



**TAMIL NADU STATE COUNCIL FOR
HIGHER EDUCATION**

CHENNAI 600 005

**Report of the Workshop on
'Chemistry Education in the 21st Century'**

November 2006

INTRODUCTION

Qualitative improvement in education in response to the changes taking place in the society can be made through curriculum development. Curriculum is more than an aggregate of courses. The curriculum should be based upon human needs and structured to make educational sense to students, creative and intellectual satisfaction to the teachers and managerial sense to those responsible for administration. In achieving this, the institutions face many problems. Colleges and universities struggle to incorporate programmes and techniques to satisfy new/fresh demands and hence the curriculum becomes a major focus of attention.

Two important things are to be considered while restructuring the curriculum.

(a) Retaining the essentials of existing ones.

(b) Injecting sufficient modernization reflecting incorporation of elements of scientific and technological advances witnessed in recent times.

The existing syllabi in all universities and colleges are to be screened and necessary changes are to be incorporated both in the subjects and in the syllabi.

Chemists are working today in diverse fields as chemical and pharmaceutical industries, agriculture and the food industry, textile and paper, electronics and aero-space and in administration. The curriculum framers of chemistry should consider the changing needs of all these fields so that the students learning chemistry finds it easier to enter into these fields. The teachers who are involved in the preparation of this model syllabi are expected to design the curriculum by retaining the essentials and incorporating the necessary changes as required by the employers.

This effort of Tamil Nadu State Council for Higher Education to prepare a model curriculum and syllabi for B.Sc., Chemistry aims at enabling the students to be efficient in what they are doing, providing intellectual satisfaction to the teachers and managerial sense to administrators.

**TAMIL NADU STATE COUNCIL FOR HIGHER EDUCATION,
CHENNAI 600 005**

Workshop on “Chemistry Education in the 21st Century”

23rd and 24th November 2006

PROGRAMME

23-11-2006

- | | | |
|-----------------------|---|--|
| 10.00 a.m. | - | Registration |
| 10.30 a.m. | - | Inauguration |
| Inaugural Address | : | Dr. A. Ramasamy,
Vice-Chairman,
TANSICHE |
| Special Address | : | Dr. S. Bhaskaran,
Member-Secretary,
TANSICHE |
| Resource Person | : | Prof. S. Swaminatha Pillai |
| 11.30 a.m. | - | Tea |
| 11.45 a.m. | - | Framing the Structure of the Curriculum |
| 1.00 p.m. | - | Lunch |
| 2.00 p.m. – 5.00 p.m. | - | Generation of Model Syllabi in groups |

24-11-2006

- | | | |
|-------------------------|---|--|
| 10.00 a.m. – 11.15 a.m. | - | Generation of Model Syllabi in groups |
| 11.15 a.m. – 11.30 a.m. | - | Tea |
| 11.30 a.m. | - | Generation of Model Syllabi in groups |
| 1.00 p.m. | - | Lunch |
| 2.00 – 4.00 p.m. | - | Finalizing the Syllabi and Valediction |
| Vote of Thanks | - | Dr. S. Padmavathy,
Research Officer, TANSICHE |

CURRICULUM DEVELOPMENT PROCESS

S. SWAMINATHA PILLAI

COMPETENCIES TO BE DEVELOPED:

Knowing the form and function of a curriculum.

Understanding the need for a curriculum.

Following several steps in developing a curriculum.

Evaluating a curriculum.

Appreciating the role of curriculum in the social process of education.

ABSTRACT:

Curriculum is a contact document between the stakeholders of the educational process. It fulfils the need for directing, implementing and satisfying their role performance in the society. Being scientific in its approach a curriculum specifies all the required conditions for effective learning and teaching including testing, besides leading to continuous individual and social development. The philosophical foundations of an society is the basis for a curriculum; the practical and successful living is the result of well-developed curriculum. Economy of efforts, materials, manpower, time and money is achieved in the otherwise long, unwieldy and indirect process of education.

INTRODUCTION

The long and continuous social process of education is often offered in terms of specified periods. These periods are identified as stages of education viz., early childhood to university education. In each stage there may be several parallel forms or structures like general, special or professional education depending on the needs of the pursuers of education at that stage. To make them ready and interested in their direction of learning and teaching, it is required that both the teachers and the learners should have a clear idea about their plans and activities. This can be set by them if they are mature enough to draw the plan. Very often there arises a situation that quantitative expansion like population increase and transfer of persons like social mobility requiring some

sort of uniformity or equality paving way for easy movement and comfort and confidence. Hence there is a need for a common source and plan to enable the younger generation to get the required education assuring a sort of commonly recognized competencies at each stage of human development. This requirement is fulfilled by what is called curriculum.

WHAT IS A CURRICULUM?

A curriculum seeks to answer questions like ‘What shall I teach or learn?’, ‘Why should I teach or learn?’, ‘How will I teach or learn?’, ‘What resources do I have at my disposal?’, and ‘How do I know if I have succeeded in my learning or teaching?’ Thus a curriculum is **a conceptual scheme** for joint implementation by teachers and learners in core, observed and appreciated by parents and users of the product/ learners in effect and valued and admired by other stakeholders as a result. It is in fact **a changing and living entity** in view of its need for continuous modification as demanded by the members of the society in view of the fast and dynamic changes around. It is obtained from **three sources** such as replacing the familiar environment of **family and friends to school and college**, moving from the **present scenario** to a predicted or even unpredicted **future situation** and making the implementers or beneficiaries **dependent or independent**, or balancing between **individuality and conformity**.

A curriculum is in fact **a programme of studies** or activities (curricular, co-curricular and extra curricular) and guidance. It can function as a scale of values providing a set of criteria. Arising from the **basic needs** and moving on to **social, cultural, individual and traditional needs**, the curriculum very often attempts to fulfil **the ideal needs also**, such as intellectual, moral, aesthetic and religious needs. Curriculum is frequently viewed as **a school/college/university function** for preserving and transmitting traditional cultures, for the transformation of culture, and primarily **for individual development** of the participants.

PRESSURES AND PRINCIPLES OF CURRICULUM DEVELOPMENT

Curriculum is developed under **economic and social pressures**, caused by **knowledge explosion** and utilizing **research findings**. The principles of governing the development of a curriculum can be stated as follows:

*Curriculum should be **dynamic** enough to accommodate the changes in social environment; it should be specifically **goal-oriented** to move towards the accepted direction causing success; **scientific** method needs to be adopted in developing a curriculum to make it reliable and successful; and curriculum has to be **evaluative** with a built-in mechanism of evaluation; and however it should be **comprehensive** enough to bring in clarity, brevity and surety in its success.*

Specifying the **objectives** in observable terms, describing a variety of alternative **learning experiences**, selecting the most appropriate **content** from the vast store of human knowledge, **organizing and integrating** the items into a homogeneous whole and providing for adequate and accurate measures of **evaluation** of the achievement of the state objectives so as to minimize, if not avoid, any loss or distortion of human development.

STAGES OF CURRICULUM DEVELOPMENT:

There are several stages in the development of a curriculum. The following are the most identifiable and adoptable stages as practiced by the curriculum developers:

PLANNING: Observing the gaps, if any, between the educational achievements and the social development there should be a systematic attempt to identify the new needs of the society by adopting the techniques of need analysis. Considering the social forces, needs, goals and objectives, knowledge has to be treated for human development on the philosophical tenets of the society incorporating the learning process with the selection of proper instructional procedure decision is to be taken on the proposed curriculum.

PREPARING: Collecting the available data, identifying the relevant sources, organizing adequate and suitable manpower, debating several styles of learning and strategies of teaching, arranging for several materials useful to cull out specific content from, a curriculum developer has to be prepared for the process. Following a systemic approach the constituent subsystems need to be integrated to deal with the collected data yielding the relevant content to be selected, organized and assessment pattern to be specified.

DESIGNING: Levels, types and structure of educational institutions which are to adopt the proposed curriculum, precepts and practices of educational technology, humanistic approach, vocational possibilities and social reconstruction contribute to the design of a curriculum. Even the concept of de-schooling or out-of-school or distance or on-line education will have a bearing process. The popular and prominent curriculum models of Tyler and Taba offer potentials of the curriculum development.

DEVELOPMENT: Curriculum development considers instructional development, learning materials and instructional media development besides strategies of teaching and techniques of testing. It is an integrated process taking into account all possible educational practices. Three different diagrammatic approaches are presented in the next section of this paper.

IMPLEMENTATION: The chief implementers of a curriculum are teachers and learners although other educational managers have assigned roles to play. Policy-makers, system managers, auxiliary manpower like technicians and other personnel and evaluators along with users like higher education system and employment organizations definitely play a secondary role in this regard.

EVALUATION: After implementing a curriculum it is essential to evaluate the same for its effectiveness, deficiencies and mishaps. There are several models of evaluation of a curriculum proposed by experts as in the

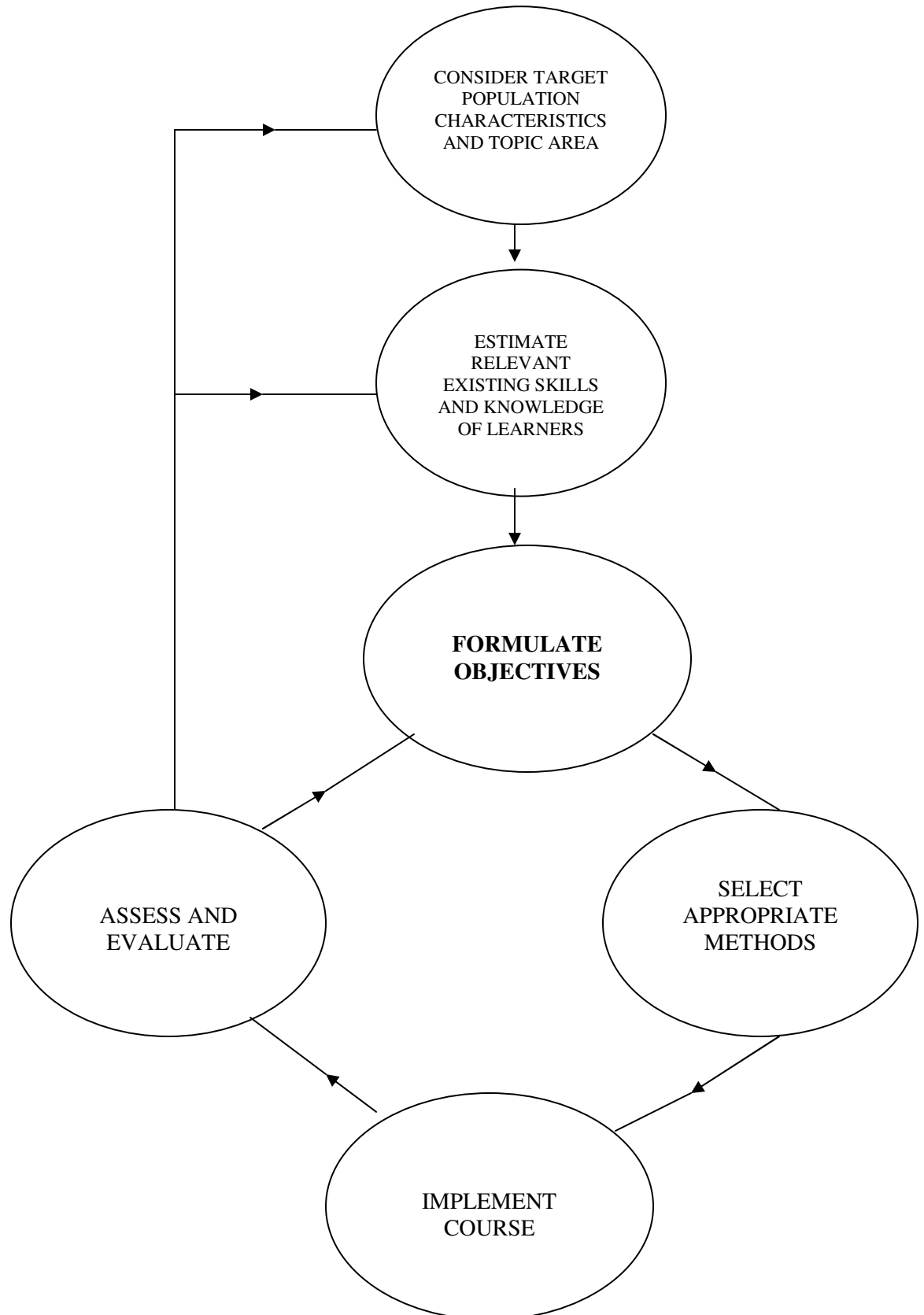
case of Stufflebeam's model or CIPP model. In any case teacher evaluation of students followed by an analysis of the latter's performance, student evaluation of students followed by their experiences, materials evaluation of all concerned and evaluation of the testing techniques adopted and the examination pattern used form the basis for valid, reliable and acceptable evaluation of a curriculum.

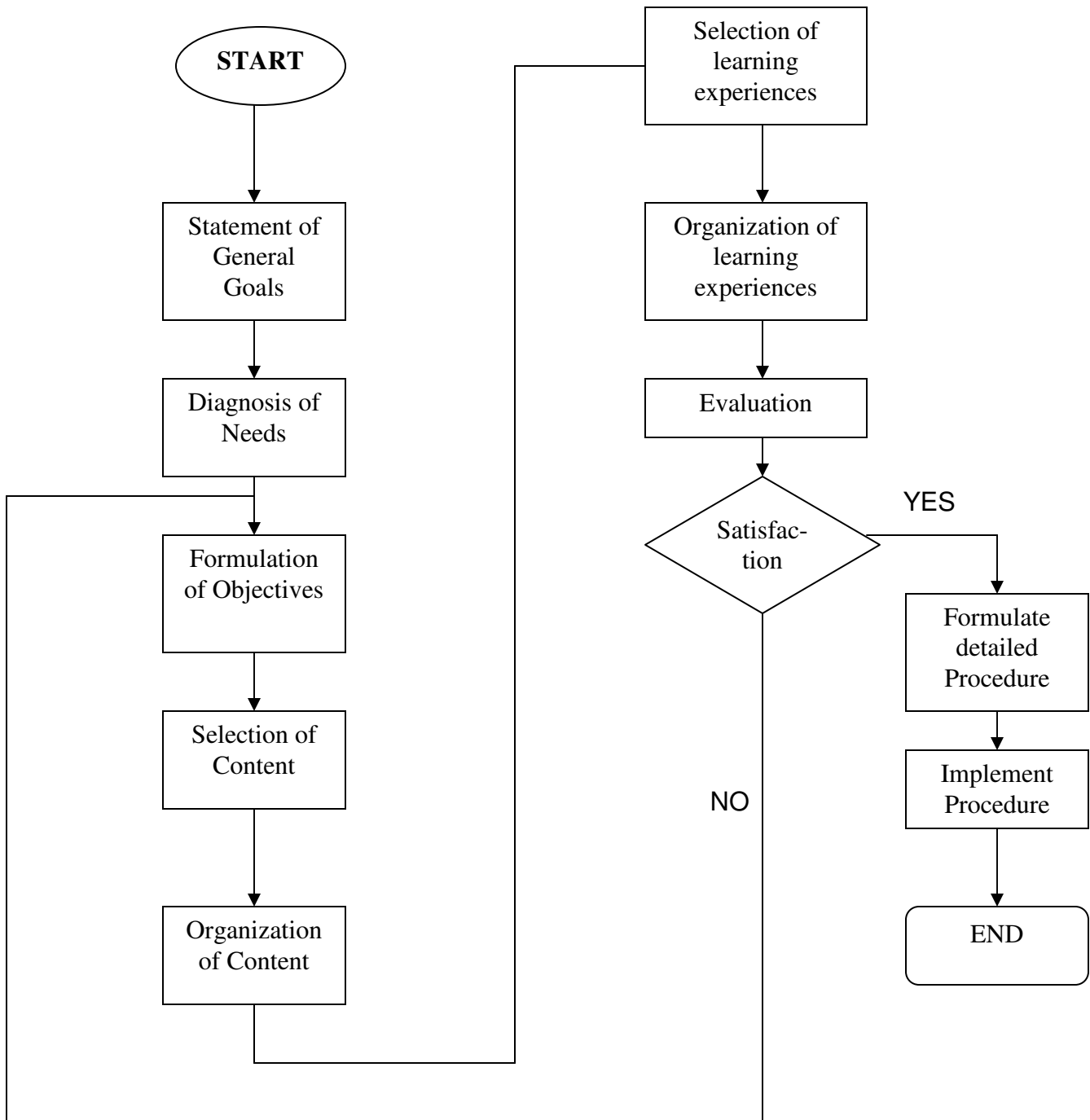
REVIEW: The after-effects of such evaluation will be the need and the mode of reviewing the developed and implemented curriculum periodically so as to make modifications in the relevant aspects of the curriculum. As per the present conditions the life of a curriculum is not even five years unlike in the past. Even annual review for making required changes in the curriculum makes it more dynamic, organizationally difficult though.

IMPROVEMENT: In order to improve a curriculum the process should have a re-look including restart from the scratch. Tinkering with a curriculum makes it lopsided and takes its life away. Total revision is always a must. In view of the fast changes in the social milieu and of the human knowledge and experience the concept of rolling curriculum will yield better results. Anyway every five, or better, three years or period of duration of a course offered there is a need Curriculum improvement or revision or even reconstruction.

