

**VIJAYANAGARA SRI KRISHNADEVARAYA
UNIVERSITY, BALLARI**



SYLLABUS

UNDERGRADUATE PROGRAM IN CHEMISTRY (Honors)

BACHELOR OF SCIENCE

(I to VIII Semester)

As per NEP-2020

With effect from 2021-2022

Name of the Degree Program: BSc (Honors) Chemistry

Discipline Core: Chemistry

Total Credits for the Program: 176

Starting year of implementation: 2021-22

Program Outcomes:

By the end of the program the students will be able to:

(Refer to literature on outcome based education (OBE) for details on Program Outcomes)

1. **PO. 1:** To create enthusiasm among students for Chemistry and its application in various fields of life.
2. **PO. 2:** To provide students with broad and balanced knowledge and understanding of key concepts in Chemistry
3. **PO. 3:** To develop in students a range of practical skills so that they can understand and assess risks and work safely measures to be followed in the laboratory.
4. **PO. 4:** To develop in students the ability to apply standard methodology to the solution of problems in chemistry
5. **PO. 5:** To provide students with knowledge and skill towards employment or higher education in Chemistry or multi-disciplinary areas involving Chemistry.
6. **PO. 6:** To provide students with the ability to plan and carry out experiments independently and assess the significance of outcomes and to cater to the demands of chemical Industries of well-trained graduates
7. **PO. 7:** To develop the ability to adapt and apply methodology to the solution of unfamiliar types of problems.
8. **PO. 8:** To instil critical awareness of advances at the forefront of chemical sciences, to prepare students effectively for professional employment or research degrees in chemical sciences and to develop an independent and responsible work ethics

Assessment:

Weightage for assessments (in percentage)

Type of Course	Formative Assessment / IA	Summative Assessment
Theory	40	60
Practical	25	25

BSc Chemistry (Honors)

I Semester B.Sc.

Course Title: DSC-1: Fundamentals of Chemistry	Code:
Total Contact Hours: 56	Course Credits: 4
Formative Assessment Marks: 40	Duration of ESA/Exam: 3 hrs
Model Syllabus Authors: BOS	Summative Assessment Marks: 60

Course Pre-requisite(s): *PUC with Chemistry*

Course Outcomes (COs):

At the end of the course the student should be able to:

1. To understand and appreciate the development of various atomic theories.
2. To justify the need for quantum mechanical structure of atoms
3. The concepts of Organic reactions and techniques of writing the movement of electrons, bond breaking, bond forming
4. The Concept of aromaticity, resonance, hyper conjugation, etc.
5. Understand the preparation of alkanes, alkenes and alkynes, their reactions, etc.
6. To make familiarization with various states of matter
7. To teach how liquid state and its physical properties are related to temperature and pressure variation.
8. Prepare the solutions after calculating the required quantity of salts in preparing the reagents/solutions and dilution of stock solution.
9. The concept of volumetric and gravimetric analysis and deducing the conversion factor for determination
10. Handling of toxic chemicals, concentrated acids and organic solvents and practice safety procedures.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs 1-8)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8
1	X							
2	X							
3	X							
4	X							

5	X							
6	X							
7	X							
8	X							
9	X							
10	X							

Course Articulation Matrix relates course outcomes of course with the corresponding program outcomes whose attainment is attempted in this course. Mark 'X' in the intersection cell if a course outcome addresses a particular program outcome.

Title of the Course: DSC-1: Fundamentals of Chemistry

Number of Theory Credits	Number of lecture hours/ semester	Number of practical Credits	Number of practical hours/ semesters
4	56	2	56
Content of Theory Course 1			56Hrs
Unit – 1: Introduction and Safety precautions in laboratory			08 hrs
Importance and scope of Chemistry. Atomic and molecular masses, mole concept and molar mass, percentage composition, empirical and molecular formula, chemical reactions, stoichiometry and calculations based on stoichiometry.			3
Basic laboratory practices, calibration of glassware (pipette, burette and volumetric flask), Sampling(solids and liquids), weighing, drying, dissolving, Acid treatment, Rules of work in analytical laboratory, General rule for performing quantitative determinations (volumetric and gravimetric), Safety in Chemical laboratory, Rules of fire prevention and accidents, First aid. Precautions to be taken while handling toxic chemicals, concentrated/fuming acids and organic solvents. Good laboratory practices			3
Titrimetric analysis: Basic principle of titrimetric analysis. Classification, Preparation and			2

