RANI CHANNAMMA UNIVERSITY, BELAGAVI

PROGRAM /COURSE STRUCTURE AND SYLLABUS

As per the Choice Based Credit System (CBCS) designed in accordance with Learning Outcomes-Based Curriculum Framework (LOCF) of National Education Policy (NEP) 2020

for

Bachelor of Science/(Hons) Chemistry

Effective from Academic Year 2021-22 and onwards

RANI CHANNAMMA UNIVERSITY, BELAGAVI

BSc (Hons) Chemistry program-2022-23

(Revised)

BoS Committee-NEP-B.Sc (Hons) Chemistry 2022-23

S.No.	Name & Address	Designation
1	Prof. K. Kantharaju Chairman & Professor, Dept. of Chemistry RCUB	**Chairman**
2	Mr.A.K.Samant Govindram Seksaria Science College, Belagavi	**Member**
3	Dr. S.M.Gaonkar Basaveshwar Science College, Bagalkot.	**Member**
4	Mr.A.D.Kamath C.S.Bembalagi College, Ramdurg	**Co-opted Member**

BoS Committee-NEP-B.Sc (Hons) Chemistry 2021-22

S.No.	Name & Address	Designation
1	Prof. K. Kantharaju Chairman & Professor, Dept. of Chemistry RCUB	**Chairman**
2	Dr.A.S.Kulkarni B.K.College, Belagavi	**Member**
3	Mr. B.I.Vasulkar B.K.College, Belagavi	**Member**
4	Dr.A.S.Jagnure G.I.Bagewadi College, Nippani	**Co-opted Member**
5	Dr.S.M.Deshpande GSS College, Belagavi	**Co-opted Member**

PREAMBLE

The objective of any programme at Higher Education Institute is to prepare their students for the society at large. The Rani Channamma University envisions all its programmes in the best interest of their students and in this endeavour, it offers a new vision to all its Under-Graduate courses. It embedded Learning Outcome-based Curriculum Framework (LOCF) for all its Under Graduate programmes.

The LOCF approach is envisioned to provide a focused, outcome-based syllabus at the undergraduate level with an agenda to structure the teaching-learning experiences in a more student-centric manner. The LOCF approach has been adopted to strengthen students' experiences as they engage themselves in the programme of their choice. The Under-Graduate Programmes will prepare the students for both, academia and employability.

Each programme vividly elaborates its nature and promises the outcomes that are to be accomplished by studying the courses. The programmes also state the attributes that it offers to inculcate at the graduation level. The graduate attributes encompass values related to well-being, emotional stability, critical thinking, social justice and also skills for employability. In short, each programme prepares students for sustainability and life-long learning.

The new curriculum of BSc (Hons) Chemistry offer courses in the areas of inorganic, organic, physical, industrial, materials and analytical. All the courses are having defined objectives and Learning Outcomes, which will help prospective students in choosing the elective courses to broaden their skills in the field of chemistry and interdisciplinary areas. The courses will train students with sound theoretical and experimental knowledge that suits the need of academics and industry. The course also offers ample of skills to pursue research as career in the field of chemistry and allied areas. As usual, B.Sc (Hons) Chemistry programme offered will continue to produce best minds to meet the demands of society.

The Rani Channamma University hopes the LOCF approach of the programme BSc (Hons) Chemistry will help students in making an informed decision regarding the goals that they wish to pursue in further education and life, at large.

Syllabus & Regulations Governing the Choice-Based Credit System (CBCS) for the Four-Year (Eight Semesters) B.Sc (Hons) Chemistry Program

Introduction to B.Sc (Hons.) Chemistry

The Choice Based Credit System (CBCS) provides an opportunity to a student to choose courses from the syllabus comprising Core, Elective, Vocational and Skill based courses. It offers a flexibility of programme structure while ensuring that the student gets a strong foundation in the subject and gains in-depth knowledge. The learning outcome based curriculum framework (LOCF) will provide students with a clear purpose to focus their learning efforts and enable them to make a well judged choice regarding the course they wish to study. This will suit the present day needs of students in terms of securing their paths towards higher studies or employment.

Programme Structure

Discipline Specific Core (DSC) Courses: First, second, third and fourth semesters will have one DSC course in each semester. Every DSC course has 6 credits and a practical component (4 credits for theory and 2 credits for practical).

Fifth and sixth semesters will have two Discipline Specific Core (DSC) courses in each semester. Every DSC course has 5 credits and has practical component (3 credits for theory and 2 credits for practical).

Seventh and eighth semesters will have three Discipline Specific Core (DSC) courses in each semester, three DSC courses have 6 credits each (4 credits for theory and 2 credits for practical).

Open Elective (OE) Courses: First, second, third and fourth semesters will have one OE course in each semester. Every OE course has 3 credits and with no practical component. OE courses are for other subject students (other than major and minor), and the candidate has to choose one OE from the each semester.

Vocational Courses: Fifth and sixth semester will have one each vocational courses of each 3 credits. In sixth semester students have 2 credits internship course (usually on research related work (basic knowledge about research, how to start, literature, journals, reviews and more can be taught and ask students to do and submit a final report for assessment). These courses can enable students to obtain the required basic research insights knowledge along with online resource or practical skills.

Discipline Specific Elective (DSE) Courses: Seventh and eighth semesters will have two DSE courses. In seventh semester will have one research methodology (3 credits) and another spectroscopy to meet the equivalence of first year master degree (4 credits).

In eighth semester again one DSE 4 credits theory and another research project for 4 credits need to perform one semester project work by selecting suitable problems by the mentors.

PROGRAMME OUTCOME from B.Sc (Hons.) Chemistry

The B.Sc (Hons) programme in Chemistry is designed to develop in students in depth knowledge of thecore concepts and principles that are central to the understanding of this core science discipline. Undergraduates pursuing this programme of study go through laboratory work that specifically develop their quantitative and qualitative skills, provides opportunities for critical thinking and team work, and exposes them to techniques useful for applied areas of scientific study.

- **Knowledge: Width and depth:**

  Students acquire theoretical knowledge and understanding of the fundamental concepts, principles and processes in main branches of chemistry, namely, organic, inorganic, physical, spectroscopy, analytical and biochemistry. In depth understanding is the outcome of transactional effectiveness and treatment of specialized course contents. Width results from the choice of electives that students are offered.

- **Laboratory Skills: Quantitative, analytical and instrument based:**

  A much valued learning outcome of this programme is the laboratory skills that students develop during the course. Quantitative techniques gained through hands on methods opens choice of joining the industrial laboratory work force early on. The programme also provides ample training in handling basic chemical laboratory instruments and their use in analytical and biochemical determinations. Undergraduates on completion of this programme can cross branches to join analytical, pharmaceutical, material testing and biochemical labs besides standard chemical laboratories.

- **Communication:**

  Communication is a highly desirable attribute to possess. Opportunities to enhance students' ability to write methodical, logical and precise reports are inherent to the structure of the programme. Techniques that effectively communicate scientific chemical content to large audiences are acquired through oral and poster presentations and regular laboratory report writing.

- **Capacity Enhancement:**

  Modern day scientific environment requires students to possess ability to think independently as well as be able to work productively in groups. This requires some degree of balancing. The chemistry honours programme course is designed to take care of this important aspect of student development through effective teaching learning process.

- **Portable Skills:**

  Besides communication skills, the programme develops a range of portable or transferable skills in students that they can carry with them to their new work environment after completion of chemistry honours programme. These are problem solving, numeracy and mathematical skills- error analysis, units and conversions, information retrieval skills, IT skills and organizational skills. These are valued across work environments.

Structure of the Programme in B.Sc (Hons.) Chemistry

The programme includes Core Courses and Elective Courses. The Core Courses are all compulsory courses (DSC).There are three types of Elective Courses – Discipline Specific Elective (DSE), Open Elective (OE), and Skill Enhancement Courses (SEC), have sub skill based and value based. In addition there are two compulsory Ability Enhancement Courses (AECC). The Core, DSE and GE Courses are six credit courses; the SEC, AEC are four credit courses.

RANI CHANNAMMA UNIVERSITY

Vidyasangama, P-B, NH-4, Belagavi. -591156

Proposed Curricular and Credits Structure under Choice Based Credit System [CBCS] of Chemistry Major& One Minor Discipline Scheme for the Four Years Chemistry B.Sc. Undergraduate Honors Programmewith effect from 2021-22

SEMESTER-I										
Category	**Course code**	**Title of the Paper**	**Marks**			**Teaching hours/week**			**Credit**	**Duration of exams (Hrs)**
			IA	**SEE**	**Total**	**L**	**T**	**P**		
L1	21BSC1L1LK1	Kannada	40	60	100	4	-	-	3	2
	21BSC1L1LFK1	Functional Kannada								
L2	21BSC1L2LEN2	English	40	60	100	4	-	-	3	2
	21BSC1L2LHI2	Hindi								
	21BSC1L2LSN2	Sanskrit								
	21BSC1L2LTE2	Telugu								
	21BSC1L2LUR2	Urdu								
DSC1	21BSC1C1CHE1L	Chemistry-1	40	60	100	4	-	-	4	2
	21BSC1C1CHE1P	Chemistry Lab-1	25	25	50	-	-	4	2	4
DSC1	Another Department Code	Another Department Course Title	40	60	100	4	-	-	4	2
			25	25	50	-	-	4	2	4
SEC1	21BSC1S1CS1	Digital Fluency	25	25	50	1	-	2	2	2
VBC1	21BSC1V1PE1	Physical Education-Yoga	25	-	25	-	-	2	1	-
VBC2	21BSC1V2HW1	Health & Wellness	25	-	25	-	-	2	1	-
OEC1	21BSC1O1CHE1	Chemistry in daily life	40	60	100	3	-	-	3	2
OEC1A	21BSC1O1CHE1A [Only for B.Sc. in Sugar Sci & Tech]	Sugarcane Production Technology	40	60	100	3	-	-	3	2
		Total Marks			**700**	**Semester Credits**			**25**	
Note: *All skill enhancement course (SEC) syllabus and title should be selected time to time notice from the university and/ or NEP committee accordingly.*										

SEMESTER-II										
Category	**Course code**	**Title of the Paper**	**Marks**			**Teaching hours/week**			**Credit**	**Duration of exams (Hrs)**
			IA	**SEE**	**Total**	**L**	**T**	**P**		
L3	21BSC2L3LK2	Kannada	40	60	100	4	-	-	3	2
	21BSC2L3FKL2	Functional Kannada								
L4	21BSC2L4EN2	English	40	60	100	4	-	-	3	2
	21BSC2L4HI2	Hindi								
	21BSC2L4SN2	Sanskrit								
	21BSC2L4TE2	Telugu								
	21BSC2L4UR2	Urdu								
DSC2	21BSC2C2CHE2L	Chemistry-2	40	60	100	4	-	-	4	2
	21BSC2C2CHE2P	Chemistry Lab-2	25	25	50	-	-	4	2	4
DSC2	Another Department Code	Another Department Course Title	40	60	100	4	-	-	4	2
			25	25	50	-	-	4	2	4
AECC 1	21BSC2AE1ES	Environmental Studies	25	25	50	1	-	2	2	2
VBC3	21BSC2V3PE2	Physical Education- Sports	25	-	25	-	-	2	1	-
VBC4	21BSC2V4NC1	NCC/NSS/R&R(S &G) / Cultural	25	-	25	-	-	2	1	-
OEC2	21BSC2O2CHE2	Molecules of life	40	60	100	3	-	-	3	2
OEC2A	21BSC2O2CHE2A [Only for B.Sc. in Sugar Sci Technol]	Sugar Factory Chemical Control	40	60	100	3	-	-	3	2
Total Marks					**700**	**Semester Credits**			**25**	

Exit option with Certificate (50 credits)

SECOND YEAR; SEMESTER-III										
Category	**Course code**	**Title of the Paper**	**Marks**			**Teaching hours/week**			**Credit**	**Duration of exams (Hrs)**
			IA	**SEE**	**Total**	**L**	**T**	**P**		
L5	21BSC3L5LK3	Kannada	40	60	100	4	-	-	3	2
	21BSC3L5LFK3	Functional Kannada								
L6	21BSC3L6EN3	English	40	60	100	4	-	-	3	2
	21BSC3L6HI3	Hindi								
	21BSC3L6SN3	Sanskrit								
	21BSC3L6TE3	Telugu								
	21BSC3L6UR3	Urdu								
DSC3	21BSC3CHE3L	Chemistry-3	40	60	100	4	-	-	4	2
	21BSC3CHE3P	Chemistry Lab-3	25	25	50	-	-	4	2	4
DSC3	Another Department Code	Another Department Course Title	40	60	100	4	-	-	4	2
			25	25	50	-	-	4	2	4
SEC2	21BSC3S2AI/ 21BSC3S2CHE	Artificial Intelligence/	25	25	50	1	-	2	2	2
VBC5	21BSC3V5PE3	Physical Education- Sports	25	-	25	-	-	2	1	-
VBC6	21BSC3V6NC2	NCC/NSS/R&R (S&G) / Cultural	25	-	25	-	-	2	1	-
OEC3	21BSC3O3CHE3	Fuel chemistry & Environmental chemistry	40	60	100	3	-	-	3	2
OEC3A	21BSC3O3CHE3A [Only for B.Sc. in Sugar Sci & Tech]	Boiler Water Management	40	60	100	3	-	-	3	2
			Total Marks		**700**	**Semester Credits**			**25**	

