SRI DHARMASTHALA MANJUNATHESHWARA COLLEGE (AUTONOMOUS)
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DAKSHINA KANNADA, KARNATAKA STATE
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DEPARTMENT OF CHEMISTRY

Syllabus of

Bachelor's Degree in
SCIENCE

CHOICE BASED CREDIT SYSTEM

SEMESTER SCHEME

UNDER NEW EDUCATION POLICY 2020

2021-22 ONWARDS

Approved by the BOS meeting held on 18th November 2021
Approved by the Academic Council meeting held on 10-12-2021

DISCIPLINE SPECIFIC CORE - CHEMISTRY

Preamble

The 21st century has opened up many new challenges in the field of Higher Education. The present alarming situation necessitates transformation and/or redesigning of the system, not only by introducing innovations but developing a "learner-centric" approach. Thus, there is a need to allow flexibility in the education system, so that students depending upon their interests can choose inter-disciplinary, intra-disciplinary and skill-based courses. It is also to bridge the increasing gap between an undergraduate degree and employability.

Keeping this in mind, on 29th July 2020 the Central Cabinet approved the National Education Policy (2019) initiated and developed by the Ministry of Human Resource Development (MHRD), Govt. of India. National Education Policy (NEP) has brought several reforms in Indian education which includes broad-based multidisciplinary Undergraduate Education with 21st century skills while developing specialized knowledge with disciplinary rigor. It is to bring equity, efficiency and academic excellence to National Higher Education System. The important ones include innovation and improvement in course-curricula, the introduction of paradigm shift in learning and teaching pedagogy, evaluation and education system.

The University Grants Commission has asked all the universities in the country to implement multidisciplinary and holistic education across disciplines for a multidisciplinary world, in all the universities and affiliated colleges. The Karnataka State Higher Education Council has also communicated general guidelines in this regard.

Further, the Karnataka State Higher Education Council has proposed a model curriculum framework and an implementation plan for the State of Karnataka. Based on these recommendations, Mangalore University issued guidelines to its affiliated and autonomous colleges to implement the National Education Policy from the academic year 2021-2022.

Hence our college thought to implement multidisciplinary and holistic education in all the undergraduate programs with multiple entries and exit options with multiple certificate/diploma/degrees to replace the present undergraduate degree programs effective from the academic year 2021-2022.

In this backdrop, the Department of Chemistry proposed a Four-year, Undergraduate Curriculum in Chemistry to cater to the needs of students with diverse talents, aspirations and

professional requirements. Students will have the option to exit after one year with the certificate, two years with an award of the diploma and after three years with the award of the bachelor's degree. Successful completion of 4- year program will lead to the award of a bachelor degree with honors.

ELIGIBILITY FOR ADMISSION

Only those candidates who have passed Pre University course in science or an equivalent course with Chemistry as one of the subjects are eligible to take Chemistry as one of the core subjects in B.Sc Programme.

PROGRAMME OUTCOMES:

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

PO. 1: To create enthusiasm among students for chemistry and its application in various fields of life.

PO. 2: To provide students with broad and balanced knowledge and understanding of key concepts in chemistry

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.

PO. 4: To develop among students the ability to apply standard methodology to the solution of problems in chemistry

PO. 5: To provide students with knowledge and skill towards employment or higher education in chemistry or multi-disciplinary areas involving chemistry.

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 through well-trained graduates

PO. 7: To develop in students the ability to adapt and apply methodology to the solution of unfamiliar types of problems.

PO. 8: To instill 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

COURSE DESCRIPTION

SI. No	Paper code	Title of the Paper	Credits	Marks		
				IA	Sem End	Total
I Semester B.Sc.						
1	DSC-1	Analytical and Organic Chemistry-I	4	40	60	100
2	DSC Lab-1	Analytical and Organic Practicals-I	2	25	25	50
3	OE-1A or OE-1B	Chemistry in Daily Life or Chemistry in Medicine and Health Care	3	40	60	100
II Semester B.Sc.						
4	DSC-2	Inorganic and Physical Chemistry-I	4	40	60	100
5	DSC Lab-2	Inorganic and Physical Practicals-I	2	25	25	50
6	OE-2A or OE-2B	Molecules of Life or Environmental Chemistry and Pollution Control	3	40	60	100
III Semester B.Sc.						
7	DSC-3	Analytical and Organic Chemistry-II	4	40	60	100
8	DSC Lab-3	Analytical and Organic Practicals-II	2	25	25	50
9	OE-3		3	40	60	100

IV Semester B.Sc.						
10	DSC-4	Inorganic and Physical Chemistry-II	4	40	60	100
11	DSC Lab-4	Inorganic and Physical Practicals-II	2	25	25	50
12	OE-4		3	40	60	100
V Semester B.Sc.						
13	DSC-5	Selected topics in Inorganic Chemistry	3	40	60	100
14	DSC Lab-5	Inorganic Chemistry Practicals	2	25	25	50
15	DSC-6	Selected Topics in Organic Chemistry	3	40	60	100
16	DSC Lab-6	Organic Chemistry Practicals	2	25	25	50
17	DSE-1		3	40	60	100
VI Semester B.Sc.						
18	DSC-7	Selected Topics in Physical Chemistry	3	40	60	100
19	DSC Lab-7	Physical Chemistry Practicals.	2	25	25	50
20	DSC-8	Spectroscopy	3	40	60	100
21	DSC Lab-8	Analytical and Industrial Chemistry Practicals	2	25	25	50
22	DSE-2		3	40	60	100