dilution of reagents/solutions. Normality, Molarity and Mole fraction. Use of $N_1V_1 = N_2V_2$ formula, Preparation of ppm level solutions from source materials (salts), conversion factors.	
Unit – 2: Atomic structure	12 hrs
Bohr's theory, its limitations and atomic spectrum of hydrogen atom. Wave mechanics: de Broglie equation, Heisenberg's Uncertainty Principle and its significance, Schrödinger's wave equation, significance of ψ and ψ^2 . Quantum numbers and their significance.	4 hrs
Normalized and orthogonal wave functions. Sign of wave functions. Radial and angular wave functions for hydrogen atom. Radial and angular distribution curves. Shapes of s, p, d and f orbitals. Contour boundary and probability diagrams.	4 hrs
Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, Aufbau's principle and its limitations- Electronic configurations of the elements (Z=1-30), effective nuclear charge, shielding/screening effect, Slater's rules. Variation of effective nuclear charge in Periodic Table.	4 hrs
Unit – 3 Basics of Organic Chemistry	12
Classification and nomenclature of organic compounds, Hybridization, Shapes of organic molecules, Influence of hybridization on bond properties	2 hrs
<u>Nature of bonding in Organic molecules</u>	5 hrs
Formation of Covalent bond, Types of chemical bonding, localized and delocalized, conjugation and cross conjugation, concept of resonance, electronic displacements: Inductive effect, Electromeric effect, Resonance and Hyper conjugation, cross conjugation explanation with examples. Concept of resonance, aromaticity, Huckel rule, anti-aromaticity explanation with examples. Strengths of Organic acid and bases: Comparative study with emphasis on factors effecting pK values. Relative strength of aliphatic and aromatic carboxylic acids-Acetic acid and chloroacetic acid, acetic acid and propionic acid, acetic acid and Benzoic acid. Steric effect- Relative stability of trans and cis-2-butene.	
<u>Carbon-carbon pi bonds</u>	5 hrs
Formation of alkenes and alkynes by elimination reaction. Mechanism of E1, E2, E1cb reaction. Saytzeff and Hofmann eliminations. Addition of HBr to propene, Free radical addition of HBr to propene. Addition of halogens to alkenes-carbocation and halonium ion	

<p>mechanism. Stereospecificity of halogen addition. Ozonolysis mechanism - ozonolysis of propene. Addition of hydrogen halides to alkenes, mechanism, regioselectivity and relative rates of addition. Hydrogenation, hydration, hydroxylation and epoxidation of alkenes, explanation with examples, 1,2 and 1,4- addition reactions in conjugated dienes. Diels-Alder reaction, Allylic and benzylic bromination and mechanism in propene, 1-butene, 1-toluene and ethylbenzene.</p>	
<p>Unit – 4: Gaseous and Liquid molecules</p>	12
<p style="text-align: center;"><u>Gaseous molecules</u></p> <p>Elementary aspects of kinetic theory of gases, Ideal and real gases. Boyle temperature (derivation not required), Molecular velocity, collision frequency, collision diameter, Collision cross section, collision number and mean free path and coefficient of viscosity, calculation of σ and η, variation of viscosity with temperature and pressure. Maxwell's Boltzmann distribution law of molecular velocities (Most probable, average and root mean square velocities). Relation between RMS, average and most probable velocity and average kinetic energies. (Mathematical derivation not required), law of equipartition of energy. Behaviour of real gases: Deviation from ideal gas behaviour. Compressibility factor (Z) and its variation with pressure for different gases. Causes of deviation from ideal behaviour, vanderWaals equation of state (No derivation) and application in explaining real gas behaviour. Critical phenomena - Andrews isotherms of CO₂, critical constants and their calculation from Van der Waals equation, Continuity of states, Law of corresponding states. Numerical problems.</p> <p><u>Liquid State</u></p> <p>Surface Tension: Definition and its determination using stalagmometer, effect of temperature and solute on surface tension Viscosity: Definition, Coefficient of viscosity. Determination of viscosity of a liquid using Oswald viscometer. Effect of temperature, size, weight, shape of molecules and intermolecular forces. Refraction: Specific and molar refraction- definition and advantages. Determination of refractive index by Abbes Refractometer. Additive and constitutive properties. Parachor: Definition, Atomic and structure parachor, Elucidation of structure of benzene and benzoquinone. Viscosity and molecular structure. Molar refraction and chemical constitution. Numerical Problems.</p>	<p style="text-align: center;">6 hrs</p> <hr/> <p style="text-align: center;">6 hours</p>

