DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,
CHHATRAPATI SAMBHAJINAGAR.

CIRCULAR NO.SU/Revised B.Sc./NEP/72/2024

It is hereby inform to all concerned that, the Revised syllabi prepared by the Board of Studies/Ad-hoc Boards and recommended by the Dean, Faculty of Science & Technology, **Academic Council at its meeting held on 08 April 2024 has accepted** the following **Revised syllabi of Bachelor of Science** under the Faculty of Science & Technology **as per Norms of National Education Policy-2020 and as per Government Letter dated 13 March 2024** run at the Affiliated Colleges, Dr.Babasaheb Ambedkar Marathwada University as appended herewith.

Sr.No.	Courses	Semester
1.	B.Sc.Botany	Ist and IInd semester
2.	B.Sc.Biotechnology	Ist and IInd semester
3.	B.Sc.Zoology	Ist and IInd semester
4.	B.Sc.Agrochemical and Fertilizer	Ist and IInd semester
5.	B.Sc.Geology	Ist and IInd semester
6.	B.Sc.Environmental Science	Ist and IInd semester
7.	B.Sc.Home Science	Ist and IInd semester
8.	B.Sc.Diary Science and Technology	Ist and IInd semester
9.	B.Sc.Automobile Technology	Ist and IInd semester
10.	B.Sc.Physics	Ist and IInd semester
11.	B.Sc.Chemistry	Ist and IInd semester
12.	B.Sc.Analytical Chemistry	Ist and IInd semester
13.	B.Sc.Polymer Chemistry	Ist and IInd semester
14.	B.Sc.Electronics	Ist and IInd semester
15.	B.Sc.Forensic Science & Cyber Security	Ist and IInd semester
16.	B.Sc.Microbiology	Ist and IInd semester
17.	B.Sc.Fisheries Science	Ist and IInd semester
18.	B.Sc.Mathematics	Ist and IInd semester
19.	B.Sc.Forensic Science	Ist and IInd semester
20.	B.Sc.Information Technology	Ist and IInd semester
21.	B.Sc.Horticulture	Ist and IInd semester
22.	B.Sc.Networking & Multimedia	Ist and IInd semester
23.	B.Sc.Biochemistry	Ist and IInd semester
24.	B.Sc.Industrial Chemistry	Ist and IInd semester
25.	B.Sc.Bioinformatics	Ist and IInd semester

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26.	**B.Sc.Instrumentation Practice**	**Ist and IInd semester**
27.	**B.Sc.Non-Conventional and Conventional Energy**	**Ist and IInd semester**
28.	**B.Sc.Statistics**	**Ist and IInd semester**
29.	**Bachelor of Computer Application**	
30.	**B.Sc.Computer Science (Degree)**	**Ist and IInd semester**
31.	**B.Sc.Computer Science (Optional)**	**Ist and IInd semester**

This is effective from the Academic Year 2024-25 and onwards.

All concerned are requested to note the contents of this circular and bring the notice to the students, teachers and staff for their information and necessary action.

University Campus,
Aurangabad-431 004.
REF.NO.SU/2024/25588-96
Date:- 29.04.2024.

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Deputy Registrar,
Academic Section

Copy forwarded with compliments to :-

1] **The Principal of all concerned Colleges,**
Dr. Babasaheb Ambedkar Marathwada University,
2] **The Director, University Network & Information Centre, UNIC, with a request to upload this Circular on University Website.**

Copy to :-

1] **The Director, Board of Examinations & Evaluation,** Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
2] The Section Officer,[B.Sc.Unit] Examination Branch, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
3] The Programmer [Computer Unit-1] Examinations, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
4] The Programmer [Computer Unit-2] Examinations, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
5] The In-charge,[E-Suvidha Kendra], Rajarshi Shahu Maharaj Pariksha Bhavan, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
6] The Public Relation Officer, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
7] The Record Keeper, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.

Dr. Babasaheb Ambedkar Marathwada University

Chhatrapati Sambhajinagar- 431001

B.Sc. Degree Programme

(Three Year / Four Years (Hons) /Four Years (Hons with Research)

Course Structure and Syllabus of B. Sc. 1st year

(Revised)

(AS PER NEP-2020)

Subject (Major): CHEMISTRY

Effective from 2024-25

Prof. Pathan Mohd Arif Ali Khan
Chairman
Board of Studies in Chemistry

PREFACE

As we stand on the threshold of a new era in education, the dawn of the National Education Policy 2020 illuminates our path toward a holistic, inclusive, and progressive educational landscape. The Bachelor of Science (B. Sc.) curriculum outlined herein reflects the ethos and aspirations of this transformative policy, aiming to equip learners with the knowledge, skills, and values necessary to thrive in the dynamic world of the 21st century.

At its core, the National Education Policy 2020 envisions an educational framework that is learner-centric, multidisciplinary, and geared towards fostering creativity, critical thinking, and innovation. It emphasizes the integration of knowledge across disciplines, breaking down traditional silos to encourage holistic understanding and application of concepts. The Bachelor of Science (B. Sc.) curriculum embodies these principles by offering a diverse array of courses spanning various scientific domains, while also incorporating interdisciplinary studies to nurture well-rounded graduates capable of addressing complex challenges with agility and insight.

Furthermore, the curriculum is designed to promote experiential learning, research, and hands-on exploration, recognizing the importance of practical engagement in deepening understanding and cultivating real-world skills. Through laboratory work, field experiences, internships, and project-based learning opportunities, students will have the chance to apply theoretical knowledge in practical settings, develop problem-solving abilities, and cultivate a spirit of inquiry and discovery.

Integral to the National Education Policy 2020 is the commitment to inclusivity, equity, and access to quality education for all. The Bachelor of Science (B. Sc.) curriculum reflects this commitment by embracing diversity in perspectives, backgrounds, and experiences, and by fostering an inclusive learning environment where every student feels valued, supported, and empowered to succeed.

Moreover, the curriculum emphasizes the cultivation of ethical values, social responsibility, and global citizenship, instilling in students a sense of accountability towards society and the environment. By integrating courses on ethics, sustainability, and social sciences, the Bachelor of Science (B. Sc.) program aims to produce graduates who are not only proficient in their respective fields but also compassionate, ethical leaders committed to making a positive impact on the world.

As we embark on this journey of educational transformation guided by the National Education Policy 2020, the Bachelor of Science (B. Sc.) curriculum stands as a testament to our collective vision of a more equitable, inclusive, and enlightened society. It is our hope that through rigorous academics, innovative pedagogy, and unwavering dedication to excellence, we can inspire the next generation of scientists, scholars, and change-makers to realize their full potential and contribute meaningfully to the advancement of knowledge and the betterment of humanity.

Structure of B. Sc. (Three / Four Years Honours / Honours with Research Degree) Programme with Multiple Entry and Exit Options

Subject (Major): Chemistry

BSc First Year: 1st Semester

Course Type	Course Code	Course Name	Teaching Scheme (Hrs / Week)		Credits Assigned		Total Credits
			Theory	Practical	Theory	Practical	
Major (Core) M1 Mandatory	DSC-1	Fundamentals of Chemistry-1	2		2		2+2 = 4
	DSC-2	Lab course -1		4		2	
Major (Core) M2 Mandatory	DSC-1		2		2		2+2 = 4
	DSC-2	Practical based on DSC-1		4		2	
Major (Core) M3 Mandatory	DSC-1		2		2		2+2 = 4
	DSC-2	Practical based on DSC-1		4		2	
Generic / Open Elective (GE/OE) (Choose any two from pool of courses) It should be chosen compulsorily from the faculty other than that of Major	GE/OE -1	It should be chosen compulsorily from the faculty other than that of Major	2		2		2
SEC (Skill Enhancement Courses) (Choose any one from pool of courses)	SEC-1	A. Water Treatment and Analysis B. Stoichiometry-I	1		1		2
	SEC-2	Practicals based on SEC-1 A. Water Treatment and Analysis B. Stoichiometry-I		2		1	
AEC, VEC, IKS	AEC-1	English (Common for all the faculty)	2		2		2+2 =4
	IKS-1	Choose any one from pool of courses	2		2		
OJT/ FP/CEP/CC/RP	CC-1	Health and Wellness (Common for all the faculty)		4		2	2
			13	18	13	09	22

GE/OE-1 : **Herbal Chemistry -I** (2 credit theory course **for the students of faculty other than science and technology)**

BSc First Year: 2nd Semester

Course Type	Course Code	Course Name	Teaching Scheme (Hrs / Week)		Credits Assigned		Total Credits
			Theory	Practical	Theory	Practical	
Major (Core) M1 Mandatory	DSC-3	Fundamentals of Chemistry-2	2		2		2+2 = 4
	DSC-4	Lab course -2		4		2	
Major (Core) M2 Mandatory	DSC-3		2		2		2+2 = 4
	DSC-4	Practical based on DSC-3		4		2	
Major (Core) M3 Mandatory	DSC-3		2		2		2+2 = 4
	DSC-4	Practical based on DSC-3		4		2	
Generic / Open Elective (GE/OE) (Choose any two from pool of courses) It should be chosen compulsorily from the faculty other than that of Major	GE/OE-2	It should be chosen compulsorily from the faculty other than that of Major	2		2		2
VSC (Vocational Skill Courses) (Choose any one from pool of courses)	VSC-1	A. Cosmetics and perfumery B. Soap and Detergent	1		1		2
	VSC-2	Practicals based on VSC- A. Cosmetics and perfumery B. Soap and Detergent		2		1	
AEC, VEC, IKS	AEC-1	English (Common for all the faculty)	2		2		2+2 =4
	VEC-1	Constitution of India (Common for all the faculty)	2		2		
OJT/ FP/CEP/CC/RP	CC-2	Yoga Education / Sports and Fitness (Common for all the faculty)		4		2	2
			13	18	13	09	22
Exit Option : Award of UG Certificate in 3 Majors with 44 credits and an additional 4 credits of core NSQF course / Internship OR continue with Major and Minor							

GE/OE-2 : **Herbal Chemistry -II** (2 credit theory course **for the students of faculty other than science and technology)**

Students will have to choose any three subjects as a **Major 1, Major 2, Major 3,** from Basket 1 under the Faculty of Science and Technology.

Students will be having three subject options of equal credits (instead of Major and / or minor verticals) in the first year. Students will have to select / declare choice of one subject **as a major subject** in the beginning of second year **out of three major options M1, M2 and M3 (which were opted in the first year).**

Detailed Illustration of Courses included in 1st and 2nd semester:

1) **Major** (Core) subject are mandatory.

   DSC-1 : This is a 2 credit theory course corresponding to Major (core) subject
   DSC-2 : This is a 2 credit practical course based on DSC-1
   DSC-3 : This is a 2 credit theory course corresponding to Major (core) subject
   DSC-4 : This is a 2 credit practical course based on DSC-3

2) **Generic / Open Elective (GE/OE)**: (Needs to be chosen (any two) from pool of courses available at respective college). **These courses should be chosen compulsorily from faculty other than that of Major.**

   GE/OE -1 : This is a 2 credit theory course should be chosen compulsorily from faculty other than that of Major.
   GE/OE -2 : This is a 2 credit theory course should be chosen compulsorily from faculty other than that of Major.

3) **SEC** (Skill Enhancement Courses) : Choose any one from pool of courses. These courses needs to be designed to enhance the technical skills of the students in specific area.

   SEC-1 : This is a 1 credit theory course to enhance the technical skills of the students in specific area.
   SEC-2 : This is a 1 credit practical course based on SEC-1.

4) **VSC** (Vocational Skill Courses) : Choose any one from pool of courses. These courses should be based on Hands on Training corresponding to Major (core) subject.

   VSC-1 : This is a 1 credit theory course based Hands on Training corresponding to Major (core) subject.
   VSC-2 : This is a 1 credit practical course based on VSC-1

5) **AEC** (Ability Enhancement courses): The focus of these courses should be based on linguistic and communication skills.

   AEC-1 : English

This is a 2 credit theory course based on linguistic proficiency. It will be common for all the faculty.

AEC-2 : English
This is a 2 credit theory course based on linguistic proficiency. It will be common for all the faculty.

6) **IKS** (Indian Knowledge System) : The courses related to traditional and ancient culture of India will be included in this section. The respective college will have to choose one of the courses from the pool of courses designed by the University.

IKS-1 : To be chosen from the pool of courses designed by the University
This is a 2 credit theory course based on Indian Knowledge System. It will be common for all the faculty

7) **VEC** (Value Education Courses): The courses such as understanding India, Environmental Science / Education, Digital and Technological solutions etc will be part of Value Education Courses.

VEC-1 : Constitution of India
This is a 2 credit theory course based on value education. It will be common for all the faculty

8) **CC** (Curricular Courses): The courses such as Health and wellness, Yoga education, Sports and Fitness, Cultural activities, NSS/NCC, Preforming Arts.

CC-1 : Health and Wellness
This is a 2 credit practical course based on Co-curricular activities. It will be common for all the faculty

CC-2 : Yoga education / Sports and Fitness
This is a 2 credit practical course based on Co-curricular activities. It will be common for all the faculty

General Guidelines for Course Selection

1) The Major subject is the discipline or course of main focus, bachelors degree shall be awarded in that discipline / subject.
2) Students will have to choose any three subjects as a Major 1, Major 2, Major 3, from **Basket 1** under the Faculty of Science and Technology (based on the available options in the respective college).
3) Students will be having three subject options of equal credits (instead of Major and / or minor verticals) in the first year.
4) In the beginning of second year, students will have to select / declare choice of **one major subject** and **one minor subject** from three major options **M1, M2 and M3 (which were opted in the first year)**
5) Once the students finalize their **Major Subject** and **Minor Subject** in the beginning of the second year of the programme, they shall pursue their further education in that particular subject as their **Major and Minor** subjects. Therefore, from second year onwards curriculum of the Major and Minor subjects shall be different.
6) Students are required to select **Minor subject** from **other discipline of the same faculty**
7) Students are required to select **Generic /Open Elective** (vertical 3 in the credit framework) **compulsorily from the faculty different than that of their Major / Minor subjects.**
8) Vocational Skill Courses and Skill Enhancement Courses (VSC and SEC) shall be related to the Major subject
9) Curriculum of Ability Enhancement Courses (AEC), Value Education Courses (VEC), Indian Knowledge System (IKS), and Co-curricular Courses (CC) will be provided by the University separately.