VII Semester B.Sc.						
23	DSC-9		3	40	60	100
24	DSC Lab-9		2	25	25	50
25	DSC-10		3	40	60	100
26	DSC Lab-10		2	25	25	50
27	DSC-11		3	40	60	100
28	DSE-3		3	40	60	100
29	Research Methodology (RM)		3	40	60	100
VIII Semester B.Sc.						
30	DSC-12		3	40	60	100
31	DSC-13		3	40	60	100
32	DSC-14		3	40	60	100
33	DSE-4		3	40	60	100
34	Project		6			

Note: Open Elective(OE) offered to non chemistry students

COURSE PATTERN AND SCHEME OF EXAMINATION

I Semester									
Paper Code	**Title of the Paper**	**Pedagogy**	**Assessment**	**Instruction Hours**	**Duration of Examination (Hrs)**	**Max. Marks**			**Credits**
						Exam	**IA**	**Total**	
DSC-1	**Analytical and Organic Chemistry-I**	Assignment Desk work	Internal Exams, Continuous Evaluation, Sem Exams	4	2	60	40	100	4
DSC Lab-1	**Analytical and Organic Practicals-I**	Assignment Desk work	Internal Exams, Continuous Evaluation, Sem Exams	4	4	25	25	50	2
OE-1	**Chemistry in Daily Life(For Non-Chemistry students)**			3	2	60	40	100	3
Total number of credits for the subjects in I Semester:09									
II Semester									
DSC-2	**Inorganic and Physical Chemistry-I**	Assignment, Desk work	Internal Exams, Continuous Evaluation, Sem Exams	4	2	60	40	100	4
DSC Lab -2	**Inorganic and Physical Practicals-I**	Assignment, Desk work	Internal Exams, Continuous Evaluation, Sem Exams	4	2	25	25	50	2
OE-2	**Molecules of Life**			3	2	60	40	100	3
Total number of credits for the subjects in II Semester: 09									

III Semester									
DSC-3	**Analytical and Organic Chemistry-II**	Assignment, Desk	Internal Exams, Continuous Evaluation, Sem Exams	4	2	60	40	100	4
DSC Lab-3	**Analytical and Organic Practicals-II**	Assignment, Desk work	Internal Exams, Continuous Evaluation, Sem Exams	4	4	25	25	50	2
OE-3				3	2	60	40	100	3
Total number of credits for the subjects in III Semester: 09									
IV Semester									
DSC-4:	**Inorganic and Physical Chemistry-II**	Assignment, Desk work	Internal Exams, Continuous Evaluation, Sem Exams	4	2	60	40	100	4
DSC Lab-4:	**Inorganic and Physical Practicals-II**	Assignment, Desk work	Internal Exams, Continuous Evaluation, Sem Exams	4	4	25	25	50	2
OE-4				3	2	60	40	100	3
Total number of credits for the subjects in IV semester: 09									
V Semester									
DSC-5:	**Selected topics in Inorganic Chemistry**	Assignment, Desk work	Internal Exams, Continuous Evaluation, Sem Exams	4	2	60	40	100	3
DSC Lab-5:	**Inorganic Chemistry Practicals**	Assignment, Desk work	Internal Exams, Continuous Evaluation, Sem Exams	4	4	25	25	50	2

DSC-6:	**Selected Topics in Organic Chemistry**	Assignment, Desk work	Internal Exams, Continuous Evaluation, Sem Exams	4	2	60	40	100	3
DSC Lab-6:	**Organic Chemistry Practicals**	Assignment, Desk work	Internal Exams, Continuous Evaluation, Sem Exams	4	4	25	25	50	2
DSE-1				3	2	60	40	100	3
Total number of credits for the subjects in V semester:13									
VI Semester									
DSC-7:	**Selected Topics in Physical Chemistry**	Assignment, Desk work	Internal Exams, Continuous Evaluation, Sem Exams	4	2	60	40	100	3
DSC Lab-7:	**Physical Chemistry Practicals**	Assignment, Desk work	Internal Exams, Continuous Evaluation, Sem Exams	4	4	25	25	50	2
DSC-8:	**Spectroscopy**	Assignment, Desk work	Internal Exams, Continuous Evaluation, Sem Exams	4	2	60	40	100	3
DSC Lab-8:	**Analytical and Industrial Chemistry Practicals**	Assignment, Desk work	Internal Exams, Continuous Evaluation, Sem Exams	4	4	25	25	50	2
DSE-2		Assignment, Desk work	Internal Exams, Continuous Evaluation, Sem Exams	3	2	60	40	100	3
Total number of credits for the subjects in VI Semester:13									

SCHEME OF EXAMINATION AND EVALUATION

ASSESSMENT IN PERCENTAGE

Type of Course	Formative /IA	Summative/Term end
Theory	40	60
Practicals	50	50

Pattern of Question Paper for Discipline Specific Courses

The Syllabus of each paper shall be grouped into four units (I, II, III, IV semester). The question papers shall consist of Parts A, B and C containing questions drawn equally from each unit.

- Part A shall contain 8 short answer (1 to 3 sentences) type questions carrying 2 marks each drawn equally from each unit of the syllabus. 6 questions are to be answered.
- Part B shall contain 8 questions (to be answered in 2 to 5 sentences) carrying 3 marks each drawn equally from each unit of the syllabus. 6 questions are to be answered.
- Part C shall contain 8 questions (descriptive type) carrying 5 marks, each drawn equally from each unit of the syllabus. 6 questions are to be answered.

Pattern of Question Paper for Open Electives

The Syllabus of each paper shall be grouped into three units (I, II, III, IV semester). The question papers shall consist of Parts A, B and C containing questions drawn equally from each unit.

