>CT</b>	<b>HA</b>	<b>S/V/Q</b>	<b>ATTD</b>	<b>EE</b>
<b>Weightage(%)</b>	15	5	5	5	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, ATTD: Attendance EE: End Semester Examination

## **Text & References:**

- William Handley, "Industrial Safety ", Hand Book McGraw-Hill Book Company 2nd Edition, 1969.
- Fawatt, H.H. and Wood, W.S., "Safety and Accident Prevention in Chemical Operation", Interscience, 1965.
- Heinrich, H.W. Dan Peterson, P.E. and Nester Rood, "Industrial Accident Prevention ", McGraw-Hill Book Co., 1980.
- Blake, R.P., "Industrial Safety ", Prentice Hall Inc., New Jersey - III Edition, 1963.
- Subbaram N.R. "Handbook of Indian Patent Law and Practice", S. Viswanathan (Printers and Publishers) Pvt. Ltd., 1998.
- Eli Whitney, Moduleed States Patent Number: 72X, Cotton Gin, March 14, 1794.
- Intellectual Property Today: Volume 8, No. 5, May 2001, [[www.iptoday.com](http://www.iptoday.com)].

# CHEMISTRY OF COSMETICS

**Course Code: CHY4309**

**CreditUnits:03**

**Course Objective:** This course is intended to provide a comprehensive survey of ingredients fundamental to the cosmetic industry. The course will emphasize current trends in the selection of cosmetic ingredients. The chemistry and technology of cosmetic raw materials will be related to their behavioral properties as utilized in the construction of stable functional systems. In this way, it is intended to generate a better understanding of the contributions of ingredients to the performance of finished product formulations. Emphasis will be placed on recognizing and dealing with problem areas associated with the use of various ingredients. Safety considerations and other pertinent matters which can influence ingredient selection will be included in these discussions.

## **Course Contents:**

### **MODULE I: INTRODUCTION**

Classification of raw materials and raw materials used in the cosmetic industry for the manufacture of finished products. Method of sampling, Indian Standard specification laid down for sampling and testing of various cosmetics in finished form by the bureau of Indian standards. Factors affecting stability of a formulation, ICH guidelines, Methods of stabilizations and Methods of stability testing. Concept of development of stability indicating analytical methods.

### **MODULE II: PHYSICAL AND CHEMICAL PROPERTIES OF COSMETICS**

Determination of Physical and chemical constants such as extractive values, moisture content, alcohol content, volatile oil content, ash values, bitterness values, foreign matters, and physical constants applicable to the lipid containing drugs. Microbial counts, bioburden and Pharmacopoeial microbial assays.

### **MODULE III: PREPARATION OF COSMETICS**

Brief introduction of the following cosmetic preparation and a detailed study on their quality control: Shampoo, Tooth paste, skin powder, skin creams, hair creams, nail polish, after shave lotion, bath and toiletries, lipstick and hair dyes, perfumes, depilatories.

### **MODULE IV: PACKAGING OF COSMETICS**

Packaging of cosmetics –Filling of solids, semisolids & liquids. Materials used for cosmetic packaging Rules & regulations and legal provisions for packaging & labeling.

## **Examination Scheme:**

<b>Components</b>	<b>CT</b>	<b>HA</b>	<b>S/V/Q</b>	<b>ATTD</b>	<b>EE</b>
<b>Weightage(%)</b>	15	5	5	5	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, ATTD: Attendance EE: End Semester Examination

## **Text & References:**



- Comprehensive Pharmacy Review 5th Edition by Leon Shargel, Alan H. Mutnick, Paul F. Souney, Larry N. Sawnsen – 2004.
- Applied Biopharmaceutics and Pharmacokinetics, 4th Edition by Leon Shargel / Andrew B.C., Yu – 1999.
- A. H. Beckett and J. B. Stenlake Practical Pharmaceutical Chemistry, Part I and Part II, 4th Edition.
- G. H. Jeffery, J. Basset, J. Mendham, R. C. Denny (Rev. by) Vogels Text Book of Quantitative Chemical Analysis, 5th Edition 1989, ELBS.
- The Controller of Publications; New Delhi, Govt. of India, Indian Pharmacopoeia, Vol. I and Vol. II - 1996.
- J. B. Wilkinson and R. J. Moore :Herry'sCosmeticology; Longman Scientific and Technical Publishers, Singapore.
- P.D. Sethi; Quantitative Analysis of Drugs in Pharmaceutical Formulations, 3rd Edition - 1997,
- ICH guideline for impurity determination and stability studies.
- Practical HPLC method development by Lloyd R. Snyder, Joseph J. Kirkland, Joseph I. Glajch, John Wiley and Sons 2nd Edition – 1997

# MEDICINAL CHEMISTRY

Course Code: CHY4310

CreditUnits:03

**Course objective:** To introduce awareness among the students about the basic ideas of medicines & their working mechanism.