Programme Educational Objectives (PEOs) :

Programme Educational Objectives (PEOs) for the Bachelor of Science Curriculum under the National Education Policy 2020:

1. **Mastery of Discipline-Specific Knowledge**: Graduates of the Bachelor of Science program will demonstrate a deep understanding of fundamental principles, theories, and methodologies in their chosen scientific discipline, enabling them to analyze complex problems, propose innovative solutions, and contribute to advancements in their field.

2. **Interdisciplinary Proficiency**: Graduates will possess the ability to integrate knowledge and skills from multiple scientific disciplines, fostering a holistic approach to problem-solving and innovation. They will be equipped to address multifaceted challenges by drawing upon diverse perspectives and methodologies.

3. **Critical Thinking and Analytical Skills:** Graduates will develop strong critical thinking abilities, enabling them to evaluate information rigorously, analyze data effectively, and make informed decisions based on evidence. They will demonstrate proficiency in applying logical reasoning and scientific methods to solve problems and generate new knowledge.

4. **Leadership and Innovation:** Graduates will demonstrate leadership qualities and entrepreneurial mindset, capable of initiating and driving positive change in their organizations and communities. They will exhibit creativity, resilience, and adaptability, harnessing innovation to address complex challenges and seize opportunities for growth and advancement.

5. **Global Citizenship and Cultural Sensitivity**: Graduates will possess a global perspective and cultural sensitivity, recognizing the interconnectedness of diverse communities and the importance of collaboration across borders. They will engage in cross-cultural dialogue, embrace diversity, and contribute to the advancement of knowledge and understanding on a global scale.

These Programme Educational Objectives serve as guiding principles for the Bachelor of Science curriculum, reflecting our commitment to nurturing well-rounded graduates who are prepared to excel in their careers, contribute to society, and lead meaningful lives in a rapidly changing world.

Programme Outcomes (POs) :

The National Education Policy (NEP) 2020 for India emphasizes several key aspects for Bachelor of Science (B.Sc.) programs, aiming to produce graduates who are not only well-versed in their respective disciplines but also equipped with skills necessary for holistic development and employability. While specific program outcomes may vary between institutions and disciplines within B.Sc. programs, here are some common outcomes aligned with NEP 2020:

- **PO1. The citizenship and society:** Apply broad understanding of ethical and professional skill in science subjects in the context of global, economic, environmental and societal realities while encompassing relevant contemporary issues.

- **PO2. Environment and sustainability**: Apply broad understanding of impact of science subjects in a global, economic, environmental and societal context and demonstrate the knowledge of, and need for sustainable development.

- **PO3. Ethics:** Apply ability to develop sustainable practical solutions for science subject related problems within positive professional and ethical boundaries.

- **PO4. Individual and team work:** Function effectively as a leader and as well as team member in diverse/ multidisciplinary environments.

- **PO5. Communication:** Communicate effectively on complex science subject related activities with the scientific community in particular and with the society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

- **PO6. Project management and finance**: Demonstrate knowledge and understanding of the first principles of science and apply these to one's own work as a member and leader in a team, to complete project in any environment.

- **PO7. Life-long learning**: Recognize the need for lifelong learning and have the ability to engage in independent and life-long learning in the broadest context of technological change.

These program outcomes align with the broader goals of NEP 2020 to transform higher education in India and prepare students for the challenges and opportunities of the 21st century. Board of Studies designing B.Sc. curricula are encouraged to incorporate these outcomes into their program objectives and learning outcomes.

Programme Specific Outcomes (PSOs):

PSO1; Core competency: The chemistry graduates will know the fundamental concepts of chemistry and applied chemistry. These fundamental concepts would reflect the latest understanding of the field, and therefore, are dynamic in nature and require frequent and time-bound revisions.

PSO2; Communication skills: Chemistry graduates will possess minimum standards of communication skills expected of a Chemistry graduate in the country. They are expected to read and understand the documents with in-depth analyses and logical arguments. Graduates are expected to be well-versed in speaking and communicating their idea/finding/concepts to wider audience.

PSO3; Critical thinking: Chemistry graduates are expected to know basics of cognitive biases, mental models, logical fallacies, scientific methodology and constructing cogent scientific arguments.

PSO4; Psychological skills: Chemistry Graduates are expected to possess basic psychological skills required to face the world at large, as well as the skills to deal with individuals and students of various sociocultural, economic and educational levels. Psychological skills may include feedback loops, self-compassion, self-reflection, goal-setting, interpersonal relationships, and emotional management.

PSO5; Problem-solving: Chemistry Graduates will be equipped with problem-solving philosophical approaches that are pertinent across the disciplines.

PSO6; Analytical reasoning: Chemistry Graduates acquire formulate cogent arguments and spot logical flaws, inconsistencies, circular reasoning etc.

PSO7; Research-skills: Chemistry Graduates will be keenly observant about what is going on in the natural surroundings to awake their curiosity. Chemistry Graduates are expected to design a scientific experiment through statistical hypothesis testing and other *a priori* reasoning including logical deduction.

PSO8; Teamwork: Chemistry Graduates will be team players, with productive cooperations involving members from diverse socio-cultural backgrounds.

PSO9; Digital Literacy: Chemistry Graduates are expected to be digitally literate for them to enroll and increase their core competency via e-learning resources such as MOOC and other digital tools for lifelong learning. Chemistry Graduates should be able to spot data fabrication and fake news by applying rational skepticism and analytical reasoning.

PSO10; Moral and ethical awareness: Chemistry Graduates will be responsible citizen of India and be aware of moral and ethical baseline of the country and the world. They are expected to define their core ethical virtues good enough to distinguish what construes as illegal and crime in Indian constitution. Emphasis be given on academic and research ethics, including fair Benefit Sharing, Plagiarism, Scientific Misconduct and so on.

PSO11; Leadership readiness: Chemistry Graduates are expected to be familiar with decision making process and basic managerial skills to become a better leader. Skills may include defining objective vision and mission, how to become charismatic inspiring leader and so on.

Semester I

DSC-1 : (Title of Paper) FUNDAMENTALS OF CHEMISTRY-1

Total Credits : 02 Total Contact Hours : 30 Hrs
Maximum Marks : 50

Learning Objectives of the Course:

i) To develop critical thinking about the Atomic Structure.
ii) To understand the structure of an atom and electron distribution in an atom.
iii) To understand variation in periodic properties.
iv) To understand the basic concept of organic reaction mechanism.
v) To understand reaction intermediate involved in organic reactions
vi) Students will learn Fundamentals of Thermodynamics
vii) To understand different laws of thermodynamics

Course Outcomes (COs) :

After completion of the course, students will be able to -

i) Write the electronic configurations of the elements
ii) Understand the changes in periodic properties in modern periodic table
iii) Understand the different types of electron displacement in a molecule
iv) Differentiate between inductive, electromeric, resonance, and mesomeric effects.
v) Understand the methods of formation, structure and properties of the intermediate.
vi) Understand the basic concepts and different laws of thermodynamics and thermochemistry
vii) The concept of chemical equilibrium

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	**Atomic Structure and Periodicity of Elements** Bohr's theory and its limitations. Idea of de-Broglie matter waves. Heisenberg uncertainty principle. Quantum numbers and its types. Significance of quantum numbers. Shapes of s, p and d atomic orbitals, nodal planes. Rules for filling electrons rules in various orbitals: i) Aufbau's principle ii) Hunds rule of maximum multiplicity iii) Pauli's exclusion principle Electronic configuration of elements from Hydrogen to Zinc. Stability of empty, half-filled and completely filled orbitals Definition and trends in Periodic table of the following	**10 Hrs**

	properties: i) atomic radii and ionic radii ii) ionization energy iii) electron affinity iv) electronegativity, Factors affecting ionization energy. Pauling's and Mullikan's scale of electronegativity	
II	A) **Fundamentals of Organic Reaction mechanism** Electronic Displacements: Inductive Effect, Electrometric Effect, Resonance and Hyperconjugation. Cleavage of Bonds: Homolysis and Heterolysis. Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive Intermediates: formation, structure, reactivity and stability of Carbocations, Carbanions, free radicals Carbene and Nitrene. Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values.	**10 Hrs**
III	**Thermodynamics** Basic concepts of thermodynamics: system, surrounding, boundary. Types of systems. State & path functions. Thermodynamic processes. Intensive & Extensive properties. First law of thermodynamics. Spontaneous & nonspontaneous processes. Statements of second law of thermodynamics. Carnot's cycle and its efficiency. Entropy, physical significance of entropy. Third law of thermodynamics. Calculation of absolute entropies of substances. **Thermochemistry** Concept of standard state, standard enthalpy of formation. Hess's law of constant heat summation and its applications. Bond dissociation energy and its calculations from thermochemical data. Temperature dependence of enthalpy- Kirchoff's equation. **Chemical Equilibrium:** Free energy change in chemical reactions. Thermodynamic derivation of the law of chemical equilibrium. Relation between Kp, Kc and Kx for reactions involving ideal gases. Le Chatelier's principle.	**10 Hrs**
Text / Reference Books: **Unit I**		

1. Lee, J.D. Concise Inorganic Chemistry ELBS, 1991.
2. Cotton, F.A., Wilkinson, G. & Gaus, P.L. Basic Inorganic Chemistry, 3rd ed., Wiley.
3. Douglas, B.E., McDaniel, D.H. & Alexander, J.J. Concepts and Models in Inorganic Chemistry, John Wiley Sons.
4. Huheey, J.E., Keiter, E.A., Keiter, R.L. & Medhi, O.K. Inorganic Chemistry:
5. Principles of Structure and Reactivity, Pearson Education India, 2006.
6. Puri, Sharma, Kalia. Principles of Inorganic Chemistry
7. Madan R. L. Chemistry for Degree Students (B . Sc. First year), S. Chand Publications

Unit II

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. Finar, I.L. Organic Chemistry (Vol. I & II), E.L.B.S.
5. Morrison, R.T. & Boyd, R.N. Organic Chemistry, Pearson, 2010.
6. Bahl, A. & Bahl, B.S. Advanced Organic Chemistry, S. Chand, 2010.
7. Stanley Pine, Organic Chemistry, 5th edition.
8. Mukharjee, Singh and Kapoor, Organic Chemistry Vol. I, II and III -Wiley Eastern.
9. S.K. Ghosh, Organic Chemistry.
10. S.M. Mukharjee and S.P. Singh, Reaction Mechanism in Organic Chemistry.
11. P.S. Kalsi, Stereochemistry and mechanism through solved problems.
12. P S Kalsi, Organic reactions and their mechanism , New age.
13. Grossman, Robert B, The Art of Writing Reasonable Organic Reaction Mechanism
14. Raj K Bansal Organic chemistry
15. Eliel, E.L. Stereochemistry of Carbon Compounds, Tata McGraw Hill education, 2000
16. P.S. Kalsi , Text book of Organic Chemistry , Macmilllan India Ltd., 1999, Delhi.

Unit III

1. Puri, Sharma and Pathania, Principles of Physical Chemistry, Vishal Publishing House, 44th Edition
2. Gurdeep Raj, Advanced Physical Chemistry GOEL Publishing House, 6th Edition
3. Bahl , Tuli and Bahl, Essentials of Physical Chemistry,

4. Soni and Dharmarha, Text Book of Physical Chemistry,
5. H J Arnikar, Essentials of Nuclear Chemistry, New Age, 4th edition.
6. F. Daniel, Mathematical preparation of Physical Chemistry :,Mc-Graw Hill Book Company Ltd.
7. S. Glasstone and D. Lewis, Elements of Physical Chemistry : (D.Van Nostrand Co.Inc)
8. W. J. Moore, Physical Chemistry : (Orient Longman)
9. Maron Prutton, Principles of Physical Chemistry :
10. B. H. Mahan, University Chemistry: (Addison - Wiseley Publ. Co.)