SEMESTER-IV

Category	Course code	Title of the Paper	Marks			Teaching hours/week			Credit	Duration of exams (Hrs)
			IA	SEE	Total	L	T	P		
L7	21BSC4L7LK4	Kannada	40	60	100	4	-	-	3	2
	21BSC4L7LFK4	Functional Kannada								
L8	21BSC4L8EN4	English	40	60	100	4	-	-	3	2
	21BSC4L8HI4	Hindi								
	21BSC4L8SN4	Sanskrit								
	21BSC4L8TE4	Telugu								
	21BSC4L8UR4	Urdu								
DSC4	21BSC4C4CHE4L	Chemistry-4	40	60	100	4	-	-	4	2
	21BSC4C4CHE4P	Chemistry Lab-4	25	25	50	-	-	4	2	4
DSC4	Another Department Code	Another Department Course Title	40	60	100	4	-	-	4	2
			25	25	50	-	-	4	2	4
AECC 2	21BSC4AE2CI	Constitution of India	25	25	50	1	-	2	2	2
VBC7	21BSC4V5PE4	Physical Education-Sports	25	-	25	-	-	2	1	-
VBC8	21BSC4V6NC3	NCC/NSS/ R&R(S&G) / Cultural	25	-	25	-	-	2	1	-
OEC4	21BSC4O4CHE4	Electrochemistry, corrosion and metallurgy	40	60	100	3	-	-	3	2
OEC4A	21BSC4O4CHE4A [Only for B.Sc. in Sugar Sci Technol]	Analytical Instrumentation	40	60	100	3	-	-	3	2
		Total Marks			**700**	**Semester Credits**			**25**	

Exit option with Diploma (100 credits)

SEMESTER-V										
Category	**Course code**	**Title of the Paper**	**Marks**			**Teaching hours/week**			**Credit**	**Duration of exams (Hrs)**
			IA	**SEE**	**Total**	**L**	**T**	**P**		
Chemistry **as Major Discipline**										
DSC5	21BSC5C5CHE5L	Chemistry-5	40	60	100	3	-	-	3	2
	21BSC5C5CHE5P	Chemistry Lab-5	25	25	50	-	-	4	2	4
DSC6	21BSC5C5CHE6L	Chemistry-6	40	60	100	3	-	-	3	2
	21BSC5C5CHE6P	Chemistry Lab-6	25	25	50	-	-	4	2	4
DSC5	Another Department Code as a Minor Subject	Another Department Course Title	40	60	100	3	-	-	3	2
			25	25	50	-	-	4	2	4
VC1	21BSC5VC1	Vocational-I	40	60	100	3	-	-	3	2
VBC9	21BSC5V5PE5	Physical Education-Sports	25	-	25	-	-	2	1	-
VBC10	21BSC5V6NC4	NCC/NSS/R&R(S&G) / Cultural	25	-	25	-	-	2	1	-
SEC3	21BSC5S3CHE3		25	25	50	1	-	2	2	2
Total Marks					**650**	**Semester Credits**			**22**	

SEMESTER-VI										
Category	**Course code**	**Title of the Paper**	**Marks**			**Teaching hours/week**			**Credit**	**Duration of exams (Hrs)**
			IA	**SEE**	**Total**	**L**	**T**	**P**		
Chemistry **as Major Discipline**										
DSC7	21BSC6C6CHE7L	Chemistry-7	40	60	100	3	-	-	3	2
	21BSC6C6CHE7P	Chemistry Lab-7	25	25	50	-	-	4	2	4
DSC8	21BSC6C6CHE8L	Chemistry-8	40	60	100	3	-	-	3	2
	21BSC6C6CHE8P	Chemistry Lab-8	25	25	50	-	-	4	2	4
DSC6	Another Department Code as a Minor Subject	Another Department Course Title	40	60	100	3	-	-	3	2
			25	25	50	-	-	4	2	4
VC2	21BSC6VC2	Vocational-II	40	60	100	3	-	-	3	2
INT1	21BSC6 INT1L	Internship	25	50	75	-	-	2	2	2
VBC1	21BSC6V5PE5	Physical Education-Sports	25	-	25	-	-	2	1	-
VBC2	21BSC6V6NC4	NCC/NSS/R&R (S&G) / Cultural	25	-	25	-	-	2	1	-
SEC4	21BSC6S4CHE		25	25	50	1	-	2	2	2
Total Marks					**700**	**Semester Credits**			**24**	
Total Marks for BSC Program					**-**	**Total Credits for BSC Program**			**146**	

*Internship between 5th and 6th semester with 3-4 weeks

Chemistry Subject as a Minor Discipline

SEMESTER-V										
Category	**Course code**	**Title of the Paper**	**Marks**			**Teaching hours/week**			**Credit**	**Duration of exams (Hrs)**
			IA	**SEE**	**Total**	**L**	**T**	**P**		
DSC5 As a Minor Subject	21BSC5C5CHE5L	Chemistry-5	40	60	100	3	-	-	3	2
	21BSC5C5CHE5P	Chemistry lab-5	25	25	50	-	-	4	2	4

SEMESTER-VI										
Category	**Course code**	**Title of the Paper**	**Marks**			**Teaching hours/week**			**Credit**	**Duration of exams (Hrs)**
			IA	**SEE**	**Total**	**L**	**T**	**P**		
DSC7 As a Minor Subject	21BSC6C6CHE7L	Chemistry -7	40	60	100	3	-	-	3	2
	21BSC6C6CHE7P	Chemistry Lab-7	25	25	50	-	-	4	2	4

Exit option with Bachelor of Science, B. Sc. Basic Degree (146 credits)

SEMESTER-VII										
Category	**Course code**	**Title of the Paper**	**Marks**			**Teaching hours/week**			**Credit**	**Duration of exams (Hrs)**
			IA	**SEE**	**Total**	**L**	**T**	**P**		
Chemistry**(General) as Major Discipline**										
DSC9	21BSC7C9CHE9L	Chemistry-9	40	60	100	4	-	-	4	2
	21BSC7C9CHE9P	Chemistry Lab-9	25	25	50	-	-	4	2	4
DSC10	21BSC7C10CHE10L	Chemistry-10	40	60	100	4	-	-	4	2
	21BSC7C10CHE10P	Chemistry Lab-10	25	25	50	-	-	4	2	4
DSC11	21BSC7C11CHE11L	Chemistry-11	40	60	100	4	-	-	4	2
	21BSC7C11CHE11P	Chemistry Lab-11	25	-	25	-	-	4	2	4
DSE1	21BSC7E1CHE1L	Spectroscopy-1	40	60	100	4	-	-	4	4
DSE2	21BSC7E2CHE2L	Research Methodology	40	60	100	3	-	-	3	4
Total Marks					**650**	**Semester Credits**			**25**	

SEMESTER-VIII										
Category	**Course code**	**Title of the Paper**	**Marks**			**Teaching hours/week**			**Credit**	**Duration of exams (Hrs)**
			IA	**SEE**	**Total**	**L**	**T**	**P**		
Chemistry**(General) as Major Discipline**										
DSC12	21BSC8C12CHE12L	Chemistry-9	40	60	100	4	-	-	4	2
	21BSC8C12CHE12P	Chemistry Lab-9	25	25	50	-	-	4	2	2
DSC13	21BSC8C13CHE13L	Chemistry-10	40	60	100	4	-	-	4	2
	21BSC7C13CHE13P	Chemistry Lab-10	25	25	50	-	-	4	2	2
DSC14	21BSC7C14CHE14L	Chemistry-11	40	60	100	4	-	-	4	2
	21BSC7C14CHE14P	Chemistry Lab-11	25	25	50	-	-	4	2	2
DSE3	21BSC8E3CHE3L	Spectroscopy-II	40	60	100	4	-	-	4	2
DSE4	21BSC8E4CHE4L	Research Project	50	100	150	-	-	8	4	2
Total Marks					**700**	**Semester Credits**			**26**	

Award of Bachelor of Science (Hons) degree in a Chemistry (197 credits)

Concept Note, Abbreviation Explanation and Coding:

Concept Note:

1. **CBCS** is a mode of learning in higher education which facilitates a student to have some freedom in selecting his/her own choices, across various disciplines for completing a UG/PG program.
2. A credit is a unit of study of a fixed duration. For the purpose of computation of workload as per UGC norms the following is mechanism be adopted in the University:
   One credit (01) = One Theory Lecture (L) period of one (1) hour.
   One credit (01) = One Tutorial (T) period of one (1) hour.
   One credit (01) = One practical (P) period of two (2) hours.
3. Course: paper/subject associated with AECC, DSC, DSEC, SEC, VBC, OEC, VC, IC and MIL
4. In case of **B.Sc**. **Once a candidate chose two courses/subjects of a particular two department in the beginning, he/she shall continue the same till the end of the degree/Hons, then there is no provision to change the course(s) and Department(s) in between.**
5. A candidate shall choose **one of the Department's courses as major and other Department course as minor in fifth and sixth semester and major course will get continued in higher semester.**
6. Wherever there is a practical there will be no tutorial and vice-versa
7. A major subject is the subject that's the main focus of Core degree/concerned.
8. A minor is a secondary choice of subject that complements core major/ concerned.
9. Vocational course is a course that enables individual to acquire skills set that are required for a particular job.
10. Internship is a designated activity that carries some credits involving more than **25 days** of working in an organization (either in same organization or outside) under the guidance of an identified mentor. Internship shall be an integral part of the curriculum.
11. **OEC: For non- chemistry students. Chemistry students have to opt for OEC from departments other than major and minor disciplines.**

Abbreviation Explanations:

1. AECC: Ability Enhancement Compulsory Course.
2. DSC: Discipline Specific Core Course.
3. DSEC: Discipline Specific Elective Course.
4. SEC: Skill Enhancement Course.
5. VBC: Value Based Course.
6. OEC: Open/Generic Elective Course
7. VC: Vocational Course.
8. IC: Internship Course
9. L1: Language One
10. L2: MIL
11. L= Lecture; T= Tutorial; P=Practical.
12. MIL= Modern Indian Language; English or Hindi or Telugu or Sanskrit or Urdu

Program Coding:

1. Code 21: Year of Implementation
2. Code BSC: BSC Program under the faculty of Applied Science of the University
3. Code 1: First Semester of the Program, (2 to 6 represent higher semesters)
4. Code AE: AECC, (C for DSC, S for SEC, V for VBC and O for OEC)
5. Code 1: First "AECC" Course in semester, similarly in remaining semester for such other courses
6. Code LK: Language Kannada, similarly Language English, Language Hindi, Language Telugu, Language Sanskrit, &Language Urdu
7. Code 1: Course in that semester.
8. CHE: Chemistry

Note: *All skill enhancement course (SEC) syllabus and title should be selected time to time notice from the university and/ or NEP committee accordingly.*

ASSESSMENT METHODS
Evaluation Scheme for Internal Assessment:

Theory:

Assessment Criteria	40 marks
1st Internal Assessment Test for30 marks 1 hr after 8 weeks and 2nd Internal Assessment Test for 30 marks 1 hr after 15 weeks. Average of two tests should be considered.	30
Assignment	10
Total	**40**

Assessment Criteria	25 marks
1st Internal Assessment Test for 20 marks 1 hr after 8 weeks and 2nd Internal Assessment Test for 20 marks 1 hr after 15 weeks. Average of two tests should be considered.	20
Assignment	05
Total	**25**

Practical:

Assessment Criteria	25 marks
Semester End Internal Assessment Test for 20 marks 2 hrs	20
Journal (Practical Record)	05
Total	**25**

Question Paper Pattern:

RANI CHANNAMMA UNIVERSITY
Department of Chemistry

Duration: 2hr ***I Semester B.Sc*** ***(Chemistry)***

Sub: **Code:** **Maximum Marks: 60**

a. Answer any SIX Questions from Question 1

b. Answer any Three in each Question from 2,3,4 and 5questions.

Q.No.1.	**Answer any SIX Questions (Two question from each Unit)** **a.** **b.** **c.** **d,** **e.** **f.** **g.** **h.**	**2X6=12**
Q.No.2.	**(Should cover entire unit-I)** **a.** **b.** **c.** **d.**	**4X3=12**
Q.No.3.	**(Should cover Entire Unit-II)** **a.** **b.** **c.** **d.**	**4X3=12**
Q.No.4.	**(Should cover Entire Unit-III)** **a.** **b.** **c.** **d.**	**4X3=12**
Q.No.5.	**(Should cover Entire Unit-IV)** **a.** **b.** **c.** **d.**	**4X3=12**

BSc (Hons) Chemistry-Semester 1

Title of the Course: DSC-1: Subject code: 21BSC1C1CHE1L Paper: Chemistry – 1

Number of Theory Credits	Number of lecture hours/ semester	Number of practical credits	Number of practical hours / semester
4	56	2	56
Content of Theory Course 1			

Unit – 1 Analytical chemistry **14 hours**

Definitions of analysis, determination, measurement, techniques and methods. Classification of analytical techniques. Choice of an analytical method - accuracy, precision, sensitivity, selectivity, method validation. Figures of merit of analytical methods and limit of detection (LOD), Limit of quantification (LOQ)

Errors and treatment of analytical data: Limitations of analytical methods – Errors: Determinate and indeterminate errors, absolute error, relative error, minimization of errors. Statistical treatment of finite samples -mean, median, range, standard deviation and variance. Numerical problems

Titrimetric analysis: Basic principle of titrimetric analysis. Classification, Preparation and dilution of reagents/solutions. Preparation of ppm level solutions from source materials (salts), conversion factors.

Acid-base titrimetry: Theory, Titration curves for all type of acid- base titrations. Quantitative applications – selecting and standardizing a titrant,

Complexometric titrimetry: Indicators for EDTA titrations - theory of metal ion indicators, titration methods employing EDTA – direct and indirect determinations, Application determination of hardness of water.

Redox titrimetry: Titration curves, Theory of redox indicators, Applications of redox titrations.

