Savitribai Phule Pune University

(Formerly University of Pune)

B.Sc. in Chemistry

(Faculty of Science & Technology)

New Syllabi of

F.Y. B. Sc. Chemistry

(As Per National Education Policy-2020)

For Colleges Affiliated to Savitribai Phule Pune University

To be implemented from Academic Year 2024-2025

Board of Studies (Chemistry)

Savitribai Phule Pune University, Pune-41107

Table of Contents

1. Abbreviations Used

- POs : Program Outcomes
- PS : Program Structure
- PSOs : Program Specific Outcomes
- COs : Course Outcomes
- TLP : Teaching-Learning Process
- AM : Assessment Method
- DSC : Discipline Specific Core
- DSE : Discipline Specific Elective
- GE : Generic Elective
- OE : Open Elective
- VSC : Vocational Skill Course
- SEC : Skill Enhancement Course
- IKS : Indian Knowledge System
- AEC : Ability Enhancement Course
- VEC : Value Education Course
- OJT : On Job Training (Internship)
- FP : Field project
- CEP : Community engagement and service
- CC : Co-curricular Courses
- RM : Research Methodology
- RP : Research Project
- MJ : Major Course
- MN : Minor Course

2. Introduction to Undergraduate Degree in Chemistry

As per the recommendations of UGC and Savitribai Phule University guidelines, the undergraduate (UG) degree course in Chemistry is a 6-semester course for 3-academic years **OR** 8-semester course for 4-academic years. The Teaching-Learning Process (TLP) is student- centric. It involves theory, practical and also vocational and skill- based components. It offers flexibility in Programme structure and ensures a strong foundation and in-depth knowledge in subject. Besides the DSCs (Major Core), students have optional courses from the syllabus comprising of DSEs (Minor), VSCs, SECs, IKSs and OEs. Thus, it will facilitate the interdisciplinary as well as multidisciplinary approach within the curriculum framework. It will also allow students to have maximum flexibility in pursuing studies at UG level to the extent of having the freedom to eventually design the degree with multiple exit options. Students will have these exit options depending upon the needs and aspirations in terms of his/her career goals. This will suit the present-day needs of students in terms of securing their paths toward higher studies or employment.

3. Program Duration and Exit Options

The duration of the UG Program is 4 years or 8 semesters. Students who desire to undergo a 3-year UG Program will be allowed to exit after completion of the 3rd year. If a student wants to leave after the completion of the first or second year, the student will be given a UG Certificate or UG Diploma, respectively, provided they secure the prescribed number of credits. Students who exit with a UG certificate or UG diploma are permitted to re-enter within three years and complete the degree Program. The minimum credit to be earned by a student per semester is 18 and the maximum 26 respectively. However, students are advised to earn 22-credits per semester. This provision is meant to provide students the comfort of the flexibility of semester-wise academic load. However, the mandatory numbers of credits which have to be secured for the award of Undergraduate Certificate/Undergraduate Diploma/Bachelor Degree in Chemistry are listed in **Table 1**.

Table1: List of award of Undergraduate Certificate/ Undergraduate Diploma/Appropriate Bachelor's Degree in Chemistry

S. No.	Type of Award	Stage of Exit	Mandatory Credits to be Secured for the Award
1	Undergraduate Certificate in Chemistry	After successful completion of Semester First year	**44**
2	Undergraduate Diploma in Chemistry	After successful completion of Semester Second Year	**88**
3	Bachelor of Science in Chemistry	After successful completion of Third year	**132**
4	Bachelor of Science in Chemistry (Honours)	After successful completion of Semester Fourth year	**176**

4. Objectives of the Program

The UG degree in Chemistry aims to provide:

a. Comprehensive knowledge and coherent understanding of the Chemistry.

b. Knowledge and skills in Chemistry and related interdisciplinary areas thereby enhancing students' employability /entrepreneurship.

c. In-depth knowledge in Chemistry through understanding of key concepts, principles, theories and their manifestations.

d. Critical and analytical thinking, scientific reasoning, creativity, problem-solving skills, communication skills and teamwork.

e. Competence and skill in solving both theoretical and applied problems.

f. Exposure to the latest advances in Chemistry, allied disciplines and research.

g. Inculcate digital skills in Chemistry and interdisciplinary areas.

h. Moral and ethical awareness, leadership qualities, innovation, and life-long learning.

i. Multicultural and multilingual competence, inclusive spirit, and value education.

j. Responsibility for Community engagement and service.

5. Program Outcomes

PO No.	PO Statement After completing the Bachelor of Science Program, students will be able to-	Knowledge and Skill
PO-1	Gain a thorough knowledge and understanding of concepts and principles in Chemistry and other subjects.	Disciplinary knowledge
PO-2	Communicate the subject knowledge in a clear and simple manner in writing and oral.	Communication skill
PO-3	Identify the given problem and apply, theories/assumptions for solving the same related to real life situations	Critical thinking & problem solving
PO-4	Plan, execute, interpret and report the results of the experiments to investigate.	Research related skill
PO-5	Work effectively and respectfully as a team member in the classroom, laboratory and field-based situations.	Co-operation / teamwork
PO-6	Correlate the ideas, evidences and experiences to analyze and interpret the scientific information with learned scientific reasoning	Scientific reasoning
PO-7	Get sensibly aware with the subject facts that can be applied for the society.	Reflective thinking
PO-8	Apply modern library search tools to locate, retrieve, and evaluate subject-related information.	Information /digitally literacy
PO-9	Identify the subject resources required for a project and manage different projects	Self-directed learning
PO-10	Motivate and inspire other colleagues/students in the subject-related activities.	Leadership readiness / qualities
PO-11	Inculcate continuous learning habit through multiple Techniques	Lifelong readiness / qualities

6. Program Specific Outcomes

PSO No.	PSO Statement After completing the Bachelor of Science in Chemistry, students will be able to-	Knowledge and Skill
PSO-1	Learn the basic terms, theories, principles of Chemistry and of its different sub-subjects.	Disciplinary knowledge
PSO-2	Identify and analyze problems and issues with well-defined solutions.	Critical thinking & problem solving
PSO-3	Get hands-on training of the Chemistry related equipment's.	Self-directed learning
PSO-4	Use modern techniques, software's, and web resources.	Digitally literacy
PSO-5	Create awareness about the impact of Chemistry on the environment, in and outside the scientific society.	Leadership
PSO-6	Know the safety rules of Chemistry required for working in and outside the laboratory.	Readiness/qualities

7. Structure of the Program

The detailed framework of Undergraduate Degree Program in Chemistry is provided in Table 2.

Table 2 Program Structure of undergraduate degree Program in Chemistry

Semester	Credits related to major					Minor	GE/ OE	SEC	AEC	VEC	CC	Total
	Discipline Specific Core (DSC) Major Core	Discipline Specific Elective (DSE) Major Elective	VSC	IKS	FP/ OJT/ CEP							
I	4T+2P	0	2T	2T	0	0	2T+2P	2(T/P)	2T	2	2	**22**
II	4T+2P	0	2P	0	0	2T	2T+2P	2(T/P)	2T	2	2	**22**
Students on exit shall be awarded **Undergraduate Certificate in Chemistry** after securing the requisite 44 credits after completion of Semester II.												**44**
III	6T+2P	0	2T	0	2(FP)	2T+2P	2T	0	2	0	2	**22**
IV	6T+2P	0	0	0	2(CEP)	2T+2P	2P	2(T/P)	2	0	2	**22**
Students on exit shall be awarded Undergraduate Diploma in Chemistry after securing the requisite 88 credits after completion of Semester IV.												**88**
V	6T+4P	2T+2T/P	2P	0	2(FP/ CEP)	2T+2P	0	0	0	0	0	**22**
VI	6T+4P	2T+2T/P	0	0	4(OJT)	2T+2P	0	0	0	0	0	**22**
Total 3-Years	**48**	**8**	**8**	**2**	**10**	**18**	**12**	**6**	**8**	**4**	**8**	**132**
Students on exit shall be awarded **Bachelor of Science in Chemistry (Degree)** after securing the requisite 132 credits after completion of Semester VI.												**132**
VII	6T+4P	2T+2T/P	0	0	4(RP)	4T(RM)	0	0	0	0	0	**22**
VIII	6T+4P	2T+2T/P	0	0	8(RP)	0	0	0	0	0	0	**22**
Total 4-Years	**68**	**16**	**8**	**2**	**22**	**22**	**12**	**6**	**8**	**4**	**8**	**176**
Students on exit shall be awarded Bachelor of Science in Chemistry (Honours with Research Degree) after securing the requisite 176 credits after completion of Semester VIII.												**176**

OR

VII	10T+4P	2T+2T/P	-	-	-	4T(RM)	-	-	-	-	-	**22**
VIII	10T+4P	2T+2T/P	-	-	4(OJT)	-	-	-	-	-	-	**22**
Total 4-Years	**76**	**16**	**8**	**2**	**14**	**22**	**12**	**6**	**8**	**4**	**8**	**176**
Students on exit shall be awarded Bachelor of Science in Chemistry (Honours Degree) after securing the requisite 176 credits after completion of Semester VIII.												**176**

8. Teaching-Learning Process

a. The courses will be taught through the traditional chalk and talk method, laboratory work, ICT enabled teaching learning tools, project work, seminars, case studies, field work, internships, hands-on training, etc.
b. Students will be engaged in various student centric activities like experiential learning, problem solving methodologies, participative learning and ICT based teaching learning process.
c. ICT tools in Basic and Advanced Chemistry software will be used to make the teaching learning process efficient and engaging.
d. Critical, analytical and problem-solving abilities will be developed through project-based learning, internships, industrial visits and hands-on training.
e. The problem-solving methodologies like quizzes, review of books and research papers, like workshops, research-based competitions will be used.
f. The vocational and skill training will be done through vocational and skill-based courses.
g. The students will be introduced to advanced laboratory instruments for hands-on training.