DSC-2 : (Title of Paper) Lab Course -1

Total Credits : 02 Total Contact Hours : 60 Hrs
Maximum Marks : 50

Learning Objectives of the Course:

i) To introduce glassware and instruments used in a Chemistry laboratory.
ii) To understand the importance of calibration of glassware and instruments in tune with concepts of precision and accuracy.
iii) To develop awareness about safety measures for handling chemicals
iv) Develop proficiency in fundamental chemical laboratory techniques.
v) To develop the skill of preparation of solution of different concentration using stoichiometry
vi) Follow established SOPs for various chemical experiments

Course Outcomes (COs) :

After completion of the course, students will be able to -
i) To consistently follow established SOPs for various chemical experiments.
ii) To prepare solution of desired concentration..
iii) To maintain accurate and thorough records of experimental data, and analyze results to draw meaningful conclusions.
iv) To apply critical thinking skills to identify and address challenges that may arise during experiments, showcasing the ability to troubleshoot and optimize procedures.
v) To gain insights into how chemical lab practices are applied in professional research or industrial settings, preparing them for future careers in diverse scientific and industrial fields.
vi) Students will demonstrate ethical conduct in all aspects of laboratory work, emphasizing integrity, responsibility, and professionalism

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	1. Recognition of Safety symbols, chemical packings and instruments together with the conception of MSDS. 2. Introduction to pictogram of chemical used. (Acids, Bases, Solvents and Salts) 3. Material Safety Data Sheets with reference to hazardous chemicals like $K_2Cr_2O_7$, Benzene, Cadmium nitrate, β-naphthol, CCl_4 and Mercury. 4. Precautions in handling of hazardous substances like conc. acids, ammonia, organic solvents like ether and alcohol. 5. Demonstration of first aid measures for chemical accidents. 6. Demonstration of preventive measures for chemical spills. 7. Demonstration of first aid measures, when chemical materials entered in human body through Eye, Mouth and Skin 1. Calibration of Burette 2. Calibration of Pipette	**20 Hrs**

	3. Calibration of Standard Measuring Flask 4. Calibration of Thermometer (Demonstration)	
II	1. Preparation of standard solution of oxalic acid by weighing and calculation of concentrations in terms of strength, normality, molarity and molality. 2. Preparation of standard solution of a base (sodium carbonate) by weighing and calculation of concentrations in terms of strength, normality, molarity and molality. 3. Prepare 1 % NaOH solution and find its exact normality using standard oxalic acid solution. 4. Determine molarity and strength of unknown hydrochloric acid with the help of standard 0.05M sodium carbonate solution. 5. Standardization of given NaOH solutions using standard 0.02 N Na_2CO_3 6. Prepare 0.1 N H_2SO_4 solution and find out its exact normality using NaOH as an intermediate solution and 0.1 N Oxalic acid as standard solution	**20 Hrs**
III	1. Determination of heat capacity of calorimeter for different volumes. 2. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide. 3. Determination of enthalpy of ionization of acetic acid. 4. Determination of integral enthalpy of solution of salts (KNO_3, NH_4Cl). 5. Determination of enthalpy of hydration of copper sulphate.	**20 Hrs**

Text / Reference Books:

1) F.G. Mann, B.C. Saunders, Practical Organic Chemistry, Orient Longman.
2) V.K. Ahluwalia and Sunita Dhingra, Comparative Practical Organic Chemistry (Qualitative Analysis), Orient Longman.
3) V.K. Ahluwalia and Renu Agrawal, Comprehensive Practical Organic Chemistry (Preparation and Qualitative Analysis) by, Orient Longman.
4) Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., Textbook of Practical Organic Chemistry, Prentice-Hall, 5th edition, 1996.
5) Mann, F.G. & Saunders, B.C. Practical Organic Chemistry Orient-Longman, 1960.
6) Svehla, G. Vogel's Qualitative Inorganic Analysis, Pearson Education, 2012
7) Advanced Practical Inorganic Chemistry by Gurdeep Raj, Goel Pulishing House, Meerut.
8) Vogel-A text book of qualitative inorganic analysis.
9) O P Pandey, D. N, Practical Chemistry (for B.Sc. I, II and III year students) –. Bajpaiand
10) Kolthoff and Sandell-Text book of qualitative inorganic analysis
11) Ahluwalia, V.K.; Dhingra, S. (2004),Comprehensive Practical Organic Chemistry: Qualitative Analysis, University Press.
12) Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R.(2012),Vogel's Textbook of Practical Organic Chemistry, Pearson.
13) Leonard, J.; Lygo, B.; Procter, G. Advanced Practical Organic Chemistry, CRC Press.
14) Palit and De, Practical Physical Chemistry:.
15) Yadav, Practical Physical Chemistry:.
16) Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011).
17) Gurdeep Raj, Advanced Practical Inorganic Chemistry, Goel Publishing House, Meerut.
18) S. W. Rajbhoj and Dr. T. K. Chondekar, Systematic Practical Physical Chemistry by Prof. Anjali Publication, Aurangabad

Web resources:

1. https://vlab.amrita.edu/?sub=2
2. https://chemcollective.org/vlabs
3. https://chem.libretexts.org/
4. https://en.wikipedia.org/wiki/Laboratory_glassware#:~:text=Laboratory%20glassware%20refers%20to%20a,%2C%20biology%2C%20and%20analytical%20laboratories.
1. https://brilliant.org/wiki/inductive-effect-electromeric-efffect-resonance/
2. https://sciencing.com/glassware-apparatus-uses-7445911.html
3. https://chem.libretexts.org/Ancillary_Materials/Laboratory_Experiments/Wet_Lab_Experiments/Organic_Chemistry_Labs/Misc/COMMON_LABORATORY_TECHNIQUES
4. https://www.youtube.com/watch?v=Q47hTa1KvN0&t=871
5. https://chem.libretexts.org/Ancillary_Materials/Demos_Techniques_and_Experiments/General_Lab_Techniques
6. https://ucblueash.edu/content/dam/refresh/blueash-62/documents/academics/academic-departments/chemistry/LabSafetyRules.pdf

SEC-1 A : (TITLE OF PAPER) - Water Treatment and Analysis

Total Credits : 01 (Theory paper) Total Contact Hours : 15 Hrs
Maximum Marks : 50

Learning Objectives of the Course:

1

i) To know the sources of water pollutants
ii) To aware about the properties of water
iii) Know the difference between industrial effluent and municipal waste
iv) Know the quality of drinking water and irrigation water

Course Outcomes (COs) :

After completion of the course, students will be able to -

i) Resources and properties of water
ii) Understand the different pollutants
iii) Understand treatment of domestic and industrial water
iv) Understand the sources of water pollution

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	**Study of Water** a. Hydrosphere- Water resources. b. Properties of water- color, odor, turbidity, total salt content, total suspended water. b. Water pollution- Definition of water pollution, types of water pollutants, sources of water pollutants, trace element in water, water quality parameters and standards d. Purification of water- Treatment of domestic and industrial water e. Sources of Pollution - Physical, Chemical, Organic & Biological properties of Industrial Wasteswater, Difference between industrial; municipal waste waters, Effects of industrial effluents on sewers and Natural water Bodies. **Chemistry of Water** a. Water Quality Parameters and Standards- Quality of drinking water, Quality of irrigation water, COD, BOD, b. Water Microbiology - TOCE-coli and total bacteria. c. Sewage analysis	**15 Hrs**

I. D.R. Khanna, R. Bhutiani, Laboratory Mannual of Water and Wastewater Analysis, Daya Publishing House, Delhi, 2008

2. R.K. Trivedy Chemical and Biological Methods for Water Pollution Studies, , P.K.Goel,

Oriental Printing Press, Aligarh, 1986

SEC-2 A : (TITLE OF PAPER) - Water Treatment and Analysis

Total Credits : 01 (Practical paper) Total Contact Hours : 30 Hrs
Maximum Marks : 50

Learning Objectives of the Course:

1

i) To know the sources of water pollutants
ii) To aware about the properties of water
iii) Know the difference between industrial effluent and municipal waste
iv) Know the quality of drinking water and irrigation water

Course Outcomes (COs) :

After completion of the course, students will be able to -

i) Resources and properties of water
ii) Understand the different pollutants
iii) Understand treatment of domestic and industrial water
iv) Understand the sources of water pollution
v) Carryout experiment for determination of water quality parameters

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	1. Collection of water samples (Field work) 2. Determination of total hardness of water 3. Determination of alkalinity of water 4. Determination of pH of water 5. Determination of conductivity of water 6. Determination of TDS in water. 7. Determination of Dissolved Oxygen (DO) in water. 8. Determination of BOD of water 9. Determination of COD of water	**30 Hrs**

I. D.R. Khanna, R. Bhutiani, Laboratory Manual of Water and Wastewater Analysis, Daya Publishing House, Delhi, 2008

2. R.K. Trivedy Chemical and Biological Methods for Water Pollution Studies, , P.K.Goel, Oriental Printing Press, Aligarh, 1986

SEC-1 B : (TITLE OF PAPER) - Stoichiometry-I

Total Credits : 01 (Theory paper) Total Contact Hours : 15 Hrs
Maximum Marks : 50

Learning Objectives of the Course:

1. To develop scientific approach among students to inculcate practical awareness
2. To know different concentration units
3. To train for preparing solution of different concentrations
4. Develop proficiency in fundamental chemical laboratory techniques.
5. To develop analytical approach in experimentation
6. Aware error and accuracy experiments

Course Outcomes (COs) :

After completion of the course, students will be able to -

1. understand theoretical aspects and working principles of chemistry labwares,
2. prepare all standards solutions, buffer solutions, indicators, common laboratory reagents,
3. perform the some basic experiments,
4. develop skills in common laboratory techniques,

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	**Fundamental Concepts of Stoichiometry (15hours)** Stoichiometric coefficient, Balancing reactions, Quantitative Information from Balanced Equations, Formula Masses, Chemical Equations, Law of conservation of mass, Avogadro's Number, Mole concept, Chemical calculations and use of molal quantities, Molar volume of gaseous substance, Equivalent Weight, Density and Specific Gravity, Specific Gravity Scales, Composition of Solid, Liquid and Gases, Mass fraction, Mass percentage, Mass ratio, Dry basis and Weight basis, Mole fraction, Mole percent, Volume fraction, Volume percent, Other Expression for Concentration, Significant figure, Precision and Accuracy, Chemical reaction and Process calculations, Excess and Limiting reagent, Conversion, Yield and Selectivity, Extent of reaction.	**15 Hrs**

Reference books

1. Stoichiometry and Process Calculation by K.V. Narayanan, B Lakshmikutty (Z-lib.org)
2. Stoichiometry Vth edition by B.L. Bhatt and S.B. Thakore
3. Complete Chemistry Guide to Stoichiometry by Mellisaa Maribel

SEC-2 B : (TITLE OF PAPER) - Stoichiometry-I

Total Credits : 01 (Practical paper) Total Contact Hours : 30 Hrs
Maximum Marks : 50

Learning Objectives of the Course:

1. To develop scientific approach among students to inculcate practical awareness
2. To know different concentration units
3. To train for preparing solution of different concentrations
4. Develop proficiency in fundamental chemical laboratory techniques.
5. To develop analytical approach in experimentation
6. Aware error and accuracy experiments

Course Outcomes (COs) :

After completion of the course, students will be able to -

1. apply working principles of chemistry labwares,
2. prepare all standards solutions, buffer solutions, indicators, common laboratory reagents,
3. perform some basic experiments with accuracy.
4. use skilfully common laboratory techniques,

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	Preparation of solutions of different molarity and normality and their standardization (Acid-base, Redox, precipitation and complexometric) Preparation of organic compound based on name reactions starting with 0.05 mole 1. Preparation of 0.1 N solution of oxallic acid and calculate its molarity. 2. Preparation of 0.1 N solutions of sulfuric acid and calculate its molarity. 3. Prepare a stock solution of 1 M NaOH. Prepare 0.5 M, 0.1 M, 0.01 M, and 0.05 M by dilution method using the stock solution. 4. Preparation of 0.1 M and 0.01 M solutions of HCl. 5. Prepare a stock solution of 100 ppm KMnO4. And prepare its 10 ppm and 1 ppm solutions by dilution method. 6. Preparation of 1 or 2% w/v solutions of NaOH/ NaCl, 7. Preparation of 1 or 2% v/v solutions of Acetic acid, HCl, HNO3, H2SO4. 8. Preparation of 0.1 M solutions of ammonia. 9. Preparation of a buffer solution of pH= 4. 10. Preparation of a buffer solution of pH= 7. 11. Preparation of a buffer solution of pH= 9.2	**30 Hrs**

Reference books

1. Stoichiometry and Process Calculation by K.V. Narayanan, B Lakshmikutty (Z-lib.org)

2. Stoichiometry Vth edition by B.L. Bhatt and S.B. Thakore

3. Complete Chemistry Guide to Stoichiometry by Mellisaa Maribel

Web References :

1. https://en.wikipedia.org/wiki/Laboratory_glassware#:~:text=Laboratory%20glassware%20refers%20to%20a,%2C%20biology%2C%20and%20analytical%20laboratories.

2 https://brilliant.org/wiki/inductive-effect-electromeric-efffect-resonance/

3. https://sciencing.com/glassware-apparatus-uses-7445911.html

4. https://chem.libretexts.org/Ancillary_Materials/Laboratory_Experiments/Wet_Lab_Experiments/Organic_Chemistry_Labs/Misc/COMMON_LABORATORY_TECHNIQUES

5. https://www.youtube.com/watch?v=Q47hTa1KvN0&t=871

6. https://chem.libretexts.org/Ancillary_Materials/Demos_Techniques_and_Experiments/General_Lab_Techniques

7. https://ucblueash.edu/content/dam/refresh/blueash-62/documents/academics/academic-departments/chemistry/LabSafetyRules.pdf

This course will be available for the students form other faculty

GE/ OE -1 : (TITLE OF PAPER) Herbal Chemistry - I

Total Credits : 02 Total Contact Hours : 30 Hrs
Maximum Marks : 50

Learning Objectives of the Course:
To aware the importance of herbs for health.
to use appropriate steps to prepare preserve herbal products.
to aware rules and regulations related herbal products

Course Outcomes (COs) :
After completion of the course, students will be able to -
CO1: acquainted with importance of herbal drugs,

CO2: know the different sources of herbal medicine and their preparation

CO3: acquire the knowledge of organic farming

CO4: know about the Indian system of drugs ayurveda, Unani, siddha and homeopathy

CO5: know health benefits and role of nutraceuticals

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	**General Introduction to Herbal Industry** Herbal drugs industry: Present scope and future prospects. A brief account of plant based industries and institutions involved in work on medicinal .and aromatic plants in India. **Herbs as raw materials** Definition of herb, herbal medicine, herbal medicinal product, herbal drug preparation Source of Herbs, Selection, identification and authentication of herbal materials Processing of herbal raw material	**10 Hrs**
II	**Biodynamic Agriculture** Good agricultural practices in cultivation of medicinal plants including Organic farming. Pest and Pest management in medicinal plants: Biopesticides /Bioinsecticides. **Indian Systems of Medicine** a) Basic principles involved in .Ayurveda Siddha, Unani and Homeopathy b) Preparation and Standardization of Ayurvedic formulations viz Aristas and Asawas, Ghutika. Churna, Lehya and Bhasma.	**10 Hrs**
III	**Nutraceuticals** General aspects. Market, growth, cope and types of products available in the market. Health benefits and role of Nutraceuticals in ailments like	**10 Hrs**

	Diabetes, CVS diseases Cancer, Irritable bowel syndrome and various Gastro intestinal diseases. Study of following herbs as health food: Alfaalfa, Chicory, Ginger, Fenugreek. Garlic. Honey, Amla, Ginseng, Ashwagandha. Spirulina **Herbal-Drug and Herb-Food Interactions:** General introduction to interaction and classification. Study of following drugs and their possible side effects and interactions: Hypercium, kava-kava, Ginkobiloba. Ginseng. Garlic, Pepper & Ephedra.	