Unit 5: Chemical Analysis	12 hrs
Acid-base titrimetry: Titration curves for strong acid vs strong base, weak acid vs strong base and weak base vs strong acid titrations. Titration curves, Quantitative applications – selecting and standardizing a titrant, inorganic analysis - alkalinity, acidity.	3 hrs
Complexometric titrimetry: Indicators for EDTA titrations - theory of metal ion indicators, titration methods employing EDTA - direct, back, displacement and indirect determinations, Application-determination of hardness of water.	2 hrs
Redox titrimetry: Balancing redox equations, calculation of the equilibrium constant of redox reactions, titration curves, Theory of redox indicators, calculation of standard potentials using Nernst equation. Applications.	2 hrs
Precipitation titrimetry: Titration curves, titrants and standards, indicators for precipitation titrations involving silver nitrate- Volhard's and Mohr's methods and their differences.	2 hrs
Gravimetric Analysis: Requisites of precipitation, mechanism of precipitation, Factors influencing precipitation, Co-precipitation, post-precipitation, Advantages of organic reagents over inorganic reagents, reagents used in gravimetry (8-hydroxy quinoline (oxine) and dimethyl glyoxime(DMG)).	3 hrs
Numerical problems on all the above aspects.	

Text Books:

1. Concise Inorganic Chemistry: J D Lee, 4thEdn, Wiley, (2021)
2. Basic Inorganic Chemistry, F A Cotton, G Wilkinson and P. L. Gaus, 3rd Edition. Wiley. India
3. Inorganic Chemistry, 2ndEdn. Catherine E. Housecroft and A.G. Sharpe, Pearson Prentice Hall (2005)
4. Morrison, R. N. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education)
5. McMurry, J. E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India Edition, 2013
6. Organic Reaction mechanism by V. K. Ahluwalia and K. Parashar (Narosa Publishers).
7. Organic Chemistry by S. M. Mukherji, S. P. Singh and R. K. Kapoor. (Narosa Publishers)
8. A Guide book to mechanism in Organic Chemistry by Peter sykes.Pearson.
9. Practical Volumetric Analysis, Peter A C McPherson, Royal Society of Chemistry, Cambridge, UK (2015).
10. Physical Chemistry by Samuel Glasstone, ELBS (1982).
11. *A Text book of Physical Chemistry*, A S Negi & S C Anand, New Age International Publishers (2007).
12. *Principles of Physical Chemistry*, Puri, Sharma &Pathania, Vishal Publishing Co.

13. *A Text Book of Physical Chemistry* P.L.Soni , O.P. Dharmarhaand and U.N.Dash, Sultan Chand and Sons.
14. *Advanced Physical Chemistry*, Gurdeep Raj, Goel Publishing House(2018)
15. *Fundamentals of Analytical Chemistry*, D.A. Skoog, D.M. West, Holler and Crouch, 8th edition, Saunders College Publishing, New York (2005).
16. *Analytical Chemistry*, G.D. Christian, 6th edition, Wiley-India (2007).

Reference books:

1. Vogel's Textbook of Quantitative Chemical Analysis, J. Mendham, R.C. Denney, J.D.Barnes and M.J.K. Thomas, 6th edition, Third Indian Reprint, Pearson Education Pvt.Ltd.(2007).
2. *Atkins Physical Chemistry*.8th Edition. Peter Atkins & Julio De Paula Oxford University Press.
3. *Fundamentals Concepts of Inorganic Chemistry*, Vol 1 and 2, 2nd Edition, Asim K Das, CBS Publishers and Distributors, (2013)
4. Finar, I. L. *Organic Chemistry (Volume I)*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education)
5. <https://www.thoughtco.com/teach-yourself-chemistry-604139>
6. <https://www.toppr.com/guides/general-knowledge/basic-science/basic-chemistry/>

Pedagogy

Formative Assessment	
Assessment Occasion/ type	Weightage in Marks
Internal Test	40
Sem End Exam	60
Total	100

DSC1: Basic Experiments in Chemistry Lab

Number of practical Credits	Number of practical hours/ semesters
2	56
IA: 25	SEE: 25