9. Methods of Assessment

The primary objective of assessment will be to assess the learning outcomes of the course in tune with the broad outcomes of strengthening core theoretical knowledge base, practical laboratory skills, and research. Assessment will be based on continuous evaluation methods and end of semester examination of Savitribai Phule Pune University, Pune.

Continuous Internal Evaluation

During a semester, students' mastery of the various learning outcomes as described in the syllabus will be assessed through like Short Questions, Class Tests, Seminars, Presentations, Group Discussion, Quizzes, MCQs, Assignments, Tutorials, Project work, etc. Each theory paper and practical paper will have 15 marks for internal assessment for 2 credit courses and 30 marks for internal assessment for 4 credit courses.

End Semester University Examinations

The end-semester university examinations will be conducted for both theory and practical courses. Besides internal assessment, both theory paper and practical paper will be of 35 marks each (2 credit course) and 70 marks (4 credit course) for end of semester examination of the

university.

Scheme of Examination

The total marks for a 2-credits course are 50, and for a 4-credits course is 100.

Internal exams will be conducted by the college and external exams will be conducted by Savitribai Phule Pune University, Pune at the end of each semester.

10. List of courses for F.Y.B.Sc. Chemistry

A. List of Discipline Specific Core (DSC) Courses (Major Core)

Major Core (Semester-I) (6 Credits) (2T+1P)

Semester I

1. CHE 101 MJ: Physical and Analytical Chemistry-I
2. CHE 102 MJ: Organic and Inorganic Chemistry-I
3. CHE 103 MJP: Chemistry Practical -I

Major Core (Semester-II) (6 Credits) (2T+1P)

Semester II

1. CHE 151 MJ: Physical and Analytical Chemistry-II
2. CHE 152 MJ: Organic and Inorganic Chemistry-II
3. CHE 153 MJP: Chemistry Practical -II

B. List of Vocational Skill Courses (VSC)

Semester I

1. CHE 121 VSC: Chemical and Lab Safety- I

Semester II

1. CHE 171 VSC: Chemical and Lab Safety- II (Practical)

C. List of Indian Knowledge System (IKS) Courses

Semester I

1. Ancient Indian Chemistry

D. List of Minor (MN) Courses

Semester II

1. Fundamental of Chemistry-I

E. List of Generic Elective (GE)/Open Elective (OE) Courses

Semester I

OE-101-CHE (A): Food and Nutrition Chemistry

OR

OE-101-CHE (B): Chemistry in Daily Life-I

OE-102-CHE: Nutritional Chemistry Practical

Semester II

OE-151-CHE (A): Food Adulteration

OR

OE-151-CHE (B): Chemistry in Daily Life–II

OE-152-CHE: Food Adulteration Practical

F. List of Skill Enhancement Courses (SEC)

Semester I

SEC-101-CHE (A): Laboratory Techniques in Chemistry

OR

SEC-101-CHE(B): Laboratory Techniques in Chemistry–II (Practical)

Semester II

SEC-151-CHE: Basics in Computer for Chemistry (Practical)

Important:

Besides, above mentioned courses students have to select VEC, AEC, and CC for both first and second semester of F.Y.B.Sc. Program.

Important for Practical Course:

a. It is mandatory to have a certified journal during the practical examination.
b. Use molar concentrations for volumetric/ estimation / synthesis experiment.
c. Use optimum concentrations and volumes.
d. Two burette methods should be used for volumetric analysis. (Homogeneous mixtures)
e. Use of microscale technique is recommended wherever possible

11. Syllabus of Courses

Semester-I

CHE 101 MJ: Physical and Analytical Chemistry-I

Course type: Major **No. of Credits: 2**

Course Outcomes

After the completion of this course, student will be able to-

CO1: define the terms related to physical and analytical Chemistry.

CO2: understand the concepts of chemical mathematics, chemical thermodynamics, and stoichiometry.

CO3: illustrate concepts, rules, principles, equations, and graphs.

CO4: solve the problems related to chemical mathematics, thermodynamics, and Stoichiometry.

CO5: justify the derivations equations and principles related to physical Chemistry and analytical Chemistry.

CO6: prepare a summary of concepts of physical and analytical Chemistry.

Course Content

Chapter 1: Chemical Mathematics **(08 hours)**

a. Graphical representation of equations: Rules for drawing graph coordinates etc., Equation of straight line, slope and intercept, plotting the graph from the data of chemical properties and problems.

b. Derivative: Rules of differentiation and partial differentiation, Algebraic, logarithmic, and exponential functions, and problems.

c. Integration: Rules of integration, Algebraic and exponential functions, and problems.

d. Functions and variables: Variables as function, variables used in Chemistry.

Chapter 2: Chemical Thermodynamics **(07 hours)**

a. Second law of thermodynamics,

b. Carnot cycle,

c. Mechanical efficiency,

d. Entropy changes for system and surroundings for reversible and irreversible processes.

e. Entropy changes for an ideal gas in isothermal, isobaric and isochoric changes.

f. Entropy Changes in chemical reactions. Entropy changes accompanying fusion.

Reference Books

1. Mathematical preparation for physical Chemistry by F. Daniel, Mc. Graw Hill publication.
2. University General Chemistry. By C.N. R. Rao Mc. Millan Publication.
3. Principles of Physical Chemistry. By Maron and Pruton 4th Ed. Oxford and IBH publication.
4. Physical Chemistry. By G.M. Barrow.
5. Mathematical preparation of Physical Chemistry by F. Daniel, Mc Graw Hill Publication.
6. University General Chemistry. By C.N. R. Rao Mc. Millan Publication.
7. Principles of Physical Chemistry. By Maron and Pruton 4th Ed. Oxford and IBH publication.
8. Physical Chemistry. By G.M. Barrow.
9. Principles of Thermodynamics By Jean-Philippe Ansermatet, Sylvain D. Brechet.

Chapter 3: Introduction to Analytical Chemistry (07 hours)

a. Introduction to Analytical Chemistry the analytical perspectives, Common analytical problems.

b. Branches of Analytical Chemistry

c. Perspectives of Analytical Chemistry

d. Applications of Analytical Chemistry in everyday life.

e. Problems.

Chapter 4: Stoichiometry (08 hours)

a. Mole concept-Determination of mol. Weight by gram molecular volume relationship, problems based onmole concept.

b. Methods of expressing concentrations, strength, normality, molarity, molality, % w/v, % v/v, ppm, standardization of solutions, primary & secondary standard substances, Preparation of standard solution ofacids & bases, problems related to acid base titrations only

Reference Books

1. Analytical Chemistry by G. D. Christain, John Weiley and sons, 5th Edition.
2. Fundamentals of Analytical Chemistry by D. A. Skoog, D. M. West and F. J. Holler, 6th Edn.
3. A text book of macro and semi micro Qualitative analysis by A. I. Vogel, 5th Edition
4. Vogel's text book of Quantitative Inorganic Analysis revised Edn. J. Barret, R. C. Danney, G.H.Jeffery and J. Mendham ELBS.
5. Quantitative Inorganic Analysis 4th Ed A. I. Vogel ELBS.
6. Basic concept of analytical Chemistry- S. M. Khopkar.
7. Instrumental methods of chemical analysis-Willard, Deen & Merrit-6th Edition.
8. Analytical Chemistry by Skoog.

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CHE 102 MJ: Organic and Inorganic Chemistry-I

Course type: Major **No. of Credits: 2**

Course Outcomes

After the completion of this course, student will be able to-

CO-1. Explain the basic concepts and principles of organic and inorganic Chemistry.

CO-2. Understand the structural effects and reactivity of organic compounds, structure of atom and periodic table.

CO-3. Compare the concepts of organic Chemistry and inorganic Chemistry.

CO-4. Predict the product of different organic reactions and explain the trends observed in periodic table.

CO-5. Discuss concepts of atomic structure, periodic table, valance bond theory and hydrogen bonding.

CO-6. Justify the concepts of organic and inorganic Chemistry.

Course Content

Chapter 1: Essentials of Organic Chemistry (07 hours)

Structure and reactivity of organic molecules, Structural effects- Inductive Effect, Resonance Effect, Hyperconjugation Effect, Steric Effect and Tautomerism. Comparative study of strength of acids and bases based on Inductive and Resonance effect. Cleavage of Bonds: Homolysis and Heterolysis. Nucleophiles and electrophiles. Reactive Intermediates: Generation and structure of- Carbocations, Carbanions, Carbene and free radicals.

Chapter 2: Chemistry of Aliphatic Hydrocarbons (08 hours)

Recapitulations-Nomenclature and Properties of alkanes, alkenes and alkynes (Up to 5 carbons).

A. **Alkanes: Preparation:** Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. **Reactions:** Halogenation and Pyrolysis

B. **Alkenes: Preparation:** Dehydrohalogenation of alkyl halides (Saytzeff's rule), Dehydration of alcohols and Partial catalytic hydrogenation- cis alkene (Lindlar Catalyst) and trans alkenes (Birch reduction). **Reactions:** Addition of Cold alkaline $KMnO_4$, Addition of Br_2, Addition of HX (Markovnikoff and anti-Markovnikoff addition), Hydration, Ozonolysis, Oxymecuration-demercuration, and Hydroboration-oxidation.

C. Alkynes: Preparation: Acetylene from CaC_2, dehydrohalogenation of vicinal-dihalide, Dehalogenation of tetra halides and higher alkynes from acetylene. **Reactions:**

Formation of metal acetylides, Addition of bromine, Addition of cold alkaline $KMnO_4$, Oxidation with hot alkaline $KMnO_4$ and Ozonolysis.

Reference Books

1. Graham Solomon, T.W., Fryhle, C.B. & Dnyder, S.A. Organic Chemistry, John Wiley & Sons, 2014.
2. McMurry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013.
3. Sykes, P. A Guidebook to Mechanism in Organic Chemistry, Orient Longman, New Delhi 1988.
4. Morrison, R.T. & Boyd, R.N. Organic Chemistry, Pearson, 2010.
5. Kalsi P. S. Organic Reactions and Their Mechanisms, New Age International (P) Limited Publishers, 2001.