## Course Contents:

### MODULE I: DRUG DEVELOPMENT

Drug development: Lead modification. (a) Identification of active part -Pharmacophore (b) Fundamental group modification (c) Structure-activity relationship (d) Structure modification to increase potency and therapeutic index (i) Homologation ii) Chain branching (iii) Ring chain transformations (iv) Bioisosterism. Drug development process: (a) Pre-formulation, product development (b) Preclinical studies; Acute toxicity, sub acute toxicity, chronic toxicity, LD<sub>50</sub>, ED<sub>50</sub>, pharmacodynamics, mutagenicity and reproductive studies.

### MODULE II: PHARMACOKINETICS

Basic principles of pharmacokinetics including absorption, distribution, metabolism and excretion of drugs and metabolites in the human body, important pharmacokinetic parameters in defining drug therapeutics, mathematical approach to pharmacokinetic modeling.

### MODULE III: PHARMACODYNAMICS

Introduction, elementary treatment of enzyme stimulation, enzyme inhibition, sulphonamides, membrane active drugs, drug metabolism, biotransformation, significance of drug metabolism in medicinal chemistry. Therapeutic index, explanation of quantal dose, graded dose, dose-effect curves, efficacy, potency, margin of safety

### MODULE IV: ANTIBIOTICS

Definition, characteristics, classification, synthesis and therapeutic uses of Penicillin, Ampicillin, Amoxicillin, Chloramphenicol, Cephalosporin, Tetracycline and Streptomycin

### Examination Scheme:

Components	CT	HA	S/V/Q	ATTD	EE
Weightage(%)	15	5	5	5	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, ATTD: Attendance EE: End Semester Examination

### Books suggested:

- Principles of Medicinal Chemistry, W. C. Foye, Philadelphia, USA
- An introduction to Medicinal chemistry, G. L. Patrick, Oxford University Press
- Burger's Medicinal Chemistry and Drug Discovery, Vol. 1-5, John Wiley
- The Organic Chemistry of Drug Design and Drug Action, Richard B. Silvermann, Academic Press
- Medicinal Chemistry, Ashutoshkar, New Age International Ltd
- Essentials of Medical Pharmacology, K. D. Tripathi, Jaypee Brothers
- A textbook of medicinal chemistry, P. Primo, CBS Publishers & Distributors
- Text book of pharmaceutical organic chemistry, Md. Ali, CBS Publishers

# POLYMER TECHNOLOGY

**Course Code: CHY4311**

**CreditUnits:03**

**Course objective:** This course is designed to familiarize students with the various polymer characterization and manufacturing techniques for converting polymer feed stocks into plastic end products. It involves a study of various plastics processing techniques. Students will become familiar with specialty polymers and their industrial uses, and design factors to create materials with desirable end-use properties

**Course Contents:**

**MODULE I: POLYMER PROCESSING**

*Plastic Technology:* Extrusion, injection molding, blow molding, compression molding, thermoforming, rotational molding, casting. *Fiber Technology-* Textile and fabric properties, spinning, fiber after-treatments. *Elastomer Technology-* Vulcanization, reinforcement, elastomer properties and compounding. Recycling of polymers Classification of polymer recycling processes. Waste polymer recovery, sortation, microsortation, polymer reprocessing, and Polymer incineration

**MODULE II: POLYMER BLENDS AND ALLOYS**

Definition, Polymer Blends, compatibilisation, Polymer Blends, Industrial applications of polymer blends.