CURRICULUM DEVELOPMENT MODELS:

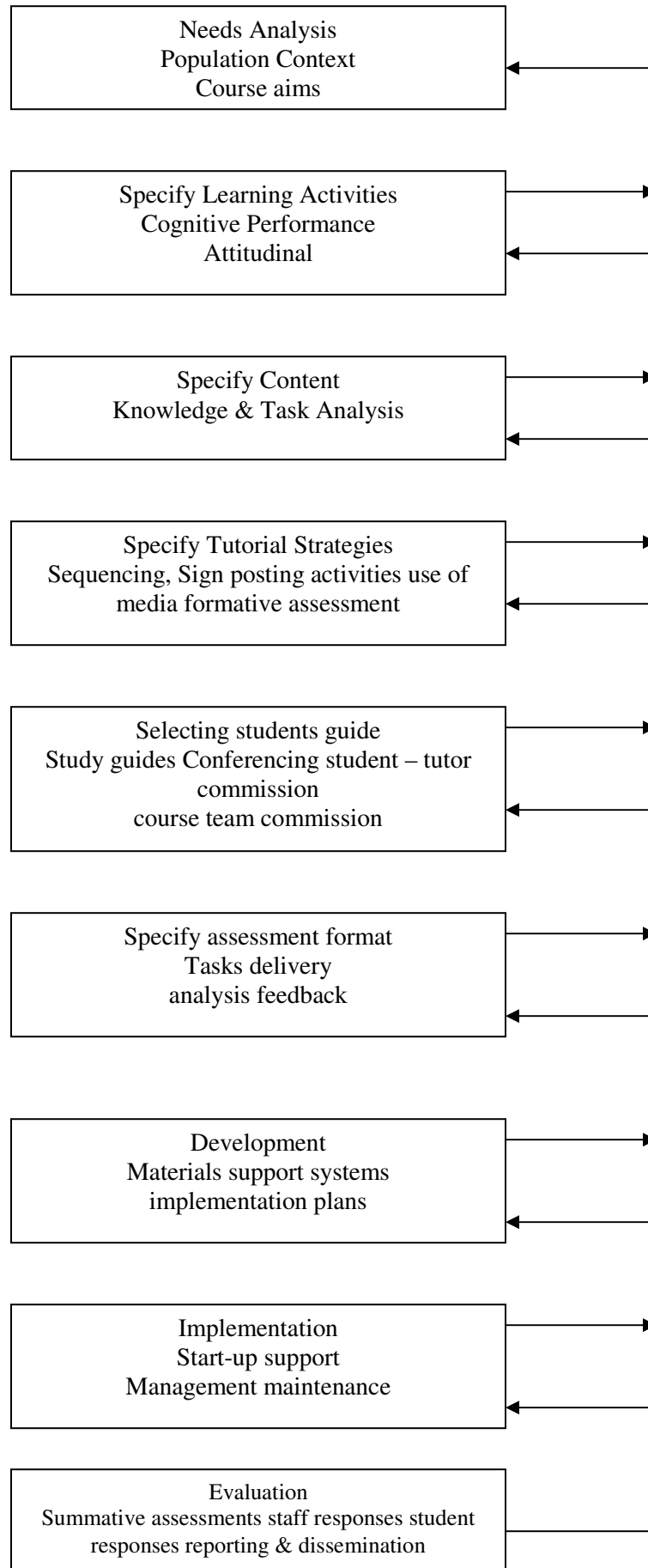
1. A SIMPLIFIED SYSTEMS APPROACH





FLOWCHART REPRESENTATION OF TABA-TYLER CURRICULUM DEVELOPMENT MODEL

3. THE COURSE DESIGN PROCESS



CURRICULUM & SYLLABUS STRUCTURE:

Structure of Curriculum

1. Introduction
2. Scope
3. Aims & Goals
4. Courses of Studies
 - Paper I
 - Paper II
 - Paper III
5. Methodology
6. Materials
7. Media
8. Evaluation
9. Outcome

Structure of Syllabus

1. Linkage
2. Objectives
 - General
 - Specific (Competences)
3. Structured Content
4. Materials
5. Methods & Media
6. Testing

F.N.:-

Objectives

Competencies

Achieve Objectives

Demonstrate

Competences

Able to -----

Can do / does -----

'Learning outcome'
skills

'Performance descriptors'
indicators

CURRICULUM CHANGES:

National aspirations and needs, cultural change, social change caused by technological development, economic changes, political variations and changes in values, the value system in vogue, philosophical, sociological and psychological approaches tend to make changes in the curriculum. The National Framework for School Curriculum 2000 has now been revised as the National Framework for School Curriculum 2005. This is an example of curriculum change due to one or more of the above contexts affecting the same.

CONCLUSION:

As an MOU between the participants in the curriculum process, any curriculum is subjected to a variety of pressures, forces and changes. The vital factor involved is the societal need arising then and there in any modern set-up. Speed on the one hand and economy on the other hand provide the essential impetus to the periodical development of different curricula of different stages of education. From a one-month programme to even a five-year programme several curricula need to be developed to supply the specifically needed manpower meeting the demands of a nation.

References

Taba, Hilda (1988) Curriculum Development
Tyler, Robert (1986) Curriculum Development Process
(not available) (1990) The Course Design

PROPOSED MODEL CURRICULUM

Prepared in the workshop organized at Chennai on the 23rd and 24th November 2006 and discussed in the meeting of the Tamil Nadu State Council for Higher Education on 27th June 2007

Recommended to the Universities in Tamilnadu offering B.Sc. Chemistry Degree programmes and all Autonomous Colleges for consideration in their Academic Bodies and consequent implementation from the next academic year.

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INTRODUCION

Chemistry has its profound implications in every walk of life of the modern man world wide. There is no system without chemistry and that is in operation in both living and nonliving things. As this world grows chemistry also grows towards satisfying the needs of mankind.

Beginning from the *stone age* through the *metal age* and up to the *silicon age* chemistry has been contributing to the mankind. The use of silicates (stones) for the fire burning and hunting were the first applications in the *stone age*. The use of silicon chips for the cyber technology is the most recent application of chemistry in the modern society. The applications are many more, wonderful and countless. These boons are the hard work of the chemists or scientists who had a thorough understanding of chemistry principles.

To note a few recent developments like *Green Chemistry* and *Nano Chemistry* shall pave the way for newer developments by the young scientists. It is the bounden duty of the academicians to enlighten the young minds with these recent aspects of chemistry. Thus, the reforming of syllabus is very imperative in the present day chemistry curriculum. Incorporating these emerging areas of chemistry in our curriculum will help the younger generation making breakthroughs in chemistry for the mankind. Giving place for newer aspects of chemistry in the curriculum does not mean omitting the old concepts. The restructuring of syllabus is well thought out to have a right blend of old and newer concepts in the undergraduate chemistry syllabus.

SCOPE

The revised syllabus may help the students understand the newer aspects of chemistry and apply the same to the real life situations. Thus, the students turn more relevant and resourceful to the society. It may enable the young minds think differently. It forms a link between old ideas and new ideas in chemistry and gives a comprehensive approach to the very learning process and the learners.

AIMS AND GOALS

- The revised syllabus throws light on the recent and emerging areas of chemistry.
- Enable the students understand chemistry and make them more relevant to the society.
- Develop the analytical ability in students so that they are become objective in solving problems.
- Help the students learn practical skills in a better way.
- Inculcate research aptitude in students
- Enable the students to go to higher levels of learning chemistry
- Improve the employability of the students

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CORE PAPERS

Year	Sl.No.	Title of the Papers	Theory/ Practical	Hours per Week	Total Hours	Credit
Year 1	1.	General Chemistry - I	Theory	6	90	6
	2.	General Chemistry - II	Theory	6	90	6
	3.	Volumetric Analysis	Practical	3+3	90	3
		Total Hours			270	15
Year 2	4.	General Chemistry - III	Theory	6	90	6
	5.	General Chemistry - IV	Theory	6	90	6
	6.	Semimicro Inorganic Qualitative Analysis	Practical	3+3	90	3
		Total Hours			270	15
Year 3	7.	Inorganic Chemistry - I	Theory	5	75	5
	8.	Organic Chemistry - I	Theory	5	75	5
	9.	Physical Chemistry - I	Theory	5	75	5
	10.	Analytical Chemistry	Theory	5	75	5
	11.	Inorganic Chemistry II	Theory	5	75	5
	12.	Organic Chemistry II	Theory	5	75	5
	13.	Physical Chemistry II	Theory	5	75	5
	14.	Optional	Theory	5	75	5
	15.	Gravimetric Analysis Semimicro organic qualitative Analysis + Physical Chemistry Experiments	Practical	10+	300	10
	Total Hours			900	50	
	Grand Total Hours				1440	80

HOURS ALLOTMENT PER WEEK

Year	Paper	Theory	Practical	Total (Hrs/Wk)	Remarks
Year 1	Language - I	6	-	6	For the semesters I and II
	Language - II	6	-	6	
	Major	6	3	9	
	Allied	6	3	9	
Year 2	Language - I	6	-	6	For the semesters III and IV
	Language - II	6	-	6	
	Major	6	3	9	
	Allied	6	3	9	
Year 3	Major - I	5		5	For the semesters V and VI
	Major - II	5		5	
	Major - III	5		5	
	Major - IV	5		5	
	Practical		10	10	

INTERNAL & EXTERNAL EXAMINATION PATTERN (For Theory)

1. Question pattern for Semester Examinations.

S. No.	Section	Marks
01.	Section A (20 Questions) Multiple choice 10 Short answer questions 10	20 x 1 = 20
02.	Section B (5 Questions) Built – in choice	5 x 5 = 25
03.	Section C (3 Questions) Long answer questions Open choice 3 out of 5	3 x 10 = 30
04.	Total Marks	75

2. Assessment pattern for the Continuous Internal Assessment

2.1 Various Components of CIA

S. No.	Components	Marks
01.	Assignment	5
02.	Formative Tests A minimum of two tests	10
03.	Summative Tests A minimum of two tests	10
04.	Total Marks	25

2.2 Question pattern for the CIA

S. No.	Sections	Marks
01.	Section A (10 Questions) Multiple choice 5 Short answer questions 5	10 x 1 = 10
02.	Section B (4 Questions) Built – in choice	4 x 4 = 16
03.	Section C (3 Questions) Long answer questions Open choice 3 out of 4	3 x 8 = 24
04.	Total Marks*	50

- The marks can be consolidated to the weightage of 10

INTERNAL & EXTERNAL EXAMINATION PATTERN (For Practical)

3. Scheme of Assessment for Semester Examinations.

S. No.	Components	Marks
01.	Rrecord Notebook Record to be maintained neatly	10
02.	Viva voce Questions from the theory of the practicals	10
03.	Procedure Including principle, calculation, tabulation, drawing, graph work, etc.	15
04	Result Final result within the prescribed error limit	40
05.	Total Marks	75

4. Scheme of Assessment for Regular Practical classes (CIA)

S. No.	Components	Marks
01.	Observation Notebook Observation to be maintained neatly and regularly	5
02.	Viva voce Questions from the theory of the practicals	5
03	Result Final result within the prescribed error limit	15
04.	Total Marks	25

A minimum of **TEN** practicals can be assessed and consolidated to 25 marks.

Semester	Subject Title	Subject Code	Total Hours	Credit
I	General Chemistry I		90	6

Units	Learning objectives
01	To know the atomic structure and the arrangement of sub atomic particles like electrons, protons and neutrons To understand the orbital concept and the electron movements in atoms
02	To know the principles of wet qualitative and quantitative analysis of chemical compounds To understand the idea of electron-donating and electron accepting nature of chemical compounds when they interact
03	To understand the covalent bonding towards forming organic molecules To appreciate the covalent bond properties and the consequent molecular structure and properties.
04	To know the systematic naming of organic compounds To understand the chemistry of hydrocarbons – alkanes and cycloalkanes
05	To understand the mechanics of microscopic particles To differentiate the classical mechanics from quantum mechanics

UNIT 1: ATOMIC STRUCTURE AND PERIODIC PROPERTIES

Atomic Orbitals, quantum, numbers - Principal, azimuthal, magnetic and spin quantum numbers and their significance - Principles governing the occupancy of electrons in various quantum levels - Pauli's exclusion principle, Hund's rule, Aufbau Principle, (n+l) rule, stability of half-filled and fully filled orbitals.

Classification as s,p,d & f block elements, variation of atomic volume, atomic and ionic radii ionisation potential, electron affinity and electronegativity along periods and groups - Variation of metallic characters - Factors influencing the periodic properties.

UNIT 2: PRINCIPLES OF WET CHEMICAL ANALYSIS AND ACID-BASE THEORY

Qualitative Analysis: Solubility Product - Principle of Elimination of interfering anions, Common Ion Effect - Complexation reactions including spot tests in qualitative analysis - Reactions involved in separation and identifications of various anions in the analysis - Semi Micro Techniques.

Titrimetry: Definitions of Molarity normality, Molality and mole fraction - Primary and Secondary standards - Types of titrimetric reactions - acid-base, redox, precipitation and complex metric titrations - Indicators - Effect of change in pH - Neutralization, redox absorption and metal ion indicators. Oxidation and Reduction

Acids and Bases: Arrhenius, Protonic and Lewis Theories of Acids and Bases - Utanovich's generalized definition Relative strengths of Acids and Bases - Dissociation constant of Acids and Bases - Levelling effect of water. Hard and soft acids and bases (HSAB)

Oxidation and Reduction Reactions: Oxidation number concept - Balancing redox equations by Oxidation number method and Ion-electron method - Equivalent weight of oxidising and reducing agents.

UNIT 3: COVALENT BONDING AND STRUCTURE

Covalent bonding – Concept of hybridization – Structure of organic molecules based on sp^3 , sp^2 and sp hybridization – Covalent bond properties of organic molecules: bond length, bond angle, bond energy, bond polarity, dipolemoment, inductive, mesomeric, electromeric, resonance and hyperconjugative effects – Naming of organic compounds (up to 10 carbon systems) – Hydrocarbons – Mono functional compounds – Bi functional compounds – Isomerism – Types of isomerism (structural and stereoisomerisms) with appropriate examples – Calculation of empirical and molecular formulas

UNIT 4: CHEMISTRY OF ALKANES AND CYCLOALKANES

Petroleum source of alkanes – Methods of preparing alkanes and cycloalkanes – Chemical properties — Mechanism of free radical substitution in alkanes by halogenation - Uses – Conformational study of ethane and n-butane - Relative stability of cycloalkanes from cyclopropane up to cyclooctane - Bayer's Strain theory – Limitations - cyclohexane and mono-and disubstituted cyclohexanes.

UNIT 5: ATOMIC STRUCTURE AND BASIC QUANTUM MECHANICS

Dualism of light - Wave nature of radiation classical theory of electromagnetic, radiation and classical expression for energy in term of amplitude. Particle nature of radiation - Black body radiation and Planck's quantum theory, photo electric dualism electric effect and Compton effect of matter - De Broglie hypothesis and Davisson and Germer experiment. Heisenberg's uncertainty principle. Schrodinger wave equation - argument in favour of Schrödinger wave equation. Physical significance of Ψ (psi) function. Properties of Ψ function - well - behaved function. Quantum numbers and their significance. Wave picture of electron - Concept of atomic orbitals. Shapes of s, p and d orbitals. Pauli exclusion principle, Aufbau principle and Hund's rule. Electronic

configuration of atoms. Nodal planes and nodal points in atomic orbitals. g and u character of atomic orbitals.

Books for Reference:

1. Puri B.R., Sharma L.R., Kalia K.K.,
Principles of Inorganic Chemistry, (23rd edition), New Delhi, Shoban Lal Nagin Chand & Co., (1993)
2. Lee J.D.,
Concise Inorganic Chemistry, UK, Black well science (2006)
3. Puri B.R., Sharma L.R., Pathania M.S.,
Principles of Physical Chemistry, (23rd edition) New Delhi, Shoban Lal, Nagin Chand & Co., (1993).
4. Glasstone S., Lewis D.,
Elements of Physical Chemistry, London, Mac Millan & Co. Ltd.
5. Morrison R.T. and Boyd R.N.,
Organic Chemistry (6th edition), New York, Allyn & Bacon Ltd., (1976)
6. Bahi B.S. and Arun Bahl,
Advanced Organic Chemistry, (12th edition), New Delhi, Sultan Chand & Co., (1997).
7. Frank J. Welcher and Richard B. Hahn,
Semi micro Qualitative Analysis, New Delhi, Affiliated East-west Press pvt. Ltd. (1969).

Semester	Subject Title	Subject Code	Total Hours	Credit
II	General Chemistry II		90	6

Units	Learning objectives
01	To know ionic bonding in inorganic molecules
02	To understand the chemistry of s-block elements – IA and IIA group elements
03	To know the chemistry of unsaturated organic molecules
04	To understand the chemical characteristics of benzenoid compounds
05	To understand the behaviour of gases and the laws governing the gaseous systems

UNIT 1: CHEMICAL BONDING

Ionic bond - Lattice Energy - Born-Haber Cycle - Pauling and Mulliken's Scales of electro negativity - Polarizing power and Polaris ability - partial ionic character from electro negativity - Transition from ionic to covalent character and vice-versa - Fajan's rule.

VSEPR Theory - Shapes of simple inorganic molecules (BeCl_2 , SiCl_4 , PCl_5 , SF_6 , IF_7 , NH_3 , XeF_6 , H_2O) - VB Theory - Principles of hybridisation - Shapes of the following molecules BeCl_2 , BF_3 , PCl_5 , SF_6 , NH_3 and H_2O - MD Theory - Bonding and antibonding orbitals - Application of MO Theory to H_2 , He_2 , N_2 , O_2 , HF and CO - Comparison of VB and MO Theories.

UNIT 2: CHEMISTRY OF s-BLOCK ELEMENTS

Position of Hydrogen in the Periodic Table, atomic hydrogen, nascent hydrogen, occluded hydrogen, uses of hydrogen. General characteristics of s-block elements – General characteristics of Group IA – diagonal relationship between Li and Mg – Extraction of Lithium – Physical and Chemical properties of Lithium – Uses – Extraction of Sodium – Physical and Chemical properties – Uses – Preparation of NaOH (Laboratory and Industrial methods) – Properties – Uses - Preparation of Na_2CO_3 (Laboratory and Industrial methods) – Properties – Uses – Extraction of Potassium – Properties – Uses – Chemistry of KOH , KBr and KI .

General characteristics of Elements of Group IIA – diagonal relationship between Be and Al – Extraction of Beryllium – Physical and Chemical properties of Be – Uses – Extraction of Mg – Physical and Chemical properties – Uses – Chemistry of some compounds of Mg: MgCO_3 , MgSO_4 , MgCl_2 , $\text{Mg}(\text{NH}_2)\text{PO}_4 \cdot 6\text{H}_2\text{O}$ – Extraction of Ca – Physical and Chemical properties – Uses – Cement manufacture – Types – Chemistry of setting of cement

UNIT 3: CHEMISTRY OF ALKENES, ALKYNES AND DIENES

Nomenclature – Geometrical Isomerism – Petroleum source of alkenes and aromatics – General methods of preparation of alkenes – Chemical properties – Uses – Elimination mechanisms (E_1 , E_2 , E_1cB) – Electrophilic, Free radical additions – Ziegler-Natta Catalytic polymerization of ethylene – polymers of alkene derivatives

Nomenclature – General methods of preparation of alkynes – Physical properties – Chemical properties – Uses – Types of alkadienes – General methods of preparation of Dienes - Physical properties – Chemical properties – Uses – Mechanisms of electrophilic and Free radical addition reactions – Polymers – Rubber as a natural polymer – Types of polymerization reactions – Mechanisms of Ionic and Free radical polymerization reactions – Chemistry of Vulcanization of rubber – Chemistry of manufacture of Film sheets, Rayon and Polyacrylic fibres -Uses of Polymers

UNIT 4: CHEMISTRY OF BENZENE AND OTHER BENZENOID COMPOUNDS

General methods of preparation of benzene – Chemical properties – Uses – Electrophilic substitution mechanism – Orientation and reactivity in substituted benzenes. Types of Polynuclear Aromatic compounds – Nomenclature – Naphthalene from coal tar and petroleum – Laboratory preparation – Structure of Naphthalene – Aromatic character – Physical properties – Chemical properties – Uses – Mechanism of Aromatic electrophilic substitution – Theory of orientation and reactivity – Anthracene, Phenanthrene from coal tar and petroleum – Laboratory preparation – Molecular orbital Structures– Aromatic characters – Physical properties – Chemical properties – Uses – Preparation of biphenyls – Physical and Chemical properties - Uses

UNIT 5: GASEOUS STATE

Maxwell's distribution of Molecular velocities (Derivation not required). Types of Molecular velocities - Mean, Most probable and root mean square velocities. Graphical representation and its significance - Collision diameter, Mean free path and collision number - Transport properties - Thermal conductivity, Viscosity and Diffusion - Law of equipartition of energies - Degree of freedom. Molecular basis of Heat capacity - Real gases - van der. Waals equation of states - derivation - significance of critical constants - Virial equations of state - Law of corresponding states - Compressibility factor

Books for Reference:

01. Puri B.R., Sharma L.R., Kalia K.K.,
Principles of Inorganic Chemistry, (23rd edition), New Delhi, Shoban Lal Nagin Chand & Co., (1993)
02. Lee J.D.,
Concise Inorganic Chemistry, UK, Black well science (2006)
03. Puri B.R., Sharma L.R., Pathania M.S.,
Principles of Physical Chemistry, 23rd edition, New Delhi, Shoban Lal, Nagin Chand & Co., (1993).
04. Glasstone S., Lewis D.,
Elements of Physical Chemistry, London, Mac Millan & Co. Ltd.
05. Morrison R.T. and Boyd R.N.,
Organic Chemistry (6th edition), New York, Allyn & Bacon Ltd., (1976)
06. Bahi B.S. and Arun Bahl,
Advanced Organic Chemistry, (12th edition), New Delhi, Sultan Chand & Co., (1997).