Chapter 3: Electronic Structure of Atom [07 hours)

Definition of atom, Subatomic particles (electron, nucleus-neutron and protons and their characteristics), atomic number atomic mass number. The atom as a nucleus with orbital electrons, Atomic spectra of hydrogen atom and Bohr theory, Refinement to the Bohr theory, type of orbitals and their shapes, Pauli exclusion principle, Buildup of the elements, Hund's rule, Sequence of energy levels, Writing electronic configuration of elements.

Chapter 4: Long Form of Periodic Table and Periodic Properties [08 hours)

Modern periodic law long form of periodic table (IUPAC system of labeling of group only -1 to 18 groups), Electronic configuration and arrangement of elements in the groups in periodic table, Four blocks in periodic table, Periodic Properties-Size of atoms and ions, Ionization energies, Electron affinity, Polarizing power and polarizability, Electronegativity, Metallic character, Variable valence and oxidation state, Types of elements-metals, non-metals, inert gases.

Reference Books

1. J. D. Lee. Concise Inorganic Chemistry, 5th Ed. Blackwell Science
2. CNR Rao. University general Chemistry, an introduction to chemical science, Macmillan.
3. Brian W. Pfennig. Principles of Inorganic Chemistry, 2015 John Wiley & Sons.

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CHE 103 MJP: Chemistry Practical -I

Course type: Major **No. of Credits: 2**

Course Outcomes

After the completion of this course, student will be able to-

CO-1. define terms and principles of Chemistry experiments.

CO-2. understand the procedure of the experiments.

CO-3. calculate and describe the results of the experiment.

CO-4. interpret the major findings and draw an outline of experiment.

CO-5. record the major findings and draw a conclusion/ result at the end of each experiment.

CO-6. summarize the experiment.

Course Content

PHYSICAL AND ANALYTICAL CHEMISTRY (Any five)

1. Determination of Heat of Neutralization of Strong Acid & Strong Base.
2. Find out Enthalpy change of Ionization of Acetic Acid.
3. Solubility of Benzoic acid in water and determination of ΔH
4. Determination of Enthalpy of hydration of $CuSO_4$
5. Determination of oxidation state and equivalent weight of metal magnesium and zinc by Eudiometric method.
6. Determination of ΔH, ΔG and ΔS for reaction between Zn metal and CuSO4 solution.

ORGANIC CHEMISTRY PRACTICAL (Any four)

1. To determine type, physical constant, detection of elements and functional group in given organic compounds (Four compounds)

INORGANIC CHEMISTRY PRACTICAL

a. Inorganic Preparations (Any Two)

1. Synthesis of potash alum from aluminium metal (scrap Aluminium metal)
2. Synthesis of Mohr's Salt $[(FeSO_4)\ (NH_4)_2SO_4]\bullet 6H_2O$
3. Synthesis of $FeSO_4\bullet 7H_2O$
4. Preparation of Dark red inorganic pigment: Cu_2O

b. Estimation of Purity of salt (Compulsory)

Determination of purity of any one of the synthesized salt by volumetric method.

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CHE 121 VSC: Chemical and Lab Safety - I

Course type: VSC **No. of Credits: 2**

Course Outcomes

After the completion of this course, student will be able to-

CO-1. state the chemical and laboratory safety and Laboratory Hazards

CO-2. understand the different types of Laboratory Hazards and Instruments Handlings methods.

CO-3. demonstrate safety rules and Instruments Handlings methods.

CO-4. illustrate the Chemical and Laboratory safety rules, and Laboratory Hazards.

CO-5. discuss the safe Handling chemicals and Minimizing hazards in laboratory.

CO-6. write a report on Case studies of chemical and laboratory accidents.

Course Content

Chapter 1: Introduction to Chemical and Laboratory Safety [4 hours]

Introduction to Good lab practice (GLP) History, Scope, fundamental Points of GLP, Four Principles of safety-RAMP, The Student Safety Ethics, Safety rules, Role as a Student, analysis of Lab incidents, Standard Operating Procedures (SOP) in the laboratory.

Chapter 2: Understanding Laboratory Hazards [4 hours]

Potential pathways of exposure and blocking these pathways to prevent exposure, Hazard recognition through the basics of understanding label, signs, symbols, terms, and other sources of information, Safe handling and interpreting the material safety data sheet (MSDS), overview of GHS Safety Data Sheets and GHS labelling.

Chapter 3: Laboratory Hazards and Responses [8 hours]

Chemical Hazards: corrosive acids, bases, gases, oxidizers, flammables, fire triangle, water reactive compounds, pyrophoric chemicals and reactions, peroxides, cryogens.

Radiation Hazards: ionizing, nonionizing radiations and electric and magnetic field.

Biological Hazards: hazards of biological agents and some general approaches to prevent exposures.

Electrical Hazards: electric shock and burns from contact with live parts, explosion caused by unsuitable electrical apparatus, measures to avoid electrical hazard.

Introduction to Toxicology: Basic principles of toxicology, Factors Influence Toxicity, Acute and Chronic Toxicity, Mercury toxicity, Carcinogens, Mutagens.

Fire-fighting in Chemical Lab: Fire Safety in Chemical Lab, Classification and Use of Fire Extinguishers, Introduction of Fire-fighting Equipment and Fire Safety Symbols)

Responses: chemical spills (acids, bases and other chemicals) and fire, classes of fires and types of fire extinguishers. First aid in chemical lab, emergency safety equipment.

Chapter 4: Handling Chemicals and Minimizing Hazards in Laboratory [8 hours]

Introduction to handling hazardous chemical waste, storing flammable and corrosive liquids, maintaining a safe and secure laboratory, managing chemicals in the laboratory. Safety measures for common laboratory operations. Managing risk- decision about safety, eye and face, skin protection- clothes, gloves and tools, chemical hoods, contamination and ventilation, safety measures for common laboratory operations, radiation, laser and biological safety cabinets. Lab waste management.

Chapter 5: Instruments Handlings [4 Hours]

Heating Devices and thermal safety, Ovens, Hot plates, heating mantles, Oil, salt and sand baths, High pressure vessels, vacuum pumps, rotary evaporators, refrigerators and freezers.

Chapter 6: Case Studies of Chemical and Laboratory Accidents [2 hours]

Introduction to chemical and Laboratory Accidents, The Bhopal gas disaster

References

1. Laboratory safety for Chemistry students, second edition, Robert H. Hill, Jr.David C. Finster, John Wiley & Sons.
2. Handbook of Good laboratory practice (GLP),UNDP/World Bank/WHO Special Program for Research and Training in Tropical Diseases (TDR) https://fctc.who.int/publications/i/item/handbook-good-laboratory-practice-%28-glp%29
3. Solid Waste Management, Principles and Practice, Ramesha Chandrappa, Diganta Bhusan Das, Springer.
4. Production-Integrated Environmental Protection and Waste Management in the Chemical Industry, Claus Christ, WILEY-VCH.
5. Laboratory safety Handbook, FENS Laboratory safety Team, 1st edition 2016. https://fens.sabanciuniv.edu/sites/fens.sabanciuniv.edu/files/2021-08/labsafety_web.pdf
6. Fundamentals of Industrial Safety and Health Dr. K.U. Mistry, Siddharth Prakashan.
7. Hazardous waste management rules-2016, 1st edition, Ministry of environment, forest & climate change, govt. of India

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CHE 101 IKS: Ancient Indian Chemistry

Course type: IKS **No. of Credits: 2**

Course Outcomes

After the completion of this course, student will be able to-

CO1: know the Indian Knowledge System, Indian Knowledge system, Chemistry in India, Chemical in Practical Arts and Contribution of Indians.

CO1: understand the Indian Knowledge System and ancient Indian Chemistry.

CO3: relate the various concepts of ancient Chemistry with modern Chemistry.

CO4: describe the concepts of ancient Indians Chemistry.

CO5: justify the role of Indians in the development of Chemistry.

CO6: summarize the Ancient Indian Chemistry.

Course Content

Chapter-1: Introduction to Indian Knowledge System **[4 hours]**

Part 1 – Indian Knowledge System: An Introduction: Indian Knowledge System: An Overview, The Vedic Corpus Philosophical Systems, Wisdom through the Ages

Part-2: Concepts of Science and Technology: Linguistics, Number System and Units of Measurement, Knowledge: Frameworkand Classification

References-1

Chapter -2: Chemistry in India **[12 hours]**

Introduction, Pre-Vedic period, The Vedic age and Post-Vedic periodand the Classical age, Alchemy, Indian Alchemy and its characteristics, possible origin of Indian Alchemy, Laboratory and Apparatus, the Chemical Laboratory at Presidency College, the Institutional Home of the Indian School of Chemistry, the School of Indian Chemistry

References-2,3,4

Chapter -3: Chemical in Practical Arts **[8 hours]**

Introduction**,** Metallurgy and working of metals: Zinc (Zn), Mercury(Hg), Gold (Au), Silver (Ag), Copper (Cu), Bronze and Brass, and iron (Fe), Tinning and alloying, enameling, recovery of gold (Au) from wastage of gold(Au) working, gunpowder, saltpetre, mineral acid, alum and green vitriol, paper, ink, soap, cosmetics andperfumery

References-5,6

Chapter- 4: Contribution of the Indian Scientists [6 hours]

Kanad, Varahamihira, Nagarjuna, Bhairava (Shiva), Acharya Nalina, Govinda, Govindacharya, Kakachandesvarimata, Somdev, Yashodhar, Iatrochemical period (1300 AD-1550 AD) Vishnudeva, Siddha Nityanatha, Devdatta, Vagbhata, Mathanasimba, , Kautilya, Brhatsamhita, Siddhas Vrndakunda, Cakrapanidatta, Sambhu, Ramchandra, , PC Ray, Yellapragada Subbarow (1895 - 1948), Kamala Sohonie (1912 - 1998), Asima Chatterjee (1917 - 2006), C. N. R. Rao (1934-present), Venkatraman Ramakrishnan (1952-present), Darshan Ranganathan (1941 - 2001).