List of Experiments:

1. Calibration of glassware, pipette, burette and volumetric flask.
2. Determination of sodium carbonate and sodium bicarbonate in a mixture.
3. Determination of alkali present in soaps/detergents
4. Determination of iron(II) using potassium dichromate
5. Determination of oxalic acid using potassium permanganate solution
6. Standardization of EDTA solution and determination of hardness of water
7. Determination of Fe^{2+} as Fe_2O_3
8. Determination of Ni^{2+} as $\text{Ni}(\text{DMG})_2$ complex.
9. Selection of suitable solvents for Purification/Crystallization of organic compounds.
10. Preparation of acetanilide from aniline using Zn/acetic acid (Green method).
11. Synthesis of p-nitro acetanilide from acetanilide using nitrating mixture.
12. Bromination of acetanilide (i) Conventional method and/or (ii) with ceric ammonium nitrate and potassium bromide (Green method).
13. Determination of density using specific gravity bottle and viscosity of liquids using Ostwald's viscometer. (Ethyl acetate, Toluene, Chloroform, Chlorobenzene or any other non-hazardous liquids)
14. Study the variation of viscosity of sucrose solution with the concentration of solute
15. Determination of the density using specific gravity bottle and surface tension of liquids using Stalagmometer. (Ethyl acetate, Toluene, Chlorobenzene, any other non-hazardous liquids)
16. Study of variation of surface tension of detergent solution with concentration.

Text Books:

1. Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, University Press (2000).
2. Green Chemistry by V. K. Ahluwalia. Narosa Publishing House Pvt. Ltd. 2012 .
3. *Advanced Practical Physical Chemistry*, J.B. Yadav, GOEL Publishing house (2017).
4. *Practical Physical Chemistry*, B.Viswanathan & P.S.Raghavan, *Viva Books* Pvt. Ltd (2017).

References:

1. Vogel's Textbook of Quantitative Chemical Analysis, 2nd or 3rd edition, ELBS
2. Practical Volumetric Analysis, Peter A C McPherson, Royal Society of Chemistry, Cambridge, UK (2015).
3. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009)
4. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry, 5th Ed., Pearson (2012) .
5. Monograph on Green Chemistry Laboratory Experiments DST. Govt of India.
6. *Practical Physical Chemistry*, B.D. Khosla, V.C Garg & Adarsh Gulati, R.Chand & Co.: New Delhi (2011)

7. *Experiments in Physical Chemistry 8th Ed.*; C W Garland, J W Nibler & D P Shoemaker, McGraw-Hill: New York (2003)
8. <https://www.lccc.edu/academics/science-and-engineering/science-in-motion/labs-equipment/chemistry-lab-experiments>

BSc Semester 1-Chemistry (Hons)

Title of the course: **SEC-1: Water analysis**

Number of Theory Credits	Number of lecture hours/ semester	Number of practical Credits	Number of practical hours/ semesters
1	14	1	28
Water Analysis			14 Hrs
Unit – 1 Water Chemistry			06 hrs
Chemistry of water development, hydrology, precipitation, rain, snowfall, water availability requirement. Quality of surface water, ground water. Impurities in water, standards of water quality for various requirements like potable, domestic use , industrial purpose, agricultural purpose.			03
Characteristics of waste water from industries- Sugar factory, Pulp and Paper mill, Distillery, Textile, Engineering, Food industry, Domestic waste. Water pollution causes and remedies.			03
Unit – 2 Water treatment			08 hrs
Water treatment technologies – House hold water treatment, Municipal water treatment, Industrial treatment, softening of water, Dis-infection of water.			04
Unit – 3 Water Microbiology			04
Water Microbiology – types and sources of contamination, prevention of water borne diseases. Water management, water harvesting, water recycling.			

SEC Practicals: Water Analysis

1. Collection and preservation of samples from open well, tap, bore well, river, water treatment plants, waste water treatment plants.
2. Determination of PH and Electrical Conductivity of water.
3. Determination of Alkalinity.
4. Determination of Hardness (Total, Permanent & Temporary)
5. Determination of calcium.
6. Determination of Magnesium.

7. Determination of Carbonates & Bi-carbonates.
8. Determination of Chemical Oxygen demand (C.O.D.)
9. Determination of Biochemical Oxygen Demand (B.O.D.)
10. Determination of M.P.N. of water.
11. Identification of fresh water algae & Protozoa by Microscopy.