Text / Reference Books:

1. Trease & Evans, Textbook of Pharmacognosy.
2. Tyler. Brady & Robber, Textbook of Pharmacognosy.
3. Kokate, Purohit and Gokhale, Pharmacognosy
4. Dr.S.H.Ansari, Essential of Pharmacognosy
5. V.D.Rangari, Pharmacognosy & Phytochemistry
6. Pharmacopeial standards for Ayurvedic Formulation (Council of Research in Indian Medicine & Homeopath)
7. Mukherjee, P.W. Quality Control of I herbal Drugs: An Approach to Evaluation of Botanicals. Business Horizons Publishers, New Delhi, India, 2002

Semester II

DSC-3 : (Title of Paper) FUNDAMENTALS OF CHEMISTRY-2

Total Credits : 02 Total Contact Hours : 30 Hrs
Maximum Marks : 50

Learning Objectives of the Course:

i) To develop critical thinking about the nature of chemical bonds.
ii) To understand the concept of hybridization and thereby the geometry of simple molecules.
iii) To train the students to predict the geometries and shapes of molecules on the basis VBT
iv) To understand the organic molecules in three dimension
v) To aware about the isomerism in organic compounds
vi) To understand the factors affection rate of reactions and order of reactions

Course Outcomes (COs) :

After completion of the course, students will be able to -

i) Identify the type bond
ii) Predict the shape and geometry and bond angle in a molecule
iii) Understand the factors affecting ionic bond formation
iv) Identify types of isomerism
v) Apply the CIP rules for nomenclature of stereoisomers
vi) Rate of reactions and factors affecting it
vii) Solve the numerical on order reactions

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	**Chemical Bonding and Molecular structure (I) (10 Hrs)** **a) Ionic Bonding** Definition and general characteristics of ionic bonding. Factors affecting on an Ionic bond formation. Lattice energy, salvation energy and their importance. Born Lande equation (no derivation) to calculate lattice energy. Born-Haber cycle for NaCl and its applications Fajan's Rule, Applications of Fajan's rule for, Polarizing power and polarizability, Ionic character in covalent compounds, Dipole moment and percentage ionic character **b) Covalent Bonding.** Concept of hybridization, different types of hybridization and geometry of following molecules on the basis of Valence bond theory. Linear geometry- $BeCl_2$ (sp hybridization), Planer trigonal geometry- BF_3 (sp^2 hybridization), Tetrahedral geometry- $SiCl_4$ (sp^3 hybridization), Trigonal bipyramidal geometry- PCl_5 (sp^3d	**10 Hrs**

	hybridization), Octahedral geometry- SF_6 (sp^3d^2 hybridization), Pentagonal bipyramidal geometry -IF_7 (sp^3d^3 hybridization)	
II	A) **Isomerism and Stereochemistry** Concept of isomerism, type, (Structural chain, position, functional group) Representation of organic, Molecules – zig- zag structures, projection formulae – (Saw horse (Andiron), Newman, Fisher & Dotted – wedge). Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations. Concept of chirality (upto two carbon atoms). Elements of symmetry Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds). Threo and erythro; D and L; cis – trans nomenclature; CIP Rules: R/ S and E / Z Nomenclature. Conformation : chair and boat form of cyclohexane	**10 Hrs**
III	**Chemical Kinetics** Rate of reaction, Definition and units of rate constant, Factors affecting rate of reaction. (Nature of reactant, Concentration, pressure, temperature and catalyst.) Order and Molecularity of reaction, Zero-order reaction, First order reaction, Characteristics of first-order reaction. examples, Pseudo-unimolecular reactions, examples. Second order reaction: Derivation of rate constant for equal and unequal concentration of the reactants. Characteristics of Second order reaction., Numerical on First order and second order reactions. Arrhenius equation, Concept of energy of activation.	**10 Hrs**

Text / Reference Books:

Unit I

1. Lee, J.D. Concise Inorganic Chemistry ELBS, 1991.
2. Cotton, F.A., Wilkinson, G. & Gaus, P.L. Basic Inorganic Chemistry, 3rd ed., Wiley.
3. Douglas, B.E., McDaniel, D.H. & Alexander, J.J. Concepts and Models in Inorganic Chemistry, John Wiley Sons.
4. Huheey, J.E., Keiter, E.A., Keiter, R.L. & Medhi, O.K. Inorganic Chemistry:
5. Principles of Structure and Reactivity, Pearson Education India, 2006.
6. Puri, Sharma, Kalia. Principles of Inorganic Chemistry
7. Madan R. L. Chemistry for Degree Students (B . Sc. First year), S. Chand Publications

Unit II

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. Finar, I.L. Organic Chemistry (Vol. I & II), E.L.B.S.
5. Morrison, R.T. & Boyd, R.N. Organic Chemistry, Pearson, 2010.
6. Bahl, A. & Bahl, B.S. Advanced Organic Chemistry, S. Chand, 2010.
7. Stanley Pine, Organic Chemistry, 5th edition.
8. Mukharjee, Singh and Kapoor, Organic Chemistry Vol. I, II and III -Wiley Eastern.
9. S.K. Ghosh, Organic Chemistry.
10. S.M. Mukharjee and S.P. Singh, Reaction Mechanism in Organic Chemistry.

11. P.S. Kalsi, Stereochemistry and mechanism through solved problems.
12. P S Kalsi, Organic reactions and their mechanism , New age.
13. Grossman, Robert B, The Art of Writing Reasonable Organic Reaction Mechanism
14. Raj K Bansal Organic chemistry
15. Eliel, E.L. Stereochemistry of Carbon Compounds, Tata McGraw Hill education, 2000
16. P.S. Kalsi , Text book of Organic Chemistry , Macmilllan India Ltd., 1999, Delhi.

Unit III

1. Puri, Sharma and Pathania, Principles of Physical Chemistry, Vishal Publishing House, 44th Edition
2. Gurdeep Raj, Advanced Physical Chemistry GOEL Publishing House, 6th Edition
3. Bahl , Tuli and Bahl, Essentials of Physical Chemistry,
4. Soni and Dharmarha, Text Book of Physical Chemistry,
5. H J Arnikar, Essentials of Nuclear Chemistry, New Age, 4th edition.
6. F. Daniel, Mathematical preparation of Physical Chemistry :,Mc-Graw Hill Book Company Ltd.
7. S. Glasstone and D. Lewis, Elements of Physical Chemistry : (D.Van Nostrand Co.Inc)
8. W. J. Moore, Physical Chemistry : (Orient Longman)
9. Maron Prutton, Principles of Physical Chemistry :
10. B. H. Mahan, University Chemistry: (Addison - Wiseley Publ. Co.)

DSC-4 : (Title of Paper) Lab course-2

Total Credits : 02 Total Contact Hours : 60 Hrs
Maximum Marks : 50

Learning Objectives of the Course:

i) To train for volumetric technique.
ii) To give skill for handling the various apparatus and chemicals in preparation and purification
iii) to train for purification of compounds
iv) to develop skill to check the purity of the compounds
v) to provide skill of handling specialized apparatus viscometer, stalagmometer for determining physical properties

Course Outcomes (COs) :

After completion of the course, students will be able to -

i) Acquire skills in common techniques for the Volumetric estimations of inorganic compound
ii) Acquire skills in common techniques preparation and purification of organic compounds.
iii) Assess the effectiveness of purification techniques
iv) Develop precision in measuring and recording physical constants
v) Analyze the relationship between melting/boiling points and purity.
vi) Develop skills in recording and reporting experimental procedures and results
vii) Handle different apparatus like eudiometer viscometer, stalagmometer for determining physical properties

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture. 2. Estimation of oxalic acid by titrating it with $KMnO_4$. 3. Estimation of water of crystallization in Mohr's salt by titrating with $KMnO_4$. 4. Estimation of Fe (II) ions by titrating it with $K_2Cr_2O_7$ using internal indicator. 5. Estimation of Cu (II) ions iodometrically using $Na_2S_2O_3$.	**20 Hrs**
II	1. Preparation of acetanilide (Acetylation). 2. Preparation of Benzanilide (Benzoylation).	**20 Hrs**

	3. Preparation of m-di-Nitrobenzene (Nitration). 4. Preparation of tri-Bromoaniline from Aniline (Bromination). 5. Preparation of Benzoic acid from Benzamide (Hydrolysis). 6. Preparation of phenyl-azo – ß – naphthol dye (Diazotisation).	
III	1. Study of the solubility of benzoic acid in water and determination of ΔH. 2. Determination of Equivalent weight of mg by Eudiometer 3. To Determine Viscosity of given liquid (Water / Ethanol) by viscometer. 4. To determine surface tension of given liquid by Staglanometer. 5. Chemical Kinetics: To study the effect of acid strength on the hydrolysis of an ester.	**20 Hrs**

Text / Reference Books:

1) F.G. Mann, B.C. Saunders, Practical Organic Chemistry, Orient Longman.
2) V.K. Ahluwalia and Sunita Dhingra, Comparative Practical Organic Chemistry (Qualitative Analysis), Orient Longman.
3) V.K. Ahluwalia and Renu Agrawal, Comprehensive Practical Organic Chemistry (Preparation and Qualitative Analysis) by, Orient Longman.
4) Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., Textbook of Practical Organic Chemistry, Prentice-Hall, 5th edition, 1996.
5) Mann, F.G. & Saunders, B.C. Practical Organic Chemistry Orient-Longman, 1960.
6) Svehla, G. Vogel's Qualitative Inorganic Analysis, Pearson Education, 2012
7) Advanced Practical Inorganic Chemistry by Gurdeep Raj, Goel Pulishing House, Meerut.
8) Vogel-A text book of qualitative inorganic analysis.
9) O P Pandey, D. N, Practical Chemistry (for B.Sc. I, II and III year students) –. Bajpaiand
10) Kolthoff and Sandell-Text book of qualitative inorganic analysis
11) Ahluwalia, V.K.; Dhingra, S. (2004),Comprehensive Practical Organic Chemistry: Qualitative Analysis, University Press.
12) Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R.(2012),Vogel's Textbook of Practical Organic Chemistry, Pearson.
13) Leonard, J.; Lygo, B.; Procter, G. Advanced Practical Organic Chemistry, CRC Press.
14) Palit and De, Practical Physical Chemistry:.
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16) Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011).
17) Gurdeep Raj, Advanced Practical Inorganic Chemistry, Goel Publishing House, Meerut.
18) S. W. Rajbhoj and Dr. T. K. Chondekar, Systematic Practical Physical Chemistry by Prof. Anjali Publication, Aurangabad

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3. https://chem.libretexts.org/

4. https://en.wikipedia.org/wiki/Laboratory_glassware#:~:text=Laboratory%20glassware%20refers%20to%20a,%2C%20biology%2C%20and%20analytical%20laboratories.
6. https://brilliant.org/wiki/inductive-effect-electromeric-efffect-resonance/
7. https://sciencing.com/glassware-apparatus-uses-7445911.html
8. https://chem.libretexts.org/Ancillary_Materials/Laboratory_Experiments/Wet_Lab_Experiments/Organic_Chemistry_Labs/Misc/COMMON_LABORATORY_TECHNIQUES
9. https://www.youtube.com/watch?v=Q47hTa1KvN0&t=871
10. https://chem.libretexts.org/Ancillary_Materials/Demos_Techniques_and_Experiments/General_Lab_Techniques
11. https://ucblueash.edu/content/dam/refresh/blueash-62/documents/academics/academic-departments/chemistry/LabSafetyRules.pdf

VSC-1 A : (TITLE OF PAPER) - Cosmetics and perfumery

Total Credits : 01 (Theory paper) Total Contact Hours : 15 Hrs
Maximum Marks : 50

Learning Objectives of the Course:

1 aware about types of perfumes and their composition

1. Give knowledge about extraction method for perfumes
2. Aware about different cosmetic products
3. Impart knowledge about constituents of cosmetic
4. Give knowledge about essence

Course Outcomes (COs) :

After completion of the course, students will be able to -

1. Classify the perfumes
2. Understand the constituent of perfumes
3. Preparation of perfumes
4. Constitutes of cosmetics
5. Method of preparing cosmetics
6. Prepare essence

.