- Part A shall contain 9 short answer (1 to 3 sentences) type questions carrying 2 marks each drawn equally from each unit of the syllabus. 6 questions are to be answered.
- Part B shall contain 9 questions (to be answered in 2 to 5 sentences) carrying 3 marks each drawn equally from each unit of the syllabus. 6 questions are to be answered.
- Part C shall contain 9 questions (descriptive type) carrying 5 marks each drawn equally from each unit of the syllabus. 6 questions are to be answered

SYLLABUS

I SEMESTER

DSC-1: Analytical and Organic Chemistry-I

Total Contact Hours: 56 hrs and Credits-4

Learning Objectives (LOs)

LO1: To learn the concepts of chemical analysis, accuracy, precision and statistical data treatment

LO2: To understand the basic concepts involved in titrimetric analysis, primary standard substances, and preparation of standard solutions.

LO3: To Learn the Organic reactions and techniques of writing the movement of electrons, bond breaking, bond forming

LO4: To understand the mechanism of Electrophilic substitution reactions and Nucleophilic substitution reaction

LO5: To conceptualize the nature of carbon-carbon pi bonds

LO6: To have an elementary idea of principles of green chemistry and its applications.

Course Outcomes (COs)

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

CO1: The concepts of chemical analysis, accuracy, precision and statistical data treatment.

CO2: Prepare the solutions after calculating the required quantity of salts in preparing the reagents/solutions and dilution of stock solution.

CO3: The concept of volumetric and gravimetric analysis and deducing the conversion factor for determination

CO4: Handling of toxic chemicals, concentrated acids and organic solvents and practice safety procedures.

CO5: The concepts of Organic reactions and techniques of writing the movement of electrons, bond breaking, bond forming

CO6: The Concept of aromaticity, resonance, hyper conjugation, etc.

CO7: Understand the preparation of alkanes, alkenes and alkynes, their reactions, etc.

CO8: Understand the mechanism of nucleophilic, electrophilic reactions

CO9: Understand the principles of green chemistry and its applications.

UNIT I **14 Hours**

Analytical Chemistry

Laboratory Practices and Safety Measures : 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.

Language of Analytical Chemistry: Definitions of analysis, determination, measurement, techniques and methods. Classification of analytical techniques. Choice of an analytical method - accuracy, precision, sensitivity, selectivity, method validation. Figures of merit of analytical methods and limit of detection (LOD), Limit of quantification (LOQ), linear dynamic range (working range).

Errors and treatment of analytical data: Limitations of analytical methods – Errors: Determinate and indeterminate errors, absolute error, relative error, minimization of errors. Statistical treatment of finite samples -mean, median, range, standard deviation and variance. Comparison of analytical results: Definition, equation with explanation of terms involved for Student's t-test, F-test and Q-test and numerical problems.

Self Study: External standard calibration - regression equation (least squares method), correlation coefficient (R^2), Numerical problems

UNIT I **14 Hours**

Analytical Chemistry

Titrimetric Analysis: Classification, Preparation and 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.

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.

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.

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.

Precipitation Titrimetry: Titration curves, titrants and standards, indicators for precipitation titrations involving silver nitrate- Volhard's and Mohr's methods and their differences

Iodometric Titrimetry

Basic principle, titrants, and indicators for precipitation titrations. Application: Determination of available chlorine in bleaching powder.

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).

Numerical problems on all the above aspects.

Self Study: Basic principle of titrimetric analysis

UNIT III 14 Hours

Organic Chemistry

Classification and nomenclature of organic compounds, Hybridization, Shapes of organic molecules, Influence of hybridization on bond properties.

Nature of Bonding in Organic Molecules: Formation of Covalent bond, Types of chemical bonding, localized and delocalized, conjugation and cross conjugation, concept of resonance, 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.

Mechanisms of Organic Reactions: Notations used to represent electron movements and directions of reactions- curly arrows, formal charges. Types of bonds breaking- homolytic and heterolytic. Types of reagents-Electrophiles, nucleophiles, nucleophilicity and basicity. Types of organic reactions- substitution, addition, elimination, rearrangement and pericyclic reactions, explanation with examples.

Chemistry of Aliphatic Hydrocarbons, Carbon-Carbon Sigma bonds

Chemistry of Alkanes: Formation of alkanes, Wurtz reaction, Wurtz-Fittig reaction, Free radical substitution, Halogenation- relative reactivity and selectivity

Carbon-Carbon pi bonds: 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 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.

Self Study: Electronic displacements: Inductive effect, Electromeric effect, Resonance and Hyper conjugation,Vanderwaal's interaction, hydrogen bonding- types of hydrogen bonding

UNIT IV **14 Hours**

Organic Chemistry

Nucleophilic Substitution at Saturated Carbon: Mechanism of S_N1 and S_N2 reactions with suitable examples. Energy profile diagrams, Stereochemistry and factors effecting S_N1 and S_N2 reactions.

Aromatic Electrophilic Substitution Reactions: Mechanisms, σ and π complexes, Halogenation Sulphonation, Friedel Crafts alkylation, Activating and deactivating groups. Orientation influence, Ortho-para ratio.

Aromatic Nucleophilic Substitution Reactions: S_NAr mechanism, S_N1 mechanism, and Benzyne mechanism with suitable examples.