Text Books

1. Manual of water & waste water analysis, NEERI, Nagpur.
2. Text book of water and waste water engineering by H. K. Hussen.
3. Water supply & sanitary engineering by Birdie.
4. Practical methods in ecology & Environmental science by R. K. Trivedi, P. K. Goel, C. L. Trisal.

Reference books

1. Standard Methods for Examination of water & waste water APHA- AWWA- WPCE
2. <https://thehomeschoolscientist.com/water-quality-experiment/>
3. https://www.who.int/water_sanitation_health/dwq/2edvol3d.pdf

Pedagogy

Formative Assessment	
Assessment Occasion/ type	Weightage in Marks
Internal Test	25
Sem End Exam	25
Total	50

BSc Semester 1 – Chemistry (Hons)**Title of the Course: OEC-1: CHEMISTRY IN DAILY LIFE**

Number of Theory Credits	Number of lecture hours/ semester	Number of practical Credits	Number of practical hours/ semesters
3	42	-	-
Content of Theory Course 1			42 Hrs
Unit – 1 Dairy products			8 hrs
Dairy Products: Composition of milk and milk products. Analysis of fat content, minerals in milk and butter. Estimation of added water in milk. Beverages: Analysis of caffeine in coffee and tea, detection of chicory in coffee, chloral hydrate in toddy, determination of methyl alcohol in alcoholic beverages.			8
Unit-2 Adulteration and contamination of food			9 hrs
Food additives, adulterants, and contaminants- Food preservatives like benzoates, propionates, sorbates, disulphites. Artificial sweeteners: Aspartame, saccharin, dulcin, sucralose, and sodium cyclamate. Flavors: Vanillin, alkyl esters (fruit flavors), and monosodium glutamate.			6 hrs
Artificial food colorants: Coal tar dyes and non-permitted colors and metallic salts. Analysis of pesticide residues in food.			3hrs
Unit – 3 Some important molecules			9 hrs
Vitamins: Classification and Nomenclature. Sources, deficiency diseases, and structures of Vitamin A1, Vitamin B1, Vitamin C, Vitamin D, Vitamin E & Vitamin K1. Oils and fats: Composition of edible oils, detection of purity, rancidity of fats and oil. Tests for adulterants like argemone oil and mineral oils. Halphen test. Soaps & Detergents: Definition, classification, manufacturing of soaps and detergents, composition and uses			9
Unit – 4 Chemical and Renewable Energy Sources			8 hrs
Chemical and Renewable Energy Sources: principles and applications of primary & secondary batteries and fuel cells. Basics of solar energy, future energy storer.			8
Unit – 5 Food products & Polymers			8 hrs
Food products and nutrients: Proteins, vitamins, carbohydrates, minerals, fats and their importance with examples. Deficiencies and respective diseases. Malnutrition Requirement of balanced and nutritious food			4
Polymers: Basic concept of polymers, classification and characteristics of polymers. Applications of polymers as plastics in electronic, automobile components, medical fields, and aerospace materials. Problems of plastic waste management. Strategies for the development of environment-friendly polymers.			4

Text Books

1. B. K. Sharma: Introduction to Industrial Chemistry, Goel Publishing, Meerut (1998)
2. Medicinal Chemistry- Ashtoush Kar.
3. Analysis of Foods – H.E. Cox: 13.
4. Foods: Facts and Principles. N. Shakuntala Many and S. Swamy, 4thed. New Age International (1998)
5. Physical Chemistry – P I Atkins and J. de Paula – 7thEd. 2002, Oxford University Press.
7. Handbook on Fertilizer Technology by Swaminathan and Goswamy, 6th ed. 2001, FAI.

Reference Books

1. Organic Chemistry by I. L. Finar, Vol. 1 & 2. 9. Polymer Science and Technology, J. R. Fired (Prentice Hall).
2. Chemical Analysis of Foods – H.E. Cox and Pearson.
3. <https://ncert.nic.in/ncerts/l/lech207.pdf>
4. <https://www.thoughtco.com/examples-of-chemistry-in-daily-life-606816>
5. <https://studiousguy.com/examples-of-chemistry-in-everyday-life/>

Pedagogy

Formative Assessment	
Assessment Occasion/ type	Weightage in Marks
Internal Test	40
Sem End Exam	60
Total	100