**MODULE III: SPECIALTY POLYMERS**

Liquid Crystal Polymers (LCP): Smectic, nematic, cholestric crystals, thermotropic main chain LCP, side chain LCP, chiral nematic LCP, properties of commercial LCP's. Electroactive polymers: Filled polymers, conducting polymers- doping, conducting mechanism, EMI shielding, applications- rechargeable batteries, sensors, photoconductive polymers. Ionic Polymers: Ionic crosslinking, ion exchange, hydrophilicity, ionomers, polyelectrolytes, applications, Synthetic Polymeric membranes- membrane preparation, membrane modules, applications, High temperature and fire resistant polymers, Hydrogels, smart polymers, . Dendritic polymers- their applications. Biomedical polymers: Contact Lens, Dental Polymers, Artificial heart, Kidney and skin cells Biobased polymers: PLA, PCL

**Examination Scheme:**

Components	CT	HA	S/V/Q	ATTD	EE
Weightage(%)	15	5	5	5	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, ATTD: Attendance EE: End Semester Examination

**Books suggested:**

- Principles of Polymerization by G. Odian, (Wiley Interscience, New Delhi)
- Polymer Science by Gowarikar
- Thermal Characterization of Polymeric Materials- E. Turi (Academic Press)
- Polymer Characterization- Physical Techniques by D. Campbell and J.R.White (Chapman and Hall)
- Text Book of Polymer Science, F.W.Billmeyer (Wiley Eastern)
- Applied Rheology in Polymer Processing by B. R. Gupta, (Asian Books, Pvt. Ltd. New Delhi)
- Polymer Blends and Alloys by R.P. Singh, C.K. Das and S. K. Mustafi, (Asian Books Pvt. Ltd.)
- Principles of Polymer Science by Bahadur and Shastry
- Plastics Technology Handbook by Manas Chanda and S.K.Roy (4<sup>th</sup> Edition, CRC Press, New York)
- Analysis of polymers- an introduction, by Crompton T.R., pergaman press 1989.
- Thermal characterization of polymeric materials, by Turi E.A., Academic press Inc.

# FOOD TECHNOLOGY

**Course Code: CHY4315**

**CreditUnits:03**

**Course objective:** To create awareness among the students about the fundamentals of food and nutrition science involved in our everyday life.

## **Course Contents:**

### **MODULE I: INTRODUCTION TO FOOD**

Carbohydrates: Structure and functional properties of mono- oligo-polysaccharides including starch, cellulose, pectic substances and dietary fibre; Proteins: Classification and structure of proteins in food; Lipids: Classification and structure of lipids, Rancidity of fats, Polymerization and polymorphism; Pigments: Carotenoids, chlorophylls, anthocyanins, tannins and myoglobin; Food flavours: Terpenes, esters, ketones and quinones; Enzymes: Specificity, Kinetics and inhibition, Coenzymes, Enzymatic and non-enzymatic browning; Nutrition: Balanced diet, Essential amino acids and fatty acids, PER, Water soluble and fat soluble vitamins, Role of minerals in nutrition, Antinutrients, Nutrition deficiency diseases.

### **MODULE II: FOOD MICROBIOLOGY**

Characteristics of microorganisms; Microbial growth in food: Intrinsic and extrinsic factors, Growth and death kinetics, serial dilution method for quantification; Food spoilage: Contributing factors, Microbial spoilage of milk and milk products, meat and meat products; Foodborne disease: Toxins; Fermented food: Buttermilk, yoghurt, cheese, sausage, alcoholic beverage, vinegar, sauerkraut and soya sauce.

### **MODULE III: FOOD PRODUCTS TECHNOLOGY**

Processing principles: Canning, chilling, freezing, dehydration, control of water activity, CA and MA storage, fermentation, hurdle technology, addition of preservatives and food additives, Food packaging, cleaning in place and food laws; Grain products processing: Milling of rice, wheat, and maize, production of bread, biscuits and breakfast cereals, Solvent extraction, refining and hydrogenation of oil; Milk and milk products processing: pasteurized and sterilized milk, cream, butter, ghee, ice-cream, cheese and milk powder; Animal products processing

### **MODULE IV: FOOD CHEMICAL ENGINEERING**

Mass and energy balance; Momentum transfer: Flow rate and pressure drop relationships for Newtonian fluids flowing through pipe, Characteristics of non Newtonian fluids - generalized viscosity coefficient and Reynolds number, Flow of compressible fluid, Flow measurement, Pumps and compressors; Heat transfer: Heat transfer by conduction, convection, radiation, boiling and condensation, heat exchangers; Mass transfer: Molecular diffusion and Fick's Law, Steady state mass transfer, Convective mass transfer;

### **MODULE V: FOOD MECHANICAL ENGINEERING**

Mechanical operations: size reduction of solids, high pressure homogenization, filtration, centrifugation, settling, sieving, flow through porous bed, agitation of liquid, solid-solid mixing, and single screw extrusion; Thermal operations: Energy requirement and rate of operations involved in process time evaluation in batch and continuous sterilization, evaporation of liquid foods, hot air drying of solids, spray and freeze-drying, freezing and crystallization.