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	**BASICS OF PERFUMES** Introduction to perfumes, history, classification of perfumes, the concept of aroma, types and physiological effects. Composition, formulation and working mechanism of perfume. Antiperspirants and deodorants: definition, working mechanism, composition, formulation chemistry and comparison. Introduction to perfumery chemicals: Natural sources, natural identical and synthetic compounds. Extraction methods of perfumery chemicals. Examples of some important perfumery chemicals (synthesis, properties and chemistry) **BASICS OF COSMETICS** Introduction to cosmetics: Definition, history and application. Cosmetology, Introduction to cosmeceutics.Anatomy of skin and hair with respective to cosmetology.Classification of cosmetics.Physiological effects of cosmetics. Cosmeceuticals: definition, classification, chemicals, mechanism of action. Chemistry of materials used in cosmeceuticals.Applications of essence in cosmetics and perfumery sector. **BASICS OF ESSENCE** Definition of Essence, Types of essence, extraction methods of essence, role of essence in skin care products, mechanism of essence in skin care products, applications of essence in perfume and cosmetics.	**15 Hrs**

Reference books

1 Hilda Butler (editor), Dordrecht Poucher's Perfumes, Cosmetics, and Soaps Kluwer Academic Publishers 2010 Austria

2 D.F. Williams Chemistry andTechnology of the Cosmetics and Toiletries Industries Springer International Edition USA

3 Anthony J. O'Lenick Jr.; Thomas G. O'Lenick Organic chemistry for cosmetic chemists Allured Publishing 2008 London

4 Schueller and Romanowsk Beginning Cosmetic Chemistry Allured Pub Corp 2009 London

5 Barel AO, Paye M, Maibach Hi Handbook of cosmetic science and technology CRC Press 2014 USA

1) Harry's Cosmeticolcgy, Wilkinson, Moore, Seventh Edition, George Godwin.
2) Cosmetics - Formulations, Manufacturing and Quality Control, .P.P. Sharma, 4th Edition, Vandana Publications Pvt. Ltd., Delhi.
3) Text book of cosmelicology by Sanju Nanda & Roop K, Khar, Tata Publishers.

Web References :

1. https://youtu.be/e-cLID1Ga5g?si=CGpPhdywIjFM0hMU
2. https://youtu.be/V-bWm2FnVk4?si=I0IyHR4lhp0J5T8-
3. https://youtu.be/gLBLOuDwqKY?si=cQ3D8KrtDQeGh857
4. https://youtu.be/3VcdyyC-nsw?si=sfB6NFaNtE6mgI5e
5. https://youtu.be/V-bWm2FnVk4?si=RlpP2nMZhCYsu51I
6. https://youtu.be/3bgTpf4U8Kk?si=MTYtkMq0N0KAKZ2v
7. https://youtu.be/s0I7ZsGqUhk?si=popfpJyB84Zb86PT
8. https://youtu.be/XD4g_9DKO0g?si=4NwJq374mpqoDE9S

VSC-2 A : (TITLE OF PAPER) - Cosmetics and perfumery

Total Credits : 01 (Practical paper) Total Contact Hours : 30 Hrs
Maximum Marks : 50

Learning Objectives of the Course:

1 aware about types of perfumes and their composition
5. Give knowledge about extraction method for perfumes
6. Aware about different cosmetic products
7. Impart knowledge about constituents of cosmetic
8. Give knowledge about essence

Course Outcomes (COs) :

After completion of the course, students will be able to -

1. Classify the perfumes
2. Understand the constituent of perfumes
3. Preparation of perfumes
4. Constitutes of cosmetics
5. Method of preparing cosmetics
6. Prepare essence

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	**PREPARATION OF PERFUMES AND COSMETICS** Six practicals should be carry out in laboratory Preparation of following using essence and perfumes: Talcum powder. Shampoo. Enamels. Face cream. Nail polish and nail polish remover. Hand wash Hand sanitizer Body lotion Tooth powder Tooth paste	**30 Hrs**

Reference books

1 Hilda Butler (editor), Dordrecht Poucher's Perfumes, Cosmetics, and Soaps Kluwer Academic Publishers 2010 Austria

2 D.F. Williams Chemistry andTechnology of the Cosmetics and Toiletries Industries Springer International Edition USA

3 Anthony J. O'Lenick Jr.; Thomas G. O'Lenick Organic chemistry for cosmetic chemists Allured Publishing 2008 London

4 Schueller and Romanowsk Beginning Cosmetic Chemistry Allured Pub Corp

2009 London

5 Barel AO, Paye M, Maibach Hi Handbook of cosmetic science and technology CRC Press 2014 USA

4) Harry's Cosmeticolcgy, Wilkinson, Moore, Seventh Edition, George Godwin.

5) Cosmetics - Formulations, Manufacturing and Quality Control, .P.P. Sharma, 4th Edition, Vandana Publications Pvt. Ltd., Delhi.

6) Text book of cosmelicology by Sanju Nanda & Roop K, Khar, Tata Publishers.

Web References :

1. https://youtu.be/e-cLlD1Ga5g?si=CGpPhdywIjFM0hMU
2. https://youtu.be/V-bWm2FnVk4?si=I0IyHR4lhp0J5T8-
3. https://youtu.be/gLBLOuDwqKY?si=cQ3D8KrtDQeGh857
4. https://youtu.be/3VcdyyC-nsw?si=sfB6NFaNtE6mgI5e
5. https://youtu.be/V-bWm2FnVk4?si=RIpP2nMZhCYsu51I
6. https://youtu.be/3bgTpf4U8Kk?si=MTYtkMq0N0KAKZ2v
7. https://youtu.be/s0I7ZsGqUhk?si=popfpJyB84Zb86PT
8. https://youtu.be/XD4g_9DKO0g?si=4NwJq374mpqoDE9S

VSC-1 B : (TITLE OF PAPER) - Soap and detergents

Total Credits : 01 (Theory paper) Total Contact Hours : 15 Hrs
Maximum Marks : 50

Learning Objectives of the Course:
To aware the different types of cleaning agents
To aware different methods used of preparation of soaps detergents and shampoos
To know the different parameters for purity of soaps, detergents and shampoos
To know the techniques for checking quality and purity of samples

Course Outcomes (COs) :
After completion of the course, students will be able to -
CO1: Can gain the information about soaps, detergents and shampoos.
CO2: Can Acquire knowledge of basic concepts and techniques of soap and detergent industry.
CO3: Get hands training of analysis of soaps and detergents.
CO4: Aware about environmental aspects of detergents.
CO5: Development Skill for detergent, liquid soap and laundry soap making

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	**Soaps and Detergents** **Soap**-Introduction. Types of soaps - Toilet soaps, washing soaps. Liquid soap. TFM and grades of soaps. Bathing bars. Saponification process, cleansing action of soap. **Detergents**-Introduction. Types of detergents - anionic, cationic, non-ionic and amphoteric detergents. Common detergent additives. Enzymes used in commercial detergents. Comparison between soaps and detergents. Environmental aspects. **Shampoos** Manufacture of SLS and SLES. Ingredients. Functions. Different kinds of shampoos – antidandruff, anti-lice, herbal and baby shampoos. Manufacture of conditioners	**15 Hrs**

Reference books

1. Handbook on Soaps- Detergents & Acid Slurry 2nd Edition by Niir Board
2. Ajay Kr. Gupta, Handbook on Soaps, Detergents & Acid Slurry , 3rd revised edition; NIIR Board publication. ISBN: 9789381039472

3. P. K. Chattopadhyay, Modern Technology of Soaps, Detergents & Toiletries (with Formulae & Project Profiles) 4th Revised Edition, NIIR Board publication; ISBN: 9789381039700
4. H. Panda, Herbal Soaps & Detergents Handbook, NIIR Board publication; ISBN: 978938103900.
5. I. Ash, M. Ash, Formulary of Detergents and other Cleaning Agents, Chemical Publishing, 1999. 3.
6. H. Butler, Poucher's Perfumes, Cosmetics and Soaps, 10th Edn., Springer, 2000)

VSC-2 B : (TITLE OF PAPER) - Soap and detergents

Total Credits : 01 (Practical paper) Total Contact Hours : 30 Hrs
Maximum Marks : 50

Learning Objectives of the Course:
To aware the different types of cleaning agents
To aware different methods used of preparation of soaps detergents and shampoos
To know the different parameters for purity of soaps, detergents and shampoos
To know the techniques for checking quality and purity of samples

Course Outcomes (COs) :
After completion of the course, students will be able to -
Can gain the information about soaps, detergents and shampoos.

CO2: Can Acquire knowledge of basic concepts and techniques of soap and detergent industry.

CO3: Get hands training of analysis of soaps and detergents.

CO4: Aware about environmental aspects of detergents.

CO5: Development Skill for detergent, liquid soap and laundry soap making

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	i) Determine the pH of shampoos, soaps and detergent. ii) Determination of physico-chemical characteristics of oil and fats iii) Moisture content iv) Acid value v) Iodine value vi) Saponification reaction and Saponification value vii) Synthesis of soap viii) Manufacture of liquid soap ix) Manufacture of laundry soap. x) Determination of free caustic alkali and combined alkali in soap. xi) Estimation of rosin in Soap	**30 Hrs**

Reference books

1. Handbook on Soaps- Detergents & Acid Slurry 2nd Edition by Niir Board
2. Ajay Kr. Gupta, Handbook on Soaps, Detergents & Acid Slurry , 3rd revised edition; NIIR Board publication. ISBN: 9789381039472

3. P. K. Chattopadhyay, Modern Technology of Soaps, Detergents & Toiletries (with Formulae & Project Profiles) 4th Revised Edition, NIIR Board publication; ISBN: 9789381039700
4. H. Panda, Herbal Soaps & Detergents Handbook, NIIR Board publication; ISBN: 978938103900.
5. I. Ash, M. Ash, Formulary of Detergents and other Cleaning Agents, Chemical Publishing, 1999. 3.
6. H. Butler, Poucher's Perfumes, Cosmetics and Soaps, 10th Edn., Springer, 2000)

This course will be available for the students from other faculty

GE/OE-2 : (Title of Paper) Herbal Chemistry-II

Total Credits : 02 Total Contact Hours : 30 Hrs
Maximum Marks : 50

Learning Objectives of the Course:
To aware the importance of herbs for health.
to use appropriate steps to prepare preserve herbal products.
to aware rules and regulations related herbal products

Course Outcomes (COs) :
After completion of the course, students will be able to -
CO1: acquainted with importance of herbal drugs,

CO2: know the different sources of herbal medicine and their preparation

CO3: acquire the knowledge of organic farming

CO4: know about the Indian system of drugs ayurveda, Unani, siddha and homeopathy

Module No.	Topics / actual contents of the syllabus	Contact Hours
I	**Herbal Cosmetics** Sources and description of raw materials of herbal origin used via, fixed oils, waxes, gums colour's, perfumes, protective agents, bleaching agents. antioxidants in products such as skin care. hair care and oral hygiene products. **Herbal excipients:** Herbal Excipients - Significance of substances of natural origin us excipients - colorants, sweeteners, binders, diluents, viscosity builders. disintegrants, flavors & perfumes.	**10 Hrs**
II	**Herbal formulations:** Conventional herbal formulations like syrups, mixtures and tablets and Novel dosage forms like phytosomes **Evaluation of Drugs** WHO & ICH guidelines for the assessment of herbal drugs Stability testing of herbal drugs	**10 Hrs**
III	**Patenting and Regulatory requirements of natural products:** a) Definition of the terms: Patent, IPR. Farmers right, Breeder's right, Bioprospecting and Biopiracy b) Patenting aspects of Traditional Knowledge and Natural Products. Case study of Curcuma & Neern. **Regulatory Issues** - Regulations in India (ASU DTAB, ASU DCC), Regulation of manufacture of ASU drugs - Schedule Z of Drugs & Cosmetics Act for ASU drugs	**10 Hrs**

Reference Books:

1. Trease & Evans Textbook of Phannacognosy.
2. Tyler. Brady & Robber Textbook of Pharrnacognosy .
3. Kokate, Purohit and Gokhale, Pharrnacognosy
4. Dr.S.H.Ansari Essential of Pharmacognosy
5. V.D.Rangari Pharmacognosy & Phytochemistry
6. Pharmacopoeal standards for Ayurvedic Formulation (Council of Research in Indian Medicine & Homeopath)
7. Mukherjee, P.W. Quality Control of Herbal Drugs: An Approach to Evaluation of Botanicals. Business Horizons Publishers, New Delhi, India, 2002.

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Prof. Pathan Mohd Arif Ali Khan
Chairman

Dr.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD

CIRCULAR NO.SU/B.Sc./CBC&GS /67/2023

It is hereby inform to all concerned that, the syllabi prepared by the Board of Studies, Ad-hoc Boards and recommended by the Dean, Faculty of Science & Technology, the Hon'ble Vice-Chancellor has accepted the **following syllabi of Bachelor of Science with Practical Pattern of Question Paper under the scheme of Choice Based Credit & Grading System** in his emergency powers under section 12(7) of the Maharashtra Public Universities Act, 2016 on behalf of the Academic Council as appended herewith.

Sr.No.	Courses	Semester
1.	**B.Sc. Biotechnology (Degree)**	**IIIrd & IVth semester**
2.	**B.Sc. Automobile Technology (Degree)**	**IIIrd & IVth semester**
3.	**B.Sc. Workshop Technology (Degree)**	**IIIrd & IVth semester**
4.	**B.Sc. Refrigeration and Air Conditioning (Degree)**	**IIIrd & IVth semester**
5.	**B.Sc.Physics (Optional)**	**IIIrd & IVth semester**
6.	**B.Sc.Chemistry (Optional)**	**IIIrd & IVth semester**
7.	**B.Sc.Analytical Chemistry (Optional)**	**IIIrd & IVth semester**
8.	**B.Sc. Statistics (Optional)**	**IIIrd & IVth semester**

This is effective from the Academic Year 2023-24 and onwards.

All concerned are requested to note the contents of this circular and bring the notice to the students, teachers and staff for their information and necessary action.