Green Chemistry – Elementary account of principles of Green Chemistry

Self Study: Mechanism of Nitration, Bromination, Friedel Crafts acylation

DSC Lab-1: CHEMISTRY PRACTICAL I

4Hrs/Week (12x4 Hrs) and Credit 2

ANALYTICAL AND ORGANIC CHEMISTRY PRACTICALS –I

PART-A: Analytical Chemistry

1. Safety Practices in the Chemistry Laboratory, knowledge about common toxic chemicals and safety measures in their handling, cleaning and drying of glass wares, MSDS (Material Safety Data Sheets).
2. Calibration of glassware, pipette, burette and volumetric flask.
3. Determination of sodium carbonate and sodium bicarbonate in a mixture.
4. Determination of alkali present in soaps/detergents
5. Determination of iron(II) using potassium dichromate
6. Determination of oxalic acid using potassium permanganate solution
7. Standardization of EDTA solution and determination of hardness of water
8. Standardization of silver nitrate and determination of chloride in a water sample (demonstration)
9. Determination of alkali content in antacids
10. Determination of pH and Electrical conductivity of water

PART-B: Organic Chemistry

1. Selection of suitable solvents for Purification/Crystallization of organic compounds.
2. Preparation of acetanilide from aniline using Zn/acetic acid (Green method).
3. Synthesis of p-nitro acetanilide from acetanilide using nitrating mixture.
4. Bromination of acetanilide (i) Conventional method and/or (ii) with ceric ammonium nitrate and potassium bromide (Green method).
5. Hydrolysis of methyl m-nitrobenzoate to m-nitrobenzoic acid (Conventional method)
6. Synthesis of diazoaminobenzene from aniline (conventional method).
7. Preparation of dibenzalacetone (Green method).
8. Diels Alder reaction between furan and maleic acid (Green method).

Reference Books

1. J. Mendham, R.C. Denney, J.D.Barnes and M.J.K. Thomas (2007), Vogel's Textbook of Quantitative Chemical Analysis, 6th edition, Third Indian Reprint, Pearson Education Pvt.Ltd.
2. D.A.Skoog, D.M. West, Holler and Crouch (2005), Fundamentals of Analytical Chemistry, 8th edition, Saunders College Publishing, New York.
3. Wiley-India (2007), Analytical Chemistry, G.D. Christian, 6th edition,.
4. Peter A C McPherson (2015), Practical Volumetric Analysis, Royal Society of Chemistry, Cambridge, UK.
5. I. L Finar (1973), Organic Chemistry ,Volume I and II ,Pearson Education
6. P.L.Soni (2012), Text Book of Organic Chemistry , 29th ed., Sultan Chand &Sons
7. Peter Sykes (2003), A Guide Book to Mechanisms in Organic Chemistry ,6th ed.,Pearson Education
8. O.P. Agarwal, Reactions and Reagent , Goel Publishing House
9. Gurdeep Chatwal (2016), Organic Reaction Mechanisms, 5th ed., Himalaya Publishing House

SEMESTER I

OE-1A: CHEMISTRY IN DAILY LIFE

Total Contact Hours: 42 hrs and Credits-3

Learning Objectives (LOs)

LO1: To learn the basic knowledge of milk, milk products and all types of beverages

LO2: To understand the role of food preservatives and food colorants in food industries

LO3: To have a basic understanding about structure and functions of Vitamins and Hormones

LO4: To understand the manufacturing of Oils, Fats, Soaps and Detergents

LO5: To get the basic knowledge of batteries, fuel cells and polymers

Course Outcomes (COs)

CO1: Gain the knowledge of milk products and all types of beverages

CO2: Understand the role of food preservatives and food colorants in food industries

CO3: Explain the structure and functions of Vitamins and Hormones

CO4: Explain the preparation of Soaps and Detergents and biological importance of Oils and fats

CO5: Understand the concepts of batteries, fuel cells and the basic knowledge and importance of polymers

UNIT –I **14 Hours**

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.

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.

Artificial Food Colorants: Coal tar dyes and non-permitted colors and metallic salts. Analysis of pesticide residues in food.

UNIT –II **14 Hours**

Vitamins : Classification and Nomenclature. Sources, deficiency diseases, and structures of Vitamin A1, Vitamin B1, Vitamin C, Vitamin D, Vitamin E & Vitamin K1.

Hormones : Definition, classification with examples, functions and deficiency diseases

Oils and Fats Biological importance of oils and fats . Fatty acids(saturated, unsaturated fatty acids, formation of triglycerides and general formula of triglycerides. Composition of edible oils, Chemical nature of oils and fats- saponification, acid hydrolysis, rancidity. Tests for adulterants like argemone oil and mineral oils. Halphen test.

Soaps & Detergents: Definition, classification, manufacturing of soaps and detergents, composition and uses

UNIT –III **14 Hours**

Chemical and Renewable Energy Sources: Principles and applications of primary & secondary batteries and fuel cells. Basics of solar energy, future energy storer.

Polymers: Basic concept of polymers, classification and characteristics of polymers. Bio – degradable and Non bio-degradable polymers with Examples : Conducting Polymers with Examples. 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.

Science behind emotions, sunscreen, rust formation, rainbow, motion sickness, salt harvesting, crystallization of sugar and kidney stones

Reference Books

1. Tom Coultate (2016), Food: The Chemistry of its components, Kindle Edition, Royal Society of Chemistry, London
2. Geoffrey Campbelt-Platt (2017), Food Science and Technology,Kindle Edition,Wiley Blackwell
3. John Emsley (2015),Chemistry at Home: Exploring the ingredients in everyday products,FirstEdition,Royal Society of Chemistry London.
4. Kripal Singh(2012),Chemistry in daily life, Third Edition, Eastern Academy Education, PHI Learning Pvt. Ltd, New Delhi.
5. ShardenduKislaya (2011), Chemistry in everyday life, Discovery Publishing House Pvt.Ltd.
6. H.K.Chopra and P.S.Panesar(2015),Food Chemistry,Narosa Publishing House
7. Gurudeep R.Charwal andM.Arora (2009), Organic Chemistry of Natural Products,(Vol-I and II) , Himalaya Publishing House.
8. P l Atkins and J. de Paula (2002),Physical Chemistry ,7thEd. 2002, Oxford University Press.
9. Swaminathan and Goswamy (2001),Handbook on Fertilizer Technology by, 6th ed. FAI.