**Examination Scheme:**

<b>Components</b>	<b>CT</b>	<b>HA</b>	<b>S/V/Q</b>	<b>ATTD</b>	<b>EE</b>
<b>Weightage(%)</b>	15	5	5	5	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, ATTD: Attendance EE: End Semester Examination

**Books suggested:**

- 1. Handbook of Food Rheology and Technology by Bernhard Senge (Editor), Joachim Kaldasch (Editor)
- Formulation Engineering of Foods by Ian T. Norton, Peter Fryer, J. Norton
- Guide to Foodborne Pathogens, 2nd Edition by Ronald G. Labbé, Santos García
- The Molecular Biology and Biochemistry of Fruit Ripening by Graham Seymour, Gregory A. Tucker, Mervin Poole, James Giovannoni

## TERM PAPER

Course Code: **CHY4320**

Credit Units: **01**

### Objectives

The objective of this course is to judge the understanding as well as application of the knowledge gained by the students. The aim of the term paper is to provide the students with an opportunity to further enhance their knowledge in a sector of their choice by undertaking a significant practical unit of examining and analyzing various aspects of Chemistry & its application at a level commensurate with the learning outcomes of the various courses taken up them in the ongoing semester.

A term paper is primarily a record of intelligent reading in several sources on a particular subject. The students will choose the topic at the beginning of the session in consultation with the faculty assigned.

### Guidelines:

1. The term paper will be related to the contemporary research issue and the topic will be given by the department.
2. The presentation of the term paper is scheduled to be held before the commencement of Semester examinations.
3. The paper will carry 100 marks that will be marked on the basis of understanding and organization of content based on the literature review. The Bibliography shall form an important part of the paper.
4. Examples of a few broad areas for term paper (List is indicative, not exhaustive)
  - Inorganic chemistry
  - Organic chemistry
  - Physical chemistry
  - Green chemistry
  - Agriculture chemistry

### Evaluation Scheme

Organisation and relevance of content	Literature Review	Bibliography	Presentation	Total
30	30	20	20	100

## SEMINAR

**Course Code: CHY4320**

**Credit Units: 01**

### Objectives

A seminar is primarily an activity based academic event that is organized to provide the students a one to one and hands on experience on any aspect of their learning for research based activity. Prereq., graduate standing in chemistry/ biochemistry/ Forensic Sciences on consent of instructor.Seminar to acquaint new graduate students. Third semester students had to present on one selected research topic.

The trainer has to make sure that the aspect covered is practically practiced by the participants. The evaluation will be done by Board of examiners comprising of the faculties. This one will be one time event in one semester.

### Major Themes for Seminar

The seminar may be conducted on any of the following major themes:

- Nuclear Chemistry
- Modern trend in Inorganic Chemistry
- Modern trend in Organic Chemistry
- Modern trend in Physical Chemistry
- Nanotechnology and its application
- Polymer Chemistry
- Pharmaceuticals
- Food Technology
- Agriculture Chemistry
- Computational Chemistry
- Green Chemistry
- Any other relevant topics
- Research topics of students

These themes are merely indicative and other recent and relevant topics of study may be included.

### Evaluation Scheme:

Attendance	Active Participation	Multiple Choice Questions/ Quiz	Solving the case/ Assignment/ Write up	Total
10	30	30	30	100

# WORKSHOP

**Course Code: CHY4320**

**Credit Units: 01**

## **Objectives**

A workshop is primarily an activity based academic event that is organized to provide the students a one to one and hands on experience on any aspect of their learning. The communication in a workshop has to be necessarily two way. The trainer has to make sure that the aspect covered are practically practiced by the participants. The student will choose the option of workshop from amongst their concentration electives. The evaluation will be done by Board of examiners comprising of the faculties.