University Campus,
Aurangabad-431 004.
REF.NO.SU/2023/ 670-77
Date:- 03.06.2023.

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Deputy Registrar,
Academic Section

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Dr. Babasaheb Ambedkar Marathwada University,

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3] The Programmer [Computer Unit-1] Examinations, Dr.BAMU,A'bad.

4] The Programmer [Computer Unit-2] Examinations, Dr.BAMU,A'bad.

5] The In-charge,[E-Suvidha Kendra], Rajarshi Shahu Maharaj Pariksha Bhavan, Dr.BAMU,A'bad.

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Dr. Babasaheb Ambedkar Marathwada University, Aurangabad

Syllabus

B.Sc. Chemistry

Semester III & IV

With effect from 2023-24

Prof. Pathan Mohd Arif Ali Khan
Chairman
Board of Studies in Chemistry,
Dr. Babasaheb Ambedkar Marathwada
University, Aurangabad (M.S)

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad

Choice Based Credit System (CBCS) Curriculum
For
Faculty of Science and Technology
Course Structure and Scheme of Examination

B.Sc. Three Year Undergraduate Degree Program for Chemistry with effect from June 2022

Semester I

	Course Code	Course Title	Teaching time/week	Credits	Scheme of Examination			
					Max Marks	CIA	UA	Min Marks
Optional I (DSC-1A) Core Courses	CHE-111	Core Course (Theory Paper-I)	2 hours	2	50	10	40	20
	CHE -112	Core Course (Theory Paper-II)	2 hours	2	50	10	40	20
	CHE -121	Lab course 1 (based on CHE -111 and CHE -112)	3 hours	1.5	50	10	40	20

Total Credits for Semester I : 5.5 (Theory : 04 ; Laboratory : 1.5)

Semester II

	Course Code	Course Title	Teaching time/week	Credits	Scheme of Examination			
					Max Marks	CIA	UA	Min Marks
Optional I (DSC-1B) Core Courses	CHE -211	Core Course (Theory Paper-III)	2 hours	2	50	10	40	20
	CHE -212	Core Course (Theory Paper-IV)	2 hours	2	50	10	40	20
	CHE -221	Lab course 2 (based on CHE -211 and CHE -212)	3 hours	1.5	50	10	40	20

Total Credits for Semester II : 5.5 (Theory : 04 ; Laboratory : 1.5)

(Dr.Anil G. Shankarwar)
Chairman BOS Chemistry
Dr.Babasaheb Ambedkar Marathwada University
Aurangabad.

24/7/22

Semester III

	Course Code	Course Title	Teaching time/week	Credits	Scheme of Examination			
					Max Marks	CIA	UA	Min Marks
Optional I (DSC-1C) Core Courses	CHE 311	Core Course (Theory Paper-V)	2 hours	2	50	10	40	20
	CHE-312	Core Course (Theory Paper-VI)	2 hours	2	50	10	40	20
	CHE -321	Lab course 3 (based on CHE -311)	3 hours	1.5	50	10	40	20
	CHE -322	Lab course 4 (based on CHE -312)	3 hours	1.5	50	10	40	20

Total Credits for Semester III : 07 (Theory : 04 ; Laboratory : 03)

Semester IV

	Course Code	Course Title	Teaching time/week	Credits	Scheme of Examination			
					Max Marks	CIA	UA	Min Marks
Optional I (DSC-1D) Core Courses	CHE -411	Core Course (Theory Paper-VII)	2 hours	2	50	10	40	20
	CHE -412	Core Course (Theory Paper-VIII)	2 hours	2	50	10	40	20
	CHE -421	Lab course 4 (based on CHE -411)	3 hours	1.5	50	10	40	20
	CHE -422	Lab course 5 (based on CHE -412)	3 hours	1.5	50	10	40	20

Total Credits for Semester IV : 07 (Theory : 04; Laboratory : 03)

29/7/22

Semester V

	Course Code	Course Title	Teaching time/week	Credits	Scheme of Examination			
					Max Marks	CIA	UA	Min Marks
Optional I (DSE-1 A) Discipline Specific Elective	CHE -511	DSE-1A(1) (Theory Paper-IX) (Select any one paper from A1/B1/C1/D1)	2 hours	2	50	10	40	20
	CHE -512	DSE-1A(2) (Theory Paper-X) (Select any one paper from A2/B2/C2/D2)	2 hours	2	50	10	40	20
	CHE -521	Lab course 6 (based on CHE -511)	3 hours	1.5	50	10	40	20
	CHE -522	Lab course 7 (based on CHE -512)	3 hours	1.5	50	10	40	20
Total Credits for Semester V : 07 (Theory : 04 ; Laboratory : 03)								

Semester VI

	Course Code	Course Title	Teaching time/week	Credits	Scheme of Examination			
					Max Marks	CIA	UA	Min Marks
Optional I (DSE-1 B) Discipline Specific Elective	CHE -611	DSE-1B(1) (Theory Paper-XI) (Select any one paper from A1/B1/C1/D1)	2 hours	2	50	10	40	20
	CHE -612	DSE-1B(2) (Theory Paper-XII) (Select any one paper from A2/B2/C2/D2)	2 hours	2	50	10	40	20
	CHE -621	Lab course 8 (based on CHE -611)	3 hours	1.5	50	10	40	20
	CHE -622	Lab course 9 (based on CHE -612)	3 hours	1.5	50	10	40	20
Total Credits for Semester VI : 07 (Theory : 04 ; Laboratory : 03)								

Total Credits for three years: Sem. I (05.5) + Sem. II (05.5) + Sem. III (07) + Sem. IV (07) + Sem. V (07) + Sem. VI (07) = 39 Credits

Shankarwar

29/7/22

(Dr.Anil G. Shankarwar)
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Important Notes:

i) **Nomenclature**: DSC- Discipline Specific Core course, SEC – Skill Enhancement Course, AECC- Ability Enhancement compulsory course, DSE- Discipline Specific Elective, UA- University Assessment (Semester End), CIA- Continuous Internal Assessment

ii) **Assessment**: 80% for University Assessment (Semester End Examination) and 20 % for Continuous Internal Assessment (CIA)

iii) Continuous Internal Assessment (CIA): **Theory** (10 Marks): Internal Test 05 Marks (Two Internal Tests of 05 marks each and average of the two test will be considered) and 05 Marks for Assignment/tutorials.

iv) Continuous Internal Assessment (CIA): **Practical** (10 Marks): 07 Marks for Internal Practical Examination and 03 Marks for record book/submission of collection and field survey report and excursion report

v) Practical examination : Annual examination

BSc III Semesters

Core course (Theory Paper V)

CHE-311 Organic Chemistry

Credits 02 Lectures 45

Aldehydes and Ketones **[10 L]**

Introduction, IUPAC nomenclature, Preparation: from acid chlorides and nitriles. Reactions of aldehydes and ketones with HCN, ROH, $NaHSO_3$, NH_2-G derivatives. Iodoform test, Aldol Condensation, Cannizzaro's reaction, Wittig reaction, Benzoin condensation, Clemenson reduction, Wolff-Kishner reduction and Meerwein-Pondorff Verley reduction.

Carboxylic acids and their derivatives **[7 L]**

Carboxylic acids (aliphatic and aromatic): Introduction and IUPAC nomenclature, factors affecting acidity of carboxylic acids. *Preparation:* Acidic and Alkaline hydrolysis of esters. *Reactions:* Hell–Vohlard – Zelinsky Reaction.

Carboxylic acid derivatives (aliphatic): (up to 5 carbons) *Preparation:* Acid chlorides, Anhydrides, Esters and Amides from acids and their inter conversion. Reaction: Comparative study of nucleophilicity of acyl derivatives. Reformatsky Reaction, Perkin condensation.

Amines and Diazonium Salts: **[6L]**

Amines (Aliphatic and Aromatic): Introduction and IUPAC nomenclature, *Preparation* from alkyl halides, Gabriel's Phthalimide synthesis, Hofmann Bromamide reaction. *Reactions:* Hofmann vs. Saytzeff elimination. Nitration, bromination and sulphonation of aniline. Preparation of p-bromo aniline from aniline, Diazotization reaction, Sandmeyer reaction.

Heteronuclear Aromatic Compounds **[10 L]**

Introduction, Classification of heterocyclic compounds, Structures of pyrrole, thiophene, furan and pyridine and their aromaticity. Basicity of pyrrole , furan thiophene, pyridine and pyrrolidine Preparation and electrophilic substitution of Furan, Pyrrole, Thiophene, and Pyridine. Chichibabin reaction

Stereochemistry of Cyclohexane: **[6 L]**

Bayer's strain theory, structure of cyclohexane, axial and equatorial H atoms, heat of combustion of cycloalkanes, conformations and stabilities of methyl cyclohexane, t-butyl cyclohexane, 1,1 dimethyl cyclohexane, 1,2 dimethyl cyclohexane, 1,3 dimethyl cyclohexane, 1,4 dimethyl cyclohexane

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Active Methylene Compounds **[06 L]**

Definition, Preparation of Ethyl acetoacetate and Synthetic uses of ethylacetoacetate. Preparation of Diethyl malonate and Synthetic uses of diethyl malonate.

REFERENCE BOOKS

1. Morrison, R.T. & Boyd, R.N. *Organic Chemistry*, Prentice Hall of India, Sixth Edition,
2. Jonathan Clayden, Nick Greeves, Stuart Warren, Peter Wothers *Organic Chemistry* - Oxford University Press, USA, 2nd Ed.
3. Bahl, A. and Bahl, B.S. *Advanced Organic Chemistry,* S. Chand,
4. Graham Solomon, T.W., Fryhle, C.B. & Dnyder, S.A. *Organic Chemistry,* John Wiley and Sons
5. Mc Murry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India Edition,
6. Sykes, P. *A Guidebook to Mechanism in Organic Chemistry,* Orient Longman, New Delhi
7. Finar, I. L. *Organic Chemistry* (Vol. I and II), E.L.B.S.

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BSc III Semesters

Core course (Theory Paper VI)

CHE-312 (Physical Chemistry)

Credits 02 Lectures 45

Surface Chemistry **[8L]**

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, Numericals.

Phase equilibrium **[8L]**

Introduction; definitions of phase, components and degrees of freedom of a system; stability of phases, criteria of phase equilibrium. Gibbs phase rule and its thermodynamic derivation, phase diagrams of one- component systems- water, carbon dioxide and sulphur systems, Numericals.

Quantum Chemistry **[10 L]**

Introduction, de Broglie hypothesis, The Heisenberg's uncertainty principle, quantization of energy, Operators, Schrodinger wave equation, well behaved function, Particle in a one-, two and three-dimensional box (no derivation), Physical interpretation of the ψ and $\psi 2$, sketching of wave function and probability densities for 1D box, degeneracy, applications to conjugated systems, zero-point energy and quantum tunnelling, Numerical

Photochemistry **[8 L]**

Introduction, Difference between thermal and photochemical processes, Laws of photochemistry: i) Grothus - Draper law ii) Stark-Einstein law, Quantum yield, Reasons for high and low quantum yield., Factors affecting Quantum yield, Experimental method for the determination of quantum yield, types of photochemical reactions - photosynthesis, photolysis, photocatalysis, photosensitization, Jablonski diagram depicting various processes occurring in the excited state: Qualitative description of fluorescence and phosphorescence, Chemiluminescence, Numericals

Conductometry **[6 L]**

Introduction, Electrolytic Conductance, Resistance, conductance, Ohm's law, cell constant, specific and equivalent conductance, molar conductance, variation of equivalent and specific

conductance with concentrations, Kohlrausch's law and its applications, conductivity cell, conductivity meter, Whetstone Bridge, determination of cell constant conductometric titrations (strong acid-strong base, strong acid-weak base, weak acid strong base) and Numericals.

Colorimetry: **[5 L]**

Introduction, interaction of electromagnetic radiation with matter, essential terms: radiant power, transmittance, absorbance, molar, Lamberts Law, Beer's Law, Lambert-Beer's Law, molar absorptivity, deviations from Beer's Law, Colorimeter: *Principle, Construction and components, Working*. Applications–unknown conc. By calibration curve method, Determination of unknown concentration of Fe(III) by thiocynate method, Numericals

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, S. Chand and Company Ltd.
4. Principles of Physical Chemistry, Fourth Edition by S.H. Marron and C. F. Pruton
5. Physical-Chemistry-4th Edition - Gilbert W. Castellan (Narosa Publication)
6. Vogel's Textbook of quantitative Chemical Analysis, 5th Ed. G. H. Jeffry, J. Basset, J. Mendham, R. C. Denney, Longman Scientific and Technical,.
7. Basic Concept of Analytical Chemistry, S. M. Khopkar, New Age International (UK) Ltd, United Kingdom
8. Analytical Chemistry, G.R. Chatwal, Sham Anand.
9. Instrumental Methods of Chemical Analysis, Chatwal and Anand

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BSc IV Semesters

Core course (Theory Paper VII)

CHE-411 Inorganic Chemistry

Credits 02 Lectures 45

Coordination Compounds [10 L]

Double salt, coordination compound, coordinate bond, ligand, types of ligands, chelate, central metal ion, charge on complex ion, calculation of oxidation state of central metal ion, metal ligand ratio; Werner's theory, Effective atomic number, equilibrium constant. chelate effect, IUPAC nomenclature. Cationic and anionic complexes, Isomerism in coordination compounds: polymerization isomerism, ionization isomerism, hydrates isomerism, linkage isomerism, coordination isomerism, coordination position isomerism, geometric isomerism, optical isomerism.