OE-1B: CHEMISTRY IN MEDICINE AND HEALTH CARE

Total Contact Hours: 42hrs and Credits-3

Learning Objectives:

LO1: To give basics and importance of medicines used in our daily life

LO2: To give an elementary account of ayurvedic medicines

LO3: To create awareness about healthcare and role of chemistry in our everyday life

Course Outcomes:

CO1: Gain knowledge about different types of medicines used in day today life

CO2: Understand the basic idea and importance of ayurvedic medicines

CO3: Understand the role of chemistry in health care and identification and treatment of Communicable and Non-Communicable diseases.

UNIT I

Chemistry in Health Care: **14 Hours**

Concepts of health and disease: Disease causing agents and prevention of diseases. Nutrition requirements: Balanced diet, nutritional deficiency disorders, their treatment and prevention, specifications for drinking water.

First Aid: Emergency treatment of shock, snake bites, burns, poisoning, fractures and resuscitation methods.

UNIT II

Communicable and non communicable diseases: **14 Hours**

Communicable Diseases: Brief outline, their causative agents, modes of transmission and prevention- Chicken pox, measles, influenza, diphtheria, whooping cough, tuberculosis, poliomyelitis, typhoid, helminthiasis, dengue, malaria, filariasis, rabies, trachoma, tetanus, leprosy.

Non-Communicable Diseases: Brief outline, their causative agents, prevention and control-Asthma, Cancer, Cardiovascular diseases, Chronic, rheumatic diseases, Diabetes, Schizophrenia, Alzheimer's, Parkinson's, Senile dementia.

Applications of chemistry in health care: X-ray, CT scan, and MRI

UNIT III

Chemistry of Medicines in daily life: **14 Hours**

Introduction to medicines used in daily life. Chemotherapy and chemotheraptic agents. Classification of drugs. Elementary study of antipyretics, anti bacterials, anti fungals,

analgesics, antibiotics, anesthetics, anti malarials, anti-histamines, anti-hypertensives, antipsychotics, anti virals, sedatives and hypnotics, anti-neoplastic agents, cardiovascular drugs, anti-inflammatory drugs and anti-fertility drugs. Prescriptions–reading and understanding of prescriptions. Dose and dosage of drugs. Mode of action of drugs. Routes of administration, mechanism of action, Combined effect of drugs, Factors modifying drug action, tolerance and dependence. Absorption, Distribution, Metabolism and Excretion of drugs. Discovery and development of new drugs.

Ayurvedic medicines:

Introduction, philosophy, classification and identification of biological activity of plants, plant products, bhasmas- formulations, methods of formation and analysis of active ingredients.

Reference Books

1. Ashutoshkar (2010), Medicinal Chemistry, Fifth Edition, New Age International (P) Limited, Bengaluru.
2. G.R.Chatwal (2009), Biopharmaceutics and Pharmacokinetics, Himalaya Publishing House, Mumbai.
3. Raghupathi Mukhopadhyay, Sriparna Datta, Rajib Kumar Das (2011), Text Book of Pharmaceutical Chemistry and Medicinal Chemistry, Books and Allied(P) Ltd., Kolkata
4. Donald Cairns (2012),Essentials of pharmaceutical chemistry, 4th Revised Ed.Pharmaceutical Press.
5. Asutoshkar(2010), Essentials of Biopharmaceutics and Pharmacokinetics, Elsevier Publishers.
6. D.Sriram, P.Yogeeshwari (2010), Medicinal Chemsitry, Doring Kindersley (India).Pvt.Ltd.
7. Jagadish.P. Prasad (2010), Conceptual Pharmacology, Universities Press (India) Limited.
8. Dr.S.L.Goel(2009), Education of Communicable and Non Communicable Diseases, Deep and Deep & Deep Publications.Pvt.Ltd.
9. David.V.Mcqueen(2013), Global Handbook on Non Communicable Diseases And Health promotion, Springer Publication.
10. Roya Kelishadi(2019), Primordial Prevention Of Non Communicable Diseases,Springer Publication.

11. Jeremy Hawker,NormanBegg, Ralf Reintijies,Karl Ekdahl, ObagheEdrghere, Jim Van Steenpergm(2018), Communicable Disease Control And Health Protection, John Wiley & Sons Ltd.
12. Roger Webber (2016), Communicable Disease Epidemiology And Control- A Global Perspective 5th Ed, CABI Publishing.
13. Edward.P.Ortleb, Richard Cadice (1993), Disease And Health, Hands On Interactive Publishing.

SEMESTER II

DSC – 2: INORGANIC AND PHYSICAL CHEMISTRY – I

Total Contact Hours: 56 hrs and Credits-4

Learning Objectives(LOs)

LO1: To learn the basic knowledge of quantum chemistry

LO2: To understand periodic properties and the characteristics of elements

LO3: To have a basic understanding about Gaseous , liquid and Plasma states

LO4: To understand the characteristics of solid states and liquid crystals

LO5: To get the knowledge of validity of distribution law and its modifications

Course Outcomes (COs)

CO1: Gain the knowledge of quantum chemistry

CO2: Understand the periodic properties and the characteristics of elements

CO3: Explain the different laws of Gaseous states and liquid states

CO4: Learn the characteristics of solid states and liquid crystals

CO5: Understand the concepts of validity of distribution law and its modifications

UNIT –1 **14 Hours**

Inorganic Chemistry

Wave Mechanical Concepts of Atomic Structure

Black body radiation,Photoelectric effect. 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.