References-2,4,6,7,8,9

References

1. Introduction to Indian Knowledge System: Concepts and Applications, Mahadevan, B. Bhat, Vinayak Rajat, Nagendra Pavana R.N.
2. A concise history of science in India by d. M. Bose, s. N. Sen, b. V. Subbarayappa, Indian National Science Academy New Delhi, 1971
3. Chapter 26, the Making of an Indian School of Chemistry, Calcutta, 1889–1924 by Madhumita Mazumdar from History of Science, Philosophy and Culture in Indian Civilization Volume XV Part-4 by D.P.Chattopadhyaya and Uma Das Gupta
4. Indian contributions to Science by Vijnana Bharati, third edition, 2018.
5. History of Chemistry in ancient and medieval India Acharya Prafulla Chandra Ray (Edited by P.Ray, Indian Chemical Society, Calcutta, 1956.
6. India’s Glorius Scientific Tradition by Suresh Soni
7. Chapter 15- SCIENTISTS OF ANCIENT INDIA http://digital.nios.ac.in/topic.php?id=223en
8. Priyadaranjian Ray - History of Chemistry in Ancient & Medieval India -AMS Press (1979)
9. Indian Contributions To Science, Compiled By Vijnana Bharati

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OE-101-CHE (A): Food and Nutrition Chemistry

Course type: Open Elective **No. of Credits: 2**

Course Outcomes

After the completion of this course, student will be able to-

CO1. define terms associated with nutrition, Carbohydrates, Lipids, Amino acids and Proteins, Vitamins and minerals, Food Preservation.

CO2. understand Digestive organs, their functions and digestion mechanism.

CO3. classify Food and nutrients.

CO4. describe the properties and functions of food and nutrients.

CO5. identify the source and deficiency effect of vitamins and minerals.

CO6. design a nutritional plan for human beings.

Course Content

Chapter 1: Introduction to Nutrition [08 hours]

Definition of nutrition, nutrients, adequate, optimum and malnutrition. Inter relationship between nutrition and health, visible symptoms of good health, Food guide-basic five food groups and usage of food guide. Process digestion, absorption, transport and utilization of nutrients in the body. role of digestive juices in digestion.

Chapter 2: Carbohydrates, Lipids, Amino Acids and Proteins [08 hours]

Carbohydrates- classification, sources, functions, changes during cooking and processing. Lipids – classification, nomenclature, saturated, unsaturated fatty acids, food sources, functions of fats. Proteins –classification, sources, functions, General properties of proteins, denaturation of proteins, protein deficiency Amino acids – Classification, Sources, Properties, structure, and functions of amino acids, amino acid deficiency

Chapter 3: Vitamins and Minerals [08 hours]

Vitamins – Classification, sources and functions, water soluble and fats soluble vitamins, deficiency diseases caused by Vitamin A, B-complex, C. D, E and K, Minerals: - functions, sources, Bio-availability and deficiency diseases of following minerals – calcium, Iron, Iodine, Fluorine, sodium, potassium.

Chapter 4: Food Preservation [06 hours]

Definition, objectives, and principles of food preservation. Different ancient and modern methods of food preservation to retain nutritive value.

References

1. Damodran, S., Parkin, K.L and Fennema, D.R. (2007). Fennema's Food Chemistry. 4th edition. CRC Press.
2. Srilakshmi B (2017): Nutrition Science,6th Multicolour Ed. New Age International (P) Ltd. [9]
3. Mann J and Truswell S(2017) : Essentials of Human Nutrition, 5th Ed. Oxford University Press.
4. Swaminathan, M. (2012). Advanced Text book on food and Nutrition, Vol. II. The Bangalore Printing
5. Handbook of Food and Nutrition- Dr. M. Swaminathan, Bangalore Press
6. Guthrie, H.A. (1983). Introductory nutrition. 5th Edition. Mosby, St. Louis.
7. Meyer, L.H. (2004). Food Chemistry. Textbook Publishers. ISBN: 0758149204.
8. Mudambi, S.R., Rao, S.M. and Rajagopal, M.V. (2006). Food science. 2nd Edition. New Age International publishers.
9. Mudambi, S.R and Rajgopal, M.V. (2001). Fundamentals of Foods and Nutrition. 4th Edition. New Age International Publishers.
10. Sadasivan S and ManikamK(2007): Biochemical Methods, 3rd Ed. New Age International (P)Ltd.
11. Gopalan C, Rama Sastri BV and Balasubramanian SC(2016): Nutritive value of Indian Foods, Indian Council of Medical Research.
12. Subalakshmi, G and Udipi, SA (2006):Food processing and preservation, 1st Ed. New Age International (P)Ltd.
13. Shakuntla, M.N and Shadaksharaswamy, M. (2013). Food Facts and Principles. New Age International.
14. Srilakshmi, B. Food science. 3rd Edition. New Age International.
15. Willson, D. (1999). Evan Principles of Nutrition. 4th Edition. John Willey & Sons: New York.

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OR

OE-101 CHE (B): Chemistry in Daily Life –I

Course type: Open Elective (OE) **No. of Credits: 2**

Course Outcomes

After the completion of this course, student will be able to-

CO1: state the terms related to dairy, Paints and Pigments and Medicines.

CO2: describe the chemical composition, properties, manufacturing, applications, and storage all daily life Chemistry products.

CO3: categorize the dairy, Paints and Pigments and Medicinal products.

CO4: describe the daily life Chemistry products and small-scale industry products.

CO5: evaluate the products based on their chemical composition, properties, and applications.

CO6: create a summary of daily life Chemistry products and small-scale industry products.

Course Content

Chapter 1: Dairy Products [10 Hours]

Cream: Definition, Classification, Composition, Food & Nutritive value, properties, Manufacture and uses of cream.

Butter: Definition, Classification, Composition, Food & nutritive value, Physicochemical properties, Manufacture and uses of Butter, packaging & Storage, use of butter.

Cheese: Definition, Classification, Food & nutritive value, properties, Manufacture and uses of cheese.

Ice-cream: Definition, Classification, Composition, Food & Nutritive value, Manufacture, packing, Storage and uses of Ice-cream.

Dried Milk Products: butter milk powder, whey powder, cream powder, milk powder, Ice-cream mix powder, cheese powder.

Chapter 2: Paints and Pigments [07 Hours]

Introduction of paints, ingredients and classification, new technologies; properties of coatings; solvents, plasticizers, paint formulations, Qualities of good dye, colour and chemical constitution, Classification based on the chemical constitution, meaning of terms: Chromophore, auxochrome, bathochromic shift, hypsochromic shifts. Pigments: Introduction, classification, and general physical properties.

Chapter 3 Medicines and their Uses [07 Hours]

Introduction, Qualities of good drugs, Classification of drugs, Meaning of the terms: Prescriptions, Doses, Analgesic, Antipyretics, Diuretics, Anaesthetics, Antibiotics, sulpha drugs, Anti-inflammatory, Tranquilizers, Anti-viral, Cardiovascular, Cough and Cold Preparations, Sedatives and Hypnotics, contraceptives, Anti-ulcer.

Chapter 4 Small Scale Industries [06 Hours]

Introduction, Aspects of Small-Scale Industries, Safety matches, agartbatties, Naphthalene balls, Wax Candles, Shoe Polishes, Gum Paste, Writing and fountain Pain ink, Plaster of Paris, Silicon Carbide Crucibles, how to Remove Stains and Liquid Phenyl Manufacturing.

References

1. Outline of Dairy Technology-Oxford University Press By-Sukumar De.(Edition-1983)
2. Dairy Chemistry and Animal Nutrition – M.M. Roy.
3. Fundamentals of Dairy Chemistry -B.H. Webb, A.H. Hooson, J.A. Alford, CBB Publishers
4. Milk and Milk Products-C.H. Eckles, H. Macy, Tata McGraw Hill Publishing Company
5. Dyes and Intermediates by Adrahaedt.
6. Industrial Chemistry, B. K. Sharma, 16th Edition, Goal Publishing House, Meerut, (U.P.) 2011, India
7. Dyes & Paints: A Hands-On Guide to Coloring Fabric, by Elin Noble.
8. Paints, coatings and solvents by D. Staye
9. Paints and surface coating theory and practice by R. L. Lambourna
10. Polymer science, Bill Meyer, F.W. Jr. John Wiley and Sons.
11. Pigments handbook by T. C. Patton 18) Coating technology handbook by D. Satas
12. Fundamentals of Dairy Chemistry – Webb Johnson and Alfred.
13. Foye's principles of medicinal Chemistry. 6th Edition, Edited by Davis William & Thomas Lemke, Indian edition by B I Publication Pvt Ltd, Lippmcolt Williams & Wilkins.
14. Medicinal Chemistry. Ashutosh Kar, New Age International Pvt. Ltd Publisher. 4th edition

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OE-102 CHE: Nutritional Chemistry Practical

Course type: Open Elective (P) **No. of Credits: 2**

Course Outcomes

After the completion of this course, student will be able to-

CO1: state the terms related to Nutritional Chemistry practical.

CO2: explain the concepts related to food Chemistry and its nutritional importance.

CO3: apply the laboratory techniques to find the physical and chemical parameters of food.

CO4: illustrate the principles used in analysis of food.

CO5: investigate the physical and chemical parameters of food.

CO6: prepare an outline/flowsheet of experiments.