Semester	Subject Title	Subject Code	Total Hours	Credit
I & II	Titrimetric Analysis		90	3

Units	Learning objectives
01	To know the significant figures and various errors To understand the principle of working of balances To become aware of handling of glass wares used in titrimetry
02	To know the principles various types of titrimetric analysis
03	To acquire the skills of doing quantitative estimations by titrimetry.
04	To become aware of doing some applied quantitative estimations by titrimetry,

UNIT 1 INTRODUCTION TO QUANTITATIVE ANALYSIS

Introduction – Types of Quantitative analyses – Theory of significant figures – Error analysis – Principles of Chemical Balances (double-pan and single-pan) – Apparatus used in Titrimetric analysis – Handling of Chemical balances and other apparatus – Concept of Molecular weight, Formula weight, Equivalent weight – Concentrations of solutions – Molarity, Formality, Normality, Weight percentage.

UNIT 2 GENERAL PRINCIPLES OF TITRIMETRY

Principle of Titrimetry – Primary and secondary standards – Preparing standard solutions – Standardising the secondary standard solutions – Types of titrimetric analyses – Principal reactions – Concepts of acids, bases, oxidants, reductants – Theory of Indicators – Calculations for strengths of solutions and the amounts of substances in solutions.

UNIT 3 TITRIMETRIC QUANTITATIVE ANALYSIS

1. Preparation of a standard solution by weighing a salt using chemical balance
2. Making up a given solution and doing a double titration
3. Estimation of HCl by NaOH using a standard oxalic acid solution
4. Estimation of Na_2CO_3 by HCl using a standard Na_2CO_3 solution
5. Estimation of Oxalic acid by KMnO_4 using a standard oxalic acid solution
6. Estimation of Iron (II) sulfate by KMnO_4 using a standard Mohr's salt solution
7. Estimation of Calcium (II) by KMnO_4 using a standard Oxalic acid solution
8. Estimation of KMnO_4 by thio using a standard potassium dichromate solution
9. Estimation of Iron (II) by $\text{K}_2\text{Cr}_2\text{O}_7$ using a standard Mohr's salt solution
10. Estimation of Copper (II) sulfate by $\text{K}_2\text{Cr}_2\text{O}_7$ solution
11. Estimation of Magnesium (II) by EDTA solution
12. Estimation of Arsenious oxide using iodine solution and standard arsenious oxide solution

UNIT 4 SOME APPLIED EXPERIMENTS

13. Estimation of Total Hardness of water
14. Estimation of Hydrogen peroxide
15. Estimation of Bleaching powder
16. Estimation of Saponification value of an oil
17. Estimation of sodium carbonate and sodium bicarbonate in a mixture by Warder's double titration method
18. Estimation of copper in brass

Books for Reference:

01. Mendham, J., Denney, R.C., Barnes, J. D. and Thomas, M. *Vogel's Textbook of Quantitative Analysis*, 6th Ed., Pearson Education,
02. Gopalan, R., Subramaniam, P.S. and Rengarajan, K. *Elements of Analytical Chemistry*, Sultan Chand and Sons,

Semester	Subject Title	Subject Code	Total Hours	Credit
III	General Chemistry III		90	6

Units	Learning objectives
01	To know the chemistry of members of boron carbon and nitrogen families
02	To know the chemistry of members of oxygen, halogen and noble gases families
03	To understand the chemistry of organohalogen compounds and their synthetic uses
04	To know the chemistry of organic molecules based on the spatial orientation of constituent atoms or groups
05	To know solid state and the liquid crystals

UNIT 1: CHEMISTRY OF p-BLOCK ELEMENTS – B, C AND N FAMILIES

General characteristics of p-block Elements – General characteristics of elements of Group IIIA – diagonal relationship between B and Si – Extraction of Boron – Physical and Chemical properties of B – Uses – Chemistry of some compounds of boron: Boric acid, Borax, Diborane, Boron nitride - Extraction of Al – Physical and Chemical properties – Uses – Chemistry of some compounds of Al: Al₂O₃, AlCl₃, Alums – Alloys of aluminium

General characteristics of Elements of Group IVA – Difference of carbon and silicon from the rest of the family – Allotropic forms of carbon – Chemistry of charcoal - Chemistry of oxides of carbon (CO & CO₂) – Use of CO₂ in fire extinguishers – Fuel gases - Preparation of silicon – Physical and Chemical properties of Si – Uses – Oxides of silicon – Structures of silicates – Chemistry of silicones – Manufacture of Glass – Types of glasses – Extraction of lead – Physical properties – Chemical properties – Uses – Lead pigments

General characteristics of Elements of VA Group – The unique features of nitrogen from the rest of the family – Preparation of nitrogen – Physical and Chemical properties of N₂ – Uses – Industrial preparation of ammonia – Physical and Chemical properties – Uses – Chemistry of some compounds of Nitrogen : Hydrazine, Hydroxylamine, Hydrazoic acid, Nitric acid – Nitrogen cycle – Artificial fixation of nitrogen – Preparation of phosphorous – Physical and Chemical properties – Uses – Chemistry of PH₃, PCl₃, PCl₅, POCl₃, P₂O₅ and oxyacids of phosphorus – Fertilizers.

UNIT 2: CHEMISTRY OF p-BLOCK ELEMENTS – O, X AND NOBLE GASES FAMILIES

Anomalous behaviour of oxygen- Paramagnetic nature of oxygen. Preparation, properties, structure and uses of oxyacids of sulphur, classification of oxides based on their chemical behaviour - Acidic oxide, Basic oxide, Amphoteric oxide and neutral oxides. Classification of oxides based on oxygen content - Normal oxides, peroxides, super oxides, dioxides, sub oxides and mixed oxides. Chemistry of Selenium and Tellurium

General characteristics of halogen with reference to electronegativity, electron affinity, oxidation states and oxidising power. Peculiarities of fluorine. Hydrides, oxides and oxo acids of halogens. Inter halogen compounds and pseudo halogens - Basic nature of iodine

Noble gases : Position in the periodic table- Isolation from atmosphere. General Characteristics- Structure and shape of Xenon compounds – XeF_2 , XeF_4 , XeF_6 , Xe O_3 and XeOF_4 – uses of noble gases

UNIT 3: ORGANOHALOGEN COMPOUNDS

Nomenclature – General methods of preparation of haloalkanes – Physical properties – Chemical properties – Uses – Nucleophilic substitution mechanisms ($\text{S}_{\text{N}}1$, $\text{S}_{\text{N}}2$ and $\text{S}_{\text{N}}\text{i}$) – Evidences – Stereochemical aspects of Nucleophilic substitution mechanisms – General methods of preparation of halobenzenes - Physical properties – Chemical properties – Uses – Mechanisms of electrophilic and nucleophilic substitution reactions – Theory of orientation and reactivity

UNIT 4: STEREOCHEMISTRY

Stereoisomerism – Types – Optical Isomerism – Chirality's based on Symmetry elements (C_n , σ , i and S_n) – Idea of asymmetry and dissymmetry – Optical activity – Measurement of optical activity – Concept of enantiomerism, diastereomerism – Axial chirality in substituted allenes and spiranes – Atropisomerism in substituted biphenyls – R, S and D, L notations to express configurations – Erythro, threo conventions – Meso and dl-forms of tartaric acid – Stereoselectivity and Stereospecificity in organic reactions with suitable examples – Resolution of Racemic mixture using chiral reagent – Walden Inversion – Asymmetric synthesis – Asymmetric induction.

UNIT 5: SOLID STATES AND LIQUID CRYSTALS

Classification of solids - Isotropic and anisotropic crystals. Laws of crystallography - Representation of planes - Miller Indices, Space lattice, Crystal systems - Seven primitive, unit cells - X-ray diffraction - Derivation of Bragg's equation - Determination of structure of NaCl by

Debye Scherrer (Powder method) and rotating crystal method - Determination of Avogadro's number - Discussion of structures of KCl & CsCl - Defects in crystals - Stoichiometric and non stoichiometric - Methods of growing crystals - From melt from solution (hydrothermal method), Gel method - Packing of ions in crystals - Radius ratio rules and its limitations. Liquid Crystals - Types, theories and applications.

Books for Reference:

- 01 Puri B.R., Sharma L.R., Kalia K.K.,
Principles of Inorganic Chemistry, (23rd edition), New Delhi, Shoban Lal Nagin Chand & Co., (1993)
- 02 Lee J.D.,
Concise Inorganic Chemistry, UK, Black well science (2006)
- 03 Puri B.R., Sharma L.R., Pathania M.S.,
Principles of Physical Chemistry, 23rd edition) New Delhi, Shoban Lal, Nagin Chand & Co., (1993).
- 04 Glasstone S., Lewis D.,
Elements of Physical Chemistry, London, Mac Millan & Co. Ltd.
- 05 Morrison R.T. and Boyd R.N.,
Organic Chemistry (6th edition), New York, Allyn & Bacon Ltd., (1976)
- 06 Bahi B.S. and Arun Bahl,
Advanced Organic Chemistry, (12th edition), New Delhi, Sultan Chand & Co., (1997).

Semester	Subject Title	Subject Code	Total Hours	Credit
IV	General Chemistry IV		90	6

Units	Learning objectives
01	To know the basic principles of metallurgy. To understand chemistry of d-block elements
02	To know the chemistry of members of f-block elements
03	To understand the chemistry of organometallic compounds and their synthetic uses
04	To know the chemistry of organochalcogens- alcohols, phenols and epoxides
05	To understand the colloidal state and their applications

UNIT 1: METALLURGY AND d- BLOCK ELEMENTS

Occurrence of Metals - Concentration of ores froth floatation, Magnetic separation, Calcinations, Roasting, Smelting, Flux, Aluminothermic process - Purification metals - Electrolysis, Zone refining, van Arkel de Boer methods - Chemistry of Transition Elements- - Electronic configuration - General periodic trend - Group study of Titanium, Vanadium, Chromium, Manganese and iron group's - Coinage metals - Comparative study and Chemistry of Photography - Comparative study of Zinc group metals - galvanization, Evidences for the existence of mercurous ion as Hg_2^{2+} .

UNIT 2: CHEMISTRY OF f-BLOCK ELEMENTS

General characteristics of f-block elements - Comparative account of lanthanides and actinides - Occurrence, Oxidation states, Magnetic properties, Colour and spectra - Lanthanides and Actinides - Separation by ion - Exchange and Solvent extraction methods - Lanthanide contraction - Chemistry of thorium and Uranium - Occurrence, Ores, Extraction and uses - Preparation, Properties and uses of ceric ammonium sulphate, thorium dioxide, Thorium nitrate, Uranium hexa fluoride, uranylacetate.

UNIT 3: CHEMISTRY OF ORGANOMETALLIC COMPOUNDS

Introduction – Preparation of OrganoMagnesium compounds – Physical and Chemical Properties – Uses – Preparation of OrganoZinc compounds – Physical and Chemical Properties – Uses – Preparation of OrganoLithium compounds – Physical and Chemical properties – Uses – Chemistry of OrganoCopper, OrganoLead, OrganoPhosphorus and OrganoBoron compounds

UNIT 4: CHEMISTRY OF ALCOHOLS, PHENOLS AND ETHERS

Nomenclature – Laboratory preparation of alcohols – Industrial source of alcohols – Physical properties – Chemical properties – Uses – Chemistry of glycols and glycerols – Uses – Preparation of phenols including di and tri-hydric phenols – Physical and Chemical properties – Uses – Aromatic electrophilic substitution mechanism – Theory of orientation and reactivity. Laboratory preparation of ethers, epoxides – Physical properties – Chemical properties – Uses – Introduction to Crown ethers – Structures – Applications.

UNIT 5: COLLOIDS

Definition - Types of colloids Sols - Preparation, Purification, properties - Kinetic, optical and electrical, stability of colloids, Gold number, Associated colloids. Emulsions - Types of emulsions, preparation, properties and applications. Gels - Types of gels, preparation, properties and applications. Donnan - Membrane equilibrium - Osmosis, Reverse osmosis, Dialysis and desalination - Macromolecules - Molecular weight of macro - Molecules - Determination of molecular weight by osmotic pressure method and light scattering methods.

Books for Reference:

01. Puri B.R., Sharma L.R., Kalia K.K.,
Principles of Inorganic Chemistry, (23rd edition), New Delhi, Shoban Lal Nagin Chand & Co., (1993)
02. Lee J.D.,
Concise Inorganic Chemistry, UK, Black well science (2006)
03. Puri B.R., Sharma L.R., Pathania M.S.,
Principles of Physical Chemistry, (23rd edition) New Delhi, Shoban Lal, Nagin Chand & Co., (1993).
04. Glasstone S., Lewis D.,
Elements of Physical Chemistry, London, Mac Millan & Co. Ltd.
05. Morrison R.T. and Boyd R.N.,
Organic Chemistry (6th edition), New York, Allyn & Bacon Ltd., (1976)
06. Bahi B.S. and Arun Bahl,
Advanced Organic Chemistry, (12th edition), New Delhi, Sultan Chand & Co., (1997).

Semester	Subject Title	Subject Code	Total Hours	Credit
III & IV	Semimicro Inorganic Qualitative Analysis		90	3

Units	Learning objectives
01	To know skills of using various glass wares and apparatus used in qualitative analysis
02	To know the chemistry principles applied in the qualitative analysis
03	To understand various techniques of salt analysis
04	To know the techniques to carry out some applied analysis

UNIT 1: WORKING IN CHEMISTRY LAB

Introduction – Personal protection – Nature of Chemicals – Toxic, Corrosive, Explosive, Inflammable, Carcinogenic, other hazardous chemicals – Safe storing and handling of chemicals – Disposal of chemical wastes – Glassware – Handling of Glassware – Handling of different types of equipments like Bunsen burner, Centrifuge, Gibb's Apparatus, etc. – Ventilation facilities – Philosophy of Lab Safety – First-Aid techniques – General work culture inside the chemistry lab.

UNIT 2: GENERAL PRINCIPLES OF QUALITATIVE ANALYSIS

Principle of Flame testing – Concept of solubility and solubility product – Theory of Acids and Bases – Concept of pH and Buffer action – Common-ion effect – Redox reactions – Theory of testing acid radicals (simple and interfering) – Principle of grouping of cations – Theory of testing cations.

UNIT 3: SEMI-MICRO QUALITATIVE ANALYSIS

01. Analysis of simple acid radicals:
carbonate, sulfide, sulfate, thiosulfite, chloride, bromide, iodide, nitrate
02. Analysis of interfering acid radicals:
Fluoride, oxalate, borate, phosphate, arsenate, arsenite
03. Elimination of interfering acid radicals and Identifying the groups of basic radicals
04. Analysis of basic radicals (group-wise):
Lead, copper, bismuth, cadmium, tin, antimony, iron, aluminium, arsenic, zinc, manganese, nickel, cobalt, calcium, strontium, barium, magnesium, ammonium
05. Repeating the tests in no. 04.
06. Repeating the tests in no. 04.
07. Analysis of a mixture-I containing two cations and two anions (of which one is interfering type)
08. Analysis of a mixture-II containing two cations and two anions (of which one is interfering type)
09. Analysis of a mixture-III containing two cations and two anions (of which one is interfering type)
10. Analysis of a mixture-IV containing two cations and two anions (of which one is interfering type)
11. Analysis of a mixture-V containing two cations and two anions (of which one is interfering type)
12. Analysis of a mixture-VI containing two cations and two anions (of which one is interfering type)

13. Analysis of a mixture-VII containing two cations and two anions (of which one is interfering type)
14. Analysis of a mixture-VIII containing two cations and two anions (of which one is interfering type)
15. Analysis of a mixture-IX containing two cations and two anions (of which one is interfering type)
16. Analysis of a mixture-X containing two cations and two anions (of which one is interfering type)

UNIT 4: SOME APPLIED EXPERIMENTS

17. Analysis of water for the presence of ions like calcium, magnesium, iron, sulfate, chloride, fluoride, carbonates.
18. Analysis of Cement for the presence of ions like calcium, aluminium, iron, zinc, sulfate, chloride, phosphate
19. Analysis of soil for the presence of minerals like potassium, sodium, nitrate, chloride, phosphate.
20. Analysis of a binary alloy.

Books for Reference:

1. Venkateswaran V, Veeraswamy R., Kulandaivelu A.R.,
Basic Principles of Practical Chemistry, 2nd edition, New Delhi, Sultan Chand & Sons, (1997).

Semester	Subject Title	Subject Code	Total Hours	Credit
V	Inorganic Chemistry I		75	5

Units	Learning objectives
01	To understand coordinate bonding in chemical systems To know the various theories explaining the coordinate bonding
02	To appreciate the chemical kinetics of complex inorganic molecules
03	To understand the biological and industrial importance of coordinate compounds
04	To know metallic bonding and the close packed arrangement of atoms To understand the conducting behaviour of metals
05	To know some special types of inorganic compounds like clathrates, silicates, silicones, phosphonitrides, etc. and their applications

UNIT 1: COORDINATION CHEMISTRY I

Types of ligands -IUPAC nomenclature - Isomerism - Theories of Coordination compounds - Werner, Sidgwick, Valence bond, crystal field, arc molecular orbital theories.

UNIT 2: COORDINATION CHEMISTRY II

Stability of Complexes - Factors affecting the stability of complexes - Unimolecular and bimolecular nucleophilic Substitution reactions in octahedral and square planar complexes - Trans effect - Magnetic properties of transition metal complexes - Elementary idea of electronic spectra of transition metal - complexes.

UNIT 3: APPLICATION OF COORDINATION COMPOUNDS

Application of coordination compounds - Estimation of nickel using DMG and aluminium using oxine - Estimations of hardness of water using EDTA - Biologically important coordination compounds - Chlorophyll, haemoglobin, vitamin - B₁₂ - Their structure and application - Metal Carbonyls - Mono and Poly nuclear Carbonyles of Ni, Fe, Cr, Co and Mn - Synthesis and structures - Nitrosyl compounds - Classification, Preparation of properties - Structures of nitrosyl chloride and sodium nitroprusside.