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

Unit - 2 Atomic structure & Periodicity of elements **14 hours**

Atomic Structure: Review of Rutherford's atomic model, Bohr's theory, Hydrogen atomic spectra. Derivation of radius and energy of an electron in hydrogen atom, limitations of Bohr's theory, dual behavior of matter and radiation, de Broglie's equations, Heisenberg Uncertainty principle and their related problems. Quantum numbers and their significance. Orbital shapes of *s,p,d and f* atomic orbitals, nodal planes. Rules for filling electrons in various orbitals, Electronic configurations of the atoms (atomic number up to 54).Concept of exchange energy. Anomalous electronic configurations. **9hrs**

Periodic properties of elements: Brief account on the following properties of elements with reference to s and p-block and trends in groups and periods. Effective nuclear

charge, screening effect, Slater rules, atomic and ionic radii, ionization enthalpy, electron gain enthalpy, and electronegativity, Pauling / Allred-Rochow scales of electronegativity**.** **5hrs**

Unit 3 Bonding in Organic Molecules and Mechanism of Organic reactions 14 hours

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

Nature of bonding in Organic molecules Types of chemical bonding, Formation of Covalent bond, localized and delocalized, conjugation and cross conjugation, concept of resonance, electronic displacements: Inductive effect, Electromeric effect, Resonance and Hyper conjugation with examples. Concept of resonance and aromaticity, Huckel rule, anti-aromaticity explanation with examples. **6hrs**

Mechanisms of Organic Reactions-I

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

Chemistry of Aliphatic hydrocarbons: Carbon-Carbon Sigma bonds Chemistry of alkanes: Formation of alkanes, Wurtz reaction, Wurtz-Fittig reaction, Free radical substitutions Mechanism of Halogenation- relative reactivity and selectivity **8hrs**

Unit - 4 Gaseous State & Distribution Law 14hours

Gaseous state: Review of kinetic theory of gases, van der Waals equation of state Boyle temperature. Molecular velocity: Maxwell's Boltzmann distribution law of molecular velocities (most probable, average and root mean square velocities). Relation between RMS, average and most probable velocity and average kinetic energies (derivation not required). Collision frequency, collision diameter, Collision cross-section, collision number and mean free path. Critical phenomena: Andrews isotherms of CO_2, critical constants and their determination Relation between critical constants and van der Waals equation (Derivation), continuity of states, law of corresponding states. Numerical problems are to be solved wherever applicable. **8hrs**

Distribution Law: Nernst Distribution Law - Statement and its derivation. Distribution constant, factors affecting distribution constant, validity of Distribution Law, Modification of distribution law when molecules undergo a) Association b) Dissociation. Application of Distribution Law in Solvent extraction. Derivation for simple and multiple extraction. Principles of distribution law in Parkes Process of desilverisation of lead. Numerical Problems. **6hrs**

LEARNING OUTCOMES / COURSE OUTCOMES:

Chemistry as Discipline Specific Course (DSC)

B.Sc. Semester –I; CHEMISTRY-1

After successful completion of three year degree program in Chemistry a student should be able to;

1. Describe the dual nature of radiation and matter; dual behaviour of matter and radiation, de Broglie's equations, Heisenberg Uncertainty principle and their related problems.
2. Electronic configurations of the atoms.
3. Define periodicity, explain the cause of periodicity in properties, and classify the elements into four categories according to their electronic configuration.
4. Define atomic radii, ionisation energy, electron affinity and electronegativity, discuss the factors affecting atomic radii, describe the relationship of atomic radii with ionisation energy and electron affinity, describe the periodicity in atomic radii, ionization energy, electron affinity and electronegativity.
5. Explain bond properties, electron displacement effects (inductive effect, electrometric effect, resonance effect and Hyper conjugation effect). Steric effect and their applications in explaining acidic strength of carboxylic acids, basicity of amines.
6. Understand basic concept of organic reaction mechanism, types of organic reactions, structure, stability and reactivity of reactive intermediates.
7. Describe important characteristics of configurationally and conformational isomers. Practice and write conformational isomers of ethane, butane and cyclohexane.
8. Understand the various concepts of geometrical isomerism and optical isomerism. Describe CIP rules to assign E,Z notations and R& S notations. Explain D and L configuration and *threo* and *erythro* nomenclature.
9. Explain racemic mixture and racemisation, resolution of racemic mixture through mechanical separation, formation of diastereomers, and biochemical methods, biological significance of chirality.
10. Explain the existence of different states of matter in terms of balance between intermolecular forces and thermal energy of the particles. Explain the laws governing behavior of ideal gases and real gases. Understand cooling effect of gas on adiabatic expansion.
11. Describe the conditions required for liquefaction of gases. Realise that there is continuity in gaseous and liquid state.
12. Explain properties of liquids in terms of intermolecular attractions.
13. Understand principles of titrimetric analysis.
14. Understand principles of different type's titrations. Titration curves for all types of acids – base titrations.
15. Gain knowledge about balancing redox equations, titration curves, theory of redox indicators and applications.
16. Understand titration curves, indicators for precipitation titrations involving silver nitrate-Volhard's and Mohr's methods and their differences.
17. Indicators for EDTA titrations - theory of metal ion indicators. Determination of hardness of water.

CHEMISTRY LAB (Inorganic and Organic Analyses)

After studying this course and performing the experiments set in it student will be able to:

1. Understand and practice the calibration of glasswares (burette, pipette, volumetric flask).
2. Basic concepts involved in titrimetric analysis, primary standard substances, preparation of standard solutions.
3. Explain the principles of acid-base, redox and iodometric titrations.
4. Work out the stoichiometric relations based on the reactions involved in the titrimetric analysis.
5. Based on principles of titrimetric analysis student can perform
6. Describe the significance of organic quantitative analysis.
7. Determine the amount of phenol, aniline, amide, ester and formaldehyde in a given solution by performing blank titration and main titrations.
8. Determine aspirin in the tablet by hydrolysis method.

Chemistry Lab-1: List of experiments to be conducted
Course code: 21BSC1C1CHE1P; Paper: Chemistry Lab-1

PART-A

1. Determination of sodium carbonate and sodium bicarbonate in a mixture
2. Determination of alkali present in soaps/detergents
3. Determination of oxalic acid using potassium permanganate solution
4. Standardization of EDTA solution and determination of hardness of water
5. Determination of phenol/aniline by bromination method
6. Determination of acetamide/ethylbenzoate by hydrolysis method

PART-B

7. Preparation of acetanilide from aniline using Zn/acetic acid (Green method)
8. Synthesis of p-nitro acetanilide from acetanilide using nitrating mixture
9. Bromination of acetanilide (i) Conventional method and /or
   (ii) with ceric ammonium nitrate and potassium bromide (Green method).
10. Hydrolysis of methyl m-nitrobenzoate to m-nitrobenzoic acid (Conventional method)

Examination

In the practical examination, a batch of maximum 15 (Fifteen) students may be made. Anyone experiment from Part-A or B can be given by selection done by the students based on lots. **Viva questions must be asked on any of the experiments prescribed in the practical syllabus.**

Part A: Distribution of marks

1. Accuracy: 12 (6+6) Marks
2. Technique and presentation: 03Marks
3. Reactions and Calculations: 05 Marks
4. Viva: 05 Marks

Total 25 marks

Deduction of marks for accuracy: ±0.4 CC – 6 marks, ± 0.6 CC- 04 marks, ±0.8 CC- 02 marks, ±1.0 CC - 01 marks. Above ±1.0 CC - 00 marks

Part B: Distribution of Marks:

1. Reaction & Mechanism-04 marks,
2. Calculation of theoretical yield – 02 mark,
3. Observed yield -10 marks,
4. M.P- 004 marks,
5. Viva-Voce-5 marks,

Total=25 marks.

Deduction of marks for observed yield: Less than 10% - 10 marks, 11-15% - 8 marks, 16-20% - 6 marks, 21-25 % - 4 marks & above 25% - zero mark.

References

1. Vogel's Textbook of Quantitative Chemical Analysis, J. Mendham, R.C. Denney, J.D. Barnes and M.J.K. Thomas, 6th edition, Third Indian Reprint, Pearson Education Pvt. Ltd.(2007).
2. Fundamentals of Analytical Chemistry, D.A. Skoog, D.M. West, Holler and Crouch, 8th edition, Saunders College Publishing, New York (2005).
3. Analytical Chemistry, G.D. Christian, 6th edition, Wiley-India (2007).
4. Practical Volumetric Analysis, Peter A C McPherson, Royal Society of Chemistry, Cambridge, UK (2015).
5. Morrison, R. N. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education)
6. Finar, I. L. *Organic Chemistry (Volume I),* Dorling Kindersley (India) Pvt. Ltd. (Pearson Education)
7. McMurry, J. E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India Edition, 2013
8. Organic Reaction mechanism by V. K. Ahluwalia and K. Parashar (Narosa Publishers).
9. Organic Chemistry by S. M. Mukherji, S. P. Singh and R. K. Kapoor. (Narosa Publishers)
10. A Guide book to mechanism in Organic Chemistry by Peter Sykes. Pearson.

BSc Semester 1 – B.Sc/(Hons) Chemistry

Title of the Course: Open Elective (OE-1): CHEMISTRY IN DAILY LIFE

Course code: 21BSC1O1CHE1

Courses	Credits	No. of Classes/ Week	Total No. of Lectures/ Hours	Duration of Exam in hrs	Internal Assessment Marks	Semester End Exam Marks	Total Marks
Theory	03	03	42	2	40	60	100
Content of Theory Course 1							**42 Hrs**

Unit – 1 **14 hours**

Dairy Products: Composition of milk and milk products. Analysis of fat content, minerals in milk and butter. Estimation of added water in milk. Beverages: Analysis of caffeine in coffee and tea, detection of chicory in coffee, chloral hydrate in toddy, determination of methyl alcohol in alcoholic beverages.

Food additives, adulterants, and contaminants- Food preservatives like benzoates, propionates, sorbates, disulphites. Artificial sweeteners: Aspartame, saccharin, dulcin, sucralose, and sodium cyclamate. Flavors: Vanillin, alkyl esters (fruit flavors), and monosodium glutamate.

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

Unit – 2 **14 hours**

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

Oils and fats: Composition of edible oils, detection of purity, rancidity of fats and oil. Tests for adulterants like argemone oil and mineral oils. Halphen test.

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

Unit – 3 **14 hours**

Chemical and Renewable Energy Sources:

Principles and applications of primary & secondary batteries and fuel cells. Basics of solar energy, future energy storer.

Polymers: Basic concept of polymers, classification and characteristics of polymers. Applications of polymers as plastics in electronic, automobile components, medical fields, and aerospace materials. Problems of plastic waste management. Strategies for the development of environment-friendly polymers

COURSE OUTCOMES: OEC-1 Chemistry

On completion of the course students will be able to:

- Understand the chemical constituents in various day today materials using by a common man.
- Understand the chemical constituents in fertilizers, insecticides and pesticides, chemical explosives etc.
- Understand the chemical constituents in polymers, surface coatings etc.

References Text Books

1. B. K. Sharma: Introduction to Industrial Chemistry, Goel Publishing, Meerut (1998)
2. Medicinal Chemistry- Ashtoush Kar.
3. Analysis of Foods – H.E. Cox: 13.
4. Chemical Analysis of Foods – H.E. Cox and Pearson.
5. Foods: Facts and Principles. N. Shakuntala Many and S. Swamy, 4thed. New Age International (1998)
6. Physical Chemistry – P l Atkins and J. de Paula – 7thEd. 2002, Oxford University Press.

BSc Semester 1 – B.Sc (Hons) Chemistry

Title of the Course: Open Elective (OE-1): SUGARCANE PRODUCTION TECHNOLOGY

[Only for B.Sc. Sugar Science and Technology students]

Course code: 21BSC1O1CHE1À

Courses	Credits	No. of Classes/ Week	Total No. of Lectures/ Hours	Duration of Exam in hrs	Internal Assessment Marks	Semester End Exam Marks	Total Marks
Theory	03	03	42	2	40	60	100

Unit – I **10**

Hours

Introduction

Origin, History and distribution of sugarcane growing regions of India. The taxonomic classification of sugarcane. Morphology – stem of sugarcane. Economic root system and inflorescence in sugarcane and growth phases in sugarcane. Economic important cane v/s beet sugar. Major varieties of sugarcane cultivated in Karnataka and their features.

Ecology

Temperature, Rainfall, Relative humidity (RH), Atmospheric CO_2 concentration, Sunlight, Frost, Wind, Microclimate, Effect of greenhouse gases (GHGs) on cultivation of sugarcane.

Unit – II **11 Hours**

Basic concepts of sugarcane physiology

Photosynthesis, factors of influencing photosynthesis, effect of temperature, photoperiod, Transpiration, Growth promoters, Growth inhibitors.

Soil

Elements of Soils and their Characters; Definition of soil. Importance and functions of soils. Soil profile, soil particles, structure, texture, density, porosity, physical properties, soil pH, Electrical Conductivity and Ion exchange process.

Soil organic matter, importance, characters and carbon and nitrogen ratio and its importance. Acid soils, saline and alkaline soils, their characters, formation, problems and their management practices. Meaning of soil fertility, soil fertility deciding factors, plant nutrients and their classification. Essential nutrients, Forms of nutrients required by plant, movement of nutrients towards roots, availability of nutrients. Organics, meaning and classification / types. Nitrogen, Phosphorus and potassium fertilizers and their characters and reactions in the soil. Complex, Mixed and liquid fertilizers and micronutrient fertilizers. Soil analysis, Recommendations of fertilizers based on soil test results.

Unit – III **11 Hours**

Production practices

Land preparation: Preparatory tillage, green manuring and application of bulky manures, seed material and seed rate, geometry of planting and planting depth, planting period, agronomy of late planted crop, planting methods, mechanical planters, aftercare. Sugarcane based cropping and farming systems, companion cropping in sugarcane, sugarcane based farming systems.

Nutrition and fertilizer management

Time and method of N application, bio-fertilizers, Time and method of applying Bio-fertilizers, Ex situ composing of trash and press mud (modified Japanese method), Vermi-composting, major nutrients and micro nutrients.

Weed management

Integrated weed control, herbicide, antidotes or softeners, surfactants and adjuvant, control of noxious, perennial weeds and methods of weed control measures.