Valance Bond Theory of Coordination Compounds [6 L]

Aspects and assumptions of VBT, applications of VBT. Hybridization, structure and bonding in Inner orbital complexes $[Ag(NH_3)_2]^+$, $[Ni(Cl_4)]^{2-}$, $[Ni(CN)_4]^{2-}$, $[Cr(H_2O)_6]^{3+}$, $[Fe(CN)_6]^{3-}$ and outer orbital complex $[Cr(H_2O)_6]^{3+}$, $[Cu(NH_3)_6]^+$, $[FeF_6]^{3-}$. limitations of VBT

Crystal Field Theory [12 L]

Shapes of d-orbitals, Assumption of Crystal field Theory (CFT), splitting of 'd' orbitals in Oh ligand field, effect of weak and strong ligand fields, spectrochemical series, crystal splitting energy, Crystal field stabilization energy and factors affecting it, tetragonal distortion in Cu(II) complexes. Crystel field splitting in octahedral, tetrahedral and square planner complexes, application of CFT.

Oxidation and Reduction [06 L]

Introduction, oxidation number, Galvanic cells, Single electrode potential, Signs of Single electrode potential, Standard electrode potentials, Electrochemical series, Nernst equation, Application of Electrochemical series, Source of electric energy in a Galvanic cell, Hydrogen over voltage, Oxygen over voltage, Redox stability in water, Oxidation by atmospheric oxygen, Latimer diagram, Frost diagram, Pourbaix diagram.

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Volumetric analysis **[07 L]**

Introduction, Terminology, Basic requirement of titration reaction, Standard solution, Primary Standards, Expressing concentration of Standard solution, Volumetric titration co-relation, P-Function, Acid-base titration, Theory of acid-base indicators, Mathematical treatment, Redox titration, Complexometric titration, Polydentate titrants for complexometric titration, EDTA titration, Indicators for EDTA titration, Titration curves, EDTA titration methods, Cautions of volumetric titrimetry, Correction for unavoidable errors.

The Chemistry Of Elements In Medicine **[04 L]**

1) Introduction, Chelation Therapy, Cancer Treatment, Anti-arthritis drugs, Imaging agents.

Books:

1. Principles of Inorganic Chemistry by Puri, Sharma and Kaliya.
2. Advanced inorganic chemistry by Gurudeep Raj and Chatwal Anand.
3. Advanced inorganic chemistry vol. II by Satyaprakash, Tuli, Basu and Madan.
4. Inorganic Chemistry by Huheey, Keiter and Keiter.
5. Nuclear Chemistry by Arnikar,
6. Concise Inorganic Chemistry by J. D. Lee.
7. Vogel's Qualitative Inorganic Analysis (Seventh Eddition),
8. A text book of Practical Chemistry for B. Sc. By V. V. Nadkarny, A. N. Kothare and Y. V. Lawande.
9. Advanced practical inorganic Chemistry by O. P. Agarwal

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BSc IV Semesters

Core course (Theory Paper VIII)

CHE-412 Applied Chemistry

Credits 02 Lectures 45

Infrared Spectroscopy: **(10L)**

Introduction, Simple Harmonic oscillator, Modes of vibration, force constant, Vibrational spectrum of a diatomic molecules: Vibrational Energy expression, Allowed vibrational energies, zero-point energy, Selection rule, Vibration- rotation Spectra: Born-Oppenheimer approximation, Energy expression for vibrational rotor, Interpreting IR Spectra: functional group and fingerprint region. Infra-red spectroscopy in organic molecules, IR spectra of alkanes, alkenes and simple alcohols (inter and intramolecular hydrogen bonding), aldehydes, ketones, carboxylic acids and their derivatives (effect of substitution on >C=O stretching absorptions. Numericals.

Raman Spectroscopy: **(4 L)**

Introduction, Classical and Quantum theory of Raman Effect, Rayleigh, Stokes and anti-stokes lines, pure rotational Raman spectra of linear diatomic molecules

Dyes and Pigments **(9 L)**

Dyes: Introduction, qualities of good dye, Colour constituents (Chromophore, auxochrome), classification of dyes according to their application, Synthesis and uses of following dyes: Nitroso dye-martius yellow, Azo dyes-Methyl orange and aniline yellow, Triphenylmethane dye-Crystal violet, Phthalein dye- Phenolphthalein, Xanthane Fluorescein, Anthraquinone Alizarin and Indigo dyes - Indigo.

Pigments: Introduction, classification and general properties of pigments. Inorganic pigments: i) Zinc oxide pigments (Fundamentals and properties, Raw materials, Direct process (American process), Precipitation process) ii) Iron oxide pigments (Fundamentals and properties, Production of iron oxide pigment by precipitation process .

Polymerization **(6 L)**

Classification of polymerization processes, mechanism of- step growth, radical chain growth, ionic chain (both cationic and anionic) and coordination polymerizations. Polymerization techniques: bulk, solution, suspension, emulsion and interfacial condensation.

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Molecular weight of Polymers **(6 L)**

Average molecular weight of polymer, Number average molecular weight (Mn), Weight average molecular weight (M_W), Number average molecular weight by end group analysis, Viscosity average molecular weight by viscometric method, kl Molecular weight distribution and its significance, polydispersity index

Cosmetics **[10 L]**

A general study including chemical composition, preparation and uses of the following:
Hair dye, hair spray, shampoo, suntan lotions, face powder, lipsticks, talcum powder, nail enamel, creams (cold, vanishing and shaving creams), Eye make-up (Mascara, Eyeshadow, Eyeliner, Eyebrow pencil), Antiperspirants, perfume

Reference Books

1. Fundamentals of molecular spectroscopy by C.N. Banwell and E. M. McCash
2. Industrial Chemistry, B. K. Sharma, Goel publishing House, 18th Ed. (2014)
3. Advanced Inorganic Chemistry, Satyaprakash, Tuli, Basu pages 458-463.
4. Advanced Inorganic Chemistry, Satyaprakash, Tuli, Basu pages 830-849
5. Inorganic Pigments by Gerhard Pfaff, Publisher-De Gruyter, 1st Ed.
6. Shreeve's chemical process industries 5th Edition, G.T. Austin, TATA McGraw-Hill
7. Edition, chemical engineering series
8. Industrial Chemistry, Part-II, R. K. Das, Kalyani Publisher, Second Ed.
9. Inorganic Pigments by Gerhard Pfaff, Publisher-De Gruyter, 1st Ed.
10. Polymer Science by V.R. Gowarikar, N.V.Vishvanathan, JaydevShreedhar New Age International Ltd. Publisher 1996. (Reprint 2012)
11. Textbook of Polymer Science by Fred Billmeyer, 3rd Edn. A Wiely-Interscience Publication
12. John Wiley& Sons New York 1984. (Reprint 2008)
13. Introductory Polymer Chemistry by G.S.Misra New Age International (P) Ltd. Publisher 1996

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BSc III Semesters

Core course (Theory Paper V)

CHE-321 Physical Chemistry

Credits 1.5 4 Lectures per week

Chemical Kinetics:

1. To Study the Acid catalysed hydrolysis of an ester (methyl Acetate) and determine the rate constant (k). (first order reaction)
2. To study the kinetics of saponification reaction between sodium hydroxide and ethyl acetate.
3. To compare the relative strength of HCl and H_2SO_4 or HNO_3 by studying the kinetics of hydrolysis of methyl acetate.
4. To determine Energy of activation of the reaction between $K_2S_2O_8$ and KI with unequal initial concentration.
5. To determine the order of the reaction with respect to $K_2S_2O_8$ by fractional life method following the kinetics of per sulphate-iodide reaction

pH Metry:

6. To determine equivalence point of neutralisation of acetic acid by pH-metric titration with NaOH

Conductometry:

7. To determine the cell constant of the given cell using 0.01 M KCl solution and determine dissociation constant of a given monobasic weak acid.
8. To investigate the conductometric titration of Strong acid against strong base
9. To investigate the conductometric titration of weak acid against strong base

Colorimetry:

10. Prepare standard solutions of $KMnO_4$ / $CuSO_4$, record their absorbance and Verify Beer's Law and determine unknown concentration.
11. Prepare solution of Fe(III) and SCN^- of in different molar proportion, record their absorbance and calculate equilibrium constant of $[Fe(SCN)]^{2+}$ complex
12. Prepare solution of Fe(III)/Cu(II) and salicylic acid in different molar proportion and determine metal ligand ratio in Fe(III) or Cu(II)–Salicylic acid complex

Potentiometry:

13. Potentiometric titrations of Strong acid vs. strong base

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14. Potentiometric titrations of Weak acid vs. strong base
15. Potentiometric titrations of Potassium dichromate vs. Mohr's salt

Reference books

1. Vogel's Textbook Quantitative Chemical Analysis, 3rd, 6th Ed. A. I. Vogel J. Mendham, et al, Addison Wesley Publishing Co.
2. Experiments in Chemistry by D. V. Jahagirdar Himalaya publication 2014
3. Systematic experimental physical chemistry S. W. Rajbhoj, T. K. Chondekar Anjali publication
4. Practical Physical Chemistry, Vishwanathan and Raghwan Viva book
5. Practical Chemistry O.P. Pandey, D.N. Bajpai& S. Giri, , S. Chand & Company Ltd.
6. Senior Practical Physical Chemistry B. D. Khosla, V. C. Garg& A. Gulati, , S. Chand & Co. New Delhi (2011).
7. Experiments in Physical Chemistry C. W. Garland, J.W. Nibler, & D.P. Shoemaker, 8th Ed.; McGraw-Hill: New York (2003).
8. Experimental Physical Chemistry A.M. Halpern & G.C. McBane, 3rd Ed.; W.H. Freeman & Co.: New York (2003)
9. Advanced Physical Chemistry Experiment, Gurtu and Gurtu, Pragati Publication

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BSc IV Semesters
Core course (Practical Paper VI)
CHE-322 Organic Chemistry

Credits 1.5 4 Lectures per week

Organic Qualitative Analysis (Five mixtures: water insoluble solid-solid type)

Separation of Two Components from given binary mixture of organic compounds containing mono and di-functional group (carboxylic acid, phenols, amines, nitro, anilide etc.) and systematic identification of one component qualitatively.

Organic Preparations

(Confirmatory Test of functional group: M.P and purity by TLC)
(Preference should be given to green approach for following synthesis)

1. Preparation of benzoic acid from ethyl benzoate
2. Acetylation of primary amine
3. Base catalysed Aldol condensation
4. Preparation of Quinone from hydroquinone
5. Preparation of phthalimide from phthalic acid.

Organic estimations

6. Determine alcoholic OH groups by pthalation with pthalic anhydride in pyridine.
7. Determination of equivalent weight of a carboxylic acid by titration with standard aqueous alkali solution.
8. Estimation of amino acids by formol titration
9. Estimation of carbonyl compound with 2,4 dinitrophenyl hydrazine
10. Estimation of aldehyde/ketone by hydroxylamine -pyridine procedure

Reference books

1. Comprehensive Practical Organic Chemistry by V. K. Ahluwalia and Renu Aggarwal
2. A hand Book of Practical Chemistry, Dr. S. J. Naik, Phadake Prakashan.
3. Practical Organic Chemistry by Mann, F.G. & Saunders, B.C. Orient-Longman,1960.
4. Vogel's Textbook of Practical Organic Chemistry, Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G.,
5. Elementary practical organic chemistry Part III quantitative analysis by A I Vogel
6. Elementary practical organic chemistry Part I qualitative analysis by A I Vogel
7. Elementary practical organic chemistry Part II preparations by A I Vogel

BSc IV Semesters
Core course (Practical Paper VII)
CHE-421 Inorganic Chemistry

Credits 1.5 4 Lectures per week

Chromatography

1. Separation of binary mixture of cations by Column Chromatography by ion exchange resins / cellulose of (Co + Al) mixture, Separation of cations must be confirmed by qualitative test
2. Separation of binary mixture of cations by Column Chromatography by ion exchange resins / cellulose of (Cu + Mg) mixture Separation of cations must be confirmed by qualitative test
3. Separation of binary mixture of cations by Column Chromatography by ion exchange resins / cellulose of (Zn + Mg) mixture. Separation of cations must be confirmed by qualitative test
4. Separation and Identification of metal ions Ni and Cr by Paper Chromatography

Synthesis of Coordination compounds

5. Synthesis of sodium cobaltinitrite from Co(II) salt and $NaNO_2$ salts.
6. Synthesis of potassium Tris(oxalate)aluminium(III) using Al metal powder(Scrap aluminium).
7. Synthesis of Tris(acetylacetone)iron(III) by green chemistry method by reaction between $Fe(OH)_3$ and acac.
8. Synthesis of Tris(ethylenediamine)nickel (II) from Ni(II) salt, ethylediamine and sodium thiosulfate.
9. Synthesis of $K[Cr(C_2O_4)_2.(H_2O)_2]$ Potassium dioxalatodiaquachromate(III)
10. Synthesis of Tetra ammine copper(II) sulphate, $[Cu(NH_3)_4]SO_4.H_2O$

Gravimetric estimation

11. Estimation of nickel (II) using Dimethylglyoxime (DMG).
12. Estimation of copper as CuSCN
13. Estimation of iron as Fe_2O_3 by precipitating iron as $Fe(OH)_3$.
14. Estimation of Al (III) by precipitating with oxine and weighing as $Al(oxine)_3$ (aluminiumoxinate).

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15. Estimation of Ba as Barium chromate

Reference books

A. I. Vogel's Quantitative Chemical Analysis Mendham, J., *6th Ed.,* Pearson, 2009
A Textbook of Quantitative Inorganic Analysis, Vogel, A.I. ELBS.