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.

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.

Self Study: Bohr's theory, its limitations and atomic spectrum of hydrogen atom.

UNIT –II **14 Hours**

Inorganic Chemistry

Periodic Table and Atomic Properties: Position of hydrogen in periodic table, Resemblance with alkali metals and halogens. Name and Position of new elements in the periodic table.

Detailed discussion of the following properties of the elements, with reference to s and p-block elements:

(a) Atomic radii (van der Waals)

(b) Ionic and crystal radii.

(c) Covalent radii

(d) Ionization enthalpy, successive ionization enthalpies and factors affecting ionization energy. Applications of ionization enthalpy.

(e) Electron gain enthalpy, trends of electron gain enthalpy.

(f) Electronegativity, Pauling's/ Mulliken's/ Allred Rachow's/ and Mulliken-Jaffé's electronegativity scales. Variation of electronegativity with bond order, partial charge, hybridization, group electronegativity.

Trends in the chemistry of the compounds of groups 13 to 17 (hydrides, carbides, oxides and halides) are to be discussed.

Self Study: The long form of periodic table. Division of elements into s, p, d and f-block elements.

UNIT -III **14 Hours**

Physical Chemistry

Gaseous State: 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.

Vander Waals equation of state (No derivation) and application in explaining real gas behaviour. Critical phenomena – Andrew's isotherms of CO_2, critical constants and their calculation from van der Waals equation, Continuity of states, Law of corresponding states. Numerical problems.

Self Study: Elementary aspects of kinetic theory of gases, Ideal and real gases. Boyle temperature, Deviation from ideal gas behavior. Compressibility factor (Z) and its variation with pressure for different gases. Causes for deviation from ideal behavior.

Liquid State

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 Abbe's Refractometer.

Parachor: Definition, Atomic and structure parachor, Elucidation of structure of benzene and benzoquinone. Viscosity and molecular structure, Molar refraction and chemical constitution. Numerical Problems.

Self Study: Structure of liquids, Vapour Pressure- Definition, Relationship between Vapour pressure and boiling point.

Plasma State:

Introduction, Types and examples, Properties (Characteristics) of plasma, Applications of plasma - Plasma in daily life and Plasma in medicine

Self Study: Comparison between plasma state and liquid state, Plasma state and gaseous state

UNIT – IV **14 Hours**

Physical Chemistry

Solid State: Laws of Crystallography: Law of constancy of interfacial angles, Law of rational indices, Law of symmetry (Symmetry elements).

Miller indices and its calculation, X–Ray diffraction by crystals: Bragg's law and derivation of Bragg's equation, Single crystal and powder diffraction methods.

Defects in crystals- Point defects (Schottky and Frenkel defects) and Impurity defects (semiconductors).

Numerical problems

Self Study: Forms of solids- Unit cell and space lattice, anisotropy of crystals, size and shape of crystals, Crystal systems, Bravais Lattice- Types and identification of lattice planes

Liquid Crystals

Explanation, classification with examples- Smetic, nematic, cholesteric, dics shaped and polymeric. Structures of nematic and cholesteric phases-molecular arrangements in nematic and cholesteric liquid crystals. Applications of liquid crystals in LCDs and thermal sensing.

Self study: Structural Differences between Solids, Liquids and Liquid crystals

Distribution Law

Nernst Distribution Law - Statement and its derivation. Distribution constant, factors affecting distribution constant, validity of Distribution Law, Modification of distribution law when molecules undergo a) Association b) Dissociation. Application of Distribution Law in Solvent extraction. Derivation for simple and multiple extraction. Principles of distribution law in Parkes Process of desilverisation of lead.

Numerical Problems.

Self Study: Liquid mixtures – Miscible, Immiscible liquid mixture and examples.

Reference Books

1. J. D. Lee (1996), Concise Inorganic Chemistry, 5th ed., Blackwell Science, London
2. F. A. Cotton, G. Wilkinson and P. L. Guas (1994), Basic Inorganic Chemistry,3rd ed, John Wiley
3. B. Douglas, D. McDaniel and J. Alexander (1994), Concepts and Models of Inorganic Chemistry, 3rd ed., John Wiley
4. B. R. Puri, L. R. Sharma, K. C. Kalia (1996), Principles of Inorganic Chemistry, ShobanLal Nagin Chand and Co.
5. W.U. Malik, G.D. Tuli and R.D. Madan (2003), Selected Topics in Inorganic Chemistry, S. Chand Publication
6. B.R. Puri, Sharma and Patiana (1998), Principles of Physical Chemistry, 37th ed., Shobanlal Nagin
7. Dash.U.N, Dharmarha.O.P, Soni.P.L (2014), A Text Book of Physical
8. Chemistry, Sultan Chand & Co. Sultan Chand & Sons
9. Glasstone and Lewis (1961), Elements of Physical Chemistry, Macmillan
10. S.Glasstone (1969), Text book of Physical Chemistry , 2nded., Macmillan Ltd
11. C.N.R. Rao (1973), Universal General Chemistry, Macmillan

DSC Lab-2: CHEMISTRY PRACTICAL II

4Hrs/Week (12x4 Hrs) and Credit 2

INORGANIC AND PHYSICAL CHEMISTRY PRACTICALS - I

PART-A : Inorganic Chemistry

Titrimetry

1. Determination of carbonate and hydroxide present in a mixture.
2. Determination of oxalic acid and sodium oxalate in a given mixture using standard $KMnO_4$/ NaOH solution
3. Standardization of potassium permanganate solution and determination of nitrite in a water sample
4. Determination of chlorine in bleaching powder using iodometric method.