Water management

Irrigation water requirement, Evapo-transpiration (ET) Water use efficiency (WUE), Different methods of Irrigation, Furrow method of irrigation Sprinkler irrigation, and Drip or trickle Irrigation.

Management of seed cane

Sett treatment, agronomy of seed cane, thermotherapy or heat therapy and Three-tier seed programme. Tissue culture and its importance in seed programme.

Unit – IV **10 Hours**

Ripening, cane maturity and harvesting

Ripening methods, Methods of cane purchase, Harvest strategy, Pre-harvest maturity survey, Methods of harvest, Mechanized harvesting. Quality assessment of late harvested cane, Composition of sugarcane and juice and quality parameters of juice, Post harvest losses and measures to reduces the losses. Cost of cultivation of sugarcane.

Management of ratoon cane

Importance of Ratoon management Ratoon cane Management practices, Time and method of fertilizer application, yield attributes of ratoon cane, ratoon v/s plant cane. Water requirement, gap filling, trash management, management of weeds, pests, and diseases associated with ratoon effect of growth regulators on sprouting and ratoon yield.

Pests and disease management

Pests: Shoot borer, top borer, internode borer, stalk borer, gurudaspur borer, root borer, White Grubs, Termites, Scale insect: (Green), Pyrillapurpusilla, Walker), White files, Non-insect pests, Biological control of sugarcane pests, parasites.

Diseases: Red rot, Smut, Wilt, Pineapple disease, Yellow Leaf Disease (YLD), Leaf spots, Ratoon stunning disease (RSD), Grassy Shoot Disease (GSD), Nematodes and Mosaic.

Reference Books:

1. Hartmann and Kester's – Plant propagation – Principles and practices – Hudscan T. Hartmann, Dale E. Kester, Fred T. Davies, Jr. Robert L. Geneve.
2. Textbook of Plant Physiology – C. P. Malik
3. Diseases of Crop plants in India – G. Rangaswami and A. Mahadevan
4. Plant Pathology – R. S. Mehrotra
5. Practical cytology – Applied Genetics and Biostatistics – H. K. Goswami and Rajeev Goswami
6. Recent Advances in Plant Diseases Vol-1 to 5-K.M. Chandniwala
7. Introduction to Principles of Plant Pathology – R.S. Singh
8. An Introduction to Plant Anatomy – Authur R. Eames and Laurence H. Mac Deniels.
9. Genetics and Plant Breeding – E. B. Babcock
10. Plant Taxonomy – O.P. Sharma
11. Plant Breeding – Theory and Techniques – S.K. Gupta
12. Breeding Asian Field Crops – John Milton Poehlman and DhirendranathBorthakur.
13. Crop Production and Field Experimentation – Dr. V. G. Vaidya, K. R. Sahasrabudhe, Dr. V. S. Khuspe.
14. Agricultural Problems of India – A. N. Agrwal and Kundam Lal
15. Elementary Principles of Plant Breeding – H.K. Chaudhari
16. Trends in Agricultural Insect Pest Management – G.S. Dhaliwal and Ramesh Arora.

SKILL ENHANCEMENT COURSE IN CHEMISTRY

Title of the Course: SEC: Course code: 21BSC1E1CS1
Paper name: Digital Fluency

Courses	Credits	No. of Classes/Week	Total No. of Lectures/Hours	Duration of Exam in hrs	Internal Assessment Marks	Semester End Exam Marks	Total Marks
Theory	02	01	11	---	---	10	10
Practical		02	22	2	25	15	40
				Total	25	25	50

BSc Semester 2 – Chemistry (Hons)

Title of the Course: DSC-2: Subject code: 21BSC1C1CHE2LPaper: Chemistry – 2

Number of Theory Credits	Number of lecture hrs/ semester	Number of practical Credits	Number of practical hrs/ sem
4	56	**2**	**56**
Content of Theory Course 2			**56Hrs**

Unit – 1 Chemical bonding, molecular structure 14hours

Ionic Bonding*:* General characteristics of ionic compounds. Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Born-Landé equation and calculation of lattice energy. Born-Haber cycle and its applications.

Polarizing power and polarizability: Fajan's rules, ionic character in covalent compounds and percentage of ionic character.

Covalent bonding: General characteristics of covalent compounds. VB approach, shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements. Concept of resonance and resonating structures of NO_3^-, CO_3^{2-} and SO_4^{2-}.

Molecular Orbital Theory: LCAO method, bonding and antibonding MOs and their characteristics for *s-s*, *s-p* and *p-p* combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules: H_2,O_2,N_2 and ions of $1^{st}$and 2^{nd}periods: He_2^{+1}, $O_2^{+1}$and heteronuclear diatomic molecules such as CO,NO and NO^+. Comparison of VB and MO approaches. Numerical problems are to be solved wherever applicable.

Unit - 2 Acidic Strengths of Organic compounds and Stereochemistry 14 hours

Strengths of Organic acid and bases: Comparative study with emphasis on factors effecting pKa values. Relative strength of aliphatic and aromatic carboxylic acids-Acetic acid and chloroacetic acid, acetic acid and propionic acid, acetic acid and Benzoic acid. Steric effect-Relative stability of trans and cis-2-butene.

Concept of Confirmational analysis with reference to Ethane & n-Butane with staggered & eclipsed confirmations & energy profile diagrams. **4hrs**

Stereoisomersim: Definition of stereoisomerism, conformational isomers and configurational isomers (distinction between conformation and configuration). Newman, Sawhorse and Fischer projection formulae and their interconversions.

Geometrical isomerism: Definition, reason for geometrical isomerism, E and Z notation - CIP rules and examples, determination of configuration of geometric isomers by dipole moment method and anhydride formation method, *syn* and *anti* isomers in compounds containing C=N.

Optical isomerism: Chirality/asymmetry, enantiomerism, diastereomerism and meso compounds. R and S notations (compounds with two asymmetric centers), D and L configurations and *threo* and *erythro* nomenclature, racemic mixture and racemization,

Resolution: Definition, Resolution of racemic mixture by: i) Mechanical separation ii) Formation of diastereomers iii) Biochemical methods. Biological significance of chirality. **10hrs**

Unit - 3 Solids &Liquid crystals **14 hours**

Liquid Crystals: Explanation, classification with examples- Smectic, nematic, cholesteric, disc shaped and polymeric. Structures of nematic and cholesteric phases-molecular arrangements in nematic and cholesteric liquid crystals. Applications of liquid crystals in LCDs and thermal sensing. **6hrs**

Solids: Types of solids. Unit cell and space lattice, anisotropy of crystals, size and shape of crystals, Laws of Crystallography: Law of constancy of interfacial angles, Law of rational indices, Law of symmetry, Symmetry elements, X–Ray diffraction by crystals: Bragg's law and derivation of Bragg's equation, Structure of NaCl. KCl and CsCl, Defects in crystals, glasses and liquid crystals. Numerical problems. **8hrs**

Unit - 4 Chemical Kinetics I, Liquid state & Gravimetric Analysis **14hours**

Chemical Kinetics I: Review of reaction rates, order and molecularity. Factors affecting rates of reaction: concentration pressure, temperature, catalyst, etc. Examples for different orders of reactions. Derivation of integrated rate equations for zero and second order reactions (both for equal and unequal concentrations of reactants). Half–life of a reaction (numerical problems). Methods for determination of order of a reaction by half-life period and differential equation method. **3hrs**

Liquid state: Molecular forces and general properties of liquids**.**

Surface tension: surface tension, surface energy, effect of temperature on surface tension, shapes of liquid drops and soap bubbles, capillary action, determination of surface tension by capillary rise method, drop weight and drop number methods using stalagmometer. Effect of temperature on surface tension. Parachor, Additive and constitutive properties: atomic and structural parachor. Elucidation of structure of benzene and benzoquinone. .

Viscosity: Definition, viscosity coefficient, fluidity, molecular viscosity, relative viscosity and absolute viscosity, determination of coefficient of viscosity using Ostwald viscometer. Effect of temperature, size, weight, shape of molecules and intermolecular forces.

Refractive index: Definition, Specific and molar refraction. Determination of refractive index using Abbe's refractometer. Additive and constitutive properties: Numerical problems are to be solved wherever applicable. **7hrs**

Gravimetric Analysis: Stages in gravimetric analysis, requisites of precipitation, factors influencing precipitation, co-precipitation and post-precipitation. Structure, specificity, conditions and applications of organic reagents such as salicylaldoxime, oxine, dimethylglyoxime, cupron in inorganic analysis. **4hrs**

Reference Books

1. **Inorganic Chemistry**

1. Lee, J.D. *Concise Inorganic Chemistry* ELBS, 1991.
2. Cotton, F.A., Wilkinson, G.& Gaus, P.L. *Basic InorganicChemistry*,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: Principles of Structure and Reactivity*, Pearson Education India,2006.
5. Shriver, D.F. & Atkins, P.W. *Inorganic Chemistry*, Oxford University Press.
6. Wulfsberg, G. *Inorganic Chemistry*, Viva Books Pvt. Ltd.
7. Rodgers, G.E. *Inorganic &Solid State Chemistry*, Cengage Learning India Ltd., 2008.
8. Mark Weller and Fraser Armstrong, 5th Edition, Oxford University Press (2011-2012) Adam, D.M. *Inorganic Solids: An introduction to concepts in solid-state structural chemistry*. John Wiley & Sons, 1974.
9. G.L. Miessler & Donald A. Tarr: *Inorganic Chemistry*, Pearson Publication.
10. Mahan, B.H. *University Chemistry* 3rd Ed. Narosa (1998).
11. Petrucci, R.H. *General Chemistry* 5thEd. Macmillan Publishing Co.: New York (1985).

Organic Chemistry

1. Organic Chemistry-P. Y. Bruice, 7th Edition, Pearson Education Pvt. Ltd., New Delhi (2013).
2. Heterocyclic Chemistry- R. K. Bansal, 3rd Edition, New- Age International, New Delhi,2004
3. McMurry, J.E. *Fundamentals of Organic Chemistry*,7thEd. Cengage Learning India Edition, 2013.
4. Sykes, P.*A Guidebook to Mechanism in Organic Chemistry*, Orient Longman, New Delhi(1988).
5. Stereochemistry-Conformation and Mechanism-P. S. Kalsi, Wiley-Eastern Ltd, New Delhi.
6. Morrison, R.T.&Boyd,R.N.*OrganicChemistry*,Pearson,2010.
7. Bahl,A.&Bahl,B.S.*AdvancedOrganicChemistry*,S.Chand,2010.
8. Graham Solomons, T.W., Fryhle, C.B. &Snyder, S.A. *Organic Chemistry*, John Wiley & Sons(2014).
9. Organic Chemistry Volume-I, II- I. L. Finar, 6th Edition, ELBS London (2004).
10. Organic Chemistry-F.A. Carey, 4th Edition, McGraw Hill (2000).
11. Modern Organic Chemistry - R.O.C. Norman and D.J. Waddington, ELBS, 1983
12. Understanding Organic reaction mechanisms - A. Jacobs, Cambridge Univ. Press, 1998
13. Organic Chemistry - L.Ferguson, Von Nostrand, 1985
14. Organic Chemistry - M. K. Jain, Nagin & Co., 1987
15. Organic Chemistry- Mehta and Mehta.

Physical Chemistry

1. Barrow, G.M. *Physical Chemistry* Tata Mc Graw-Hill(2007).
2. Castellan, G.W. *Physical Chemistry* 4th Ed.Narosa(2004).
3. Kotz, J.C., Treichel, P.M. & Townsend, J.R. *General Chemistry* Cengage Learning India Pvt.Ltd.,New Delhi(2009).
4. P.W. Atkins: PhysicalChemistry.
5. W.J. Moore: PhysicalChemistry
6. Text Book of Physical Chemistry - P.L. Soni, S. Chand & Co.,1993
7. Text Book of physical chemistry - S. Glasstone, Mackmillan India Ltd., 1982

8. Principles of Physical Chemistry - B. R. Puri, L.R. Sharma and M.S.Patania, S.L.N. Chand & Co. 1987
9. Physical Chemistry - Alberty R. A. and Silbey, R.J.John Wiley and sons, 1992
10. Physical Chemistry - G.M.Barrow, McGraw Hill, 1986
11. Physical Chemistry(3rd Edition) - Gilbert W. Castilian, Narosa Publishing House,1985
12. Chemical Kinetics by K. J. Laidler, Tata McGraw Hill Publishing Co., New Delhi.
13. Kinetics and Reaction Mechanisms by Frost and Pearson, Wiley, New York.

Analytical Chemistry

1. Jeffery, G.H., Bassett, J., Mendham, J. & Denney, R.C. *Vogel's Textbook of Quantitative Chemical Analysis*, JohnWiley&Sons,1989.
2. Willard, H.H., Merritt, L.L., Dean, J. & Settle, F.A. *Instrumental Methods of Analysis*,7thEd. Wadsworth Publishing Company Ltd.,Belmont, California, USA, 1988.
3. Christian, G.D; *Analytical Chemistry*, VI Ed. John Wiley & Sons, NewYork, 2004.
4. Harris, D.C. *Exploring Chemical Analysis*, Ed.New York, W.H. Freeman,2001.
5. Skoog, D.A. Holler F.J. & Nieman, T.A. *Principles of Instrumental Analysis*, Cengage Learning India Ed.

Content of Chemistry Lab-2: List of Experiments to be conducted
Title of the Course: DSC-2: Subject code: 21BSC1C1CHE2P; Paper: Chemistry Lab-2

PART-A Inorganic Chemistry

A.1. TITRIMETRY

1. Determination of carbonate and hydroxide present in a mixture.
2. Standardization of potassium permanganate solution and determination of nitrite in a water sample
3. Determination of chlorine in bleaching powder using iodometric method.