Course Content

NUTRITIONAL CHEMISTRY PRACTICAL (ANY 12) **(60 hours)**

1) Determination of moisture in a given food sample.
2) Determination of ash in a given food sample.
3) Determination of pH of a given sample using universal indicator and pH meter.
4) Determination of acidity of given food sample/beverage.
5) Identification of pigments in a given food sample.
6) Detection of Saccharine in beverages.
7) Identification and isolation of starch in given food sample
8) Test for detection of different oil samples by Baudouin test, Halphens test and Hexabromide test
9) Preparation of different gel system
10) Effect of baking soda on CO_2 production
11) Determination of specific gravity and refractive index of given oil samples
12) Effect of temperature on taste of food.
13) Preparation of gluten balls/sugar cookies/Chocolate cakes
14) Detection of amino acid in given food sample by Maillard reaction
15) Qualitative Test for Protein using biuret, xanthoproteic, reduced sulphur test
16) Visit to hospital/slide show on various nutritional deficiency disorders and prepare report accordingly

References

1) The Food Chemistry Laboratory: A Manual for Experimental Foods, Dietetics, and Food Scientists by Connie M. Weaver and James R. Daniel, 2nd edition, CRC Press
2) Manual Of Methods Of Analysis Of Foods (Milk And Milk Products)- Directorate General Of Health Services Ministry Of Health And Family Welfare Government Of India New Delhi, 2005, Page No:10.

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SEC-101 CHE (A): Laboratory Techniques in Chemistry - I

Course type: SEC **No. of Credits:2**

Course Outcomes

After the completion of this course, student will be able to-

CO1: know the Lab Safety

CO2: demonstrate laboratory apparatus, equipments, reagents and laboratory techniques.

CO3: prepare reagents and solutions of various concentrations.

CO4: explain standard safety guidelines, apparatus, reagents, solvents, solutions and laboratory techniques.

CO5: justify the filing and record systems.

CO6: create a standard operating procedure for working in a laboratory.

Course Content

Chapter 1: Chemistry Laboratory Introduction [04 Hours]

A general introduction to the Chemistry laboratory, Standard safety guidelines for safe operations within chemical laboratories, Laboratory layout and design considerations, Proper storage methods for chemicals, Adequate ventilation and lighting within the lab, The importance of fume cupboards, Arrangement and organization of storage areas, Safety measures and provisions, The structure and organization of practical laboratory work, Maintenance protocols for laboratory equipment and apparatus, Cleaning procedures for both laboratories and preparation rooms.

Chapter 2: Introduction to Lab Apparatus [10 Hours]

(A) Glass Apparatus

Beaker, test tube, boiling tube, conical flask, filtration flask, round-bottom flask, flat-bottom flask, Liebeg Condenser, funnel, separating funnel, watch glass, measuring cylinder, Petri dish, desiccator, measuring cylinder, glass rod, glass tube.

(B) Volumetric and Heating apparatus

Volumetric apparatus: Volumetric flask, burette, pipette, analytical balance, electronic balance.

Heating Apparatus: Bunsen burner, water bath, sand bath, oil bath, hot air, oven, heating mantle

(C) Miscellaneous Apparatus

Buchner funnel, burner, test tube stand, tong, burette stand, clamp, retort clamp, Mohr clip, china dish, wire gauze, cork, vacuum pumps, crucibles, clay pipe triangle, pestle and mortar, spatulas, thermometer, pH meter/pH paper, laboratory centrifuge

(D) Handling and storage of glass apparatus

Kipp's apparatus

Chapter 3: Laboratory Reagents and Solvents [04 Hours]

Reagents: Classification of reagents according to their action; (i) acids (ii) bases (iii) salts (iv) complexing agents (v) oxidizing and reducing agents (vi) precipitating agents (vii) chelating agents. Each type to be explained with at least one suitable example. Primary and secondary standards: Definition, characteristics, uses examples for different types of reactions.

Solvents: Solute, Solvent & Solution, classification of solvents (i) Protic and aprotic (ii) Acidic, basic amphiprotic and neutral (iii) Aqueous and non-aqueous (iv) Polar and nonpolar. Each type is to be explained with at least one example.

Chapter 4: Solution Preparation [04 Hours]

Solutions, components of a solution, types of solution, solubility, concentration terms - percentage, ppm, ppb, g/L, molarity, normality, molality, calculation of masses and volumes for preparation of solutions and their practical approach.

Chapter 5: Common Laboratory Techniques [04 Hours]

Refluxing: Apparatus with interchangeable ground glass joints (Quick fit),

Filtration: Techniques and filter media, filter paper, simple filtration,

Recrystallization: Choice of solvent and precautions with flammable solvents,

Distillation: recovery of solvents through partial distillation, distillation under reduced pressure, and Determination of Boiling Point

Chapter 6: Stock and Inventory Control [02 Hours]

Arranging stock, locating and referencing, shelf arrangement of stock, order books, inventory.

Chapter 7: Files and Records [02 Hours]

Filing Systems- Classification of files, filing methods, filing system for equipment's and chemicals, filing of printed and written material, preparation of lab manuals.

Records system: Stock records, recording stock (used and misused), record of use of listed poisons, record of use of alcohol, record of breakages, information about equipment serial numbers, record maintenance, miscellaneous records.

Recommended Texts:

1. Vogel, Arthur I: A Test book of Quantitative Inorganic Analysis (Rev. by GH Jeffery and others) 5th Ed. The English Language Book Society of Longman

2. Willard, Hobert H. et. al: Instrumental Methods of Analysis, 7th Ed. Wardsworth Publishing Company, Belmont, California, USA, 1988.

3. Christian, Gary D; Analytical Chemistry, 6th Ed. New York- John Willy, 2004.

4. Harris, Daniel C,Quantitative Chemical Analysis, 3 rd Edition, W.H. Freeman and Company, New York, 2001.

5. Khopkar, S.M. Basic Concepts of Analytical Chemistry New Age, International Publisher, 2009.

6. Koogs, West and Holler, Fundamentals of Analytical Chemistry, 6th Edition, Sauders College Publishing, New York. 1991.

Suggestive digital Platforms web links:

1. http://chemcollective.org/vlabs
2. https://www.vlab.co.in/broad-area-chemical-sciences
3. https://wp.labster.com/Chemistry-virtual-labs/
4. https://www.youtube.com/watch?v=O_nyEj_hZzg
5. https://www.youtube.com/watch?v=gR_3Z_02mi0
6. https://byjus.com/Chemistry/concentration-of-solution-and-the-calculation/
7. https://chem.libretexts.org/Bookshelves/General_Chemistry/Book%3A_Chem1_(Lower)/08%3A_Solutions/8.01%3A_Solutions_and_their_Concentrations
8. https://www.ncbi.nlm.nih.gov/books/NBK55884/
9. https://www.lehman.edu/administration/environmental-health-safety/documents/chemical-storage.pdf
10. https://www.acs.org/content/dam/acsorg/about/governance/committees/chemicalsafety/publications/acs-secondary-safety-guidelines.pdf
11. http://www.srsvidyamahapitha.org/images/uploads/Laboratory%20Equipments.pdf
12. https://studiousguy.com/list-of-Chemistry-laboratory-apparatus-and-their-uses/
13. https://chem.hbcse.tifr.res.in/wp-content/uploads/2019/10/vogels-textbook-of-quantitative-chemical-analysis-5th-edition.pdf
14. https://www.youtube.com/watch?v=dLUdhFlxZfo
15. https://chemicalsafety.com/chemical-inventory-management-software/
16. https://www.youtube.com/watch?v=D7rnlaR8Arc

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OR

SEC-101 CHE (B): Laboratory Techniques in Chemistry – II (Practical)

Course type: SEC **No. of Credits: 2**

Course Outcomes

After the completion of this course, student will be able to-

CO1. Learn the Chemistry laboratory techniques.

CO2. Know the safe manipulation of various glassware, apparatus and equipments.

CO3. explain safe and proper management of chemicals and laboratory apparatus/equipment.

CO4. formulate operational guidelines for chemical and instruments methods.

CO-5. Evaluate the glassware, apparatus, and equipment's on the basis of need of the experiments.

CO-6. Create a report/guideline on Chemistry Laboratory Techniques.

Course Content

Any 12 experiments from the given list- (60 hours)

1. Conduct an investigation into the proper procedures for managing, operating, and utilizing the standard laboratory equipment.
2. Perform experiments with different laboratory equipment made from various materials, including Pyrex Glass (borosilicate Glass), Fused Silica (Corning Vycor Glass), Porcelain, Plastic, and Metal, based on the materials they are composed of.
3. Cork boring experiment
4. Comprehending the procedure for cleaning, drying, and polishing glassware equipment.
5. Conduct thorough examinations involving the identification, schematic depiction, assembly setup, and in-depth exploration of operational procedures for glassware equipment featuring interchangeable ground glass joints, specifically focusing on typical assemblies.
6. i. Perform the calibration of volumetric and graduated glassware equipment while providing an explanation of temperature standards.
   ii. Perform thermometer calibration.

7. i. Carry out exploration and investigations of working protocol for various heating equipment in laboratory: Burners, Hot Plates, Electrical Heating Mantles, Electric Oven, Microwave Oven, Muffle Furnace, Infrared lamps, Crucible and Beaker Tongs and Emersion heaters.

   ii. Carry out exploration and investigations of working protocol for various Stirring apparatus in laboratory: Stirring rods; Policeman, Boiling rods, Use of Mechanical agitation-Magnetic Stirrer and Mechanical Shaker.

   iii. Carefully analyze the Glass, Cork and Rubber Stoppers and investigate their preparation and appropriate applications.
8. i. Conduct thorough examinations of Heating and Cooling Baths to establish their operational limits and operational procedures.

   ii. Investigate and distinguish various types of water suitable for laboratory applications, including Distilled (Grade I to III), De-ionized, and tap water. Perform conductance measurements and other analytical assessments to distinguish between them.
9. i. Distinguish between different types of filter paper and investigate their uses.

   ii. Creating corrugated filter paper and its benefits.

   iii. Categorizing chemicals as either analytical reagent (AR) or general reagent (GR) grade.
10. i. Understanding the proper handling and operation of Analytical balances: Mass and Weight, Dual-Pan Balance and Electronic Balance.

    ii. Performing the calibration of weighing balances and ensuring precision in measurements.
11. i. Utilization of a melting point instrument for the experimental determination of the melting points through diverse techniques.

    ii. Experimental determination of the boiling point using various methods.
12. To purify given organic solvents.
13. i. Hand on training for working with typical assemblies of apparatus for distillation and refluxing.

    ii. Assessment of Fire hazards attending the distillation of inflammable solvents
14. i. Purification of given solid organic compounds by crystallisation method.

    ii. Recrystallization of given non-volatile organic solids and outline the Difficulties encountered in recrystallization process.