UNIT 4: METALIC BONDING

Metallic State - Packing of atoms in metal (BCC, FCC, HCP and Simple cube) - Theories of metallic bonding - Electron gas, Pauling and band theories - Semi conductors - n-type and p-type,

transistors - Uses - Structure of alloys - Substitutional and interstitial solid solutions - Hume Rothery ratio.

UNIT 5: SOME SPECIAL TYPE OF COMPOUNDS

Organo metallic compounds of alkenes, alkynes and cyclopenta diene - Binary compounds - Hydrides, borides, carbides and nitrides - Classification, preparation, properties and uses.

Some special classes of compounds - Clathrates - Examples and structures - Interstitial and non-stoichiometric compounds - Silicones - Composition, manufacture, structure properties and uses - Silanes, coordination polymers and their polymers - Applications of Phosphozenes - Applications of Phosphazenes - Silicates their polymers - Classification in to discrete anions - one, two and three dimensional structures with examples - Composition, properties and uses of beryl, asbestos, tale, mica, zeolites and ultramarines.

Books for Reference:

01. Soni P.L.,
Text book of Inorganic Chemistry, S.Chand & Co, New Delhi (2006).
02. Purii B.R., Sharma L.R. and Kalkithar,
Principles of Inorganic Chemistry, New Delhi (2002).
03. Madan R.D., Juli G.D. and Malik S.M.,
Selected Topics in Inorganic Chemistry, S.Chand & Co, New Delhi (2006).
04. Lee J.D.,
Concine Inorganic Chemistry, ELBS Edition.

Semester	Subject Title	Subject Code	Total Hours	Credit
V	Organic Chemistry I		75	5

Units	Learning objectives
01	To know the chemistry of carbonyl compounds and their uses
02	To understand the chemistry of carboxylic acids and their derivatives and their uses
03	To understand the chemistry of organonitrogen compounds including amines and nitro compounds and their uses
04	To know the chemistry of heterocyclic and their industrial uses
05	To know the chemistry of dyes, polymers, pharmaceuticals, etc.

UNIT 1: CHEMISTRY OF CARBONYL COMPOUNDS

Introduction - Nomenclature – Laboratory preparation aliphatic carbonyl compounds– Physical properties – Chemical properties – Uses – Molecular Orbital picture of Carbonyl group – Nucleophilic addition mechanism at carbonyl group – Acidity of alpha-hydrogen – General methods of preparation of aromatic carbonyl compounds – Physical and Chemical properties – Uses – Effect of aryl group on the reactivity of carbonyl group

UNIT 2: CHEMISTRY OF CARBOXYLIC ACIDS

Nomenclature – General methods of preparation of carboxylic acids – Physical properties – Structure and acidity – Hammett equation – Chemical properties – Uses – preparation of Dicarboxylic acid – Physical and Chemical properties – Uses – Introduction to Derivatives of Carboxylic acids – Nucleophilic substitution mechanism at acyl carbon – Preparation, Physical and Chemical properties of the compound: Acyl chlorides, Anhydrides, Esters, Amides –Chemistry of compounds containing active methylene group - Introduction to oils and fats – Fatty acids – Manufacture of soap – Mechanism of cleansing action of soap.

UNIT 3: CHEMISTRY OF NITROGEN COMPOUNDS

Nitrogen Compounds - Nomenclature - Nitro alkanes - Alkyl nitrites - Differences - Aromatic Nitro compounds - Preparation and reduction of Nitro benzene under different conditions. Amino compounds - Effect of substituents on basicity, reaction of amino compounds (primary, secondary, tertiary and quaternary amine compounds). Mechanism of carbylamine reaction, diazotization, and

comparison of aliphatic and aromatic amines - Diazonium compounds - Preparation and synthetic importance of diazomethane, benzene diazonium chloride and diazo acetic ester.

UNIT 4: CHEMISTRY OF HETEROCYCLIC COMPOUNDS

Heterocyclic compounds - Nomenclature - Preparation and properties of Furan, Pyrrole, Thiophen
comparison of the basicities of pyrrole, pyridine and piperidine with amines - Synthesis and reactions of quinoline, Isoquinoline and indole with special reference to Skraup, Fisher Napieraloki and Fischer indole syntheses - Structural elucidation of quinoline and isoquinoline.

UNIT 5: INDUSTRIAL ORGANIC CHEMISTRY

Dyes - Theory of color and constitution - Chromophore, auxochrome, Classification according to application and structure - Preparation and uses of nitro dyes - Naphthol yellow, nitroso - Fast Green O, azo dyes - Methyl orange, triphenyl methane dyes - malachite green, indigo dyes - Indigotin, anthraquinone dyes - alizarin, phthalein dyes - fluorescein - sulphonic acid and derivatives - Preparation and properties of benzene sulphonic acid - Saccharin, chloramines - T, Sulphonamides

Polymers - Definition - Types of polymers - Mechanism of cationic, anionic and free radical polymerisation, thermo and thermo setting polymers - Preparation of caprolactam, Nylon 66, Polyester, epoxide resin - Molecular weight of polymers (elementary treatment)

Books for Reference:

01. Finar I. L,
Organic Chemistry, Vol 1&2, (6th edition) England, Addison Wesley Longman Ltd.(1996)
02. Morrison R.T, Boyd R.N.,
Organic Chemistry, (6th edition) New York, Allyn & Bacon Ltd., (2006)
03. Bahl B.S, Arun Bahl,
Advanced Organic Chemistry, (12th edition) New Delhi, Sultan Chand and Co., (1997)
04. Pine S. H,
Organic Chemistry, (4th edition) New Delhi, McGraw- Hill International Book Company. (1986)
05. Seyhan N. Ege,
Organic Chemistry, New York, Houghton Mifflin Co., (2004)

Semester	Subject Title	Subject Code	Total Hours	Credit
V	Physical Chemistry I		75	5

Units	Learning objectives
01	To know the various thermodynamic terms – systems, surroundings, reversible and irreversible terms To understand the first law of thermodynamics
02	To understand the second law of thermodynamics, concepts of entropy, master equations and its applications
03	To understand the energy changes involved in chemical equilibriums To know the third law of thermodynamics
04	To know the thermodynamics of solutions
05	To know the thermodynamics of phase changes

UNIT 1: THERMODYNAMICS I

System and surrounding - Isolated closed and open systems - State of the system - Intensive and extensive variables. Thermodynamic processes - Reversible and irreversible, isothermal and adiabatic processes - State and path functions - Exact and inexact differentials. Work of expansion at constant pressure and free expansion.

First Law of Thermo Dynamics - Statement - Definition of internal Energy (E), Enthalpy (H) and heat capacity. Relation between C_p and C_v . Calculation of w , q , dE and dH for expansion of ideal and real gases under isothermal and adiabatic conditions of reversible and irreversible processes.

Definition of Joule-Thomson coefficient ($\mu_{J.T.}$) - Calculation of ($\mu_{J.T.}$) for ideal and real gases - Inversion temperature.

Thermochemistry- Relation between enthalpy of reaction at constant volume (q_v) and at constant pressure (q_p) - Temperature dependence of heat of reaction - Kirchoffs equation - Bond energy and its calculation from thermochemical data - Integral and differential heats of solution and dilution.

UNIT 2: THERMODYNAMICS II

Second Law of Thermo Dynamics - Need for the law - Different statements of the law - Carnot's cycle and efficiency of heat engine - Carnot's theorem - Thermodynamic scale of temperature - Concept of Entropy - Definition and physical significance of entropy - Entropy as a function of P, V and T - Entropy changes during phase changes - Entropy of mixing - Entropy criterion for spontaneous and equilibrium processes in isolated systems - Gibb's free energy (G) and Helmholtz free energy (A) - Variation of A and G with P, V and T - Gibb's - Helmholtz equation and its

applications - Thermodynamic equation of state - Maxwell's relations ΔA and ΔG as criteria for spontaneity and equilibrium - Advantage of ΔG over entropy change.

UNIT 3: THERMODYNAMICS III

Equilibrium constant and free energy change - Thermodynamic derivation of law of mass action - Equilibrium constants in terms of pressure and concentration - NH_3 , PCl_5 , CaCO_3 - Thermodynamic interpretation of Lechatelier's principle (Concentration, temperature, pressure and addition of inert gases). Systems variable composition - Partial molar quantities - Chemical potential - Variation of chemical potential with T, P and X (mole fraction) - Gibb's - Duhem equation. Van't Hoff's reaction isotherm - Van't Hoff's isochore - Clapeyron equation and Clausius - Clapeyron equation - Applications - Third Law of Thermodynamics: Nernst heat theorem - Statement of III law and concept of residual entropy - Evaluation of absolute entropy from heat capacity data. Exception to III law (*ortho* and *para* hydrogen, CO, N_2O and ice).

UNIT 4: SOLUTIONS

Ideal and Non-ideal solutions, methods of expressing concentrations of solutions - Mass percentage, volume percentage, normality, molarity, molality, mole fraction. Concept of activity and activity coefficients- Completely miscible liquid systems - benzene and toluene. Raoult's law and Henry's law. Deviation from Raoult's' law and Henry's law. Duhem-Margules equation, Theory of fractional distillation. Azeotropes - HCl-water and Ethanol-water system - Partially miscible liquid systems - phenol-water, Triethanolamine - water and Nicotine - water systems. Lower and upper CSTs - Effect of impurities on CST - Completely immiscible liquids - principle and applications of steam distillation. - Nernst Distribution Law - derivation. Applications - determination of formula a complex ($\text{KI} + \text{I}_2 = \text{KI}_3$). Solvent extraction - principle and derivation of a general formula of the amount unextracted - Dilute solutions: Colligative properties, relative lowering of vapour pressure, osmosis, Law of osmotic pressure, Thermodynamic derivation of elevation of boiling point and depression in freezing point. Determination of molecular masses using the above properties. Abnormal molecular masses, Molecular dissociation - degree of dissociation - Molecular association.

UNIT 5: THERMODYNAMICS OF PHASE CHANGES

Definition of terms in the phase rule - Derivation and application to one component systems - water and sulphur - super cooling, sublimation. Two component systems - solid liquid equilibria, simple eutectic (lead-silver, Bi-Cd), desilverisation of lead - Compound formation with congruent melting point. (Mg-Zn) and incongruent melting point (Na-K). Solid solutions- (Ag-Au) - Fractional crystallisation. Freezing mixtures - FeCl₃-H₂O systems, CuSO₄-H₂O system.

Books for Reference:

01. Puri B.R., Sharma L.R., Pathania M.S.,
Principles Of Physical Chemistry, (23rd edition), New Delhi, Shoban Lal, Nagin Chand & Co., (1993)
02. Maron and Prutton,
Physical Chemistry, London, Mac Millan.
03. Atkins P.W.,
Physical Chemistry, (5th edition) Oxford University Press.(1994)
04. Castellan G.V.,
Physical Chemistry, New Delhi, Orient Longmans.

Semester	Subject Title	Subject Code	Total Hours	Credit
V	Analytical Chemistry		75	5

Units	Learning objectives
01	To learn the theory and importance of analytical chemistry. To know the safe working in the Lab and Lab hygiene
02	To acquire knowledge about various methods of quantitative estimations.
03	To know the methods of analyzing the chemicals applying the electroanalytical and thermogravimetric instruments
04	To know methods of analyzing the chemical compounds by spectroscopic instruments
05	To know the method of separating the mixture of compounds by chromatographic techniques.

UNIT 1: INTRODUCTION TO ANALYTICAL CHEMISTRY

Types of Analytical methods: Importance of analytical methods in Qualitative and Quantitative analysis: Chemical and instrumental methods- advantages and limitations of chemical and instrumental methods.

Laboratory Hygiene and Safety: Storage and handling of corrosive, flammable, explosive, toxic, carcinogenic and poisonous chemicals.

Simple First Aid procedures for accidents involving acids, alkalies, bromine, burns and cut by glass. Threshold vapour concentration - safe limits. Waste disposal and fee me disposal.

Evaluation of Analytical data: Idea of significant figures - its importance. Accuracy - methods of expressing accuracy. Error analysis - types of errors - minimizing errors. Preceision - methods of expressing precision Mean, Median, Mean deviation, standard deviation and confidence limit.

Method of least squares - Problems involving straight line graphs.

UNIT 2: QUANTITATIVE ANALYSIS

Estimations of Commercial Samples - Determination of percentage purity of samples - Pyrolusite – Iron ore - washing soda and Bleaching powder estimation of glucose and phenol.

Gravimetric analysis - Principle - Theories of Precipitation - solubility product and precipitation - conditions of Precipitations-Types of Precipitatants - Specific and Selective precipitants -organic and inorganic precipitants - Types of Precipitation - Purity of Precipitates - coprecipitation - Post Precepitation - Precepitation from homogeneous solution - use of Sequestering agents.

UNIT 3: THERMO AND ELECTRO ANALYTICAL TECHNIQUES

Thermo analytical methods: Principle of thermo gravimetry, differential thermal analysis, differential scanning calorimetry - Instrumentation for TGA, DTA and DSC-Characteristics of TGA and DTA curves - Factors affecting TGA and DTA curves. Applications - TGA of calcium oxalate monohydrate DTA of calcium acetate monohydrate - Determination of purity of Pharmaceuticals by DSC.

Electro analytical Techniques- Electro gravimetry Theory of electro gravimetric analysis - Determination of copper (by constant current Procedure) - Electrolytic separation of metals: Principle - Separation of copper and Nickel. Coulometry: Principle of Coulometric analysis - Coulometry at controlled potential - apparatus and technique - Separation of Nickel and Cobalt.

UNIT 4: SPECTRO ANALYTICAL TECHNIQUES

Colorimetry and Spectro Photometry- Beer - Lambert is Law - Principle of Colorimetric analysis - Visual Colorimetry -Standard series method - balancing method - Estimation of Ni^{+2} and Fe^{+3} Colorimetrically - Photoelectric Photometer method - Spectro Photometric determination of Chromium and manganese in alloy steel. Infra Red Spectroscopy (Instrumentation only) - Block diagram - Source - Monochromator - Cell - Detectors and recorders - sampling techniques. - NMR Spectroscopy (Instrumentation only).

UNIT 5: CHROMATOGRAPHY TECHNIQUES

Column/Chromatography - Principle, Types of adsorbents, preparation of the column, elution, recovery of substances and applications. Thin Layer Chromatography - Principle, Choice of adsorbent and solvent, Preparation of Chromatoplates, R_f -Values, factors affecting the R_f -values. Significance of R_f - values. Paper Chromatography - Principle, Solvents used, Development of Chromatogram, ascending, descending and radial paper chromatography. Paper electrophoresis - separation of amino acids and other applications. - Ion - Exchange Chromatography - Principle - types of resins - requirements of a good resin - action of resins. Experimental techniques - Separation of Na-K, Ca- Mg, Co-Ni and chloride - bromide mixture. Analysis of milk and apple juice. - Gas Chromatography - Principle - Experimental techniques - Instrumentation and applications. - High Pressure Liquid Chromatography (HPLC)- Principle- Experimental techniques - Instrumentation and advantages.

Books for Reference:

01. Douglas A. Skoog and Donald M. West, F.J. Holler,
Fundamentals of Analytical Chemistry, 7th edition, Harcourt College Publishers.
02. Mendham J., Denney R.C., Barnes J.D., Thomas M.,
Vogel's Text book of Quantitative Chemical analysis. 6th edition, Pearson education.
03. Sharma, B.K.,
Instrumental Methods of Chemical Analysis, Coel Publishing House, Merrut. (1997)
04. Gopalan. R. , Subramaniam P.S. and Rengarajan.K.,
Elements of Analytical Chemistry, Sultan Chand and Sons.
05. Usharani S.,
Analytical Chemistry, Macmillan.

Semester	Subject Title	Subject Code	Total Hours	Credit
VI	Inorganic Chemistry II		75	5

Units	Learning objectives
01	To understand nuclear forces that operate in atoms
02	To understand the different mechanisms of nuclear changes To know the various applications of nuclear reactions
03	To know some inorganic solids To understand the symmetry operations and group theoretical aspects of some molecules
04	To understand the chemistry principles applied in some of the industrial processes
05	To become aware of the environmental pollution To know the chemical principles involved in combating the pollution

UNIT 1: NUCLEAR CHEMISTRY I

Introduction - Composition of Nucleus and Nuclear forces (Meson Field Theory) Nuclear Stability - Mass defect - Binding Energy - Packing fraction - N/P ratio, Magic numbers - Nuclear Models - Liquid drop - Shell and Collective Model - Isotopes - Detection and Separation - Deviation of Atomic weights from whole numbers - Isobars - Isotones and Isomers.

UNIT 2: NUCLEAR CHEMISTRY II

Radioactivity - Discovery, detection and measurements, laws of radioactivity - Rate of disintegration - Half life and average life, Group displacement law - Radio active series - Nuclear transformations - Use of projectiles - Nuclear reactions - Fission and fusion - Nuclear reactors, Applications of nuclear science in agriculture and medicine carbon dating- Rock dating - Radioactive waste disposal.

UNIT 3: INORGANIC SOLID STATE CHEMISTRY

Radius ratio rule and its application in determination of structure of solids like ZONES, Wurzite, Fluorite, Anti-Fluorite, CdI_2 and NiH_2 - Crystal Defects - Schottky and Frenkel Defects - Group Theories and its applications - Symmetry elements - Symmetry operations - Mathematical group multiplication tables - Point Group of simple molecules (H_2 , HCl , CO_2 , H_2O , BF_3 , NH_3)

UNIT 4: INDUSTRIAL INORGANIC CHEMISTRY

Fossil fuels - Varieties of coal and petroleum - Petroleum refineries in India Fuel Gases - Calorific value - Composition and preparation of - Water gas, semi water gas, carburelted water gas, producer gas, natural gas, LPG and biogas.

Fertilizers – manufacture of N-P-K and mixed fertilizers - Micronutrients and their role in plant life

Safety matches, fire works and Explosives - Manufacturing details

Paints and varnishes - Manufacture and uses

UNIT 5: ENVIRONMENTAL CHEMISTRY

Soil, water and air pollution – control measures – ozone hole – green house effect – acid rain- global warming. Effluents and their treatment from various industries like dyeing, cement, tannery and distillery units.

Books for Reference:

- 01 Soni P.L.,
Text Book of Inorganic Chemistry, S.Chand & Co, New Delhi (2006)
- 02 Lee J.D.,
Concise Inorganic Chemistry ELBS Edition.
- 03 Puri B.R. and Sharma L.R.,
Principles of Inorganic Chemistry, Soban Lal Nagin Chand & Co.
- 04 Satyaprakash, Tuli, G.D., Basu, S.K. and Madan, R.D.
Advanced Inorganic Chemistry (Vol I & II), S.Chand, New Delhi (2006).