A.2. GRAVIMETRY

1. Determination of Ba^{2+} as BaSO4
2. Determination of Cu^{2+} as CuSCN

PART-B Physical Chemistry

1. Determination of density using specific gravity bottle and viscosity of liquids using Ostwald's viscometer (Ethyl acetate, Toluene, Chloroform, Chlorobenzene or any other non-hazardous liquids).
2. Study of the variation of viscosity of sucrose solution with the concentration of a solute.
3. Determination of the density using specific gravity bottle and surface tension of liquids using Stalagmometer (Ethyl acetate, Toluene, Chlorobenzene, any other non-hazardous liquids.
4. Study of variation of surface tension of detergent solution with concentration.
5. Determination of specific and molar refraction by Abbes Refractometer. (Ethyl acetate, Methyl acetate, Ethylene Chloride).
6. Determination of the composition of liquid mixture by refractometry. (Toluene & Alcohol, Water & Sucrose).

** Standard solution is to be prepared by students for both in regular and in practical examination.

Examination

In the practical examination, a batch of maximum 15 (Fifteen) students may be made. Anyone experiment from Part-A or B can be given by selection done by the students based on lots. **Viva questions must be asked on any of the experiments prescribed in the practical syllabus.**

Part A1: Distribution of marks

1. Accuracy: 12 (6+6) Marks
2. Technique and presentation: 03Marks
3. Reactions and Calculations: 05 Marks
4. Viva: 05 Marks

Total 25 marks

Deduction of marks for accuracy: ±0.4 CC – 6 marks, ± 0.6 CC- 04 marks, ±0.8 CC- 02 marks, ±1.0 CC - 01 marks. Above ±1.0 CC - 00 marks

Part A2: Distribution of marks

1. Accuracy: 12 Marks
2. Technique and presentation: 03Marks
3. Reactions and Calculations: 05 Marks
4. Viva: 05 Marks

Total 25 marks

Deduction of marks for accuracy : ±6mg – 12 marks, ± 7 mg- 10 marks, ±8mg - 08 marks, ±10 mg - 06 marks. Above 10mg - 00 marks

Part B: Distribution of marks

1. Accuracy: 12 Marks
2. Technique and presentation: 03marks
3. Graphs and Calculations: 05 Marks
4. Viva: 05 Marks

Total 25 marks

Deduction of marks for accuracy: Error up to 5% - 12 marks, 6 - 10% 09 marks, 11-15% 6 marks, 16 % or above 3 marks.

Open Elective Course-Chemistry

Title of the Course: OEC-2: Subject code: 21BSC1O2CHE2; Paper: Molecules of Life
B.Sc. Semester –II

Course	Credits	No. of Classes/ Week	Total No. of Lecture Hours	Duration of Exam in hrs	Internal Assessment Marks	Semester End Exam Marks	Total Marks
Theory	03	03	42	2	40	60	100

UNIT I

Carbohydrates

Sugars, non-sugars, reducing and non-reducing sugars. Occurrence and general properties of glucose and fructose. Open chain and Haworth ring structures of glucose and fructose. Epimers, mutarotation and anomers.

Disaccaharides: Occurance of disaacharides (Sucrose, Maltose and Lactose). Glycosidic linkage in disaccharides. Ring structures of sucrose, maltose and lactose. Polysaccharides: Starch – monomer units, glycosidic linkage, components-difference in their structure (explanation only) and solubility in water. Cellulose and glycogen– monosaccharide, glycosidic linkage, structure (explanation only). Biological importance of carbohydrates **8hrs**

Amino Acids, Peptides and Proteins

α- amino acids , general formula, zwitter ion form of α- amino acid, general formula.Isoelectric point and its importance.Classification of amino acids as essential and non-essential-examples. Configuration of optically active α-amino acids (found in proteins). Peptide bond. Proteins: classification based on molecular shape–fibrous and globular, examples. Structure of protein – qualitative idea about primary, secondary, tertiary, and quaternary structures (diagrams not required).Denaturation of protein. **8hrs**

UNIT II

Enzymes and correlation with drug action

Mechanism of enzyme action, factors affecting enzyme action, Co-enzymes and cofactors and their role in biological reactions, Specificity of enzyme action (including stereo specificity),Enzyme inhibitors and their importance, phenomenon of inhibition (Competitive and Non-competitive inhibition including allosteric inhibition). **7hrs**

Drug action- Receptor theory. Structure–activity relationships of drug molecules, binding role of –OH group, -NH_2 group, double bond and aromatic ring. **4hrs**

Oils and fats

Biological Importance of oils and fats. Fatty acids (saturated, unsaturated fatty acids, formation of triglycerides and general formula of triglycerides. Chemical nature of oils and fats-saponification, acid hydrolysis, rancidity and its prevention methods, refining of oils, hydrogenation of oils, drying of oils. Iodine value.

Introduction to lipids, classification. Biological importance of triglycerides, phospholipids, glycolipids, and steroids (cholesterol). **6hrs**

UNIT III

Nucleic Acids

Components of nucleic acids: Adenine, guanine, thymine and cytosine (Structure only), other components of nucleic acids, Nucleosides and nucleotides (nomenclature), Structure of polynucleotides; Structure of DNA (Watson-Crick model) and RNA (types of RNA), Genetic Code, Biological roles of DNA and RNA: Replication, Transcription and Translation. **6hrs**

Vitamins and Hormones

Classification and biological significance, source and structure of Vitamin A, B1 (thiamine), B2 (riboflavin), B6 (pyridoxine), α-tocopherol, K1 (phylloquinone), C (ascorbic acid). Deficiency diseases of vitamins,

Hormones: definition, classification with examples, functions and deficiency diseases of hormones. **5hrs**

Course Outcome / Learning Outcome:

After studying this paper the student would be able to

1. Acquire knowledge about different types of sugars and their chemical structures.
2. Identify different types of amino acids and determine the structure of peptides.
3. Explain the actions of enzymes in our body and interpret enzyme inhibition.
4. Predict action of drugs. Depict the biological importance of oils and fats. Importance of lipids in the metabolism Differentiate RNA and DNA and their replication. Explain production of energy in our body.

Reference Books:

1. Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Finar, I. L. *Organic Chemistry* (*Volume 1*), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
3. Finar, I. L. *Organic Chemistry* (*Volume 2)*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
4. Nelson, D. L. & Cox, M. M. *Lehninger's Principles of Biochemistry 7th Ed.,*
5. W. H. Freeman. Berg, J.M., Tymoczko, J.L. &Stryer, L. *Biochemistry*, 2002.

Open Elective Course-Chemistry-2A

Title of the Course: OEC-2A: Subject code: 21BSC1O2CHE2A;

[Only for B.Sc. Sugar Science and Technology students]

Paper: SUGAR FACTORY CHEMICAL CONTROL

B.Sc. Semester –II

Courses	Credits	No. of Classes/ Week	Total No. of Lectures/Hours	Duration of Exam in hrs	Internal Assessment Marks	Semester End Exam Marks	Total Marks
Theory	03	03	42	2	40	60	100

Unit – I **11 Hours**

General: Weighment system & estimation of % cane figures – MJ/imbibition/ bagasse, Calculation for estimation of Pol in bagasse, Pol in MJ, Pol % cane

Unit – II **11 Hours**

Milling control: Fundamental equations for milling control**,** Mill extraction, fiber % cane, fiber % bagasse, Estimation of RME, Deer & RME (Mittal), Imbibition % cane, Imbibition % fibre, dilution indicator

Unit – III **10 Hours**

Sugar balance and its losses – Estimation of sugar losses –bagasse/filter cake/ molasses/ recovery/ unknown, Estimation of Pol balance, RS balance and total losses.
Available sugar / available molasses, General stock taking, Reduced boiling house control,

Unit – IV **10 Hours**

Boiling house recovery, Reduced BHR, Purity drop, % exhaustion, Massecuite % cane, Steam % cane

Overall: Preparation of daily manufacturing report (DMR),RT(8)C,RT(7)C.

Reference Books:

1. Training manual for sugar mills; Mangal Singh; Somaiya publications Pvt.Ltd. Mumbai.
2. Efficient Management of sugar factories, Mangal Singh, Somaiya publication Pvt., Ltd. Bombay
3. Cane Sugar Manufacture in India, Kulkarni, D.P., The Sugar Technologists Association of India N.Delhi.
4. System of Technical control for cane sugar factories in India; Varma, N.C. The Sugar Technologists Association of India New Delhi.

DSC-3: Semester-III: Chemistry-3

Number of Theory Credits	Number of lecture hrs/semester	Number of practical Credits	Number of practical hrs/ sem
4	56	**2**	**56**
Content of Theory Course 3			**56Hrs**

Workload:4Hours/Week.

Course objectives:

1. Interrelationship among frequency, wavelength and wave number and importance of validation parameters of an instrumental method will be taught
2. Principle,instrumentationandapplicationsofspectrophotometry,nephelometry and turbidometry will be taught
3. Fundamentals of separation methods and principles of paper, thin layer and column chromatography will be taught
4. Principle, types and applications of solvent extraction will be taught
5. Principle and mechanism of ion-exchange, types of resins and domestic and industrial applications of ion-exchange chromatography will be taught
6. The concept of mechanism and its importance will be taught to the student
7. Concept and importance of intermediates inorganic chemistry will be taught taking proper examples
8. The various techniques for identification of reaction mechanism will be taught to the student taking proper examples
9. Concept of stereochemistry and its importance will be taught.
10. The various projection formulae and the techniques of designating the molecules into R, S, D, L will be taught taking proper examples
11. The theory and concept of Cis-,Trans-isomerism and its importance and the techniques to differentiate between them will be taught taking examples

Course Specific Outcomes

After the completion of this course, the student would be able to

1. Understand the importance of fundamental law and validation parameters in chemical analysis
2. Know how different analytes in different matrices (water and real samples) can be determined by spectrophotometric nephelometric and turbidometric methods.
3. Understand the requirement for chemical analysis by paper, thin layer and column chromatography.
4. Apply solvent extraction method for quantitative determination of metal ions in different samples
5. Utilize the ion-exchange chromatography for domestic and industrial applications
6. Explain mechanism for a given reaction.
7. Predict the probable mechanism for a reaction. explain the importance of reaction intermediates, its role and techniques of generating such intermediates
8. Explain the importance of Stereochemistry in predicting the structure and property of organic molecules.
9. Predict the configuration of an organic molecule and able to designate it.
10. Identify the chiral molecules and predict its actual configuration.

Syllabus

Unit-I Quantitative analysis-Instrumental methods 14hrs

Electromagneticspectrum,absorptionofelectromagneticradiationBeer'slaw,Beer-Lambert law derivation, deviations from Beer's law, limitations, construction of calibration graph (Plot of absorbance versus concentration), Evaluation Procedures-standard addition, Internal standard addition, validation parameters-detection limits, sensitivity, dynamic/linearity range, Instrumentation: single beam and double beam spectrophotometers, quantitative applications of colorimetry (determination of Fe, Mo, Cu, Ti and PO_4^{3-}) and numerical problems on application of Beer's law. **10hrs**

Nephelometry and Turbidometry: Introduction, principle, instrumentations of nephelometry and turbidometry; effects of concentration, particle size and wavelength on scattering; choice between nephelometry and turbidometry, applications of nephelometry and turbidimetry (determination of $S0_4^{2-}$and PO_4^{3-}) **4hrs**

Unit-II Structure and Bonding-I 14 hrs

Structure and Bonding-I

The ionic bond II: Structures of ionic solids, Radius ratio rules, Calculation of some limiting radius ratio values, Coordination number 3 (planar triangle), Coordination number 4 (tetrahedral and square planar), Coordination number6 (octahedral) close packing. **4hrs**

Classification of ionic structures:
Ionic compounds of the type AX (ZnS, NaCl, CsCI), Ionic compounds of the type AX_2 (Calcium fluoride (fluorite) and Rutile structure, Layer structures CdI_2, Cadmium iodide structure, Limitations of radius ratio concept, Kapustinskii equation, solvation energy and solubility of ionic solids, Numerical problems **5hrs**

Covalent bond II: The Lewis theory, octet rule, exceptions to the octet rule, Sidgwick-Powell theory. Review of Valence shell electron pair repulsion (VSEPR) theory, Effect of lone pairs, electronegativity, isoelectronic principle, Examples using VSEPR theory: $BF_3$and BF_4^-, NH_3 and NH_4^+, CIF_3, SF_4, $I_3^-$and I_3^+, SF_6 and IF_7. Limitations of VSEPR. **5hrs**

Unit III Mechanism of Organic Reactions II 14hrs

Carbon-carbon pi bonds: Formation of alkenes and alkynes by elimination reaction. Mechanism of E1, E2, E1cB reaction. Saytzeff and Hofmann eliminations. Addition of HBr to propene, Free radical addition of HBr to propene. Addition of halogens to alkenes-carbocation and halonium ion mechanism. Stereo-specificity of halogen addition. Ozonolysis mechanism - ozonolysis of propene. Diel –Alder reaction and Mechanism of Allylic and benzylic bromination and mechanism in propene, 1-butene, 1-toluene and ethylbenzene. **7 hrs**

Nucleophilic substitution at saturated carbon: Mechanism of SN_1 and SN_2 reactions with suitable examples. Energy profile diagrams, Stereochemistry and factors effecting SN_1 and SN_2 reactions.

Aromatic Electrophilic substitution reactions**:** Mechanisms, σ and π complexes, Halogenation, Nitration, Sulphonation, Friedel Crafts alkylation and acylation with their mechanism. Activating and deactivating groups. Orientation influence, Ortho-para ratio. Aromatic nucleophilic substitution reaction: SN_{Ar} and Benzyne mechanism with suitable examples. **7 hrs**

UNIT IV Thermodynamics and surface chemistry 14hrs

First Law of Thermodynamics

Thermodynamic Processes, Reversible and Irreversible Processes, Nature of Heat and Work, Internal Energy, First Law of Thermodynamics, Enthalpy of a System, Work done in isothermal and adiabatic expansion of an ideal gas, Numerical problems, Joule -Thomson Expansion, Relation between Joule-Thomson coefficient and other thermodynamic parameters

Second law of Thermodynamics

Concept of entropy, thermodynamic scale of temperature, Statements of the Second Law of Thermodynamics, molecular interpretation of entropy, Calculation of entropy change for reversible and irreversible processes. Free Energy Functions: Gibbs and Helmholtz energy, Variation of S, G, A with T, V and P, Numerical problems, Free energy change and spontaneity, Gibbs-Helmholtz equation

Third Law of Thermodynamics

Statement of third law, concept of residual entropy, calculation of absolute entropy of molecules. **9Hrs**

Surface Chemistry

Adsorption

Types of adsorption isotherms. Freundlich adsorption isotherm (only equation), its limitations. Langmuir adsorption isotherm (derivation to be done) and BET equation (derivation not included).