15. Removal of traces of colouring matter and use of decolourising carbon.
16. i. Carry out exploration and investigations of working and working protocol for Filtration Apparatus: Filtration with suction.

    ii. Explore and imbibe knowledge about types of Vacuum Pump; Water and Oil Pump and their applications.
17. Investigate Conventions for Drying of the recrystallized material.
18. i. Introduction to Gas absorption traps and their importance.

    ii. Recrystallization in an atmosphere of inert gas
19. i. Performing Evaporation of the solvent in the laboratory.

    ii. Preparation of anhydrous liquids or solutions of organic compounds in organic solvents.
20. i. Various procedures for the precipitation and washing of the precipitates.

    ii. Application of various methods and instruments for drying of solid organic compounds.
21. i. Incineration of Filter paper with precipitate.

    ii. Differentiate between various types of centrifugation methods, principle, uses and application of centrifugation method
22. Comprehensive knowledge and preparation of reagents for chemical laboratory purposes.
23. Examine approaches for creating and preserving standard solution preparations.

References

1. Skoog D.A., West D.M., Holler F.J., Stanley R.C., Fundamentals of analytical Chemistry, 9th Edition, Cengage Learning.
2. Mendham, J.; Denney, R.C.; Barnes, J.D.; Thomas, M.J.K. (2007), Vogel's Quantitative Chemical Analysis, 6th Edition, Prentice Hall.
3. Furniss, B. S; Hannaford, A. J.; Smith, Peter W. G.; Tatchell, A. R; Vogel's Text Book of Practical Organic Chemistry, 5th Edition, Longman Scientific and Technical, Longman Group Ltd.
4. Garland, C. W.; Nibler, J. W.; Shoemaker, D. P. (2003), Experiments in Physical Chemistry, 8th Edition, McGraw-Hill, New York.
5. https://iupac.org/
6. https://edu.rsc.org/resources/practical/experiments

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Semester-II

CHE 151 MJ: Physical and Analytical Chemistry-II

Course type: Major **No. of Credits:2**

Course Outcomes

After the completion of this course, student will be able to-

CO1: define concepts of surface Chemistry, photochemistry, errors, and chromatographic techniques.

CO2: learn various principles involved in surface Chemistry, photochemistry, errors, and chromatographic techniques.

CO3: differentiate the Chemistry concepts, errors and chromatographic techniques.

CO4: solve the problems based on the concepts of physical and analytical Chemistry.

CO-5: describe different theories, laws, principles of Chemistry and chromatographic techniques.

CO-6: justify the adsorption isotherms, BET theory, Laws of photochemistry, Errors and chromatographic techniques.

Course Content

Chapter 1: Surface Chemistry (07 hours)

Introduction to surface Chemistry - some basic terms related to surface Chemistry adsorption, adsorption materials, factors affecting adsorption, characteristics of adsorption, types of adsorption, classification of adsorption isotherms, Langmuir adsorption isotherm, Freundlich's adsorption isotherm, BET theory (only introduction), application of adsorption, problems.

Reference Books

1. Atkins' Physical Chemistry by Peter Atkins, Julio de Paula, James Keeler -11th edition.
2. Principles of physical Chemistry by B.R. Puri, L.R. Sharma**,** M.S. Pathania.
3. Essentials of Physical Chemistry by Bahl Tuli-Revised Multi colour Edition 2009, S. Chand and CompanyLtd.
4. Physical-Chemistry-4th Edition - Gilbert W. Castellan Narosa (2004).
5. Principles of ChemicalKinetics-2rdEdition- James E. House.
6. University Chemistry, 3rd Ed. Narosa (1998).

7. General Chemistry, 5th Ed., Macmillan Publishing Co. New York, 1985).
8. Physical Chemistry by Thomas Engel, Philip Reid, Warren Hehre.

Chapter 2: Photochemistry (08 hours)

a. Introduction, Difference between thermal and photochemical processes.

b. Laws of photochemistry i) Grothus - Draper law ii) Stark-Einstein law.

c. Quantum yield, Reasons for high and low quantum yield. Factors affecting Quantum yield, Experimentalmethod for the determination of quantum yield & Problems.

d. Fluorescence, Phosphorescence, Chemiluminescence.

Reference books:

1. Essential of Physical Chemistry, Bahl and Tuli (S. Chand).
2. Principles of Physical Chemistry by Puri, Sharma, Pathania.
3. Physical Chemistry, Singh, N.B., et al. Volume 2, New Age International Ltd, 2000
4. Physical Chemistry by, R. A. Alberty, Wiley Eastern Ltd.
5. The Elements of Physical Chemistry by P. W. Atkins, Oxford.

Chapter 3: Errors in Quantitative Analysis (6 hours)

a. Introduction to errors, limitations of analytical methods, classifications of errors, accuracy, precision,minimization of errors, significant figures and computation.

b. Methods of expressing accuracy and precision: mean and standard deviations, reliability of results and numerical.

Reference Books

1. Vogel's Textbook of quantitative Chemical Analysis, 5th Ed. G. H. Jeffry, J. Basset, J. Mendham, R. C.Denney, Longman Scientific and Technical, 1989.
2. Analytical Chemistry, G. D. Christian, P. K. Dasgupta, K. A. Schug, 7th Ed, Wily, 2004.
3. Fundamentals of Analytical Chemistry- Skoog, west, Holler, Crouch, 9th Ed. Brooks / Cole, 2014/2004.
4. Basic Concept of Analytical Chemistry- S. M. Khopkar.
5. Instrumental methods of chemical analysis- Chatwal Anand.

Chapter 4: Chromatographic Techniques (09 hours)

a. Introduction to chromatography, definition of chromatography classification of chromatographic methods

b. History of Chromatography- paper chromatography, Thin Layer Chromatography, Ion

exchangeChromatography, Gas chromatography, High Performance Liquid Chromatography, Capillary Electrophoresis.

c. Principle of chromatographic analysis, an applications Numerical Problems.

Reference Books

1. Textbook of Quantitative Chemical Analysis- 3rd Edition, A. I. Vogel.
2. Instrumental Methods of Chemical Analysis- Chatwal and Anand.
3. Basic Concept of Analytical Chemistry- 2nd edition S.M. Khopkar.
4. Instrumental Methods of Chemical Analysis- 6th edition Willard, Merritt, Dean and Settle.
5. Analytical Chemistry by Skoog.
6. Introduction to Instrumental Analysis- R.D. Braun.
7. Instrumental methods of Chemical Analysis-Willard, Dean & Merrit-6th Edition.

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CHE 152 MJ: Organic and Inorganic Chemistry-II

Course type: Major **No. of Credits: 2**

Course Outcomes

After the completion of this course, student will be able to-

CO-1: define the basic concepts and principles of organic and inorganic Chemistry.

CO-2: know the chemistry of Aromatic Hydrocarbons, Stereochemistry of Aliphatic Compounds, Lewis Theory, VSEPR Theory and Valence Bond Theory.

CO-3: predict the stereochemistry and products of organic reactions and structure of inorganic compounds.

CO-4: discuss different laws and theories of organic and inorganic Chemistry.

CO-5: determine the stereochemistry of organic compounds and structure of inorganic compounds.

CO-6: solve problems based on different laws and theories of organic and inorganic Chemistry.

Course Content

ORGANIC CHEMISTRY

Chapter 1: Chemistry of Aromatic Hydrocarbons (5 hours)

Aromaticity, Nomenclature,

Benzene: Preparation- From Phenol and Chlorobenzene. **Reactions**: Nitration, Sulphonation, Halogenation, Friedel-Craft alkylation and Acylation.

Naphthalene: Preparation: From benzene (Haworth Synthesis). **Reactions:** Nitration, Sulphonation, Halogenation, Friedel-Craft alkylation and Acylation.

Chapter 2: Stereochemistry of Aliphatic Compounds (10 hours)

Introduction, Classification of isomerism, Interconversion of Dotted - Wedge, Newmann, Sawhorse and Fischer representations. Conformational isomerism with respect to ethane and n-butane. Configurational Isomerism: **a) Geometrical isomerism:** cis- trans, Sequence rule (CIP rule) and E / Z Nomenclature (Up to two C=C systems), Properties of geometrical isomers. **b) Optical isomerism:** Construction and working of Polarimeter, Causes of optical activity, Enantiomerism, Diastereomerism, Racemic modification and Meso compounds). Concept of chirality (Up to two carbon atoms), Properties of optical isomers. **c) Configuration:** Relative and absolute configuration, R/ S configuration.

INORGANIC CHEMISTRY

Chapter 1: Introduction to Bonding [4 hours]

Attainment of a stable configuration, Types of chemical bonds, Transition between main types of bonding (Ionic bond, Covalent Bond, Oxidation number, Double and triple bonds, co-ordinate and metallic bonds, melting points, conductivity, solubility, speed of reaction. ***Reference-6: pp 30 to 42.***

Chapter 2: Covalent Bond: Lewis Theory and VSEPR Theory [5 hours]

Introduction, Lewis theory, Octet rule, Exceptions to the Octet rule, Sidgwick-Powell Theory, Valence Shell Electron Repulsion (VSEPR) Theory, Effect of lone pairs, Effect of electronegativity, Isoelectronic principle, Some examples using VSEPR (BF_3, NH_3, H_2O, PCl_5, ClF_3, SF_4, I_3^-, SF_6) ***Reference-6: pp 72 to 80. Reference-7-8:*** *Relevant pages.*

Chapter 3: Covalent Bond: Valence Bond Theory [6 hours]

Valence Bond Theory, Hybridization, The extent of d-orbitals participation in molecular bonding, Structure of some molecules BeF_2, BF_3, CH_4, PCl_5, SF_6 on the basis of hybridization, Sigma and Pi bonds (CO_2 molecules), ***Reference-6: pp 80 to 89. Reference-7-8: Relevant pages.***

Reference Books

1. Graham Solomon, T.W., Fryhle, C.B. & Dnyder, S.A. Organic Chemistry, John Wiley & Sons (2014).
2. McMurry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013.
3. Sykes, P. A Guidebook to Mechanism in Organic Chemistry, Orient Longman, New Delhi (1988).
4. Eliel, E.L. StereoChemistry of Carbon Compounds, Tata McGraw Hill education, 2000.
5. Morrison, R.T. & Boyd, R.N. Organic Chemistry, Pearson, 2010.
6. J. D. Lee. Concise Inorganic Chemistry, 5th Ed. Blackwell Science
7. CNR Rao. University general Chemistry, an introduction to chemical science, Macmillan.
8. Brian W. Pfennig. Principles of Inorganic Chemistry, 2015 John Wiley & Sons.