## **Major Themes for Workshop**

The workshop may be conducted on any of the following major themes:

- Nuclear Chemistry
- Modern trend in Inorganic Chemistry
- Modern trend in Organic Chemistry
- Modern trend in Physical Chemistry
- Nanotechnology and its application
- Polymer Chemistry
- Pharmaceuticals
- Food Technology
- Agriculture Chemistry
- Computational Chemistry
- Green Chemistry
- Any other relevant topics

These themes are merely indicative and other recent and relevant topics of study may be included.

## **Guidelines for Workshop**

The procedure for earning credits from workshop consists of the following steps:

3. Relevant study material and references will be provided by the trainer in advance.
4. The participants are expected to explore the topic in advance and take active part in the discussions held
5. Attending and Participating in all activities of the workshop
6. Group Activities have to be undertaken by students as guided by the trainer.
7. Evaluation of workshop activities would be done through test and quiz at the end of the workshop.
8. Submitting a write up of at least 500 words about the learning outcome from the workshop.

## **Methodology**

The methodology followed at the workshop could be based on any one or more of the following methods:

- Case Study
- Simulation
- Quiz
- Quality analysis& characterization
- Identification and preparation of materials



**Evaluation Scheme:**

<b>Attendance</b>	<b>Active Participation</b>	<b>Multiple Choice Questions/ Quiz</b>	<b>Solving the case/ Assignment/ Write up</b>	<b>Total</b>
<b>10</b>	<b>30</b>	<b>30</b>	<b>30</b>	<b>100</b>

## APPLIED CHEMISTRY LAB

Course Code: CHY4316

CreditUnits:02

Minimum 15 experiments to be performed

### List of Experiments

#### **Polymers**

1. Caprolactum from cyclcohexanone.
2. Synthesis of Nylon-6,10
3. Preparation of Polystyrene.
4. Study the morphology of polymers through optical microscopy.
5. Preparation of Epoxy resin using Bisphenol-A and Epichlorohydrin.
6. Determination of molecular weight of high polymer using viscosity method.
7. Determination of melt flow index of polymers and Compare their Melt Flow Characteristics

#### **Dyes**

8. Preparation of Methyl Orange- An azodye.
9. Preparation of Indigo

#### **Food Industry**

10. Separation of artificial colorants in confectionary using TLC.
11. Determination of protein content of wheat flour.

#### **Cosmetic Products**

12. Shampoo
13. Detergent
14. Talc
15. Lipstick
16. Perfumes

#### **Drugs Analysis**

17. Preparation of Paracetamol and Aspirin
18. Analysis of Drugs:
  - a. Novalgin
  - b. Sulfa-drugs
  - c. Paracetamol

### **Examination Scheme:**

IA				EE	
A	PR	LR	V	PR	V
5	10	10	5	35	35

Note: IA –Internal Assessment, EE- External Exam, PR- Performance, LR – Lab Record, V – Viva.

### **Text & References:**

- A Textbook of quantitative chemical analysis, VIth Edition Vogel, Pearson Education Limited.
- Practical Organic Chemistry, Mann and Saunders, IV Edition, ELBS and Longman Publication
- Comprehensive Experimental Chemistry, V. K. Ahluwalia, New Age Publication, Delhi
- Practical Manual of Organic Chemistry, R. K. Bansal
- A Textbook of quantitative inorganic analysis including elementary instrumental analysis, IVth Edition Vogel, ELBS and Longman Publication
- Advanced Practical Inorganic Chemistry, Gurdeep Raj, Goel Publishing House, Meerut

## INSTRUMENTAL LAB

Course Code:CHY4317

CreditUnits: 01

Minimum 8 experiments to be performed

### Course Contents:

1. Determination of  $R_f$  value of the materials using Paper Chromatography
2. Separation of metal ions using chromatographic techniques
3. Spectral analysis of organic compounds
4. Measurement of molecular weight using intrinsic viscosity measurements
5. pH measurements
  - (a) Measurement of pH of different solutions using pH-meter.
  - (b) Preparation of buffer solutions
    - (i) Sodium acetate-acetic acid
    - (ii) Ammonium chloride-ammonium hydroxide
  - (c) Measurement of the pH of buffer solutions and comparison of the values
6. Determine the crystallinity and phase identification of metal oxides using X-Ray diffractometer
7. Determine the thermal stability of materials using Thermo gravimetric analysis
8. Determine the  $\lambda_{\text{Max}}$  of the materials using UV-Visible Spectrophotometer
9. Identification of particle size measurement of the materials using Photon Correlation Spectroscopy
10. Determination of Morphology of the materials using SEM analysis

### Examination Scheme:

IA				EE	
A	PR	LR	V	PR	V
5	10	10	5	35	35

Note: IA –Internal Assessment, EE- External Exam, PR- Performance, LR – Lab Record, V – Viva.