Catalysis

Types of Catalysis and theories with examples (intermediate compound theory and adsorption theory), Michaelis-Menten equation-derivation. Heterogeneous catalysis: surface reactions, unimolecular, bimolecular surface reactions. Autocatalysis with examples. Applications: Design process to removal of toxic compounds from industrial wastewater and treatment of portable water requirements. **5Hrs**

References:

1. Fundamental of Analytical Chemistry, D.A. Skoog, D.M. West, Holler and Crouch, 8th edition, Saunders College Publishing, New York (2005).
2. Analytical Chemistry, G.D. Christian, 6th edition, Wiley-India (2007).
3. Quantitative Analysis, R.A. Dayand A.L.Underwood, 6thedition, PHI Learning Pvt Ltd. New Delhi (2009).
4. Vogel's Textbook of Quantitative Chemical Analysis, J. Mendham, R.C. Denney, J.D.Barnes and M.J.K. Thomas, 6th edition, Third Indian Reprint, Pearson Education Pvt. Ltd.(2007).
5. Organic Reaction Mechanism by V.K.Ahluwalia and R.K.Parashar (Narosa Publishers)
6. Organic Chemistry by S.M.Mukherji, S.P.Sinha and R.K.Kapoor (Narosa Publishers)
7. Morrison R.N and Boyd R.N, Organic Chemistry, Darling Kindersley (India) Pvt. Ltd. (Pearson Education)
8. Finar I.L, Organic Chemistry (VolumeI); Finar I.L (VolumeII) Stereochemistry and the Chemistry of Natural Products.,Dorling Kindersley (India) Pvt. Ltd. (Pearson Education)
9. Kalsi P.S.Stereochemistry, conformation and Mechanism, Newage International
10. Eliel E.Landwilen S.H,Stereochemistry of OrganicCompounds,Wiley,(London).

PRACTICALS

Credit Points: 2 Teaching Hours: 4 hrs
Evaluation: Continuous InternalAssessment-25marks
Semester End Examination: 25marks

Course Objectives

1) To impart skills related to preparation of stock and working solutions and handling of instrumental methods
2) To know the principle of colorimetric analysis and construction of calibration plot
3) To understand the chemistry involved in colorimetric determination of metal ions and anions
4) To determine R_f values of different metal ions present in a mixture
5) To impart knowledge on the importance of functional groups inorganic compounds.
6) Techniques to identify the functional groups in a compound by performing physical and chemical tests
7) To record its melting point/boiling point.
8) To prepare suitable derivative for that compound and to characterize it.

Course Specific outcomes

After the completion of this course, the student would be able to

1) Understand the importance of instrumental methods for quantitative applications Apply colorimetric methods for accurate determination of metal ions and anions in water or real samples
2) Understand how functional groups in a compound is responsible for its characteristic property
3) Learn the importance of qualitative tests in identifying functional groups.
4) Learn how to prepare a derivative for particular functional groups and how to purify it.

Experiments list

PART-A

1) Colorimetric determination of copper using ammonia solution
2) Colorimetric determination of iron using thiocyanate solution
3) Determination of R_f values of two or three component systems by TLC /Paper Chromatography
4) Separation of different metal ions by paper chromatography/ Solvent extraction of iron using oxine solution **(demonstration)**

PART-B

Qualitative analysis of Organic compounds such as

1) Salicylic acid, p-Nitrobenzoic acid, Antranilicacid, p-Chloro benzoic acid
2) o-Cresol, p-Cresol, Resorcinol, o-Nitrophenol, p-nitophenol
3) o-Nitro aniline, p-Nitroaniline, p-Toluidine, p-Chloroaniline, p-Bromoaniline,
4) Ethyl Salicylate, Salicylaldehyde, Acetophenone, p-Dichlorobenzene, p-Nitrotoluene, Benzamideetc. (At least 6-8compounds to be analysed in a semester)

Examination

In the practical examination, a batch of maximum 15 (Fifteen) students may be made. Anyone experiment from Part-A or B can be given by selection done by the students based on lots. **Viva questions must be asked on any of the experiments prescribed in the practical syllabus.**

Part A: Distribution of marks

1. Accuracy: 12 Marks
2. Technique and presentation: 03 Marks
3. Graphs and Calculations: 05 Marks
4. Viva: 05 Marks

Total 25 Marks

Deduction of marks for accuracy: Error up to 5% - 12 marks, 6 - 10% 09 marks, 11-15% 6 marks, 16 or above 3 marks.

Part B: Distribution of Marks:

1. Preliminary tests and presentation - 03 marks,
2. Group test based on solubility: 02 marks
3. Distinguishing test and C.T: 10 marks (4+6)
4. Preparation of derivative: 03marks
5. Melting point of derivative: 02marks
6. Viva-Voce-5 marks

Total=25 marks.

References

1) Vogel's Textbook of Quantitative Chemical Analysis, J. Mendham, R.C. Denney, J.D.BarnesandM.J.K.Thomas,6thedition,ThirdIndian Reprint, Pearson Education Pvt. Ltd.(2007)
2) Vogels Text Book of Qualitative Chemical Analysis, ELBS

Semester-3: BSc/B Sc (Honors)

Title of the Course: Open Elective: Fuel Chemistry and Environmental Chemistry

Course	Credits	No. of Classes/ Week	Total No. of Lecture Hours	Duration of Exam in hrs	Internal Assessment Marks	Semester End Exam Marks	Total Marks
Theory	03	03	42	2	40	60	100

This course provides a broad introduction to the fundamental principles of Fuel chemistry, and Environmental Chemistry. The student will gain an understanding of basic and practical applications aspects of Fuels and environmental chemistry. This course is a valuable prerequisite for taking more technically challenging courses that will be required for career development.

Course Objectives

This course will deal with

1. Types of energy sources, concept of fuels, Petroleum and Environmental chemistry
2. Concept of different types of fuels and calorific values,
3. Basic principles of fuel sources, their preparation and applications.
4. Different types of lubricants and their applications
5. Concept of pollution, types of pollution and its prevention.

Expected Course Outcomes

Upon completion of the course students will be able to

1. Understand the concept of fuels, and their classifications.
2. Learn the different types of fuels and their applications.
3. Know the different types of pollution and their prevention

UNIT-I: FUEL CHEMISTRY: 14hrs

Review of energy sources (renewable and non-renewable). Classification of fuels and their calorific value. Coal: Uses of coal (fuel and nonfuel) in various industries, its composition, carbonization of coal. Coal gas, producer gas and water gas—composition and uses. Fractionation of coal tar, uses of coal tar bases chemicals, requisites of a good metallurgical coke, Coal gasification (Hydro gasification and Catalytic gasification).
Petroleum and Petrochemical Industry: Composition of crude petroleum, Refining and different types of petroleum products and their applications

UNIT-II 14 hrs

Fractional Distillation (Principle and process), Cracking (Thermal and catalytic cracking), Reforming Petroleum and non-petroleum fuels (LPG, CNG, LNG, bio-gas, fuels derived from biomass), fuel from waste, synthetic fuels (gaseous and liquids), clean fuels.

Lubricants: Classification of lubricants, lubricating oils (conducting and non-conducting) Solid and semisolid lubricants, synthetic lubricants. Properties of lubricants (viscosity index, cloud point, pore point) and their determination.

UNIT-III ENVIRONMENTAL CHEMISTRY 14 hrs

Energy and Environment: Sources of energy: coal, petrol and natural gas. Nuclear fusion/ fission, solar energy, hydrogen and geo-thermal energy. **3 hrs**
Air pollution: Major regions of atmosphere,

Air pollutants: types, sources, particle size and chemical nature. Control measures of air pollution. Photochemical smog: its constituents and photochemistry. Green house effect, global warming and ozone depletion. **4 hrs**
Water pollution, water quality standards: Water pollutants and their sources. Industrial effluents and their treatment (primary and secondary treatment). Sludge disposal. Water quality parameters for waste water, industrial water and domestic water.

Nuclear pollution: Disposal of nuclear waste, nuclear disaster and its management.**7hrs**

Reference:

1. Stocchi, E. Industrial Chemistry, Vol-I, Ellis Horwood Ltd. UK (1990).
2. Jain, P.C. & Jain, M. Engineering Chemistry DhanpatRai& Sons, Delhi.
3. Sharma, B.K. & Gaur, H. Industrial Chemistry, Goel Publishing House, Meerut (1996).
4. Environmental Chemistry, A. K. De, 6th Edn. New Age International (P) Ltd.,(2008).
5. Environmental Chemistry-S. K. Banerji, (Prentice Hall India), 1993
6. Industrial Chemistry, B.K.Sharma, 9th Edn. Krishna Prakashan Media (P) Ltd. Meerut (1997-98)

SEMESTER III

OEC3-BOILER WATER MANAGEMENT

[Only For B. Sc. (Sugar Science & Technology) Students]

Credits – 3	Max. Marks: 100
Teaching Hours / week: 4 Hours	Marks: Theory = 60
Theory Examination duration :2 Hours	Internal assessment= 40

UNIT – I **14 hours**

General boiler mounting/accessories & working: General boiler types, Water tube boiler- General parts – furnace / combustion zone / feed water tank/feed pump/ steam drum /mud drum /super heater/level indicators/ economizer/air heater/ID fan/FD fan/SA fan/ etc, High pressure & low pressure boilers

UNIT – II **14 hours**

Water: Water properties & nature, Sources of water, Use of water & basic chemistry, water related tables, Impurities in water and their effects on boiler working – scale formation – boiler tubes &economiser / carry over / Silica deposition/Super heater & turbine deposits/ Corrosion

Water quality requirement & treatment: General standards for boiler water/boiler feed water for high pressure as well as low pressure boilers, Objectives of boiler water treatment, External & Internal treatment

UNIT – III 1**4 hours**

External water treatment - Clarification, Filtration, , Chlorination, Ion exchange, De-areation, Reverse Osmosis, Silica removal, Oil removal, deareation

Ion exchange methods: Softner, De-alkalisation, Demineralisation application & limitation, Resin

Membrane Technology: Ultra filtration, Nano Filtration, Reverse Osmosis, Electro-dialysis

UNIT - IV **14 hours**

Internal treatment: Organic polymers & their role in scale inhibition, Dispersants & sludge conditioners, various chemical dosing, corrosion due to low pH, prevention of corrosion in boiler. Use of oxygen scavengers

Boiler operations & water quality: Boiler blow down, Reasons for boiler failures, Boiler preventive maintenance, Tubes internal chemical cleaning, water tube boilers – fire side cleaning

REFERENCE BOOKS:

1. Practical boiler water treatment Handbook, N. Manivasakam, By Shakti Book Services, Coimbatore
2. Training manual for sugar mills. Mangal Singh; Somaiya publications Pvt.Ltd. Mumbai.
3. Efficient Management of sugar factories, Mangal Singh, Somaiya publication Pvt.Ltd. Bombay
4. System of Technical control for cane sugar factories in India; Varma, N.C. The Sugar Technologists Association of India N.Delhi.

Semester –IV; CHEMISTRY: DSC-4: Chemistry-IV

Number of Theory Credits	Number of lecture hrs/semester	Number of practical Credits	Number of practical hrs/ sem
4	56	**2**	**56**
Content of Theory Course 4			**56Hrs**

Course Objectives: Students learn about

1. Different types of bonding in molecules/compounds/ions
2. The structures of molecules/compounds/ions based on different models/theories
3. Properties of compounds based on bonding and structure
4. The fundamentals of thermodynamics including the laws, the concept of entropy and free energy functions and their applications.
5. The concepts of surface chemistry, catalysis and their applications.
6. The theoretical and experimental aspects of chemical kinetics including basic theories of reaction rates and methods of determining order.
7. Electrochemistry dealing with electrolytes in solution. Conductance measurements and applications. Concept of ionic mobility and their determination.