Gravimetry

1. Determination of Ba^{2+} as $BaSO_4$
2. Determination of Cu^{2+} as CuSCN
3. Determination of Fe^{2+}as Fe_2O_3
4. Determination of Ni^{2+} as Ni $(DMG)_2$ complex.

PART-B: Physical Chemistry

1. 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)
2. Study of the variation of viscosity of sucrose solution with the concentration of a solute
3. Determination of the density using specific gravity bottle and surface tension of liquids using Stalagmometer (Ethyl acetate, Toluene, Chlorobenzene, any other non-hazardous liquids
4. Study of variation of surface tension of detergent solution with concentration.
5. Determination of specific and molar refraction by Abbe's Refractometer. (Ethyl acetate, Methyl acetate, Ethylene Chloride)
6. Determination of the composition of liquid mixture by refractometry. (Toluene & Alcohol, Water & Sucrose)
7. Determination of partition/distribution coefficient - i) Acetic acid in water and cyclohexane. ii) Acetic acid in Water and Butanol. iii) Benzoic acid in water and toluene.
8. Determination of pH and Electrical Conductivity of Soil

SEMESTER II

OE – 2A: MOLECULES OF LIFE

Total Contact Hours: 42hrs and Credits-3

Learning Objectives (LOs)

LO1: To understand the different types of amino acids and determine the structure of peptides

LO2: To Explain the actions of enzymes in our body and interpret enzyme inhibition.

LO3: To Predict action of drugs. Depict the biological importance of oils and fats. Importance of lipids in the metabolism. Differentiate RNA and DNA and their replication.

LO4: To understand the energy conversions in bio systems

Course Outcomes (COs)

CO1: Identify different types of amino acids and determine the structure of peptides

CO2: Explain the actions of enzymes in our body and interpret enzyme inhibition.

CO3: Predict action of drugs. Depict the biological importance of oils and fats. Importance of lipids in the metabolism. Differentiate RNA and DNA and their replication.

CO4: Understand the energy conversions in bio systems

UNIT –I **14 Hours**

Carbohydrates

Classification of carbohydrates, reducing and non-reducing sugars, General properties of glucose and fructose, their open chain structures. Epimers, mutarotation and anomers.

Linkage between monosaccharides, structure of disaccharides (sucrose, maltose, lactose) and polysaccharides (starch and cellulose) excluding their structure elucidation.

Amino Acids, Peptides and Proteins

Classification of aminoacids, Zwitterion structure and Isoelectric point. Overview of Primary, Secondary, Tertiary and Quaternary structure of proteins. Determination of primary structure of peptides.

UNIT –II **14 Hours**

Chemistry in Health Care: Introduction to Drugs – History and Development, Absorption, Distribution, Elimination and Dissolution of Drugs. Classification of Drugs-Analgesics, Antibiotics, Anesthetics, Antimalarials, Antihypertensives, Antibacterials, Antifungals

Enzymes and Correlation with Drug Action: Mechanism of enzyme action, factors affecting enzyme action, Co-enzymes and cofactors and their role in biological reactions, Specificity of enzyme action (including stereo specificity), Enzyme inhibitors and their

importance, phenomenon of inhibition (Competitive and Non competitive inhibition including allosteric inhibition).

Drug Action - Receptor theory. Structure–activity relationships of drug molecules, binding role of –OH group, -NH_2 group, double bond and aromatic ring

Lipids: Introduction to lipids, classification. Biological importance of triglycerides, phospholipids, glycolipids, and steroids (cholesterol).

UNIT –III **14 Hours**

Nucleic Acids

Components of nucleic acids: Adenine, guanine, thymine and cytosine (Structure only), other components of nucleic acids, Nucleosides and nucleotides **(**nomenclature), Structure of polynucleotides; Structure of DNA (Watson-Crick model) and RNA (types of RNA), Genetic Code, Biological roles of DNA and RNA: Replication, Transcription and Translation.

Concept of Energy in Biosystems

Calorific value of food. Standard caloric content of carbohydrates, proteins and fats. Oxidation of foodstuff (organic molecules) as a source of energy for cells. Introduction to Metabolism (catabolism, anabolism), ATP: the universal currency of cellular energy, ATP hydrolysis and free energy change. Conversion of food into energy. Outline of catabolic pathways of Carbohydrate- Glycolysis, Fermentation, Krebs Cycle. Overview of catabolic pathways of Fats and Proteins. Interrelationships in the metabolic pathways of Proteins, Fats and Carbohydrates.

Reference Books

1. Tom Coultate (2016), Food: The Chemistry of its components, Kindle Edition, Royal Society of Chemistry, London

2.Geoffrey Campbelt-Platt (2017), Food Science and Technology,Kindle Edition,Wiley Blackwell

3.John Emsley (2015),Chemistry at Home: Exploring the ingredients in everyday products,FirstEdition,Royal Society of Chemistry London.

4.Kripal Singh(2012),Chemistry in daily life, Third Edition, Eastern Academy Education, PHI Learning Pvt. Ltd, New Delhi.

5.ShardenduKislaya (2011), Chemistry in everyday life, Discovery Publishing House Pvt.Ltd.

6.H.K.Chopra and P.S.Panesar(2015),Food Chemistry,Narosa Publishing House

7.GurudeepR.Charwal andM.Arora (2009), Organic Chemistry of Natural Products,(Vol-I and II) , Himalaya Publishing House.