Semester	Subject Title	Subject Code	Total Hours	Credit
VI	Organic Chemistry II		75	5

Units	Learning objectives
01	To understand the chemistry of carbohydrates
02	To know the chemistry aspects of amino acids, proteins, nucleic acids To know the chemical aspects of vitamins and their biological importance
03	To know chemistry of some alkaloid and terpenoid compounds and their structural characteristics
04	To understand the organic chemical reactions involving structural changes
05	To know the various physicochemical techniques of probing the organic molecules to understand the structural characteristics

UNIT 1: CHEMISTRY OF CARBOHYDRATES

Carbohydrate - Classification, Properties of Mono saccharide (Glucose and fructose), structure and configuration of mono saccharide, interconversion, ascending and descending series, muta rotation, epimerisation cyclic structure - Determination of size of sugar rings - Disaccharide - Sucrose, Maltose - Structure elucidation - Polysaccharide - Starch and Cellulose (Elementary treatment).

Polynuclear hydrocarbon - Naphthalene - Isolation, Properties and structure - Anthracene and phenanthrene - Properties and structure - Pschorr reaction.

UNIT 2: CHEMISTRY OF PROTEINS AND VITAMINS

Amino Acids - Classification, General methods of preparation and reactions of amino acids, zwitter ion - isoelectric points, action of heat on α, β and γ amino acids. Peptides and proteins - Peptide linkage - Polypeptide - Classification of proteins - Synthesis of peptides - Merrifield synthesis - Primary structure - End group analysis - Dantyl chloride, Edman method - Secondary structure - Tertiary structure - Denaturation - Colour reactions of proteins - Nucleic Acids - Elementary treatment of DNA and RNA. Vitamins (Structural elucidation not needed) - Classification, biological importance of Vitamins A, B₁, B₂, B₆, B₁₂ and C.

UNIT 3: CHEMISTRY OF ALKALOIDS AND TERENOIDS

Chemistry of natural products - Alkaloids - Isolation, classification, general methods of elucidating structure - structural elucidation and synthesis of coniine, piperine, nicotine and ephedrine, Terpenes - classification - isoprene, special isoprene rule, general methods of structural elucidation - structural elucidation and synthesis of citral, limonene, menthol, camphor. Sulfa drugs – penicillin – tetracycline – anesthetics – analgesics- antimalarials – antipyretics – antiseptics – disinfectants – antacids – antioxidants.

UNIT 4: MOLECULAR REARRANGEMENTS

Molecular rearrangements - Types of rearrangement (nucleophilic and electrophilic) - Mechanism with evidence for the following re-arrangements - pinacol - pinacolone, benzil - benzilic acid, benzidine, Claisen, Fries, Hofmann, Curtius, Lossen, Beckmann, dienone - phenol and Orton - Photochemical reactions of ketones - Norrish Type I and II.

UNIT 5: ORGANIC SPECTROSCOPY

UV-VIS spectroscopy - Types of electronic transitions - Solvent effects on Γ_{\max} , - Woodward - Fieser rules - Calculation of Γ_{\max} : dienes and α, β - unsaturated carbonyls.

IR spectroscopy - Number and types of fundamental vibrations - Modes of vibrations and their energies, Position of IR absorption frequencies for functional groups like aldehyde, ketone, alcohol, acid and amide, Factors affecting the frequency absorption - Conjugation, inductive effect and hydrogen band.

NMA spectroscopy - Principle - Equivalent and non-Equivalent protons - Shielded and deshielded protons, anisotropy, chemical shift - TMS, Tau and delta scales, integral, splitting of signals - Spin-Spin coupling, NMA spectrum of EtOH, n-propyl bromide and isopropyl bromide.

Books for Reference:

01. Finar I. L.,
Organic Chemistry, Vol 1&2, (6th edition) England, Addison Wesley Longman Ltd.(1996)
02. Morrison R.T, Boyd R.N.,
Organic Chemistry, (4th edition) New York, Allyn & Bacon Ltd., (1976)
03. Bahl B.S, Arun Bahl,
Advanced Organic Chemistry, (12th edition) New Delhi, Sultan Chand and Co., (1997)
04. Pine S. H,
Organic Chemistry, (4th edition) New Delhi, McGraw- Hill International Book Company. (1986)
05. Seyhan N. Ege,
Organic Chemistry, New York, Houghton Mifflin Co., (2004)
02. William Kemp,
Organic Spectroscopy, 3rd edition, ELBS.

Semester	Subject Title	Subject Code	Total Hours	Credit
VI	Physical Chemistry II		75	5

Units	Learning objectives
01	To know the reaction rates and pathways To understand the energy changes involved chemical reactions
02	To know the various photochemical processes in the chemical systems
03	To know conducting behaviour of ions To understand the theory of electrical conductance
04	To understand the transformation of chemical energy into electrical energy in Galvanic cells
05	To understand the symmetry aspects in chemical systems To know the principles involved in various spectroscopic techniques

UNIT 1: CHEMICAL KINETICS AND CATALYSIS

Rate of reaction, Average and instantaneous rates, rate equation, order of reaction. Rate laws: Rate constants - Derivation of rate constants and characteristics for zero, first order, second and third order (equal initial concentration) - Derivation of time for half change with examples. Methods of determination of order of reactions - Experimental methods of determination of rate constant of a reaction - Volumetry, manometry, polarimetry. Mechanism of complex reactions - equilibrium and steady state approximations.

Effect of temperature on reaction rate - concept of activation energy, energy barrier Arrhenius equation. Theories of reaction rates - Collision theory - derivation of rate constant of bimolecular gases reaction - Failure of collision theory. Lindemann's theory of unimolecular reaction. Theory of absolute reaction rates - Derivation of rate for a bimolecular reaction - significance entropy and free energy of activation. Comparison of collision theory and ARRT. Kinetics of fast reactions - Flow methods and pulse methods.

Catalysis - Homogenous and heterogeneous - Homogeneous catalysis - Kinetics of Acid - base and enzyme catalysis. Heterogeneous catalysis - Adsorption - Types - Chemical and physical. Characteristics of adsorption. Different types of isotherms - Freundlich and Langmuir

UNIT 2: PHOTO CHEMISTRY

Consequences of light adsorption - Jablonski diagram Radiative and non-radiative transitions. Laws of photo chemistry - Lambert - Beer Grothus - Draper and Stark - Einstein. Quantum efficiency. Photo chemical reactions - rate law - Kinetics of H_2-Cl_2 , H_2-Br_2 and H_2-I_2 reactions, comparison between thermal and photochemical reactions. Photo sensitization and quenching. Fluorescence, phosphorescence and chemiluminescence. Laser and uses of Lasers - population inversion and optical pumping.

UNIT 3: ELECTRICAL CONDUCTANCE

Electrical transport and conductance in metal and in electrolytic solution. Specific conductance and equivalent conductance. Measurement of equivalent conductance. Using Kohlraush's bridge. Arrhenius theory of electrolytic dissociation and its limitations. Weak and strong electrolyte according to Arrhenius theory Ostwald's dilution law - applications and limitation. Variation of equivalent conductance with concentration.

Migration of ion - ionic mobility. Kohlraush's law and its applications. The elementary treatment of the Debye - Huckel Onsager equation for strong electrolytes. Evidence for ionic atmosphere. The conductance at high fields (with effect) and high frequencies (Debye - Falkenhagen effect). Transport number & Hittorf's rule. Determination by Hittorf's method and moving boundary method. Application of conductance measurements - Determination of strong electrolytes and acids. Determination of K_a of acids. Determination of solubility product of a sparingly soluble salt. Common ion effect. Conductometric titrations.

UNIT 4: ELECTROCHEMICAL CELLS

Electrolytic & Galvanic cells - Reversible and irreversible cells. Conventional representation of electrochemical cells. Electromotive force of a cell and its measurement computation of E.M.F calculation of thermodynamic quantities of cell reactions (ΔG , ΔH , ΔS and K). Application of Gibbs Helmholtz equation. Concentration and E.M.F Nernst equation.

Types of reversible electrodes - Gas/metal ion - metal/metal ion; metal/insoluble salt/anion and - Redox electrodes. Electrode reactions - Nernst equation - Derivation of cell. E.M.F. and single electrode potential standard hydrogen electrode - reference electrodes - standard electrode potentials - sing convention - Electrochemical series and its significance.

Concentration cell with and without transport. Liquid junction potential. Application of EMF concentration cells. Valency of ion solubility product and activity co-efficient. Potentiometric

titrations. Determination of pH using Hydrogen, quinhydrone Determination of pKa of acids by potentiometric method. Corrosion - general and electrochemical theory - passivity - prevention of corrosion.

UNIT 5: GROUP THEORY AND SPECTROSCOPY

Symmetry elements and symmetry operation. Group postulates and types of groups - Abelian and non-Abelian - symmetry operation of H₂O molecule, Illustration of Group postulates using symmetry operations of H₂O molecule. Construction of multiplication table, for the operation of H₂O molecule. Point group - Definition Elements (symmetry operations) of the following point groups. C_n(C₂, C₃), S_n(S₁, S₂), C_{1v}(C_{2v}, C_{3v}) and (C_{2h}). Group theory and optical activity.

Electromagnetic spectrum - The regions of various types of spectra. Microwave spectroscopy: Rotational spectra of diatomic molecules treated as rigid rotator, condition for a molecule to be active in microwave region, rotational constants (B), and selection rules for rotational transition. Frequency of spectral lines, calculation of inter-nuclear distance in diatomic molecules.

Infrared spectroscopy: Vibrations of diatomic molecules - Harmonic and anharmonic oscillators, zero point energy, dissociation energy and force constant, condition for molecule to be active in the IR region, selection rules for vibrational transition, fundamental bands, overtones and hotbands. Diatomic vibrating rotator - P, Q, R branches. Determination of force constant. UV visible spectroscopy - conditions - theory of electronic spectroscopy- types of electronic transitions - Frank-Condon principle - Pre-dissociation - Applications.

Raman spectroscopy: Rayleigh scattering and Raman scattering. Stokes and anti-Stokes lines in Raman spectra, Raman frequency, quantum theory of Raman effect, condition for a molecule to be Raman active. Comparison of Raman and IR spectra, Structural determination from Raman and IR spectroscopy, Rule of mutual exclusion.

NMR spectroscopy: Nuclear spin and conditions for a molecule to give rise to NMR spectrum - Theory of NMR spectra, number of NMR signals, equivalent and non-equivalent protons, position of NMR signals, shielding, de-shielding, chemical shift, δ and τ scales. Peak area and number of protons. Splitting of NMR signals - spin - spin coupling.

Books for Reference:

- 01 Maron S.H. and Lando J.B.,
Fundamentals of Physical Chemistry, Macmillan.
- 02 Puri B.R., Sharma L.R. and Pathania B.K.,
Principles of Physical Chemistry, Vishal Publishing Company.
- 03 Glasstone S. and Lewis D.,
Elements of Physical Chemistry, Macmillan
- 04 Rajaram and Keeriacose,
Thermodynamics for students of chemistry.
- 05 Kheterpal S.C. Pradeeps,
Physical Chemistry, Volume I & II, Pradeep Publications Jalandhur, (2004).
- 06 Jain D.V.S. and Jainhar S.P.,
Physical chemistry, Principles and problems, Tata Mc Graw Hill, New Delhi, (1988).

Semester	Subject Title	Subject Code	Total Hours	Credit
V & VI	Inorganic Quantitative Analysis - Gravimetry		100	4

Units	Learning objectives
01	To know the basic principles of gravimetric analysis To learn the skills of precipitation, filtration and weighing
02	To know the chemistry principles involved in estimations of various inorganic salts
03	To learn the skills of doing different gravimetric estimations
04	To know the method of carrying out colorimetric, pHmetric and flamephotometric estimations

UNIT 1: THEORY OF GRAVIMETRY

Principles of quantitative precipitation – Conditions for precipitation – Methods of Digestion – Quantitative filtrations – Techniques of drying - Theory of weighing – Handling of chemical balance – Scientific Reporting

UNIT 2: THEORY OF SOME QUANTITATIVE ESTIMATIONS

Principles of colorimetry, pHmetry and flamephotometry – preparation of standard solutions of different concentrations – construction of standard graphs – deciphering the concentration of the analyte from the standard graph – scientific reporting

UNIT 3: GRAVIMETRIC ANALYSIS

1. Estimation of Lead as Lead chromate
2. Estimation of Barium as Barium chromate
3. Estimation of Nickel as Nickel-DMG complex
4. Estimation of Copper as Copper(I) thiocyanate
5. Estimate of Magnesium as Magnesium oxinate
6. Estimation of Calcium as Calcium oxalate
7. Estimation of Barium as Barium sulfate
8. Estimation of Iron as Iron(III) oxide

UNIT 4: DEMONSTRATION EXPERIMENTS

1. Determination of Iron by colorimetry
2. Determination of pH of solid samples using pH meter
3. Determination of sodium and potassium by Flamephotometry

Books for Reference:

1. Venkateswaran V, Veeraswamy R., Kulandaivelu A.R.,
Basic Principles of Practical Chemistry, 2nd edition, New Delhi, Sultan Chand & sons, (1997).
2. Furniss, B.S., *et al.*,
Vogel's Textbook of Practical Organic Chemistry, 7th edition, London, ELBS – Longman, (1984).

Semester	Subject Title	Subject Code	Total Hours	Credit
V & VI	Organic Quantitative Analysis and Organic Preparations		100	3

Units	Learning objectives
01	To know the basic principles of organic qualitative analysis To learn the skills of handling of organic chemicals
02	To know the basic principles of organic preparations To learn the skills of handling of organic chemicals and doing the To learn the skills of recrystallization, drying, etc.
03	To know the methods of analyzing the organic chemicals qualitatively for the various characteristics
04	To know methods of preparing some organic chemicals by converting the functionalities
05	To know the method of determining the melting point or boiling point of organic chemicals

UNIT 1: THEORY OF ORGANIC ANALYSIS

Principles of qualitative analysis – Handling of apparatus and hazardous chemicals like bromine, sodium, NaNO₂, concentrated acids and bases, etc. – Theory of the various chemical reactions / tests – Techniques of derivatization – Scientific Reporting

UNIT 2: THEORY OF ORGANIC PREPARATIONS

Principles of chemical conversions – Handling of organic chemicals and the glass ware – Filtration techniques – Drying techniques – Recrystallization techniques – Scientific Reporting.

UNIT 3: ORGANIC ANALYSIS

Analysis of simple organic compounds (a) characterization functional groups (b) confirmation by preparation of solid derivatives / characteristic colour reactions

Note: 1. mono-functional compounds are given for analysis. In case of bi-functional compounds, students are required to report any one of the functional groups

2.. Each student is expected to do the analysis of at least 15 different organic Substances

UNIT 4: ORGANIC PREPARATION

Preparation of Organic compounds involving the following chemical conversions

1. Oxidation
2. Reduction
3. Esterification
4. Acetylation
5. Hydrolysis
6. Nitration
7. Bromination
8. Diazotization
9. osazone formation

UNIT 5: DETERMINATION OF PHYSICAL CONSTANTS

Determination of boiling / melting points by semimicro method.

Books for Reference:

1. Venkateswaran V, Veeraswamy R., Kulandaivelu A.R.,
Basic Principles of Practical Chemistry, 2nd edition, New Delhi, Sultan Chand & sons, (1997).
2. Furniss, B.S., *et al.*,
Vogel's Textbook of Practical Organic Chemistry,
7th edition, London, ELBS – Longman, (1984).

Semester	Subject Title	Subject Code	Total Hours	Credit
V & VI	Physical Chemistry Practicals		100	3

Units	Learning objectives
01	To know the basic principles of various physical chemistry experiments To learn the skills of drawing graph, handling of some precision instruments
02	To learn to do some experiments in two cycles
03	To and understand the computer programming in chemistry, the applications of C++ programming and the gas analysis

UNIT 1: INTRODUCTION TO PHYSICAL CHEMISTRY PRACTICALS

Introduction – Theory of the practicals – Critical solution temperature – transition temperature – Heat of neutralization – Kinetics of ester hydrolysis and persulphate oxidation – Viscosity – Phase Diagram (simple eutectic) – polarimetry of inversion of sugar – potentiometry – Conductometry – Partition coefficient and Equilibrium constant – Calculation of parameters with units – Drawing Graphs – Handling of various equipments used in physical chemistry practicals

UNIT 2: TWO CYCLES OF EXPERIMENTS

Cycle 1:

01. Critical Solution Temperature
02. Heat of Neutralization
03. Transition Temperature
04. Kinetics of Ester Hydrolysis
05. Conductometric Acid-Base Titration
06. Potentiometric Acid-Base Titration
07. Viscosity

Cycle 2:

08. Rast Method
09. Effect of impurity on Critical solution Temperature
10. Partition Coefficient, Equilibrium constant of $KI + I_2 = [KI_3]$
11. Kinetics of Persulphate-Iodide Reaction
12. Conductometric Precipitation Titration
13. Potentiometric Redox Titration
14. Phase Diagram (Simple eutectic system)

UNIT 3: DEMONSTRATION EXPERIMENTS

01. Computer based experiments

- a) Using MOPAC Program, Calculate the required parameters (dihedral angle, dipole moment etc.) of simple molecular like H_2O , NH_3 and CH_4 and exhibiting the output.
- b) Solving problems by unifying and running programs in C++ and exhibiting the output.
(Two problems shall be given to each student in the examination).

The problems may be selected from Kinetic theory of gases (Calculation of different velocities and heat capacities of gases and thermodynamics (Calculation of enthalpy changes, work done and entropy changes of ideal systems).

02. Analysis of gases like CO₂, SO₂, CO, CH₄, NO₂ and O₂.
Quantitative estimation using
- i) Orsat's apparatus
 - ii) Pollution level studies
 - iii) Using latest devices.
03. Study of inversion of cane sugar using Polarimeter.

Books for Reference:

1. Venkateswaran V, Veeraswamy R., Kulandaivelu A.R.,
Basic Principles of Practical Chemistry, 2nd edition, New Delhi, Sultan Chand & sons, (1997).
2. Daniels *et al.*,
Experimental Physical Chemistry, 7th edition, New York, McGraw Hill, (1970).
3. Findlay, A.,
Practical Physical Chemistry, 7th edition, London, Longman (1959).
4. Ahluwalia, V. K., Dingra, S. and Gulati, A.
College Practical Chemistry, Orient Longman Pvt. Ltd., Hyderabad. (2005)
5. Sharma, K. K. and Sharma, D. S.
Introduction to Practical Chemistry, , Vikas Publishing House, New Delhi. (2005)

PROPOSED MODEL SYLLABI FOR OPTIONAL PAPERS

OPTIONAL PAPERS

Coordinator : Dr. A. Thamarai Chelvan,
Reader in Chemistry,
Thiagarajar College,
139-140 Kamarajar Salai,
Madurai – 625 009.