Course outcomes: After the completion of this course, the student would be able to

1. Predict the nature of the bond formed between different elements
2. Identify the possible type of arrangements of ions in ionic compounds
3. Write Born-Haber cycle for different ionic compounds
4. Relate different energy parameters like, lattice energy, entropy, enthalpy and solvation energy in the dissolution of ionic solids
5. Explain covalent nature in ionic compounds
6. Write the M.O. energy diagrams for simple molecules
7. Differentiate bonding in metals from their compounds
8. Learn important laws of thermodynamics and their applications to various thermodynamic systems
9. Understand adsorption processes and their mechanisms and the function and purpose of a catalyst.
10. Apply adsorption as a versatile method for waste water purification.
11. Understand the concept of rate of a chemical reaction, integrated rate equations, energy of activation and determination of order of a reaction based on experimental data
12. Know different types of electrolytes, usefulness of conductance and ionic mobility measurements
13. Determine the transport numbers

Syllabus

Unit-I Separation methods **14 hrs**

Fundamentals of chromatography: General description, definition, terms and parameters used in chromatography, classification of chromatographic methods, criteria for selection of stationary and mobile phase, nature of adsorbents. Principles of paper, thin layer, column chromatography. Column efficiency, factors affecting the column efficiency, van Deemter's equation and its modern version. **5 hrs**

Paper chromatography: Theory and applications

Thin layer chromatography (TLC): Mechanism, $R_f$value, efficiency of TLC plates, development, spray reagents, identification and detection, qualitative applications **2 hrs**

Solvent Extraction: Types-batch, continuous, efficiency, selectivity, distribution coefficient, factors affecting the partition, relationship between % extraction and volume fraction, Numerical problems on solvent extraction. Solvent extraction of iron and copper. **4hrs**

Ion exchange Chromatography

Resins, types with examples-cation exchange and anion exchange resins, mechanism of cation and anion exchange process and applications of ion -exchange chromatography (softening of hard water, separation of lanthanides,). **3hrs**

Unit-II Structure and Bonding-II **14hrs**

Structure and Bonding-II

Concept of resonance, resonance energy, hybridisation, types of hybridization, sp, sp^2, sp^3, dsp^2, dsp^3, d^2sp^3, sp^3d^2, with one example each, and energetics of hybridization. Bent's rule, Limitations of Valence Bond Theory. **4hrs**

Molecular Orbital theory-II:

Calculation of bond order, relationship between bond order, bond energy and bond length. Magnetic properties based on MOT. Examples of molecular orbital treatment for homonulcear diatomic molecules: He_2, Li_2, Be_2, B_2, C_2, N_2, N_2^+, and O_2^{2-} **5hrs**

Metallic Bonding:

General properties of metals: Conductivity, Lustre, Malleability and cohesive force, Crystal structures of metals and Bond lengths. Theories of bonding in metals: Free electron theory, Valence bond theory, Molecular orbital or band theory of solids. Prediction of conducting properties of conductors, insulators and semiconductors, extrinsic and intrinsic semiconductors using M.O. theory. **5hrs**

Unit III Reaction Intermediates and methods of identification **14hrs**

Reaction Intermediates: Generation, Stability and Reactions of,

i) Carbocations: Dienone-phenol; and Pinacol-Pinacolone Rearrangement.
ii) Carbanions: Perkin Reaction, Aldol condensation,
iii) Free Radicals: Sandmeyer Reaction
iv) Carbenes and Nitrenes: Singlet and Triplet states, their relative stability and reactions
v) Arynes: Formation and detection **9hrs**

Methods for Identifying Reaction Mechanism:

Product analysis, Isolation and identification of intermediates, stereochemical evidences, crossover experiments, isotopic studies, kinetic studies **5 hrs**

UNIT-IV Kinetics and Electrochemistry 14hrs

Chemical Kinetics-II

Temperature dependence of reaction rates; Arrhenius equation, activation energy, Numerical problems on Arrhenius equation in calculating energy of activation and rate constants. Collision theory of reaction rates-Lindemann's mechanism, qualitative treatment of the theory of absolute reaction rates. Experimental determination of kinetics of (i) inversion of cane sugar by polarimetric method (ii) spectrophotometric method for the reaction between potassium persulphate and potassium iodide. **5 Hrs**

Electrochemistry–I

Arrhenius theory of electrolytic dissociation. Merits and Demerits, Conductance, Specific conductance, equivalent and molar conductivity and their variation with dilution. Molar conductivity at infinite dilution. Numerical problems.

Kohlrausch's law of independent migration of ions and its applications, Debye-Hückel-Onsager equation. Ionic mobility and its determinations, transference numbers and their relation to ionic mobility's, determination of transference numbers using Hittorf and Moving Boundary methods.

Applications of conductance measurement: (i) degree of dissociation of weak electrolytes (ii) ionic product of water (iii) solubility and solubility product of sparingly soluble salts (iv) conductometric titrations (acid base titrations only) and (v) Hydrolysis constants of salts. Numerical problems. **9hrs**

Reference Books

1. Peter Atkins & Julio De Paula, Physical Chemistry, 9th Ed., Oxford University Press(2010)
2. GWCastellan,PhysicalChemistry,4thEd.,Narosa(2004)
3. RGMortimer,PhysicalChemistry3rdEd.,Elsevier:Noida,UP(2009)
4. B R Puri, L R Sharma and M S Pathania, Principal of Physical Chemistry, Vishal Publishing Co.
5. B S Bahl, G D Tuli and ArunBahl, Essentials of Physical chemistry, S Chand & Company Ltd.
6. A S Negi and S C Anand, A textbook of Physical Chemistry, New Age International Publishers.
7. BN Bajpai, Advanced Physical chemistry, S Chand and Company ltd.
8. R L Madan, Chemistry for Degree Students, Semester I, II, III and IV, S Chand and Company Ltd.
9. P L Soni, O P Dharmarha and U N Dash, Textbook of Physical Chemistry, Sultan Chand and Sons.

PRACTICALS

Credit Points: 2 Teaching Hours: 4Hrs
Evaluation: Continuous Internal Assessment: 25marks
Semester End Examination: 25 marks

Course objective: To attain practical knowledge about:

1. Analytical skills in detecting the constituents present in unknown samples by systematically carrying out the qualitative analysis.
2. The methods of determining rates of chemical reactions.
3. Designing electrochemical cells and making measurements related to it.
4. Determination of physical characteristics of electrolytes using conductivity measurements in solution.
5. Adsorption phenomenon, mechanism and basic models to explain adsorption.
6. Simple techniques like conductometry to obtain physicochemical parameters of electrolytes.

Course outcomes: At the end of the course student would be able to

1. Understand the chemical reactions involved in the detection of cations and anions.
2. Explain basic principles involved in classification of ions into groups in semi-micro qualitative analysis of salt mixture
3. Carry out the separation of cations into groups and understand the concept of common ion effect.
4. Understand the choice of group reagents used in the analysis.
5. Analyse a simple inorganic salt mixture containing two anions and cations
6. Use instruments like conductivity meter to obtain various physicochemical parameters.
7. Apply the theory about chemical kinetics and determine the velocity constants of various reactions.
8. Learn about the reaction mechanisms.
9. Interpret the behaviour of interfaces, the phenomena of physisorption and chemisorptions and their applications in chemical and industrial processes.
10. Learn to fit experimental data with theoretical models and interpret the data

Part A- Inorganic Chemistry Practicals

Qualitative semi-microanalysis of mixtures containing 2anions and 2 cations. Emphasis should be given to the understanding of different reactions.
The following cations and anions are suggested.

Cations: NH_4^+,Pb^{2+},Bi^{3+},Cu^{2+},Al^{3+},Fe^{3+},Co^{2+},Cr^{3+},Ni^{2+},Zn^{2+},Mn^{2+},Ba^{2+},Ca^{2+}, Sr^{2+}, Mg^{2+},Na^+, K^+.

Anions: CO_3^{2-},Cl^-,Br^-,I^-,NO_3^-,,SO_4^{2-}, S^{-2}(Sulphide)

Spot tests and flame tests to be carried out wherever possible.

Part B- Physical Chemistry Practicals

1. Determination of the enthalpy of neutralization of a strong acid with strong base.
2. Determination of velocity constant for acid catalysed hydrolysis of methylacetate.
3. Determination of equivalent conductivity of strong electrolyte and verification of DHO equation.
4. Determination of dissociation constant of weak acid by conductivity method.
5. Conductometric titration of strong acid and strong base.
6. Conductometric titration of weak acid and strong base.

Examination

In the practical examination, a batch of maximum 15 (Fifteen) students may be made. Anyone experiment from Part-A or B can be given by selection done by the students based on lots. **Viva questions must be asked on any of the experiments prescribed in the practical syllabus.**

Part A: Distribution of Marks:

Preliminary tests and presentation - 04 marks,
Anions (group test + C.T +ionic reactions) (1+1+1)×2=6 marks,
Cations (group test + C.T+ ionic reactions) (1+3+1)×2=10 marks,
Viva-Voce-5 marks,
Total=25 marks.

Part B: Distribution of marks

1. Accuracy: 12 Marks
2. Technique and presentation: 03 Marks
3. Graphs and Calculations: 05 Marks
4. Viva: 05 Marks

Total 25 Marks

Deduction of marks for accuracy: Error up to 5% - 12 marks, 6 - 10% 09 marks, 11-15% 6 marks, 16 or above 3 marks.

References

1. Vogel's Qualitative analysis, Revised by G. Svehla, Pearson education, 2002
2. J B Yadav, Advanced Physical Chemistry, Krishna Prakashan Media (P) Ltd, Meerut.
3. Khosla, B. D.; Garg, V. C. &Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co. New Delhi (2011).
4. Garland, C.W. Nibler,J.W.& Shoemaker, D.P. Experiments in Physical Chemistry 8th Ed.; McGraw-Hill:NewYork(2003).
5. Halpern, A.M. & McBane, G.C. Experimental Physical Chemistry 3rd Ed.; W.H.Freeman &Co.New York(2003).

Semester4

BSc/B Sc(Honors)

Title of the Course: **Open Elective: Electrochemistry, Corrosion and Metallurgy**

Course	Credits	No. of Classes/ Week	Total No. of Lecture Hours	Duration of Exam in hrs	Internal Assessment Marks	Semester End Exam Marks	Total Marks
Theory	03	03	42	2	40	60	100

This course provides a broad introduction to the fundamental principles of Electrochemistry, Corrosion and Metallurgy. The student will gain an understanding of basic and practical applications in various fields of Electrochemistry, Corrosion and Metals and Alloy behaviour and manufacturing processes. This course is a valuable prerequisite for taking more technically challenging courses that will be required for career development.

Course Objectives

This course will deal with

1. Types of conductance, concept of electrolytes, electrolysis, redox reactions and EMF
2. Concept of different types of electrochemical cells, Types of electrodes and electrode potential. Application of electrochemical series.
3. Basic principles and applications of conductometric, potentiometric and pH titrations.
4. Different types of Batteries their principle construction and working, lead-acid storage and lithium ion battery. Study of Fuels cells.
5. Concept of corrosion, types of corrosion and its prevention by different methods. Introduction to electroplating.
6. Introduction to ores and minerals, extraction of metals from their ores, and purification. Eg: Manganese, Titanium and Uranium.
7. Study of alloys, classification, production and uses of alloys.

Expected Course Outcomes

Upon completion of the course students will be able to

1. Understand the concept of conductance in electrolytic solutions, electrolysis and redox reactions involved in electrode reactions.
2. Learn the different types of electrochemical cells, their symbolical representation and application of electrochemical series.
3. Apply conductometric, potentiometric and pH titrations
4. Know the principle, construction and working of batteries
5. Understand different types of corrosion and its prevention by different methods
6. Learn the methods of extraction of metals from their ores and purification

Unit I Electrochemistry **14hrs**

Conductance, specific and molar conductance Types of Electrolytes, Conductivity in electrolytic solution, Electrolysis, Kohlrausch's law and its application, Equivalent Conductance of Weak electrolyte at Infinite dilution.
Oxidation -reduction reactions, electrode potential, EMF of an electrochemical cell, cell reaction, Daniel cell, dry Cells-electrolytic and Galvanic cell, Representation of a cell. Standard electrode potential, Nernst equation (No derivation) and its application to chemical cell, Electrochemical series and its importance. Types of Electrodes.
Basic Principles of (i) Conductometric titrations-HCl Vs NaOH, CH_3COOH Vs NaOH
(ii)Potentiometric titrations: Acid-base titration HCl Vs NaOH,
Redox titration (FAS Vs $K_2Cr_2O_7$) **12hrs**

Batteries- Primary and Secondary batteries, Battery components and their role. Working of the following Batteries-Lead acid, Lithium Storage, Batteries, Fuel cells. **2hrs**

Unit II Corrosion **14hrs**

Corrosion: Introduction, definition, Types of Corrosion, Corrosion rate, Factors affecting corrosion rate, Metallic factor-purity, electrode potential of metal, hydrogen overvoltage, nature of corrosion product. Environmental Factors-Temperature, pH of the medium, humidity, presence of impurities, electrical conductivity of the medium, velocity of the medium, concentration of the medium. **7hrs**

Prevention of Corrosion: Material selection-Metals and alloys, metal purification, non-metallic, Alteration of environment - Changing media, inhibitors, Design-wall thickness, design rules, Coating-Metallic and other inorganic coatings, organic coating. **4hrs**

Electroplating: Introduction, Electroplating of chromium (hard and decorative). Electro lessplating: Introduction, distinction between electroplating and electroless plating processes. Electroless plating of copper. **3hrs**

Unit III Metallurgy **14hrs**

Introduction: Ore, minerals, important ores of some common elements in India, General Principles of pyrometallurgy, roasting, Calcination, Gangue, Smelting, Flux, Gravity separation, Froth flotation process, leaching. Techniques employed for Purification of metal Distillation process, Bessemerization, Electro-refining, Van Arkel and DeBoer's filament **6hrs**

Extraction of metals: Extraction of Manganese (Pyrolusite) Titanium (Ilmanite) and Uranium. **4hrs**

Alloys: Introduction, Classification of alloys, commercially important alloys, gold karats, Production of Ferroalloys; Ferrochrome, Ferro Manganese, Uses of alloy **4hrs**

Reference Books

1. Barrow. G.M, Physical Chemistry, Tata McGraw-Hill,(2007)
2. An introduction to electrochemistry, Samuel Glasstone, East-West edition New Delhi,(1942)
3. Text book of physical chemistry, Samuel Glasstone, 2nd Edition, Mac Millan India Ltd,(1991)
4. Principles and applications of Electrochemistry, D. R. Crow, 3rd edition, Chapmanhall London,(1988)
5. Fundamentals of electrochemical deposition, Milan Paunovic and Mordechay Schlesinger,Wiley Interscience Publications,NewYork,(1998)
6. Engineering Chemistry, VR Kulkarni and K Ramakrishna Reddy, New Age International, (2015)
7. Electrochemistry and Corrosion Science, Nestor Perez, Springer (india) Pvt. Ltd.,(2004)
8. Principles and Prevention of Corrosion, D.A. Jones ,Macmillan Publ. Co.,(1996)
9. Essentials of Materials Science and Engineering, Donald R.Askeland, Thomson Learning, 5th Edition, (2006)
10. Introduction to Engineering Materials, B.K.Agarwal,TataMcGrawHill,1st Edition
11. Material Science and Engineering,V.Raghavan,PHILearning,5th Edition
12. Engineering Materials and Metallurgy, R.K.Rajput,S.Chand-1st Edition,(2011)

SEMESTER IV

OEC 4 - ANALYTICAL INSTRUMENTATION

[Only For B. Sc. (Sugar Science & Technology) Students]

Credits – 3	Max. Marks: 100
Teaching Hours / week: 4 Hours	Marks: Theory = 60
Theory Examination duration :2 Hours	Internal assessment= 40

Unit – I **14 Hours**

Spectroscopy: General principles of absorption spectroscopy, theory of Colorimetry, Beers & Lambert Law, Instrumentation of Photoelectric Colorimeter, construction of standard curve and applications.