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CHE 153 MJP: Chemistry Practical-II

Course type: Major **No. of Credits: 2**

Course Outcomes

After the completion of this course, student will be able to-

CO-1. learn the basic concepts and principles through practical.

CO-2. know the various test and validate the basic concepts of the theory.

CO-3. perform the different techniques of purification and improve the practical skills.

CO-4. predict the product in different organic reactions.

CO-5. examine the techniques of qualitative and quantitative analysis.

CO-6. create a report of Chemistry experiment.

Course Content

(60 hours)

PHYSICAL AND ANALYTICAL CHEMISTRY (any five)

1. To Investigate the Adsorption of acetic acid by activated charcoal and verify Freundlich adsorption isotherm.
2. Investigate the adsorption of oxalic acid by activated charcoal and verify Langmuir adsorption isotherm.
3. Determination of unknown concentration of $KMnO_4$ by Colorimetry.
4. Estimation of Cu^{++} ion by using EDTA Calorimetrically.
5. Estimation of aspirin from given tablet and find error in qualitative analysis.
6. Balancing of chemical equation using titration data between Oxalic acid and $KMnO_4$.

ORGANIC CHEMISTRY (any three)

Organic Purification Techniques (One compound by each technique)

1. Purification of organic compounds by-

i) Crystallization (from water and alcohol)

ii) Sublimation

iii) Simple distillation

iv) Steam distillation

INORGANIC CHEMISTRY

1. Inorganic Investigative Experiments (any-2)

1: Study stoichiometry of reaction between $KMnO_4$ and $FeSO_4$ by titration method hence determination of number of electrons involved in the reaction and equivalent weight of oxidizing agent - $KMnO_4$.

2: Determination of dissociable H^+ ions (basicity) of boric acid hence determination of its equivalent weigh by acid base titration. Explain observed basicity of the boric acid.

3: Estimation of number of water of crystallization in Mohr's salt by titrating with $KMnO_4$.

2. Table work (compulsory)

4: Polar plots of s and p orbitals

5: Study of molecular properties of some molecules using open access computational Chemistry package AVOGADRO and give the explanations for observed properties.

6. Draw the structure of using Avogadro. Record their bond length and dipole moment of these molecules and explain observed trend in periodicity of these two properties of in halide group elements.

7. Draw the structure of H_2O, H_2S, H_2Se and H_2Te molecules using Avogadro. Optimize structure. Record their bond length, bond Angel and dipole moment of these molecules. Explain observed trend in periodicity of these three properties of in halide group elements.

8. Draw the structure of CH_4, NH_3, H_2O, molecules using Avogadro. Optimize structure. Record their bond length, bond Angle and dipole moment of these molecules. Explain observed bond angles.

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CHE 171 VSC: Chemical & Lab Safety – II (Practical)

Course type: VSC **No. of Credits: 2**

Course Outcomes

After the completion of this course, student will be able to-

CO1: know the fundamental concepts of safe laboratory practice.

CO2: learn the techniques of handling of chemicals, apparatus, equipments and instruments.

CO3: create an outline/ flowsheet of experimental set up.

CO4: investigate the experimental findings and record the results.

CO-5: compare the experimental results with the theoretical data.

CO-6: create a report of experiment, MSDS, Chemical safety and waste management method.

Course Content

(60 hours)

Any 12 Experiments from the given list-

1. a) Identify and list the Incompatible Chemicals from a given set of chemicals available in the laboratory, b) Carry out preparation of the indicative MSDS (Material Safety Data Sheet) of given set of chemicals as per Standard MSDS format c) Carry out Classification and labelling of the given set of chemicals based upon the Globally Harmonized System.
2. Demonstration of fire extinguisher, fuming hood and First aid box (any two).
3. Preparation of solutions and Standardization of solutions (any two).
4. Purification of Binary organic liquid mixture (one volatile and one non-volatile liquid).
5. Calibration of pH meter & measurement of pH of solutions of different concentrations.
6. Calibration of conductometer & measurement of conductivity of solutions of different concentrations.
7. Estimation of Hardness of Water by EDTA Method
8. Determination of chloride concentration in a sample of water
9. Determination of Saponification value of oil.
10. Perform the crystallization of organic solids (two examples)
11. Determination of Rf value by thin layer chromatography (TLC) of two organic compounds.
12. Determination of equivalent weight of Mg by eudiometer.
13. Green Chemistry experiments (any one)

a. Nitration of salicylic acid by calcium nitrate.

b. Bromination of acetanilide by KBr and CAN.

14. Study the Standard Operating procedure (SOP) of laboratory instruments (pH meter, Conductometer, calorimeter, Refractometer, Potentiometer).
15. **Compulsory Activity:** Visit to any industry or Chemical supplier laboratory/shop or Agriculture field (pesticide survey) or Milk industry or any other industry using chemical processes.
    It is mandatory to have a hard copy of a report on compulsory activity along with a certified journal during the practical examination.

References:

1. A Guide to Green Chemistry Experiments for Undergraduate Organic Chemistry Labs
2. Vogel's Textbook of Practical Organic Chemistry
3. Vogel - A Text-Book of Quantitative Inorganic Analysis
4. Monograph on Green Chemistry Laboratory Experiments

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CHE 191 MN: Fundamentals of Chemistry-I

Course type: Minor **No. of Credits:2**

Course Outcomes

After the completion of this course, student will be able to-

CO1: learn the terms related to atom, molecule, matter & states of matter.

CO2: understand the periodic table and the properties of elements.

CO3: solve problems based on normality, molarity, molality, equivalent weight, PPM, mole concept & standard solution.

CO4: distinguish the concepts related to atom, molecule, matter, measurement, acid, base, salts and biomolecules.

CO5: justify the concepts of fundamental Chemistry.

CO6: create a summary on any topic of fundamentals of Chemistry

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Course Content

Chapter 1: Introduction to Chemistry (12 hours)

Concepts of Matter, classification of matters, change of state (sublimation, evaporation, condensation, solidification, melting), Atom concept (Kanad, John Dalton, Thomson, Rutherford, Niles Bhor), structure of atom, atomic number, atomic mass, electronic configuration, valency, isotope, isobars, molecule, molecular formula, Introduction to the periodic table, Dobereiners triads, Newlands octave, Mendeleev periodic table, Modern periodic table, blocks in periodic table, Metal, Non-metal & metalloid.

Chapter 2: Measurements (5 hours)

Stoichiometry- mole concept, Avogadro's number, Solution- solute solvent, types of solution, Methods of expressing concentrations, strength, Normality, Molarity & Molality, ppm, % solution, weight by volume solution, volume by volume solution & density. Standardization of solution, primary and secondary standard substances.

Chapter 3: World of Carbon Chemistry (7 hours)

Introduction to hydrocarbons, Alkane, Alkene & Alkynes- their preparation, physical and

Chapter 4: Acid, Base & Salts **(2 hours)**

Introduction, chemical properties, catenation, uses of carbon & application of carbon. Definition of acids and bases, Arrhenius theory, Lowry Brønsted theory, Lewis theory, pH, salts.

Chapter 5: Introduction to Biomolecules **(4 hours)**

Introduction, carbohydrates, amino acids, proteins, enzymes & lipids (definition, classification with example).

References:

1. Concise Inorganic Chemistry - J.D. Lee, Chapman & Hall 5th Ed. (1996)
2. Basic Inorganic Chemistry by Cotton & Wilkison
3. Calculation of Analytical Chemistry by Hamilton, Simpson &Ellis 7th Edn.
4. Advanced Organic Chemistry – Jerry March
5. Organic Chemistry - 6h Ed. Morrison and Boyd Prentice Hall of India Pvt Ltd, New Delhi
6. Outline of BioChemistry 5h Ed., Conn, Sumpf, Bruening and Roy Doi John wiley 1987.

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OE-151-CHE (A): FOOD ADULTERATION

Course type: OE **No. of Credits: 2**

Course Outcomes

After the completion of this course, student will be able to-

CO1: learn the concepts of food adulteration of common foods and their adverse impact on health.

CO2: know the methods of detections of food adulteration.

CO3: identify the adulteration in food adulteration.

CO4: differentiate between the pure and adulterated food.

CO5: explain the laws and regulations related to food adulteration.

CO6: suggest the methods to identify the food adulteration.

Course Content

Chapter 1: Common Foods and Adulteration [12 hours]

Adulteration-Definition; types-Intentional, incidental, metallic and packaging hazard. Causes and methods of food adulteration. General Impact on Human Health. Detection and Prevention of Food Adulteration. Mitigation measures for addressing food adulteration. Food additives- Definition, classification, role of additives in processed foods. Safe levels of additive uses and the institutions involved in the process.

Chapter 2: Adulteration of Common Foods and Methods of Detection [12 hours]

Nature of adulterants, methods of detection of food adulterants and toxic constituents in foods, common food adulterants & their detection on various foods: Milk and Milk products, Oils and fats, Spice and condiments, Wheat and other flours, processed food, Fruit and Vegetable products. Additives and Sweetening agents

Chapter 3: Food Laws and Regulation: [06 hours]

Prevention of Food Adulteration Act 1954, Food Safety and Standards Act (2006), Food Safety and Standards Authority of India (FSSAI), BIS, FPO, APEDA.