- | | | | |
|----|---|----|--|
| 1. | Dr. N. Kannan,
Reader in Chemistry,
Ayya Nadar Janaki Ammal College,
Sivakasi – 626 124. | 5. | Mrs. V. Jayalakshmi,
HOD of Chemistry,
V.V.Vanniperumal College for Women,
Virudhunagar 626 001. |
| 2. | Dr. T. Rajendran,
Reader in Chemistry,
Vivekananda College,
Tiruvedagam (West),
Near Sholavandan Railway Station,
Madurai - 625 217. | 6. | Dr. Jesurietta Sathian,
Lecturer (SG),
Department of Chemistry,
Stella Maris College,
17CathedralRoad,
Chennai – 600 086. |
| 3. | Mr. N. Krishnamoorthy,
SG Lecturer,
Department of Chemistry,
Arul Anandar College,
Karumathur – 625 514. | 7. | Mrs. P. Manjula,
HOD of Chemistry,
Arulmigu Palani Andavar Arts
College for Women,
Chinnakalayamputhur,
Palani – 624 615. |
| 4. | Dr. G. Chandramohan,
Reader in Chemistry,
A.Veeraiya Vandayar Memorial
Sri Pushpam College,
Poondi – 613 503. | 8. | Dr. S. Balakumar,
HOD of Chemistry,
Aditanar College of Arts and Science,
Tiruchendur - 628 216. |

OPTIONAL PAPERS

1. Material Chemistry and Nanotechnology
2. Industrial chemistry
3. Textile Chemistry
4. Biomolecules
5. Pharmaceutical Chemistry
6. Dairy Chemistry
7. Food Chemistry
8. Applied Electrochemistry
9. Agricultural Chemistry
10. Leather Chemistry
11. Polymer Chemistry
12. Forensic Chemistry

Semester	Subject Title	Subject Code	Total Hours	Credit
VI	Optional: Material Chemistry and Nanotechnology		75	5

Units	Learning objectives
01	To learn the conductance of solids and the different types of crystal defects.
02	To acquire knowledge about different types of magnetic and insulating materials.
03	To understand modern engineering materials like metallic glasses, biomaterials and advanced ceramics.
04	To learn the different techniques for the synthesis of nanophase materials and their applications.
05	To acquire knowledge about the modern techniques in nanotechnology and nanomaterials.

UNIT 1: IONIC CONDUCTIVITY AND SOLID ELECTROLYTES

Types of ionic crystals - Alkali halides - Silver chloride - Alkali earth fluorides - Simple stoichiometric oxides. Types of ionic conductors - halide ion conductors - oxide ion conductors - solid electrolytes - applications of solid electrolytes. Electrochemical cell - principles - batteries, sensors and fuel cells - crystal defects in solids - line and plane defects - point defects - Schottky and Frenkel defects. Electronic properties and band theory: metals, semiconductors - Inorganic solids - colour, magnetic and optical properties, luminescence, lasers. (15 h)

UNIT 2: MAGNETIC MATERIALS

Introduction - types of magnetic materials - diamagnetism - paramagnetism, ferromagnetism. Ferrites: Preparation and their applications in microwave - floppy disk - magnetic bubble memory and applications. Insulating Materials: Classification - on the basis of temperature - Polymer insulating materials and ceramic insulating materials. Ferroelectric materials: Examples - applications of ferroelectrics. (15 h)

UNIT 3: MODERN ENGINEERING MATERIALS:

Metallic glasses - Introduction - Composition, properties and applications. Shape memory alloys: Introduction - examples - application of SMA - advantages and disadvantages. Biomaterials: Introduction - metals and alloys in biomaterials - ceramic biomaterials, composite biomaterials - polymer biomaterials. (15 h)

UNIT 4: NANOPHASE MATERIALS

Introduction - techniques for synthesis of nanophase materials - sol-gel synthesis - electrodeposition - inert gas condensation - mechanical alloying - properties of nanophase materials - applications of nanophase materials. Composite materials: Introduction - types. (15 h)

UNIT 5: NANO TECHNOLOGY

Introduction - importance - various stages of nanotechnology - nanotube technology - nanoparticles - fullerenes - nanodendrimers - nanopore channels, fibres and scaffolds - CVD diamond technology - FCVA technology and its applications - nanoimaging techniques. (15 h)

Books for Reference:

- 01 Aathony R. West,
Solidstate chemistry and its applications, John Wiley & Sons (1989).
- 02 Raghavan V.R.,
Materials Science and Engineering, Printice Hall (India) Ltd., (2001).
- 03 Kenneth J. Klabunde,
Nanoscale materials in chemistry, A. John Wiley and Sons Inc. Publication.

Semester	Subject Title	Subject Code	Total Hours	Credit
VI	Optional: Industrial Chemistry		75	5

Units	Learning objectives
01	To understand the requirements to start an industry - different fuels used and the industrial catalysts used.
02	To know about different petrochemical industries thoroughly.
03	To understand the manufacture of fertilizers and speciality chemicals.
04	To acquire knowledge about oils, soaps, detergents, sugar industry, leather and pesticide industries.
05	To understand the important process of metallurgy extraction of metals and environmental problems caused by chemical industries.

UNIT 1: INDUSTRIAL REQUIREMENTS

Requirements of an industry - location - water - industrial water treatment - safety measures - pilot plants. Fuels - types of fuels with examples - coal - carbonization of coal - coal tar distillation - liquid fuels - gaseous fuels - selection of fuels - nuclear fuels. Energy - sources of energy - renewable and non-renewable energies - non conventional energies. Industrial catalysts - Types of catalysts - Functions and applications of Raney Nickel, Pd, CuCrO₄, TiO₂, Al, V and Pt based catalysts and zeolites. (15 h)

UNIT 2: PETROCHEMICAL INDUSTRIES

Crude oil - constitution and distillation - composition of different distillates - pour points, depressants, drag reducers, viscosity reducers, ignition point, flash point octane number - cracking - catalysts used in petroleum industries - structure, selectivity and applications. Manufacture of synthetic petrol - Dergius and Fischer Tropsh processes - Manufacture of petrochemicals and petrochemical polymers - Manufacture of higher olefins, Acetaldehyde, Acetic acid, Ethylene glycol, Glycerine, Acetone, Phenol, Carbon disulphide, Vinylacetate, Cumene, Chlorophrene, Butane diols, Xylenes, Linal alkyl benzenes and their Sulphonates. (15 h)

UNIT 3: FERTILIZERS AND SPECIALITY CHEMICALS

Manufacture - Properties and industrial uses of solvents - DMF, DMSO, THF and Dioxane. Fertilizers - Raw materials, manufacture (flow chart chemical process with equations) of ammonium nitrate, ammonium sulphate, urea, calcium cyanamide, calcium ammonium nitrate, sodium nitrate,

ammonium chloride, ammonium phosphate, super phosphate of lime, NPK fertilizers. Manufacture in pure form of the following - Sodium carbonate, Oxalic acid, Potassium dichromate, Perchloric acid. (15 h)

UNIT 4: OILS, SOAPS AND DETERGENTS

Manufacture of Cl_2 , NaOH and Chlorates of Na and K - manufacture of perchlorate. Oils - difference between oils and fats - manufacture of cotton seed oil and soybean oil - refining of oil - manufacture of soaps - toilet and transparent soaps - Detergents - synthetic detergents - surface active agents and their classification - manufacture of anionic, cationic and non ionic detergents and shampoo. Sugar industry - manufacture of sugar from cane sugar and beet root. Manufacture of leather - hides - Vegetable and chrome tanning finishing. Manufacture of DDT, dinitrophenols, BHC, gamaxane, malathion, parathion, schradan and dementon. (15 h)

UNIT 5: METALLURGY

General methods of metallurgy - ores - types - methods of concentration of ores - hydro metallurgy, pyrometallurgy - various methods of reduction process, refining of metals - extraction of Cr, Mn, V, Co, Pt, U and Th. Environmental problems of chemical industries - methods of control - sewage treatment and waste management. Man power in chemical industries - labour problems - Six sigma (Basic concept only).

(15 h)

Books for Reference:

- 01 Sharma B.K.,
Industrial chemistry, Goel publishing House, 2003, Meerut.
- 02 Drydens C.E.,
Outlines of Chemical Technology, Gopala Rao, Eastwest press, NewDelhi.
- 03 Shreve R.V.,
Chemical Process Industries, Tata Mc Graw Hill publishing company, Mumbai.
- 04 Steines H.,
Introduction to Petrochemicals, Pergaman Press.
- 05 Alan Cottrel,
An Introduction to Metallurgy, Orient Longman (2000)

Semester	Subject Title	Subject Code	Total Hours	Credit
VI	Optional: Textile Chemistry		75	5

Units	Learning objectives
01	To understand the classification of natural fibres as vegetable fibres and animal fibres and their physical and chemical properties.
02	To know about different synthetic fibres, their manufacture and properties.
03	To acquire knowledge about scouring and desizing processes.
04	To have clear idea about bleaching technique.
05	To acquire knowledge about principles of dyeing, synthesis of dyestuffs and fastness properties. Students should be able to dye different fibres and test various fastness properties.

UNIT 1: VEGETABLE FIBRES AND ANIMAL FIBRES

Definition - classification of textile fibres - essential and desirable properties of textile fibres - Cotton fibre - Physical and Chemical properties, Jute - Purification; physical and chemical properties of jute, silk and wool (12 Hrs)

UNIT 2: REGENERATED AND SYNTHETIC FIBRES

Rayon - different types of rayon and their sources - manufacture of viscose rayon - physical and chemical properties - acetate rayon - manufacture - properties, ammonium rayon - manufacture and properties. Manufacture - properties and uses of polyamides - polyester - polypropylene and polyacrylonitrile. (12 Hrs)

UNIT 3: PREPARATORY PROCESS PRIOR TO DYEING

Scouring: Objectives of scouring - process of caustic scouring on open kier and closed kier machine with sine diagram, scouring with NaOH and Na₂CO₃ - Precautions to be taken before scouring. Desizing using malt extract - merits and demerits of acid and enzyme desizing. Singeing - Impurities present in grey cotton and cotton fabric - objects of singeing - process of singeing on gas singeing machine - precautions to be taken during gas singeing. (12 Hrs)

UNIT 4: PRINCIPLES OF BLEACHING

Principles of wetting and mechanism of detergency - synthetic detergents - surface active agents - bleaching processes - bleaching agents - H_2O_2 , $NaOCl$, bleaching powder and biobleaching and their properties - bleaching of cotton, rayon, wool and synthetic fibres. (12 Hrs)

UNIT 5: PRINCIPLES OF DYEING

Colour and chemical constitution - Chromophore and auxochromes - natural and synthetic dyes - dyes - classification, synthesis of dyeshift - Congo red, bismark brown and erifstal violet, theories of dyeing - effect of temperature and salt on dyeing - dyeing of wool, silk and poly-esters - dyeing of cotton with reactive dyes - fastness properties - washing, light, rubbing and perspiration. (12 Hrs)

Books for Reference:

1. Shenai V.A., Textile fibres (Vol. I), Mahajan Publishers, Ahmedabad.
2. Shenai V.A., Technology of bleaching, Mahajan Publishers, Ahmedabad.
3. Shenai V.A., Chemistry of dyes and Principles of dyeing Vol.II, Mahajan Publishers, Ahmedabad.
4. Gopalakrishnan R. 1988, Textile Fibre, SSM, Institute of Textile Technology, Komarapalayam, Namakkal District., Mahajan Publishers, Ahmedabad.

PRACTICALS

(15 Hrs)

1. Desizing of cotton fabric (greep sample) with acid/hot water.
2. Scouring of desized cotton fabric with alkali.
3. Bleaching of scoured cotton fabric using $H_2O_2/CaOCl_2$.
4. Dyeing of cotton fabric using a direct dye/reactive dye.
5. Testing of colour fastness of dyed fabrics to washing and light.
6. Dyeing of silk fabric or yarn with acid dyes.

Semester	Subject Title	Subject Code	Total Hours	Credit
VI	Optional: Biomolecules		75	5

Units	Learning objectives
01	To understand the chemistry of carbohydrates
02	To know the chemistry of proteins and lipids
03	To acquire knowledge about nucleic acids and the energy changes involved in the metabolic processes
04	To understand the chemistry of enzymes and their kinetics
05	To acquire knowledge about various analytical techniques involved in biochemistry

UNIT 1: CARBOHYDRATES

Definition - classification - mono, di and poly saccharides - isolation - preparation properties and uses of mono saccharides - sucrose and fructose - their structures pyranose and furanose structures (elucidation not needed) - inter conversion of sucrose and fructose disaccharides - Isolation of sucrose and maltose (elucidation not needed) - distinction between mono and disaccharide. General study of polysaccharides - starch and cellulose - bioenergy derived from carbohydrate. (15 Hrs)

UNIT 2: PROTEINS AND LIPIDS

Amino acid - structure - proteins - classification - peptide bond - protein- classification structures - primary, secondary, tertiary and quaternary. Globulins - egg and milk protein - membranes - Ion pumps and ion channels - Glycolipids and sulfolipids. (15 Hrs)

UNIT 3: NUCLEIC ACIDS AND BIOENERGETICS

Nucleotides - nucleosides - DNA - RNA - types of metabolism of nucleic acid and biosynthesis - ADP - ATP - low and high energy metabolites - Metabolism - Concept of ΔS - ΔG - exergonic and endergonic reaction - Glycolysis - simplified reaction - Krebs cycle. (15 Hrs)

UNIT 4: ENZYMES

Nomenclature classification biological role of enzymes - specificity - enzyme action - Michaelis-Menten equation - models - Fisher's lock and key model - Koshland's induced fit model - Co-enzymes - NAD, NADPH - Chymotrypsin - coenzymes. (15 Hrs)

UNIT 5: ANALYTICAL BIOCHEMISTRY

Application of various analytical tools to various Biomolecules - chromatography - column paper, TLC, Ion Exchange – X-ray Diffraction - Isotopic Tracer techniques - Neutron activation analysis - Ultra centrifugation - electrophoresis. (15 Hrs)

Books for Reference:

1. Jain J.L., Jain S. and Jain, Fundamentals of Biochemistry Schaned Report 2007, New Delhi.
2. Jain J.L., Jain and Jain N., Elementary Biochemistry Scand, III Revised edn. 2007, New Delhi.

Semester	Subject Title	Subject Code	Total Hours	Credit
VI	Optional: Pharmaceutical Chemistry		75	5

Units	Learning objectives
01	To understand the common diseases and the cure To know the terms of pharmacology
02	To understand the mechanism of drug action
03	To acquire knowledge about chemotherapy and the antibiotics
04	To understand the drugs used for diabetes, hypertension, cholesteralaemia
05	To acquire knowledge about various health promoting drugs

UNIT 1: INTRODUCTION

Common diseases - Infective diseases - insect-borne, air-borne and water-borne - hereditary diseases - Terminology - drug, pharmacology, pharmacognesy, pharmacodynamics, pharmacokinetics, antimetaboli-tes Absorption of drugs - routes of administration of drugs, factors affecting absorption - Assay of drugs - chemical, biological, immunological assays, LD₅₀ and ED₅₀ therepeutic index, drug dosage. (15 Hrs)

UNIT 2: DRUGS

Various sources of drugs, pharmacologically active constitutents in plants, Indian medicinal plants - tulasi, neem, keezhanelli - their importance - Classification of drugs-biological chemical - Mechanism of drug action-Action at cellular and extra cellular sites. Drug receptors and biological responses - Metabolism of drugs through oxidation, reduction hydrolysis and conjugate processes; factors affecting metabolism. (15 Hrs)

UNIT 3: CHEMOTHERAPY

Designation of drugs based on physiological action; Definition and two examples each of Anaesthetics-General, IV and local - Analgesics - Narcotic and synthetic - Antipyretics and anti inflammatory agents - Antibiotics - penicillin, streptomycin, chloramphenicol, tetracyclins - Antivirals, AIDS - symptoms, prevention, treatment - Cancer and neoplastic agents. (15 Hrs)

UNIT 4: COMMON BODY AILMENTS

Diabetes - Causes, hyper and hypoglycemic drugs - Blood pressure - Sistolie & Diastolic Hypertensive drugs - Cardiovascular drugs - antiarrhythmic, antianginals, vasodilators - CNS

depressants and stimulants - Psychedelic drugs, hypnotics, sedatives (barbiturates, LSD) - Lipid profile - HDL, LDL cholesterol, lipid lowering drugs. (15 Hrs)

UNIT 5: HEALTH PROMOTING DRUGS

Nutraceuticals-Vitamins A B C D E and K micronutrients Na K Ca Cu Zn I -Medically important inorganic compounds of Al P As Hg Fe - L examples each their role and applications - Organic Pharmaceutical acids; Agents for kidney function(Aminohippuric acid); Agents for liver function (Sulfo bromophthalein); Agents for pituitary function (metyrapone) - Organic pharmaceutical bases - antioxidants, treatment of ulcer and skin diseases. (15 Hrs)

Book for Study:

Jayashree Ghosh, Pharmaceutical chemistry, S.Chand and Company Ltd., 2006, New Delhi.

Books for Reference:

1. Lakshmi S., Pharmaceutical chemistry, S.Chand & Sons, 1995, New Delhi.
2. Ashutosh Kar, Medicinal chemistry, Wiley Eastern Ltd., 1993, New Delhi.
3. David William & Thomas Lemke, Foyes principles of medicinal chemistry, 5th edition 2005, BI publishers.
4. Romas Nogrady, Medicinal chemistry, II Edition 2004, Oxford Univ. Press.

Semester	Subject Title	Subject Code	Total Hours	Credit
VI	Optional: Dairy Chemistry		75	5

Units	Learning objectives
01	To understand the chemical composition of milk
02	To know the techniques of milk processing
03	To acquire knowledge about various milk products
04	To understand the chemistry of other types of special milk
05	To acquire knowledge about techniques of fermentation of milk and various milk products

UNIT 1: COMPOSITION OF MILK

Milk - definition-general composition of milk - constituents of milk - lipids, proteins, carbohydrates, vitamins and minerals - physical properties of milk - colour, odour, acidity, specific gravity, viscosity and conductivity - Rennet effect - factors affecting the composition of milk - adulterants, preservatives and neutralizer - examples and their detection - estimation of fat, acidity and total solids in milk. (15 Hrs)

UNIT 2: PROCESSING OF MILK

Microbiology milk - destruction of micro organisms in milk - physico-chemical changes taking place in milk due to processing - boiling, pasteurization - types of pasteurization - Bottle, Batch and HTST (High Temperature Short Time) - Vacuum pasteurization - Ultra High Temperature Pasteurization. (15 Hrs)

UNIT 3: MAJOR MILK PRODUCTS

Cream - definition-composition-chemistry of creaming process-gravitational and centrifugal methods of separation cream-estimation of fat in cream.

Butter - definition - composition - theory of churning - desibutter - salted butter - estimation of acidity and moisture content in butter.