# Syllabus- Fourth Semester

## PROJECT (DISSERTATION)

Course Code: CHY4437

CreditUnits: 10

### GUIDELINES FOR PROJECT FILE AND PROJECT REPORT

Research experience is as close to a professional problem-solving activity as anything in the curriculum. It provides exposure to research methodology and an opportunity to work closely with a faculty guide. It usually requires the use of advanced concepts, a variety of experimental techniques, and state-of-the-art instrumentation.

Research is genuine exploration of the unknown that leads to new knowledge which often warrants publication. But whether or not the results of a research project are publishable, the project should be communicated in the form of a research report written by the student.

Sufficient time should be allowed for satisfactory completion of reports, taking into account that initial drafts should be critically analyzed by the faculty guide and corrected by the student at each stage.

### PROJECT FILE

The Project File may be a very useful tool for undertaking an assignment along-with a normal semester, an exploratory study, sponsored projects, a project undertaken during summer period or any other period as per curriculae where the researcher is working with a company/organization. The project/ assignment may also be a part of the bigger research agenda being pursued by a faculty/ institution/ department

The Project File is the principal means by which the work carried out will be assessed and therefore great care should be taken in its preparation. This file may be considered in continuous assessment.

#### **In general, the File should be comprehensive and include:**

- A short account of the activities that were undertaken as part of the project;
- A statement about the extent to which the project has achieved its stated objectives;
- A statement about the outcomes of the evaluation and dissemination processes engaged in as part of the project;
- Any activities planned but not yet completed as part of the project, or as a future initiative directly resulting from the project;
- Any problems that have arisen and may be useful to document for future reference.

### PROJECT REPORT

The Project Report is the final research report that the student prepares on the project assigned to him. In case of sponsored project the lay out of the project could be as prescribed by the sponsoring organization. However, in other cases the following components should be included in the project report:

#### ➤ **Title or Cover Page**

The title page should contain Project Title; Student's Name; Programme; Year and Semester and Name of the Faculty Guide.

#### ➤ **Acknowledgement(s)**

Acknowledgment to any advisory or financial assistance received in the course of work may be given. It is incomplete without student's signature.

#### ➤ **Abstract**

A good "Abstract" should be straight to the point; not too descriptive but fully informative. First paragraph should state what was accomplished with regard to the objectives. The abstract does not

have to be an entire summary of the project, but rather a concise summary of the scope and results of the project. It should not exceed more than 1000 words.

➤ **Table of Contents**

Titles and subtitles are to correspond exactly with those in the text.

➤ **Introduction**

Here a brief introduction to the problem that is central to the project and an outline of the structure of the rest of the report should be provided. The introduction should aim to catch the imagination of the reader, so excessive details should be avoided.

➤ **Materials and Methods**

This section should aim at experimental designs, materials used (wherever applicable). Methodology should be mentioned in details including modifications undertaken, if any. It includes organization site(s), sample, instruments used with its validation, procedures followed and precautions.

➤ **Results and Discussion**

Present results, discuss and compare these with those from other workers, etc. In writing this section, emphasis should be laid on what has been performed and achieved in the course of the work, rather than discuss in detail what is readily available in text books. Avoid abrupt changes in contents from section to section and maintain a lucid flow throughout the thesis. An opening and closing paragraph in every chapter could be included to aid in smooth flow.

Note that in writing the various sections, all figures and tables should as far as possible be next to the associated text, in the same orientation as the main text, numbered, and given appropriate titles or captions. All major equations should also be numbered and unless it is really necessary, do not write in “point” form.

While presenting the results, write at length about the the various statistical tools used in the data interpretation. The result interpretation should be simple but full of data and statistical analysis. This data interpretation should be in congruence with the written objectives and the inferences should be drawn on data and not on impression. Avoid writing straight forward conclusion rather, it should lead to generalization of data on the chosen sample.

Results and its discussion should be supporting/contradicting with the previous research work in the given area. Usually one should not use more than two researches in either case of supporting or contradicting the present case of research.