References

1. Gould, W.A and Gould, R.W. (1998). Total Quality Assurance for the Food Industries, CTI Publications Inc. Baltimore.

2. Furia, T.E. Ed. 1980. Regulatory Status of Direct Food Additives. CRC Press, Florida.
3. Rekha S. Singhal, Pushpa R. Kulkarni, Dananesh V. Rege, (1997). Hand Book of Indices of food Quality and Authenticity, wood head Publishing Ltd.
4. First course in Food Analysis, A.Y. Sathe, New Age International (P) Ltd., 1999.
5. Food Safety, case studies – R. V. Bhat, NIN, 1992.
6. Siva Kiran, R.R. (2012). Manual for Detection of Common Food Adulterants, First Edition, IAPEN.
7. Battershal, J.P. (2013). Food Adulteration & its detection, General Books LLC.
8. Prevention of Food Adulteration Act, 4th Edition, Ashoka Law House, 2002.

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OR

OE-151 CHE (B): Chemistry in Daily Life –II

Course type: OE **No. of Credits:2**

Course Outcomes

After the completion of this course, student will be able to-

CO1: learn basic concepts and principles related to soaps, Detergents, oils, fats, Polymers and Fibres.

CO2: understand manufacturing of soaps, Detergents, oils, fats, Polymers and Fibres.

CO3: classify soaps, Detergents, oils, fats, Polymers and Fibres.

CO4: describe the terms associated with soaps, Detergents, oils, fats, Polymers and Fibres.

CO5: justify the concepts related to soaps, Detergents, oils, fats, Polymers and Fibres.

CO6: design a plan/flowsheet for making of soaps, Detergents, oils, fats, Polymers and Fibres.

Course Content

Chapter 1: Soaps and Detergents **[10 hours]**

Introduction of soaps, raw materials for soaps and their selection. General principles of soap making, Chemistry of soap boiling and saponification reaction,manufacture of soap (cold, hot and semi boiled process), bleaching of soap, Introduction of detergents, classification of detergents (anionic, cationic, non-ionic, amphoteric), biodegradability. Inorganic compounds of detergents (builder & other additives, phosphates, silicates, zeolites, etc)

Chapter 2: Oils and Fats **[10 hours]**

Introduction, Common fatty acids present in oils and fats, Composition of edible oils, classification of oils and fats – Omega fatty acids, Trans fats, role of oils and fats in plants, animals and human beings, Physical properties of oils and fats, smoke fire and flash point Structure and composition of oils and fats , triglyceride composition of natural fat, saponification, rancidity and its types

Chapter 3 Polymers and Fibres **[10 hours]**

Classification of polymers, Source and general characteristics of natural and synthetic polymers. Natural fibers- cotton, wool, silk, rayon, artificial Fibers-polyamides, acrylic acid, PVC, PVA; Polymers used as plastics, in textiles, in electronic and automobile

components, in the medical and aerospace materials. Problems of plastic waste, management. Strategies for the development of environment friendly polymers.

References

1. Handbook on Soaps, Detergents & Acid Slurry, 3rd revised edition, Asia Pacific Business Press
2. Soaps & detergents by K.S. Parasuram
3. Surface Active Agents &Detergents, Vol II, Anthony M. Schwartz, James W. Perry & Julian Berch, interscience Publisher
4. Soaps: Their Chemistry &Technology by J.G. Kane
5. Standard Methods for the Analysis of Oils, Fats and Derivatives 1St Supplement to the 7 th Revised and Enlarged Edition Prepared for publication by A. Dieffenbacher, W.D. Pocklington
6. A. Bahl and B.S. Bahl, Advanced Organic Chemistry, 1st Multicolour Edition, S. Chand &Company, New Delhi, 2010
7. K.S. Tewari, N.K. Vishnoi and S.N. Mehrotra, A Textbook of Organic Chemistry, 2nd Edition, Vikas Publishing House (Pvt.) Ltd., New Delhi, 2004.
8. Polymer science, V. R. Gowariker, N. V.Viswanathan, J. Sreedhar, New Age International
9. Polymer Science and Technology, J.R. Fired (Prentice Hall)

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OE 152 CHE: Food Adulteration Practical

Course type: OE **No. of Credits: 2**

Course Outcomes

After the completion of this course, student will be able to-

CO1: learn different food adulterants.

CO2: understand adulterants and their characteristics.

CO3: distinguish between the pure and adulterated food.

CO4: analyse the adulterants in food.

CO5: justify the effect of adulterants on human health.

CO6: summarize the experimental procedures and their major findings of the experiments.

Course Content

Any 12 experiments from the given list-

1. Detection of preservatives in milk
   a) formaldehyde
   b) boric acid (Ref:1,2,3,6)
2. Determination of pH of Buffalo and Cow milk. (Ref:1,2,3)
3. Detection of hydrogen peroxide from milk samples (Ref:1,2,3)
4. Detection of adulterants in ice cream. (Ref:1,2,3)
5. Detection of starch in different sweet products (eg. Khoya / ice-cream) (Ref:1,2,3)
6. Detection of coloured adulterants in red chili powder. (Ref:4,6)
7. Detection of sugar /dextrose from Honey (Ref:5)
8. Detection of adulterants in tea powder (Ref:6)
9. Detection of adulterants in oil /vanspati ghee (Ref:6)
10. Detection of sodium bicarbonate from different food samples (cooked food)
11. Visual identification of adulterants from different food grains. (Like-pebbles, stones, weed seeds, damaged grains etc.) (Ref:6)
12. Identification of adulterants used in fruits and vegetables. (Ref:6)
13. Detection of artificial color on green peas. (Ref:6)

14. Detection of chalk powder /urea /washing soda from sugar (Ref:6,7)
15. Detection of adulterants from turmeric powder (Ref:6)
16. Detection of adulterants from black pepper. (Ref:6)
17. Field visit and report writing.
    a) Poultry farm
    b) Dairy
    c) Pharmaceutical industries
    d) Sugar industry
    e) Food Industry etc.
    f) Oil mill

References

1. Food safety and standard authority of India (FSSAI) New Delhi
2. Manual of methods of analysis of foods: Milk and milk products D.G.H. Services (Ed.) 2005
3. Detection of adulterants in milk, A laboratory manual In N.D.R. Institute (Ed.) Karnal Haryana India 2012.
4. www.rjptonline.org. Research Journal of Pharm and Tech.Sept.2017.
5. Manual of methods of analysis of foods honey& other bee hive products (FSSAI)
6. Manual of methods of analysis of foods food safety and standards authority of India ministry of health and family welfare government of India new Delhi 2015
7. Food Adulteration Testing Manual (14th Revised Edition) –Consumer Guidance Society of India (CGSI) Mumbai-2019

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SEC-151 CHE: Basics in Computer for Chemistry

Course type: SEC **No. of Credits: 2**

Course Outcomes

After the completion of this course, student will be able to-

CO1: know basic application of computer such as computer app such as word, Excel, Power Point and other Chemistry and data analysis software.

CO2: understand the significance of computer and its apps in collections and analysis of Chemistry-related information.

CO3: collect, validate, organize, process the data using different software.

CO4: compare the results of processed data using software with the raw data related to Chemistry.

CO5: evaluate the results of processed data with other resources.

CO6: write a scientific report or perform calculations, on Chemistry topics using different computer applications.

Course Content

- **All experiments are compulsory.**
- **Students should submit the coloured hard copy of each experiment in a file for evaluation.**

1. Basic and advanced features of Microsoft Word
   - Preparation of 3-to-5-page document on topic related to chemistry.
   - Documents should contain tables, figures, equations, and symbols etc.
2. Basic and advanced features of Microsoft Excel
   - Calculations related to equations that are used in CHE 103 MJP and CHE-153 MJP.
   - Prepare word document for the above calculations.
3. Creation of Graph related to Chemistry using Microsoft Excel.
   - Prepare graphs of the experimental data from CHE 103 MJP and CHE-153 MJP.
   - Prepare word document of above graphs with appropriate captions.
4. Basic and advanced features of Microsoft Power Point.
   - Preparation of 10-15 slides on topic related to chemistry.
   - Documents should contain tables, figures, equations, symbols, images, videos, links and e-resources etc.
5. Mastering Google forms, Google documents, and google drive.
   - Conduct a survey on topics related to Chemistry using google form.
   - Analyze the data using google spreadsheet.

- Prepare word document of the same.

6. Introduction to Chemistry software.
   - Draw a chemical structure, reaction scheme, reaction mechanism etc using ChemSketch / Chemdraw or any other software.
   - Prepare word document of the same.
7. Introduction to Google scholar.
   - Prepare google scholar account.
   - Search literature on topic related to chemistry on google scholar.
   - Prepare a word document of the same.
8. Exploring online Chemistry Resources
   - Search online learning resources of chemistry such as SWAYAM, NPTEL, e-PG pathshala.
   - Student should enroll for any course related to F.Y.B.Sc. Chemistry syllabus.
   - Prepare a 2-page report on the same.
9. Introduction to Paint/Paint 3D/ any image creating software.
   - Prepare JPG, JPEG, PNG and Tiff image (two images each) on any topic related to chemistry.
   - Prepare a word document of the same.
10. Introduction to video making software.
    - Prepare a video (on Power Point Slides prepared as in experiment no.4) using any video recording software like Screen recorder OBS (freeware software).
    - Upload the video to YouTube channel and submit the link of the same.
11. Preparation of report on various Chemistry e-resources.
    - Preparation of 2-to-3-page document.
    - Prepare a table indicating the name of the e-resource, link and information about the e-resource.
12. Preparation of report on various Chemistry software.
    - Preparation of 2-to-3-page document.
    - Prepare a table indicating the name of the software, link and information about the software.