Ghee - major constituents - common adulterants added to ghee and their detection - rancidity - definition - prevention - antioxidants and synergists - natural and synthetic. (15 Hrs)

UNIT 4: SPECIAL MILK

Standardised milk - definition - merits - reconstituted milk - definition - flow diagram of manufacture - Homogenised milk - flavoured milk - vitaminised milk - toned milk - Incitation milk - vegetable toned milk - humanised milk - condensed milk - definition composition and nutritive value. (15 Hrs)

UNIT 5: FERMENTED AND OTHER MILK PRODUCTS

Fermented milk products - fermentation of milk - definition, conditions, cultured milk - definition of culture - examples, conditions - cultured cream - cultured butter milk - Bulgaxious milk - acidophilous milk - Yoheer Indigeneour products - Khoa and chchana definition - Preparation of khoa and chahana sweets - Gulabjamun, chana sweet, Rassogilla. Ice cream - definition - percentage composition types - ingredients - manufacture of ice-cream stabilizers - emulsifiers and their role milk powder - definition - need for making milk powder - drying process - types of drying dairy detergents - characteristics - classification - washing procedure - sterilization - chloramine T and hypochlorite solution. Visit to a pasterization factory/Milk product company and submission of a report. (15 Hrs)

Books for Reference:

1. Robert Jenness and Patom S., Wiley, Principles of Dairy Chemistry, New York.
2. Rangappa K.S. and Acharya K.T., Indian Dairy Products.
3. Wond F.P., Fundamentals of Dairy Chemistry, Springer.
4. Lampert L.M., Modern Dairy products, Chemical Publishing Company Inc., New York.
5. Warner, Wiley, Principles of Dairy Procesing, New York.
6. Sukumar De, Outlines of Dairy technology.

Semester	Subject Title	Subject Code	Total Hours	Credit
VI	Optional: Food Chemistry		75	5

Units	Learning objectives
01	To understand the chemistry of food adulteration and adulterants To know the methods of analyzing the adulterants
02	To know the chemistry of food poisoning
03	To acquire knowledge about food additives
04	To understand the chemistry of beverages and soft drinks To know the methods of preparing the soft drinks by field visits
05	To acquire knowledge about various edible oils and the processing techniques related to oils

UNIT 1: FOOD ADULTERATION

Sources of food, types, advantages and disadvantages. Food adulteration - contamination of Wheat, Rice, Alial, Milk, Butter etc. with clay stones, water and toxic chemicals - Common adulterants. Common adulterants Ghee adulterants and their detection. Detection of adulterated Foods by simple analytic techniques. (10 Hrs Theory + 5 Hrs Practicals)

UNIT 2: FOOD POISON

Food poisons - natural poisons (alkaloids - nephrotoxic) - pesticides. (DDT, BHC, Malathion) - Chemical poisons - First aid for poison consumed victims. (15 Hrs)

UNIT 3: FOOD ADDITIVES

Food additives - artificial sweeteners - Saccharin - Cyclamate and aspartate. Food flavours - esters, aldehydes and heterocyclic compound. Food colours - restricted use - spurious colours - Emulsifying agents - preservatives learning agents. Baking powder yeast - taste makers - MSG vinegar. (15 Hrs)

UNIT 4: BEVERAGES

Beverages - Soft drinks - soda - fruit juices - alcoholic beverages examples. Carbonation - addiction to alcohol - cirrhosis of liver and social problems. (10 Hrs Theory + 5 Hrs Practical(Field work))

UNIT 5: EDIBLE OILS

Fats, Oils - Sources of oils - Production of Refined vegetable oils - Preservation. Saturated and unsaturated fatty acids – I_2 value - Role of MUFA and PUFA in preventing heart diseases - determination of I_2 - value RM value, saponification values and their significance. Estimation of I_2 and RM values in Edible oils. (10 Hrs Theory + 5 Hrs Practical)

Books for Reference:

1. Swaminathan M., Food Science and Experimental foods, Ganesh and Company.
2. Jayashree Ghosh, Fundamental concepts of Applied chemistry, S. Chand & Co. Publishers.
3. Thanamma Jacob, Text Books of applied chemistry for Home Science and allied Sciences, Macmillan.

Semester	Subject Title	Subject Code	Total Hours	Credit
VI	Optional: Applied Electrochemistry		75	5

Units	Learning objectives
01	To understand the electrochemistry principles applied in industries
02	To know the chemistry of electrometallurgical techniques
03	To acquire knowledge about electroplating techniques
04	To understand the electrochemical cells as sources of power
05	To understand the chemistry of metallic corrosion and methods of prevention

UNIT 1: INDUSTRIAL ELECTROCHEMISTRY

Electrochemical process in industry - components of electrochemical reactors - Types of electrolytes - Cathodes and anodes in electrochemical reactor - separators. Inorganic Electrochemicals: Caustic soda and chlorine production, mercury cells, diaphragm cells, membrane cells - Advantage chlorates, perchlorates, hydrogen peroxide. Organic Electrochemicals: Special features of electro-organic synthesis - electrochemical oxidation. Kolbe synthesis - Electro reduction of carbonyl compounds - adiponitrile synthesis. (15 Hrs)

UNIT 2: ELECTROMETALLURGY

Electro deposition of metals - principles - nucleation and growth of crystals - nature of electro deposits. Hydrometallurgy: Recovery of metals from aqueous electrolytes. Recovery of silver from photographic emulsion - electro refining - production of high purity copper; process description. Pyrometallurgy: Necessity for using molten electrolytes - reactors for molten salt electrolysis - Production of aluminium - electrodes and electrode reactions in cryolite melt. Electrochemical purification of aluminium - other metals through molten salt electrolysis - Magnesium and sodium brief outline. (15 Hrs)

UNIT 3: ELECTROPLATING

Fundamental principles - nature of deposits for electroplating - Hull cell experiments - operating conditions and nature of deposits - throwing power - preparation of samples for electroplating - chemical and electrochemical cleaning - electroplating of copper, nickel and cadmium.

Electroless plating: Importance, plating of non metals - Both composition - electroless plating of copper and nickel. (15 Hrs)

UNIT 4: ELECTROCHEMICAL POWER SOURCES

Basic principles, chemical and electrical energies - inter conversion - charging and discharging - requirements for a good power source - Types of power sources. Primary Batteries:

Description of primary cells - alkaline, manganese cells - silver oxide - zinc cells - lithium primary cells - applications. Secondary Batteries: Importance applications - charge discharge efficiency - cycle life - energy density - lead acid batteries - batteries for electric vehicles. Fuel Cells: Basic principles - Hydrogen, oxygen fuel cells - gas diffusion electrodes for fuel cells - alkaline fuel cells. (15 Hrs)

UNIT 5: CORROSION AND PREVENTION

Principles - stability of metals - EMF series - active and noble metals. PH effect on stability - pourbaix diagram - Kinetics of corrosion - Mixed potential process - Cathodic reaction - anodic reaction - corrosion current - active dissolution - passivation - break down of passivity - Evans diagram. Methods of Corrosion Protection: Principles - Inhibition of anodic, cathodic processes - Inhibitive additives for corrosion protection - protective coatings - types of coatings - protection of structures and pipelines - cathodic protection - examples - sacrificial anodes - protection of ships in sea water. (15 Hrs)

Books for Reference:

1. Pletcher D. and Walsh F.C., Industrial Chemistry (II edition).
2. Hamann C.H., Hamnett A., and Vielstich W., Electrochemistry.
3. Hibbert D.B., Introduction to electrochemistry.

Semester	Subject Title	Subject Code	Total Hours	Credit
VI	Optional: Agricultural Chemistry		75	5

Units	Learning objectives
01	To understand the soil and its formation
02	To know the physical properties of soil and other related aspects
03	To acquire knowledge about chemistry aspects of soil and nitrogen fixing process
04	To understand the chemistry of nutrients that are present in soil
05	To understand the chemistry of pesticides, fungicides and herbicides

UNIT 1: ORIGIN OF SOIL

Definition of soil - origin - igneous - metamorphic and sedimentary rocks - rock systems - weathering of rocks and minerals - main components of soil - organic, inorganic, liquid and gaseous phase - Minerals of importance with respect to soils, industries and agriculture - Soil formation - physical, chemical and biological factors responsible for soil formation-soil forming processes - Major soil groups of Tamil Nadu - Soil survey standard soil survey - methods of soil survey - methods of soil surveys - remote sensing and soil mapping - soil resource management - use of satellite data for source inventory. (15 Hrs)

UNIT 2: PHYSICAL PROPERTIES OF SOIL

Physical properties of soil - soil texture and textural classification - pore space - bulk density, particle density - soil structure and soil colour - surface area - soil colloids - plasticity, shrinkage - flocculation and deflocculation - soil air, soil temperature, their importance in plant growth - soil reaction - Ion exchange reaction - cation exchange - anion exchange - Buffering capacity - hydrogen ion concentration - determination of pH values - Factors affecting soil pH - Soil pH and nutrient availability - Soil degradation - causes. (15 Hrs)

UNIT 3: CHEMISTRY ASPECTS OF SOIL

Origin of problem soils, their properties acid, alkali and saline soils - diagnosis - remediation of acid and salt affected soils - Methods of reclamation and after care - Quality of irrigation water - causes for poor quality waters for irrigation, their effects in soils and crops. Soil testing - Concept, objectives and basis - soil sampling, tools, collection processing, dispatch of soil and water samples. soil organic matter - its decomposition and effect on soil fertility - source of organic matter

in soil - maintenance and distribution - soil organism - their role - nitrification - denitrification, nitrogen fixation in soils - biological nitrogen fixation - microbial interrelationship in soil - microbes in pest and disease management - Bio-conversion of agricultural wastes. (15 Hrs)

UNIT 4: PLANT NUTRIENTS

Plant nutrients - macro and micro nutrients - their role in plant growth - sources - forms of nutrient absorbed by plants - factors affecting nutrient absorption - deficiency symptoms in plants - corrective measures - chemicals used for correcting nutritional deficiencies - nutrient requirement of crops, their availability, fixation and release of nutrients. Fertilizers - classification of NPK fertilizers - sources - natural and synthetic - straight - complex - liquid fertilizers, their properties, use and relative efficiency - secondary and micro nutrient fertilizers - mixed fertilizers - principle of fertilizers use - the efficient use of various fertilizers - integrated nutrient management biofertilizers - rhizobium, azospirillum, azotobacter - Blue green algae and azolla production and quality control of bio-fertilizers. (15 Hrs)

UNIT 5: PESTICIDES, FUNGICIDES AND HERBICIDES

Pesticides: Definition – Classification – organic and inorganic pesticides – mechanism of action – Characteristics – Safe handling of pesticides – impact of pesticides on soil, plants and environment – Acts and Laws concerning the pesticides. Fungicides: Definition – classification – mechanism of action – sulfur, copper, mercury compounds, dithanes, dithiocarbamates. Herbicides: Definition – Classification – mechanism of action – Arsenic and boron compounds – nitro compounds, chloro compounds, Triazines, propionic acid derivatives, urea compounds. Acaricides – Rodenticides – Attractants – Repellants – Fumigants defoliant (15 Hrs)

Books for Reference:

1. Biswas, T. D. and Mukeherjee, S. K. Textbook of Soil Science, 1987
2. Daji, A.J. A Textbook of Soil Science, Asia Publishing House, Madras, 1970
3. Tisdale, S.L., Nelson, W.L. and Beaton, J. D. Soil Fertility and Fertilizers, Macmillan Publishing Company, New York, 1990
4. Hesse, P.R. A Textbook of Soil Chemical Analysis, John Murray, New York, 1971.
5. Buchel, K.H. Chemistry of Pesticides, John Wiley & Sons, New York, 1983
6. Sree Ramula, U. S. Chemistry of Insecticides and Fungicides, Oxford and IBH Publishing Co., New Delhi, 1979

Semester	Subject Title	Subject Code	Total Hours	Credit
VI	Optional: Leather Chemistry		75	5

Units	Learning objectives
01	To understand the distinction between hide, skin and leather and their structure and composition.
02	To acquire knowledge on the different types of tanning and the pre-tanning processes.
03	To understand in detail the chemistry of tanning process.
04	To study the chemical methods of curing and preservation of hider and skins.
05	To understand the impact of tannery effluents on the environment, project on effluent analysis.

UNIT 1: INTRODUCTION TO LEATHER CHEMISTRY

Importance of leather industry - scope of leather chemistry - distinction between hides, skins and leather - a detailed steed of the structure and composition of hider and skins - Proteins and their characteristics - Anatomy and histology of protein constituents of leather. (15 Hrs)

UNIT 2: TANNING PROCESSES

Basic principle involved in pre-tanning - soaking, liming, deliming, bating, pickling and depickling. Types of tanning - Vegetable and mineral tanning - different types of vegetable tanning - materials - classification and chemistry of vegetable tanning - factors and physico-chemical principles involved in vegetable tanning - Fixation of vegetable tanning - Synthetic tanning - classification - General methods. (15 Hrs)

UNIT 3: CHEMISTRY OF TANNING

The preparation and chemistry of chrome tanning liquids - olation, oxolation and hydrolysis of chrome liquids. Effect of adding tanning agents. Role of pH in the reaction of chromium complexes with hide proteins. Factors governing chrome tanning. Chemistry of neutralisation process. A brief survey of chemistry of other tanning agents like Al, Zr and Te salts and their relative merit in contrast with chrome tanning.

(15 Hrs)

UNIT 4: PRESERVATION AND PROCESSING OF LEATHER

Chemical methods of curing and presentation of hides and skins in acid and alkaline solutions. Principle of methods employed in curing, liming, deliming, bating and pickling - Process of dyeing leather - Use of mordants - Dyeing auxiliaries such as leveling, wetting and dispersing agents - Dye fixations. (15 Hrs)

UNIT 5: ENVIRONMENTAL IMPACT OF TANNERY INDUSTRIES & PROJECT WORK

Tannery effluent and treatment - Types of water pollution - Different types of tannery effluents and wastes - Solid waste - Origin and disposal.

Project: A small group project on collecting tannery effluents from various sources and their chemical analysis. (10 Hrs Theory + 5 Hrs Practical)

Books for Reference:

1. Woodroffe, John Wiley, Fundamentals of leather science.
2. Visit to a leather processing unit to understand the process of tanning and leather processing.
3. Visit to CLRI to have an idea of the research and development in leather industry.

Semester	Subject Title	Subject Code	Total Hours	Credit
VI	Optional: Polymer Chemistry		75	5

Units	Learning objectives
01	To know about the types of polymers and the chemistry of polymerisation.
02	To understand the physical properties of polymers, their reactions and degradation.
03	To acquire knowledge about the polymerisation techniques and polymer processing.
04	To know the chemistry of individual polymers, their preparation & properties
05	To have an idea about the recent advances in polymer science

UNIT 1: INTRODUCTION TO POLYMERS

Importance of polymers: Basic concept- Monomers and polymers - definition. Classification of polymers on the basis of microstructures, macrostructures and applications (thermosetting and thermoplastics) Distinction among plastics, elastomers and fibers. Homo and heteropolymers. Copolymers.

Chemistry of polymerization Chain polymerisation, Free radical, ionic, coordination step Polymerisation

Polyaddition and polycondensation miscellaneous ring-opening & group transfer polymerisations. (15 Hrs)

UNIT 2: PHYSICAL PROPERTIES AND REACTIONS OF POLYMERS

Properties: Glass transition temperature (T_g)- Definition- Factors affecting T_g-relationships between T_g and molecular weight and melting point. Importance of T_g. Molecular weight of polymers: Number average, weight average, sedimentation and viscosity average molecular weights. Molecular weights and degree of polymerisation. Reactions: hydrolysis - hydrogenation - addition - substitutions-cross-linking vulcanisation and cyclisations reactions. Polymer degradation. Basic idea of thermal, photo and oxidative degradations of polymers. (15 Hrs)

UNIT 3: POLYMERIZATION TECHNIQUES AND PROCESSING

Polymerisation techniques: Bulk, solution, suspension, emulsion, melt condensation and interfacial polycondensation polymerisations. Polymer processing: Calendering - die casting, rotational casting - compression. Injection moulding. (15 Hrs)

UNIT 4: CHEMISTRY OF COMMERCIAL POLYMERS

General methods of preparation, properties and uses of the following

Polymers: Teflon, polydimethylmethacrylate. Polyethylene, polystyrene, PAN, polyesters, polycarbonates, polyamides, (Kevlar), polyurethanes, PVC, epoxy resins, rubber-styrene and neoprene rubbers, Phenol - formaldehydes and urea-formaldehyde resins. (15 Hrs)

UNIT 5: ADVANCES IN POLYMERS

Biopolymers-biomaterials. Polymers in medical field. High temperature and fire-resistant polymers. Silicones. Conducting polymers- carbon Fibers. (basic idea only). (15 Hrs)

TEXT BOOK

Billmeyer F.W., Text book of polymer science, Jr. John Wiley and Sons, 1984.

Books for Reference:

1. Gowariker V.R., Viswanathan N.V. and Jayadev Sreedhar, Polymer Science, Wiley Eastern Ltd., New Delhi, 1978.
2. Sharma, B.K., Polymer Chemistry, Goel Publishing House, Meerut, 1989.
3. Arora M.G., Singh M. and Yadav M.S., Polymer Chemistry, 2nd Revised edition, Anmol Publications Private Ltd., New Delhi, 1989.

Methods and Media

Visit to a polymer processing unit, seminar. test-based term paper.

Semester	Subject Title	Subject Code	Total Hours	Credit
VI	Optional: Forensic Chemistry		75	5

Units	Learning objectives
01	To learn Crime investigation through diagnosis of poisoning and postmortem.
02	To acquire knowledge about explosions, the causes (gelatin sticks, RDX etc) and the security measures.
03	To understand the methods of detecting Forgery in bank and educational records.
04	To acquire a comprehensive knowledge about tracks and traces.
05	To understand the chemical methods used in crime investigation. (Medical aspects).

UNIT 1: POISONS

Poisons-types and classification-diagnosis of poisons in the living and the dead - clinical symptoms - postmortem appearances. Heavy metal contamination (Hg, Pb, Cd) of sea foods-use of neutron activation analysis in detecting Arsenic in human hair. Treatment in cases of poisoning - use of antidotes for common poisons.

UNIT 2: CRIME DETECTION

Accidental explosion during manufacture of matches and fire works (as in Sivakasi). Human bombs- possible explosives (gelatin sticks and RDX) - metal defector devices and other security measures for VVIP- composition of bullets and detecting powder burne. Analysis of incendiary and timed bombs - spill of toxic and corrosive chemicals from tankers.

UNIT 3: FORGERY AND COUNTERFEITING

Documents - different types of forged signatures-simulated and traced forgeries - inherent signs of forgery methods - writing deliberately modified- uses of ultraviolet rays - comparison of type written letters - checking silver line water mark in currency notes - alloy analysis using AAS to detect counterfeit coins - detection of gold purity in 22 carat ornaments - detecting gold plated jewels - authenticity of diamond.

UNIT 4: TRACKS AND TRACES

Tracks and traces - small tracks and police dogs-foot prints - costing of foot prints - residue prints, walking pattern or tyre marks - miscellaneous traces and tracks - glass fracture - tool marks-paints - fibres-Analysis of biological substances - blood, semen, saliva, urine and hair- Cranial analysis (head and teeth) DWA Finger printing for tissue identification in dismembered bodies-detecting steroid consumption in athletes and race horses.

UNIT 5: MEDICAL ASPECTS

Aids - causes and prevention - misuse of scheduled drugs - burns and their treatment by plastic surgery. Metabolite analysis using mass spectrum – gas chromatography. Arson-natural fires and arson - burning characteristics and chemistry of combustible materials - nature of combustion. Ballistics - classification - internal and terminal ballistics - small arms - laboratory examination of barrel washing and detection of powder residue by chemical tests.