BSc IV Semesters
Core course (Practical Paper VIII)
CHE-422 Applied Chemistry

Credits 1.5 4 Lectures per week

1. Estimation of Aspirin from a given tablet and find errors in quantitative analysis.
2. Determination of acetic acid in commercial vinegar by titrating with standard NaOH. Express results as average ± standard deviation
3. Determination of Hardness of water from given sample by complexometric titration (Using E.D.T.A.) method
4. Removal of dyes / by Fenton's process or by adsorption on activated charcoal.
5. Removal of nitrophenols / by Fenton's process or by adsorption on activated charcoal.
6. Deionization water using cation and anion exchange resins / zeolites.
7. Estimation of paracetamol content in tablet
8. Estimation of the vitamin-c content in tablet
9. Estimation of Casein from milk sample
10. Estimation of Rhodamine B from chilli powder spectrophotometrically
11. Estimation of lead chromate in turmeric powder.
12. Estimation of Tannic acid from tea sample spectrophotometer/Colorimeter.
13. Estimation nutritive value of ghee sample (Desi Ghee)
14. To determine the molecular weight of a high polymer by using solutions of different concentrations
15. Quantitative estimation of reducing sugar from jam and jelly

Reference books

1) Food analysis by Pearson
2) Food analysis by A. G Woodman. Mc Graw Hill
3) Food analysis by S. S. Neilson.
4) Standard methods of biochemical analysis by S. R Thimmaiah
5) Biophysical chemistry (Principles and techniques), Upadhyay, Upadhyay and Nath

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SYLLABUS

B.Sc. (Chemistry)

THIRD YEAR

SEMESTER SYSTEM

FIFTH / SIXTH SEMETER

[Effective from – June- 2011 onwards]

B.Sc. CHEMISTRY

(Three Year Degree Course)

THIRD YEAR

Paper XVII **Physical Chemistry** **Fifth Semester**

(45hrs)
3 **Hrs/ Week**

I. Elementary Quantum Mechanics	10 Hrs.
II. Spectroscopy	10 Hrs.
III. Photochemistry	08 Hrs.
IV. Physical Properties and Molecular Structure	10 Hrs.
V. Nano Material	07 Hrs.

Paper XVIII **Organic Chemistry** **Fifth Semester**

(45hrs)
3 **Hrs/ Week**

I. Spectroscopy	16 Hrs.
II. Organometallic Compounds	08 Hrs.
III. Organic Synthesis via Enolates	13 Hrs.
IV. Fats, Oils and Detergents	08 Hrs.

Paper – XIX Lab. Course IX Organic Chemistry (45 Hrs)

Paper – XX Lab. Course X Inorganic Chemistry (45 Hrs)

B.SC. CHEMISTRY

(Three Year Degree Course)

THIRD YEAR

Paper XXI **Inorganic Chemistry** **Sixth Semester**

(45hrs)
3 **Hrs/ Week**

I. Metal-ligand Bonding in Transition Metal Complexes 12 Hrs.

II. Electron Spectra of Transition Metal Complexes 07 Hrs.

III. Organometallic Chemistry 10 Hrs.

IV. Bioinorganic Chemistry 10 Hrs.

V. Chromatography 06 Hrs.

Paper XXII **Organic Chemistry** **Sixth Semester**

(45hrs)
3 **Hrs/ Week**

I. Heterocyclic Compounds 13 Hrs.

II. Carbohydrates 10 Hrs.

III. Synthetic Polymers 07 Hrs.

IV. Synthetic Dyes and Drugs 15Hrs.

Paper – XXIII Lab. Course XI **Organic Chemistry (45 Hrs)**

Paper – XXIV Lab. Course XII **Physical Chemistry (45 Hrs)**

B. SC. THIRD YEAR

Paper XVII Physical Chemistry [Vth Semester]
45 Hrs. (3 Hrs/week)

I Elementary Quantum Mechanics 10 Hrs.

Black body radiation, Planck's radiation law, photoelectric effect, Bohr's modes of hydrogen atom (no derivation) and its defects. Compton effect. De Broglie Hypothesis, the Heisenberg's uncertainty principles, Harmiltonian operator, Schrödinger wave equation and its importance, physical interpretation of the wave function, postulates of quantum mechanics. Schrödinger wave equation for H-atom, separation into three equations (without derivation), quantum numbers and their importance.

II Spectroscopy 10 Hrs.

Introduction - Electromagnetic radiation, regions of the spectrum, basic features of different spectrometers, statement of the born-oppenheimer approximation. Rotational Spectrum - Diatomic molecules, energy levels of a rigid rotor (semi classical principles), selection rule, rotational spectra of rigid diatomic molecule, determination of bond length, numerical problems.

III Photochemistry 08 Hrs.

Introduction of radiation with matter, difference between thermal and photochemical processes. Laws of photochemistry, Grothus - Drapper law, Stark-Einstein law, Jablonsiki diagram qualitative description of fluorescence, phosphorescence, non-radiative processes (Internal conversion, Intersystem crossing), quantum yield, photosensitized reactions.

IV Physical properties and molecular structure 10 Hrs.

Optical activity and its measurement, dipole moment and its measurement by temperature change method, magnetic property and its measurement by Guoy balance method, Applications of optical activity, dipole moment and magnetic property for determination of structure of molecule.

V Nano Material 07 Hrs.

Introduction to nano-materials Methods of Synthesis - i) High energy ball milling, ii) Physical vapour deposition (PVD) iii) Chemical vapour deposition (CVD) iv) Micro emulsion. Synthesis using micro-organisms and plant extract.

B. SC. THIRD YEAR

Paper XVIII Organic Chemistry [Vth Semester]
45 Hrs. (3 Hrs/week)

I Spectroscopy 16 Hrs.

Nuclear magnetic resonance (NMR) spectroscopy. Proton magnetic resonance (1H NMR) spectroscopy, nuclear shielding and deshielding, chemical shift and molecular structure, spin-spin splitting and coupling constants, areas of signals, interpretation of PMR spectra of simple organic molecules such as ethyl bromide, ethanol, acetaldehyde, 1, 2, 2 tribromoethane, ethyl acetate, toluene and Acetophenone. Problems pertaining to the structure elucidation of simple organic compounds using UV, IR and PMR spectroscopic techniques. (Combine and single λ max using woodwordfischer rule)

II Organometallic Compounds 08 Hrs.

Organomagnesium compounds: The Grignard reagent formation, structure and chemical reactions. Organozinc compound, formation and chemical reactions, organolithium compound, formation and chemical reactions.

III Organic Synthesis via Enolates. 13 Hrs.

Defination, Active methylene compounds, Preparation of Aceto acetic ester, (Claisen condensation with Mechanism), Acidity of alpha hydrogen, properties and

reactions involving formation of mono, di and unsaturated carboxylic acids, also synthesis of ketone, di ketone, 4-methyl uracil from acetoacetic ester, keto-enol tautomerism. Preparation of diethyl malonate, properties and reactions involved in alkylation, formation of mono, di and unsaturated carboxylic acids, and also synthesis of glycine and barbutric acids from diethyl malonate.

IV Fats, oils and detergents 08 Hrs.

Natural fats, edible and industrial oils of vegetable origin, manufacture of soyabean oil by solvent extraction method and isolation and uses of essential oils. Types of animals fats and oils and defination of saponification value, iodine value, and acid value. Detergents: Defination, Introduction and preparation of sodium alkyl sulphonate, alkyl benzene sulphonate, and amide sulphonate, (one example each), Cleansing action of detergent.

B. SC. THIRD YEAR

Semester V **Paper XIX**

Organic Chemistry

Lab Course: IX **Marks: 50**

Binary Mixture:

Separation and Identification of both components

i) Benzoic Acid + β-naphthol

ii) Salicylic Acid + P- nitro aniline

iii) β-naphthol + Acetanilide

iv) p-toluidine + Naphthalene

v) α-naphthol + diphenyl amine

vi) Cinnamic Acid + Naphthalene

vii) Salicylic Acid + Naphthalene

viii) β-naphthol + m-dinitrobenzene

ix) Cinnamic Acid + P- nitro aniline

x) Salicylic Acid + β-naphthol

B. SC. THIRD YEAR

Semester V **Paper XX**

Inorganic Chemistry

Lab Course: X **Marks : 50**

1 Inorganic Qualitative Analysis (Semi-Micro Analysis)
(Atleast five mixtures)

2. Separation of calcium and Barium and estimation of Ca-volumetrically or Ba-gravimetically

3. Separation of Cu and Ni from binary mixture solution and estimation of Cu-volumetrically and Ni-gravimetrically

4. Estimation of oxalic acid and H_2SO_4 in a given mixture Solution using NaOH and $KMnO_4$ solution.

5. Estimation of Fe by potassium dichromate using diphenyl ammine indicator.

6. Estimation of available chlorine in the given sample of bleaching powder.

B. SC. THIRD YEAR

Paper XXI Inorganic Chemistry [VIth Semester]
45 Hrs. (3 Hrs/week)

1. Metal-Ligand Bonding in Transition Metal Complexes 12 Hrs

Limitations of Valence Bond Theory

An Elementary idea of Crystal Field Theory

Crystal Field Splitting in Octahedral, Tetrahedral and Square Planar Complexes

Factors affecting Crystal Field Parameters

2. Electronic Spectra of Transition Metal Complexes 7 Hrs

Types of Electronic Transitions

Selection rules for d -d transitions

Spectro -chemical series

Orgel Energy level diagram for d^1, d^5 and d^9

Electronic Spectrum of $[Ti(H_2O)6]^{3+}$ complex ion.

3. Organometallic Compounds 10 Hrs

Definition, Nomenclature and classification of Organometallic Compounds

Preparation, Properties, Bonding and Applications of alkyls and aryls of - Li,

Al, Hg, Sn and Ti.

A Brief account of metal - ethylenic Complexes

Nature of bonding in metal carbonyls.

4. Bioinorganic Chemistry 10 Hrs

Essential and trace elements in biological processes

Metalloporphyrins with special reference to hemoglobin and myoglobin

Biological role of alkali (Na^+, K^+) and alkaline earth metal ions(Mg^{2+}, Ca^{2+}).

Nitrogen fixation

5. Chromatography 06 Hrs

Definition and classification of chromatography

Paper and Thin Layer Chromatography

Method of Development (Ascending, Descending Chromatography)

Locating Technique (UV-light / Chemicals)

R f value

Comparison between paper and TLC

Applications.

B. SC. THIRD YEAR

Paper XXII Organic Chemistry [VIth Semester]
45 Hrs. (3 Hrs/week)

1. Heterocyclic Compounds 13 Hrs.

Introduction: Molecular orbital picture and aromatic characteristics of pyrrole, furan, thiophene and pyridine, Methods of synthesis and chemical reactions with particular emphasis on the mechanism of electrophilic substitution. Mechanism of nucleophilic substitution reactions in pyridine. Comparison of basicity of pyridine, piperidine and pyrrole. Condensed Heterocyles: Introduction, Preparation of Quinoline (Skraups Synthesis), Isoquinoline (Bischler - Napirlaski) and Indole (Fischer indole Synthesis).

2. Carbohydrates 10 Hrs.

Defination, Introduction and Classification.

Monsaccharides-Interconversion of Glucose and Fructose, chain lengthening, chain shortening of aldoses. Conversion of Glucose in to mannose. Determination of ring size of Monosaccharide, Mechanism of Mutarotation and Introduction to disaccharides (maltose, sucrose and lactose) and

Polysaccharides (Starch and cellulose) without involving structure determination.

3. Synthetic Polymers. 07 Hrs.

Introduction, Classification based on nature of synthesis (without mechanism) with examples. (Addition and condensation polymers). Properties, uses and synthesis of polyvinyl chloride, polyvinyl acetate, polystyrene, polyacrylonitrile, Nylon 6, Nylon 66. Introduction to synthetic and natural rubber, properties, uses and synthesis of Buna N., Neoprene and silicon rubber.

4. Synthetic Dyes and Drugs 15 Hrs.

Definition, colour and constitution (electronic concept) of dye, classification based on chemical constitution, synthesis of methyl orange, Congo red, malachite green, crystal violet, Alizarin and indigo dyes. Synthetic Drugs, Defination, introduction, classification of drugs. Properties of ideal drug. Synthesis of chloromycetien, paracetamol, phenacetien, sulphaguainidine.

B. SC. THIRD YEAR

Semester VI **Paper XXIII**

Organic Chemistry

Lab Course: XI **Marks: 50**

Organic Estimation

i) Estimation of Carbonyl group by hydrazone formation method

ii) Estimation of vitamin C in commercial soft drink / Glucon D

iii) Estimation of ascorbic acid

iv) Estimation of Saponification value of oil

Organic Preparation and its purity by TLC

i) Preparation of Hydrazobenzene from azobenzene.

ii) Preparation of Phthalic anhydride from phthalic acid.

iii) Preparation of 2, 4 dinitrophenyl hydrazone of acetone.

iv) To prepare picrate of Naphthalene.

v) To prepare picrate of Anthracene**.**

B. SC. THIRD YEAR

Semester VI **Paper XXIV**

Physical Chemistry

Lab Course: XII **Marks: 50**

Instrumental

1. Determine the % composition of HCl and CH_3COOH in a given mixture by titrating against strong base conductometrically.
2. Determine the strength of oxalic acid conductometrically using sodium hydroxide solution.
3. To determine empirical formula of ferric -5-sulphosalicylate
4. Determine the amount of Fe2+ in the given solution potentiometrically
5. To determine the refractive indices of series of salt solutions and to find out concentration of the salt in given unknown solution.

Non-Instrumental

1. To determine the interfacial tension between two immiscible liquids.
2. To study the effect of addition of an electrolyte NaCl / KCl on the solubility of benzoic acid at room temperature.
3. To determine the standard free energy change ΔG^0 and equilibrium constant for the reaction.

   $Cu + 2\ Ag+ = Cu^{+2} + 2\ Ag$

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