➤ **Conclusion(s) & Recommendations**

A conclusion should be the final section in which the outcome of the work is mentioned briefly.

Check that your work answers the following questions:

- Did the research project meet its aims (check back to introduction for stated aims)?
- What are the main findings of the research?
- Are there any recommendations?
- Do you have any conclusion on the research process itself?

➤ **Implications for Future Research**

This should bring out further prospects for the study either thrown open by the present work or with the purpose of making it more comprehensive.

➤ **Appendices**

The Appendices contain material which is of interest to the reader but not an integral part of the thesis and any problem that have arisen that may be useful to document for future reference.

➤ **References**

References should include papers, books etc. referred to in the body of the report. These should be written in the alphabetical order of the author's surname. The titles of journals preferably should not be abbreviated; if they are, abbreviations must comply with an internationally recognised system.

**Examples:**

For research article:

Voravuthikunchai SP, Lortheeranuwat A, Ninrprom T, Popaya W, Pongpaichit S, Supawita T. (2002) Antibacterial activity of Thai medicinal plants against enterohaemorrhagic *Escherichia coli* O157: H7. *ClinMicrobiolInfect* ,**8**(suppl 1): 116–117.

For book:

Kowalski,M.(1976) Transduction of effectiveness in *Rhizobium meliloti*. SYMBIOTIC NITROGEN FIXATION PLANTS (editor P.S. Nutman IBP), **7**: 63-67

**The Layout Guidelines for the Project File & Project Report:**

- A4 size Paper
- Font: Arial (10 points) or Times New Roman (12 points)
- Line spacing: 1.5
- Top and bottom margins: 1 inch/ 2.5 cm; left and right margins: 1.25 inches/ 3 cm

**ASSESSMENT OF THE PROJECT FILE AND THE PROJECT REPORT**

Essentially, the assessment will be based on the quality of the report, the technical merit of the project and the project execution. Technical merit attempts to assess the quality and depth of the intellectual efforts put into the project. Project execution is concerned with assessing how much work has been put in.

The Project should fulfill the following *assessment objectives*:

- Range of Research Methods used to obtain information
- Execution of Research
- Data Analysis (Analyze Quantitative/ Qualitative information)
- Quality Control
- Conclusions

**Assessment Scheme:**

**Continuous Evaluation:**

40% (Based on punctuality, regularity of work, adherence to plan and methodology, refinements/mid-course corrections etc. as reflected in the Project File.)

**Final Evaluation:**

60% (Based on the Documentation in the file, Final report layout, analysis and results, achievement of objectives, presentation/ viva)

**It is recommended that the Final evaluation should be carried out by a panel of evaluators.**

# ADVANCED ANALYTICAL TECHNIQUES

Course Code: CHY4404

CreditUnits: 03

**Course Objective-** To give the students an advanced knowledge of analytical techniques, which will provide them enough confidence to start their career in research as well as in industry with ease.

## Course Contents:

### Module-I: Mass spectrometry

Mass spectrometry - high resolution mass spectrometry, linked scans, MIKES, HV scan, negative ion mass spectrometry, applications of field desorption, plasma desorption, fast atom bombardment, electrospray and tandem mass spectrometry and FTMS. Determination of biomolecules by absorption photometry, fluorimetry, biochemical applications of mass spectrometry. Manometry and respiration measurement, oxygen polarography, BOD estimation, resting cells preparation. Principles of microscopy - light, darkfield, phase contrast, fluorescence and electron microscope, fixing and preparation of samples.

### Module-II: Centrifugation and advanced chromatographic techniques

Principles of centrifugation - calculation of r.c.f. values, ultracentrifuges, density gradients. Enzyme assays- Biomolecules separation by chromatography, paper, thin layer and column chromatography, ion exchangers, molecular sieves, affinity columns, Gas chromatography and HPLC. Electrophoresis - theory and practice, mobility,

### Module III: Research based analytical techniques:

Preparations of solutions of different strength and scales (molarity, molality, normality, formality, w/w, v/v ratio calculation exercises) buffers, agarose and polyacrylamide matrices, gel apparatuses, native and SDS -PAGE gels, Isoelectric focussing, Zymograms. Immunochemical methods - immunoassays, immunodiffusion, rocket immunoelectrophoresis. Use of radioisotope tracer techniques in biochemical experiments and their detection.