Books for Reference:

1. T.H.James, Forensic Sciences, Stanley Thornes Ltd.
2. Richard, Criminalistics - An Introduction to Forensic Science (College Version), 8th Edition, Sofeststein, Printice Hall.

PROPOSED MODEL SYLLABI FOR ALLIED PAPERS

Allied Chemistry Syllabus Committee

Coordinator

Dr. V. Veeraiyan,
Reader in Chemistry,
Government Arts College,
Karur - 639 005.

Members

1. Mrs. N. Anandha Parameswari,
HOD of Chemistry,
G.V.G. Visalakshi College for Women,
Venkatesa Mills (Post),
Udamalpet – 642 128.
2. Dr. M.A. Kandhaswamy,
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Coimbatore – 641 020.
3. Thiru. M. Kuppuswamy,
Lecturer in Chemistry,
Chikkanna Government Arts College,
Tirupur - 641 602.
4. Prof. P. Mani,
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Gobi Arts and Science College,
Karattadipalayam,
Gobichettipalayam – 638 453.
5. Tmt. K. Rajalakshmi,
SG Lecturer &
HOD of Chemistry,
Quaid-E-Milleth College for Women,
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Salem - 636 007.
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9. Mrs. V. Sakthi,
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10. Tmt. R. Thamilarasi,
Reader in Chemistry,
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Mylapore,
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Evaluation

Internal Assessment

Test	25	
Assignment	25	
Seminar	25	
Quiz	25	
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Total	100	Reduced to 25
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External Examination

75 Marks

Unit	Part A (Short Answer)	Part B (Paragraph Answer)	Part C** (Essay Type)	Total
1	2(4)	* 2(5)	1 (10)	5(24)
2	2(4)	*2(5)	1(10)	5(24)
3	2(4)	*2(5)	1(10)	5(24)
4	2(4)	*2(5)	1(10)	5(24)
5	2(4)	*2(5)	1(10)	5(24)
Total No. of Questions	10	10	5	25
Total Marks	20	50	50	120
No. of Questions to be answered	10	5	3	18
Max. Marks scored	20	25	30	75

* either or type

** answer any three only.

Semester	Subject Title	Subject Code	Total Hours	Credit
I	Allied Chemistry I		90	6

Units	Learning objectives
01	To understand the nuclear particles To know the nuclear reactions and the radioactivity of some nuclei
02	To understand the chemistry principles involved in some preparations of industrial products To know the principle of softening the hard water
03	To understand the fundamentals of organic chemistry and reactions To know the electrophilic substitution mechanism in benzene
04	To know the methods of preparation of some organic chemical compounds and their uses
05	To understand the photochemical phenomenon in systems and the laws that govern them To understand the phenomenon of photosynthesis

Note: For Biology and Geology students

UNIT 1: NUCLEAR CHEMISTRY

Fundamental particles of Nuclear Isotopes, Isobars, Isotones and Isomers - Differences between chemical reactions and nuclear reactions: Fusion and fission - Radio active series, group displacement law - Mass defect, derivation of $E=mc^2$ - Applications of radio isotopes carbon dating, rock dating and medicinal applications.

UNIT 2: INDUSTRIAL CHEMISTRY

Fuels- Classification-gaseous fuels like water gas, producer gas, liquefied petroleum gas, gobar gas, Compressed natural gas - Fertilizers- Classification - urea, Ammonium sulphate, superphosphate, Triple super phosphate, potassium nitrate- manufacture and uses - Silicones - Preparation, properties and applications.

Hardness of water: temporary and permanent hardness, disadvantages of hard water - Softening of hard water - Zeolite process, demineralization process and reverse osmosis - Purification of water for domestic use: use of chlorine, Ozone and UV light - Definition and determinations of BOD and COD.

UNIT 3: FUNDAMENTALS OF ORGANIC CHEMISTRY

Classification of organic compounds – Hybridization in methane, ethane, acetylene, benzene - Classification of reagents - electrophiles, nucleophiles and free radicals - Classification of reactions - addition, substitution, elimination, condensation of polymerisation - Polar Effects-Inductive effect,

resonance, hyper-conjugation, steric effect and Keto-enol tautomerism – electrophilic substitution mechanism in benzene (Nitration and Sulphonation)

UNIT 4: CHEMISTRY OF SOME USEFUL ORGANIC COMPOUNDS

Preparation and uses of CH_2Cl_2 , CHCl_3 , CCl_4 , CF_2 , Cl_2 , BHC, DDT and Teflon - Hetero cyclic compounds -) - Introduction to heterocyclics – Chemistry of furan, thiophene, pyrrolr, pyridine and their uses

UNIT 5: PHOTOCHEMISTRY

Introduction to Photochemistry - statement of Grothus - Draper Law, Stark- Einstein's Law, Quantum yield. Hydrogen-Chlorine reaction (Elementary idea only) Photosynthesis, photosensitization, phosphorescence, Fluorescence, Chemiluminescence's - Definition with examples.

Books for Reference:

- 01 Dr. Veeraiyan V., *Text book of Ancillary Chemistry*, Highmount Publishing house, Chenna-14. Edition - 2006. (Both in Tamil and English)
- 02 Vaithyanathan S. and Others, *Text book of Ancillary Chemistry*, Priya Publications, Karur-2. Edition - 2006.
- 03 Soni P.L. and Others, *Text book of Organic chemistry*, Sultan Chand and Company, New Delhi, Edition - 2006.
- 04 Soni P.L. and Others, *Text book of Inorganic Chemistry*, Sultan Chand and Company, New Delhi, Edition - 2006.
- 05 Puri B.R., Sharma and Pathania, *Text book of Physical Chemistry*, Vishal Publishing Co., New Delhi. Edition - 2006.
- 06 Dara S.S., *Text book of Environmental chemistry and Pollution Control.*- S.Chand and Co., NewDelhi, Edition 2006.

Semester	Subject Title	Subject Code	Total Hours	Credit
II	Allied Chemistry II		90	6

Units	Learning objectives
01	To understand the coordinate bonding in molecules and the theories related to this bonding To know the Chelation and its applications
02	To understand the chemistry carbohydrates like glucose, fructose, starch, etc.
03	To know the chemistry of proteins and amino acids To understand the peptide linkage in these biopolymers
04	To understand the principles of electrochemical reactions To appreciate the behaviour of electrolytes
05	To understand the principles of chemical analysis – qualitative and quantitative To know the separation techniques and spectroanalytical techniques

Note: For Biology and Geology students

UNIT:1 CO-ORDINATION CHEMISTRY

Definition of terms - classification of legends- Nomenclature - Chelation-EDTA and its Applications - Werner's Theory - Effective Atomic Number - Pauling's Theory - Postulates - Applications to $(Ni(CO)_4)$ $(Ni(CN)_4)^{2-}$, $(Co(CN)_6)^{3-}$ Merits and demerits of Werner and Pauling's Theory - Biological role of hemoglobin and chlorophyll.(Elementary idea only) - Applications of coordination compounds in qualitative and quantitative analysis like separation of copper and cadmium ions; Nickel and cobalt ions; identification of metal ions like Cu, Fe and Ni - Estimation of Nickel using DMG and estimation of Aluminium using Oxine.

UNIT 2: CARBOHYDRATES

Classification, preparation and reactions of glucose and fructose Discussion of open and ring structure of glucose, mutarotation. Inter conversion of glucose to fructose and vice versa - Preparation and properties of sucrose. Properties of starch, Cellulose and derivatives of cellulose - Diabetes - Causes and control measures.

UNIT 3: PROTEINS

Amino acids-Classifications, Preparation and properties of alanine - Preparation of dipeptide using Bergman method - Proteins -Classification according to composition, biological functions and shape - Denaturation and colour reactions of Proteins - Primary and secondary structure of Proteins - Nucleic acids: DNA and RNA-Their components and biological functions.

(18 Hrs)

UNIT 4: ELECTROCHEMISTRY

Galvanic cells - emf - standard electrode potential - reference electrodes - electrochemical series and its applications - Determination of pH using electrometric method - Electroplating process - Nickel and Chrome plating - Different type of cells - primary cell, Secondary cell and fuel cells - Corrosion and methods of prevention. Conductometric titrations hydrolysis of salts. Derivation of K_h and x - Definition of p^H and its determinations by colorimetric method. Buffer solution - Henderson's equation. Applications of p^H and buffer in biological processors and industries - Corrosion and its prevention.

UNIT 5: ANALYTICAL CHEMISTRY

Introduction to Qualitative and Quantitative Analysis – Principle of volumetric analysis – Separation techniques – extraction – distillation - crystallization – Chromatographic separations - Principles and applications of column paper, thin layer, gas-liquid and ion-exchange

Books for Reference:

- 01 Dr. Veeraiyan V., *Text book of Ancillary Chemistry*, Highmount Publishing house, Chenna-14. Edition - 2006. (Both in Tamil and English)
- 02 Vaithyanathan S. and Others, *Text book of Ancillary Chemistry*, Priya Publications, Karur-2. Edition - 2006.
- 03 Soni P.L. and Others, *Text book of Organic chemistry*, Sultan Chand and Company, New Delhi, Edition - 2006.
- 04 Soni P.L. and Others, *Text book of Inorganic Chemistry*, Sultan Chand and Company, New Delhi, Edition - 2006.
- 05 Puri B.R., Sharma and Pathania, *Text book of Physical Chemistry*, Vishal Publishing Co., New Delhi. Edition - 2006.
- 06 Dara S.S., *Text book of Environmental chemistry and Pollution Control.*- S.Chand and Co., NewDelhi, Edition 2006.

SCHEME OF EVALUATION (for theory)

Internal Assessment 25 marks

Test 25

Assignment 25

Seminar 25

Quiz 25

100

External Examination 75 marks

Unit	Part A (Short Answer)	Part B (Paragraph Answer)	Part C (Essay Type)	Total
1.	2(4)	*2(5)	1(10)	
2.	2(4)	*2(5)	1(10)	
3.	2(4)	*2(5)	1(10)	
4.	2(4)	*2(5)	1(10)	
5.	2(4)	*2(5)	1(10)	
Total No. of questions	10	10	5	25
Total marks	20	50	50	120
No. of questions to be answered	10	5	3	18
Max. marks scored	20	25	30	75

* Answer either or type

** Answer any three questions.

Semester	Subject Title	Subject Code	Total Hours	Credit
I	Allied Chemistry I		90	6

Units	Learning objectives
01	To understand the nuclear particles To know the nuclear reactions and the radioactivity of some nuclei
02	To understand the chemistry principles involved in some preparations of industrial products To know the principle of softening the hard water
03	To understand the fundamentals of organic chemistry and reactions To know the electrophilic substitution mechanism in benzene
04	To know the laws of Thermodynamics and various thermodynamic processes To understand the energy changes between the system and the surrounding
05	To understand the rates of chemical reactions and the energy factor that controls the chemical reactions To know the catalytic phenomena in reactions To understand the photochemical phenomenon in systems and the laws that govern them

Note: For Maths and Physics students

UNIT 1: NUCLEAR CHEMISTRY

Fundamental particles of nucleus, isotopes, isobars, isotones and isomers - Differences between chemical reactions and nuclear reactions; fusion and fission - Radio active series, group displacement law - Mass defect, derivation of $1\text{amu} = 931\text{ MeV}$ - nuclear binding energy and calculation - Applications of radio isotopes - carbon dating, rack dating and medicinal applications.

UNIT 2: INDUSTRIAL CHEMISTRY

Fuels- Classification-gaseous fuels like water gas, producer gas, liquefied petroleum gas, gobar gas, Compressed natural gas - Fertilizers- Classification - urea, Ammonium sulphate, superphosphate, Triple super phosphate, potassium nitrate- manufacture and uses - Silicones - Preparation, properties and applications.

Hardness of water: temporary and permanent hardness, disadvantages of hard water - Softening of hard water - Zeolite process, demineralization process and reverse osmosis - Purification of water for domestic use: use of chlorine, Ozone and UV light - Definition and determinations of BOD and COD.

UNIT 3: FUNDAMENTALS OF ORGANIC CHEMISTRY

Classification of organic compounds – Hybridization in methane, ethane, acetylene, benzene - Classification of reagents - electrophiles, nucleophiles and free radicals - Classification of reactions - addition, substitution, elimination, condensation of polymerisation - Polar Effects-Inductive effect, resonance, hyper-conjugation, steric effect and Keto-enol tautomerism – electrophilic substitution mechanism in benzene (Nitration and Sulphonation) - Heterocyclic compounds - Preparation, properties and uses of furan, Thiophene, pyrrole and pyridine

UNIT 4: THERMODYNAMICS

Definition of certain terms – system, surrounding, reversible and irreversible processes - Limitations of I Law - Need for II Law - Different Statements of II Law - Carnot cycle - Efficiency - Carnot Theorem - Thermodynamic Scale of Temperature - Entropy- Definition Unit and phase transformation - Free energy - nature of process in terms of Free energy and entropy - Statement of Third Law.

UNIT 5: CHEMICAL KINETICS

Rate of chemical reaction- Differential rate expression - order and molecularity – Integrated rate expression for first, second and zero order reactions – Half-life period – Effect of temperature on rate – Activation energy – Arrhenius equation – Arrhenius reaction rate theory – Homogeneous and heterogeneous catalysis. Photo chemistry - Statement of Grothus - Draper Law, Stark-Einstein's Law, Quantum Yield. Hydrogen chlorine reaction (elementary idea only) Photosynthesis, Photosensitisation, Phosphorescence Fluorescence, Chemiluminescence - Definition with examples.

Books for Reference:

- 01 Dr. Veeraiyan V., *Text book of Ancillary Chemistry*, Highmount Publishing house, Chenna-14. Edition - 2006. (Both in Tamil and English)
- 02 Vaithyanathan S. and Others, *Text book of Ancillary Chemistry*, Priya Publications, Karur-2. Edition - 2006.
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- 06 Dara S.S., *Text book of Environmental chemistry and Pollution Control*.- S.Chand and Co., NewDelhi, Edition 2006.

Semester	Subject Title	Subject Code	Total Hours	Credit
II	Allied Chemistry II		90	6

Units	Learning objectives
01	To understand the coordinate bonding in molecules and the theories related to this bonding To know the Chelation and its applications
02	To understand the chemistry of biomolecules like sugars, proteins and nucleic acids
03	To understand the phase rule and working of this rule in one component and two component systems
04	To know the basic principles of electrochemical changes like galvanic cells and electrolysis To understand the working of electrochemical cells
05	To understand the principles of chemical analysis – qualitative and quantitative To know the separation techniques and spectroanalytical techniques

Note: For Maths and Physics students

UNIT 1: CO-ORDINATION CHEMISTRY

Definition of terms - Classification of Ligands - Nomenclature - Chelation - EDTA and the application - Werner's Theory - Effective Atomic Number - Pauling's theory - Postulates - Applications to $Ni(CO)_4$, $(Ni(CN))_2^4$, $(CO(CN))_6^3$ - Merits and Demerits of Werner's and Pauling's theory - Biological Role of Haemoglobin and Chlorophyll (elementary idea only) - Applications of co-ordination compounds in Qualitative analysis and Quantitative analysis like Separation of copper and cadmium ions; Nickel and cobalt ion; Identification of metal ions like Cu, Fe and Ni. Estimation of Ni using DMG and Al using Oxine.

UNIT 2: BIOMOLECULES

Classifications, preparation and reactions of glucose and fructose. Discussion of open and ring structure of glucose. Mutarotation. Interconversion of glucose to fructose and vice versa - Preparation and properties of sucrose. Properties of starch, cellulose and derivations of cellulose - Diabetes - causes and control measures.

RNA and DNA (elementary idea only) - Amino acids: Classification, preparation and properties of alanine - Preparation of dipeptide using Bergman method.

UNIT 3: PHASE DIAGRAM

Phase rule: Definition of terms, application of phase rule to water system - reduced phase rule and its application to Pb-Ag system. Freezing mixture - Completely miscible and partially miscible liquid systems – upper and lower critical solution temperatures

UNIT 4: ELECTROCHEMISTRY

Galvanic cells - emf - standard electrode potential - reference electrodes - electrochemical series and its applications - Determination of pH using electrometric method - Electroplating process - Nickel and Chrome plating - Different type of cells - primary cell, Secondary cell and fuel cells - Corrosion and methods of prevention. Conductometric titrations hydrolysis of salts. Derivation of K_h and x - Definition of p^H and its determinations by colorimetric method. Buffer solution - Henderson's equation. Applications of p^H and buffer in biological processors and industries - Corrosion and its prevention.

UNIT 5: ANALYTICAL CHEMISTRY

Introduction to Qualitative and Quantitative Analysis – Principle of volumetric analysis – Separation techniques – extraction – distillation - crystallization – Chromatographic separations - Principles and applications of column paper, thin layer, gas-liquid and ion-exchange

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- 02 Vaithyanathan S. and Others, *Text book of Ancillary Chemistry*, Priya Publications, Karur-2. Edition - 2006.
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- 05 Puri B.R., Sharma and Pathania, *Text book of Physical Chemistry*, Vishal Publishing Co., New Delhi. Edition - 2006.
- 06 Dara S.S., *Text book of Environmental chemistry and Pollution Control*.- S.Chand and Co., NewDelhi, Edition 2006.

SCHEME OF EVALUATION (for practicals)

External Exam 75

a)	Expt.	60
b)	Record	15
		<hr/>
		75

Internal Exam 25

a)	Expts :	50
b)	Record	25
c)	writing	25
		<hr/>

100

Marks reduced to 25

Allied Chemistry Practical

(Common to all branches)

3 Hrs

Linkage

Practical experiments concerned with the corresponding Theoretical components stated in the respective syllabus.

I. Volumetric Analysis

1. Estimation of Sodium hydroxide using Standard Sodium Carbonate.
2. Estimation of Hydrochloric acid - Standard Oxalic acid.
3. Estimation of Ferrous sulphate - Standard Mohr's salt
4. Estimation oxalic acid - Standard Ferrous Sulphate
5. Estimation of Potassium permanganate - Standard Sodium hydroxide.
6. Estimation of Magnesium using EDTA.
7. Estimation of Ferrous ion using diphenylamine as internal indicator.

II Organic Analysis

1. Dectection of Elements (N,S, Halogens)
2. To distinguish between aliphatic and aromatic Saturated and unsaturated compounds.
3. Functional group tests for phenol, acids (mono, did) aromatic primary amine, amide, dioxide, Glucose. Systematic analysis of organic compounds containing one functional group and characterization by confirmatory test. (Phenol/cresol, cinnamic acid, benzoic acid, phthalic acid, Succinic acid, aniline, benzamide, urea, glucose, benzaldehyde & salicylic acid.)

Materials

Text Book of practical chemistry : Manian of Thomas Chemistry.
Basic Principles of practical Chemistry : Venkateswaran, Veerasamy & Kulandaivel Chand & Co.

Methods & Media
Lab work

Unit	Teaching Methods	Evaluation methods.
I	Chalk and Talk method	Periodic Tests.
II	Seminar	Assignment
III	Assignment	Seminar
IV	OHP and Power point	Quiz.
	Quiz.	
V	Group discussion	