8.M.Gopala Rao (1998), Outlines of chemical technology, Affiliated East West pressKafarow (1985), Wasteless chemical processing, Mir publishers, Moscow, Russia.Sawyer.W (2000), Experimental cosmetics,Dover publishers, New york.

9.Shashi Chawla (2013), Engineering Chemistry, Darpat Rai and Co. (P) Ltd, New Delhi.

10.B.K. Sharma(2000), Industrial Chemistry, Reprinted, Goel publishing house.

11.CNR Rao (2000), Understanding Chemistry, Universities Press (India) Limited

OE-2B: ENVIRONMENTAL CHEMISTRY AND POLLUTION CONTROL

Total Contact Hours: 42hrs and Credits-3

Learning Objectives:

LO1: To know the basic idea of atmospheric compositions

LO2: To know about pollutions and its major source

LO3: To study different techniques used in the treatment of pollution

LO4: To study solid waste- pollution, treatment and disposal

Course Outcomes:

CO1: Understand the atmospheric problems and ways to overcome that

CO2: Awareness about environmental pollution

CO3: Awareness about various analytic instruments used to control the pollution

CO4: Understand the concept of solid waste management

UNIT 1

Atmospheric composition: **14 Hours**

Environmental segments- Lithosphere, biosphere, hydrosphere and atmosphere, Composition of Atmosphere, Atmospheric structure- Troposphere, stratosphere, mesosphere and thermosphere. Radiation balance of the earth, chemical species and particulates present in the atmosphere- ions, radicals, particles, reactions in atmosphere.

Carbon Cycle, Nitrogen Cycle, Photochemical Smog, Ozone layer and its importance. El Nino phenomenon and its effects - Greenhouse effect, Global warming, Acid rain.

UNIT II

Pollution types and control: **14 Hours**

Air Pollution- Air pollutants- Carbon Monoxide, Oxides of nitrogen, Sulphur Dioxide, Volatile Organic Compounds, Effects of air pollution on living organisms and vegetation. Instruments and techniques to monitor pollution and control.

Water Pollution–Nature of water pollutants, surfactants, impacts of water pollution on hydrological and ecosystems, techniques for measuring water pollution and control. Water purification methods (reverse osmosis, electro dialysis, ion exchange).

Soil Pollution– Importance of soil to the biosphere, sources of soil pollution, effects of soil pollution, effects of modern agricultural practice, synthetic fertilizers, pesticides, effects of industrial effluents, effects of urban waste. Control of soil pollution.

UNIT III

Solid wastes- pollution, treatment and disposal: 14 Hours

Introduction, classification and origin, magnitude of the problem, characteristics of solid wastes, objectives and considerations in solid waste management, method of solid waste management and disposal, microbiology involved in solid waste disposal,. Methods of solid waste disposal- composting, sanitary landfilling-economic, easthetic and environmental problems, thermal processes-incineration, pyrolysis, recycling and reuse of solid wastes, co-disposal, bioconversion.

Reference Books

1. Manahan, Stanley E. (2001), Fundamentals of Environmental Chemistry, Boca Raton: CRC Press LLC.
2. Sonja Krause, Herbert M. Clark, James P. Ferris, Robert L (2002), Strong Chemistry of the Environment, Elsevier Science & Technology Books.
3. Eugene R (2000), Weiner Applications of Environmental Chemistry, CRC Press, LLC.
4. Clair N.Sawyer, Perry L. McCarty, Gene F.Parkin (2004), Chemistry for Environmental Engineering And Science (5th edition) McGrawHill Publishers.
5. K. De (2006), Environmental Chemistry, New Age International Pvt., Ltd, New Delhi.
6. S. M. Khopkar (2015), Environmental Pollution Analysis, Wiley Eastern Ltd, NewDelhi.
7. S.E. Manahan (2005), Environmental Chemistry,CRC Press.
8. H. Kaur (2010), Environmental Chemistry, Pragathi Edition.
9. B.R.Puri, L.R.Sharma, K.C.Kalia (2017), Principles of Inorganic Chemistry,Vallabh Publications, Delhi.
10. V.Salker (2017), Environmental Chemistry Pollution and Remedial Perspective, Narosa Publishing House.

QUESTION PAPER PATTERN (THEORY)

CHEMISTRY PAPER – (For DSC)

Time: 02 hours **Max Marks: 60**

PART A

Answer any **SIX** of the following 2x6 = 12

1.
2.
3.
4.
5.
6.
7.
8.

PART B

Answer any **SIX** of the following 3x6 = 18

9.
10.
11.
12.
13.
14.
15.
16.

PART C

(Two questions from each unit)

Answer any **SIX** of the following 5x6 = 30

17.
18.
19.
20.
21.
22.
23.
24.

Department of Chemistry

QUESTION PAPER PATTERN (THEORY)

CHEMISTRY PAPER – (FOR OE)

Time: 02 hours **Max Marks: 60**

PART A

Answer any **SIX** of the following 2x6 = 12

1.
2.
3.
4.
5.
6.
7.
8.
9.

PART B

Answer any **SIX** of the following 3x6 = 18

10.
11.
12.
13.
14.
15.
16.
17.
18.

PART C

(Two questions from each unit)

Answer any **SIX** of the following 5x6 = 30

19.
20.
21.
22.
23.
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25.
26.
27.

Department of Chemistry

PRACTICAL EXAMINATION PATTERN

B.Sc, Semester I to II (DSC Lab-1 and Lab-2)

Time: 4 hours **Max Marks: 50**

1. Internal assessment 25 marks

2. Practical Exam 25 marks

(Pattern of a paper, scheme of valuation – depends upon the expt. set for the candidate)