### Module-IV: UV & CD spectroscopy

UV-visible spectroscopy - advancements in experimental methods, analysis of mixtures, dissociation constants of acids and bases, study of enzyme catalysis, applications of ORD and CD.

### Module V: NMR Spectroscopy–

experimental aspects, FT NMR, factors influencing sensitivity and resolution, applications of chemical shift and spin-spin coupling, Karplus equation and conformational analysis; NMR of carbon-13, fluorine-19, phosphorus-31, Nitrogen- 14 and 15 and oxygen 17. EPR Spectroscopy - epr spectra of solutions, frozen solution, especially organic molecules.

## Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

**Text & References:**

- Scopes R, Protein purification: Principles and practice, Springer-Verlag NY 1982.
- Plummer D.T., An introduction to practical biochemistry, 3rd edition, Tata McGraw Hill, 1988.
- P.Gerhardt (Ed.), Methods for General Bacteriology, Amer.Soc. Microbiol/ Washington, 1981.
- N.C. Price and L. Stevens, Fundamentals of Enzymology, Oxford University Press, 1989.
- C.N.R. Rao, UV and Visible spectroscopy, Butterworths, 3rd edition, London,1972.
- K. Nakanishi, Infrared absorption spectroscopy - practical, Holden-Day, Inc., San Francisco and Nankodo Company Ltd., Tokyo, 1962.
- J.K.M. Sanders and B.K. Hunter, Modern NRM Spectroscopy: A Guide for chemists, Oxford University Press, London, 1987.
- W. Kemp, NMR in Chemistry, A Multinuclear Introduction, McMillan, London, 1986.
- W.R. Croasmun and R.M.K. Carlson (Ed), Two-dimensional NMR spectroscopy, Applications for Chemists and Biochemists, VCH, New York, 1987.



## RESEARCH /REVIEW PAPER

Course Code: **CHY4406**

Credit Units: **01**

### Objectives

The objective of this course is to judge the understanding as well as application of the knowledge gained by the students. The aim of the term paper is to provide the students with an opportunity to further enhance their knowledge in a sector of their choice by undertaking a significant practical unit of examining and analyzing various aspects of Chemistry & its application at a level commensurate with the learning outcomes of the various courses taken up them in the ongoing semester.

A research paper is primarily a record of intelligent reading in several sources on a particular subject. The students will choose the topic at the beginning of the session in consultation with the faculty assigned.

### Guidelines:

1. The research paper will be related to the contemporary research issue and the topic will be given by the supervisors of the department.
2. The research paper has to prepared/communicated before the commencement of Semester examinations.
3. The paper will carry 100 marks that will be marked on the basis of understanding and organization of content based on the literature review. The Bibliography shall form an important part of the paper.
4. Examples of a few broad areas for researchh paper (List is indicative, not exhaustive)
  - Inorganic chemistry
  - Organic chemistry
  - Physical chemistry
  - Green chemistry
  - Agricultre chemistry

### Evaluation Scheme:

Organisation and relevance of content	Literature Review	Bibliography	Publication	Total
30	30	20	20	100

## SEMINAR

**Course Code: CHY4406**

**Credit Units: 01**

### Objectives

A seminar is primarily an activity based academic event that is organized to provide the students a one to one and hands on experience on any aspect of their learning for research based activity. Prereq., graduate standing in chemistry/ biochemistry/ Forensic Sciences on consent of instructor.Seminar to acquaint new graduate students. Students of fourth semester will present seminars on their six months projects topics. This will be running throughout the semester on monthly basis.

The trainer has to make sure that the aspect covered is practically practiced by the participants. The evaluation will be done by Board of examiners comprising of the faculties. This one will be one time event in one semester.

### Major Themes for Seminar

The seminar may be conducted on any of the following major themes:

- Nuclear Chemistry
- Modern trend in Inorganic Chemistry
- Modern trend in Organic Chemistry
- Modern trend in Physical Chemistry
- Nanotechnology and its application
- Polymer Chemistry
- Pharmaceuticals
- Food Technology
- Agriculture Chemistry
- Computational Chemistry
- Green Chemistry
- Any other relevant topics
- Research topics of students

These themes are merely indicative and other recent and relevant topics of study may be included.

### Evaluation Scheme:

Attendance	Active Participation	Multiple Choice Questions/ Quiz	Solving the case/ Assignment/ Write up	Total
10	30	30	30	100