Flame Photometry: General discussion and elementary theory, Instrumentation of flames photometer, monochromators, detectors and applications

Unit – II **14 Hours**

Polarimetry: Introduction, plane polarized light, optical activity, Instrumentation of Polarimeter, types of polarimeter, Laurenzpolarimeter, Industrial polarimeter, white lamp single wedge and double wedge polarimeter, automatic polarimeter, measurement of specific rotation and determination of unknown concentration and other applications in sugar technology.

Refractometry: Introduction, Snell's law, specific refraction, molar refraction, Hand Refractometer, Abbe's Refractometer, experimental techniques and applications.

Unit – III **14 Hours**

pH and Conductivity measurements: Introduction sensors, Electroanalytical Sensors, different types of sensor electrodes, pH meter, standardization and pH measurements, conductivity solutions, specific and equivalent conductivity, equivalent conductivity at infinite dilution, measurement of conductivity/resistivity of solution, Conductometers, conductivity cell applications.

Laboratory equipment calibration process – Brix hydrometer, Thermometer, weight box, lab oven, Polarimeter, Refractometer, pH meter, conductivity meter, TDS meter, spectrophotometer

Unit – IV **14 Hours**

Chromatography: Introduction, Classification of chromatographic methods, introduction of terms used in chromatography,

Thin layer chromatography: Introduction of basic concept and technique, methodology, application,

Gas chromatography: General introduction of terminology, stationary phases, supports used for making GLC column

REFERENCE BOOKS:

1. Vogel's Textbook of quantitative inorganic revised by J. Bassett et al.
2. Instrumental Methods of Chemical Analysis by H. Kaur.
3. Instrumental methods of analysis by Strobel.
4. Practical Physical Chemistry by Findley.
5. Instrumental methods of chemical analysis by Bhal and Tuli.

SEMESTER-V										
Category	**Course code**	**Title of the Paper**	**Marks**			**Teaching hours/ week**			**Credit**	**Duration of exams (Hrs)**
			IA	**SEE**	**Total**	**L**	**T**	**P**		
DSC5	21BSC5C5 CHE5L	Chemistry-5	40	60	100	4	-	-	4	2
	21BSC5C5 CHE5P	Chemistry Lab-5	25	25	50	-	-	4	2	4
DSC6	21BSC5C5 CHE6L	Chemistry-6	40	60	100	4	-	-	4	2
	21BSC5C5 CHE6P	Chemistry Lab-6	25	25	50	-	-	4	2	4

SEMESTER-VI										
Category	**Course code**	**Title of the Paper**	**Marks**			**Teaching hours/week**			**Credit**	**Duration of exams (Hrs)**
			IA	**SEE**	**Total**	**L**	**T**	**P**		
DSC7	21BSC6C6 CHE7L	Chemistry-7	40	60	100	4	-	-	4	2
	21BSC6C6 CHE7P	Chemistry Lab-7	25	25	50	-	-	4	2	4
DSC8	21BSC6C6 CHE8L	Chemistry-8	40	60	100	4	-	-	4	2
	21BSC6C6 CHE8P	Chemistry Lab-8	25	25	50	-	-	4	2	4
INT1	21BSC6 INT1L	Project work/ Industrial Tour and report	25	25	50	-	-	2	2	2

BSc Chemistry-Semester V

Title of the Course: DSC Chemistry-5: Subject code: 21BSC5C5 CHE5L Paper:1

Course title	**DSC5 Chemistry -5**		
Course Code	**21BSC5C5 CHE5L**	No. of Credits	**04**
Contact hours	**60 Hours (4 Hours/ week)**	Duration of SEA/Exam	**2 hours**
Formative Assessment Marks	**40**	Summative Assessment Marks	**60**

Course Objectives:

Students learn about

1. General group trends of d and f block elements
2. Valence Bond Theory (VBT) and Structural and stereoisomerism in coordination complexes
3. Classification and synthesis of Heterocyclic compounds
4. Sources, classification and general characteristics of Alkaloids
5. Principles of green chemistry
6. Selection rules, energy levels and respective transitions in molecular spectroscopy
7. Overview of nanostructures and nanomaterials and polymers

Course outcomes:

After the completion of this course, the student would be able to

1. Predict the Electronic configurations, oxidation states, colour, magnetic properties of d and f block elements
2. Identify the possible types of inner and outer orbital complexes with coordination numbers 4 and 6
3. Write molecular orbital picture and Aromatic character of heterocyclic compounds
4. Write the constitution of Coniine, hygrine and nicotine
5. Appreciate the need for green chemistry and eco-efficiency
6. Identify the selection rules for electronic, vibrational and rotational spectra
7. Elucidate the Properties of Polymers and nanomaterials

V semester
Paper – I

Unit – I **15 hours**

d- and f- block Elements 7 hours

Transition Elements (3d series): General group trends with special reference to electronic configuration, variable valency, colour, magnetic and catalytic properties, ability to form complexes.

Lanthanoids and actinoids: Electronic configurations, oxidation states, colour, magnetic properties, lanthanide contraction, separation of lanthanides (ion exchange method only).

Coordination Chemistry - I 8 hours

Classification of ligands, IUPAC system of nomenclature, Valence Bond Theory (VBT): Inner and outer orbital complexes of Cr, Fe, Co, Ni and Cu (coordination numbers 4 and 6). Structural and stereoisomerism in complexes with coordination numbers 4 and 6. Drawbacks of VBT.

Unit – II **15 hours**

Heterocyclic compounds 8 hours

Classification, molecular orbital picture and Aromatic character of furan, thiophene, pyrrole and pyridine, synthesis of the following compounds.

i). Furan and pyrrole from 1,4- diketones. ii) Pyridine by Hantzch synthesis. Electrophilic substitution reactions of pyrrole, furan and pyridine (chlorination and nitration), comparison of basicities of pyridine, piperidine and pyrrole.

Alkaloids 4 hours

Definition, source, classification and general characteristics, Hofmann exhaustive methylation with pyridine as an example. Isolation, constitution and confirmation by synthesis – Coniine, hygrine and nicotine

Green Chemistry 3 hours

The need for green chemistry and eco-efficiency, green methods, green products, recycling of wastes, 12 principles of green chemistry

Unit – III **15 hours**

Introduction to Molecular Spectra 2 hours

Electromagnetic radiation, regions of the spectrum, Born-Oppenheimer approximation, degrees of freedom

Electronic Spectroscopy 4 hours

Concept potential energy curves for bonding and antibonding molecular orbitals, qualitative description of selection rules, energy levels and respective transitions, Frank–Condon principle

Rotational Spectroscopy 4 hours

Classification of molecules, rotational spectra of rigid diatomic molecules, criteria for showing the spectra, energy levels of rigid rotator, selection rules (final equations only), calculation of bond length and moment of inertia of HCl molecule

Vibrational Spectroscopy 5 hours

Simple harmonic oscillator, Hooke's law, energy level of simple harmonic oscillator model of diatomic molecule (final equations only), selection rules, zero- point energy determination of force constant and qualitative relation between force constant and bond dissociation energies. Vibrational degrees of freedom of molecules (Linear and nonlinear).

Unit – IV **15 hours**

Properties of Polymers 8 hours

Physical, thermal, Flow & Mechanical Properties, Brief introduction to preparation, structure, properties and application of the following polymers:

polyolefins, polystyrene and styrene copolymers, poly (vinyl chloride) and related polymers, poly (vinyl acetate) and related polymers, acrylic polymers, fluoro polymers, polyamides and related polymers. Phenol formaldehyde resins (Bakelite, Novalac), polyurethanes, silicone polymers, polydienes, Polycarbonates, Conducting Polymers, [polyacetylene, polyaniline, poly (p-phenylene sulphide polypyrrole, polythiophene)]

Inorganic Polymers 3 hours

Inorganic polymers, Types, comparison with organic polymers, silicones, phosphonitrilic halides-formation, structure and applications

Nanomaterials 4 hours

Overview of nanostructures and nanomaterials: classification. Preparation of gold and silver metallic nanoparticles, self-assembled nanostructures-control of nanoarchitecture-one dimensional control. Carbon nanotubes and inorganic nanowires. Bio- inorganic nanomaterials.

BSc Chemistry-Semester V

Title of the Course: DSC-6: Subject code: 21BSC5C5 CHE6L Paper:2

Course title	**DSC6 Chemistry -6**		
Course Code	**21BSC5C5 CHE6L**	No. of Credits	**04**
Contact hours	**60 Hours (4 Hours/ week)**	Duration of SEA/Exam	**2 hours**
Formative Assessment Marks	**40**	Summative Assessment Marks	**60**

Course Objectives:

Students learn about

1. Industrial Chemistry of alloys, abrasives, glass, cement and fuels
2. Preparation, mechanism of action and applications of various reagents
3. Classification, colour constitution and synthesis of dyes.
4. Electrochemistry – EMF and Batteries and Fuel Cells
5. Applications of infra-red spectroscopy, UV-Vis spectroscopy and mass spectrometry in organic chemistry

Course outcomes:

After the completion of this course, the student would be able to

1. Write the manufacture and application of alloys, abrasives, glass, cement and fuels
2. Preparation, mechanism of action and applications of various reagents like DCC, DDQ, LTA, NBS, PCC
3. Write the synthesis of various dyes
4. Write the types of electrodes, sign conventions and applications of EMF measurements
5. Understand construction and applications of batteries and fuel cells
6. Identify the molecules using the data from infra-red spectroscopy, UV-Vis spectroscopy and mass spectrometry

V semester
Paper – II

Unit – I **15 hours**

Industrial Chemistry – I 9 hours

Alloys-Significance, types of alloys (ferrous and non-ferrous alloys), preparation (fusion and electro-deposition) and their applications.

Abrasives- Classification, Mohr scale of hardness, Manufacture and application of carborundum, alundum, tungsten carbide.

Glass - physical and chemical properties of glass, raw materials, manufacture using tank furnace, annealing of glass, types, composition and uses of glasses.

Industrial Chemistry – II 6 hours

Cement: Raw materials, composition of Portland cement, manufacture by rotary kiln method, mechanism of setting.

Fuels: characteristic and calorific values of fuels, advantages of gaseous fuels, Manufacture of water gas and biogas.

Unit – II **15 hours**

Reagents and Reactions 9 hours

Preparation, mechanism of action and applications DCC (Amide formation), $LiAlH_4$ (reduction of aldehyde, carboxylic acid and ester), DDQ (Benzylic

oxidation of tetralin, aromatization of tetralin), Lead Tetra Acetate(oxidation of 1,2-diols), NBS(allylic bromination), OsO_4 (hydroxylation of alkenes), PCC(Pyridinium chlorochromate) in the oxidation of primary alcohols.

Dyes 6 hours

Classification, requirement of a dye, colour and constitution. The synthesis of each of the following Class of dyes: Azo dyes-Congo red, Vat dyes–Indigo, Anthraquinone dyes– Alizarin Triphenylemethane dyes–Malachite green, Crystal violet, Phthalein dyes- Fluoroscein, Eosin; Synthesis of each dyes.

Unit – III **15 hours**

Electrochemistry – EMF 10 hours

Electrochemical cells, Reversible and irreversible cells, EMF of a cell and its measurement by potentiometer, standard cell (Weston standard cell), types of electrodes, reference electrode-calomel electrode, sign conventions, Nernst equation, electrochemical series and its applications, salt bridge and its applications. Determination of pH of solution by hydrogen electrode, quinhydrone electrode and glass electrode methods, concentration cell with and without transference, liquid junction potential.

Numerical problems.

Applications of EMF measurements-

i) Determination of solubility and solubility product of sparingly soluble salts.

ii) Potentiometric titrations- acid– base and redox titrations,
iii) Determination of redox potential

Batteries and Fuel Cells 5 hours

Primary and secondary batteries – Construction and Applications of Pb-acid battery, Li-Battery, Lithium-polymer cell, and nickel-cadmium cell. Fuel cells-hydrogen-oxygen and Hydrocarbon–Oxygen fuel cells and their applications.

Unit – IV **15 hours**

Infrared Spectroscopy 5 hours

Introduction to infrared spectroscopy, intensity of absorption band, position of absorptions, C-H, >C=O, O-Hand N-H absorption bands with explanation for variation in stretching frequencies. Identification of H- bonding in alcohols, phenols and carboxylic acids using IR spectroscopy

UV and Visible Spectroscopy 5 hours

Types of electronic transitions, chromophores and auxochromes, bathochromic shift and hypochromic shift, intensity of absorption, Woodward- Fieser rules for calculating λ_{max} of Conjugated dienes such as alicyclic, homoannular and hetero annular dienes. Applications of UV spectroscopy

Mass Spectrometry 5 hours

Principle, determination of m/e ratio, instrumentation, determination of molecular mass and isotopic abundance, molecular ion peak and base peak, McLafferty rearrangement with respect to 2-hexanone, hexenoic acid and methyl hexanoate.

BSc Chemistry-Semester V

Title of the Course: DSC Chemistry Lab-5: Subject code: 21BSC5C5 CHE5P Paper:1

Course title	**DSC5:** Chemistry Lab-5		
Course Code	**21BSC5C5 CHE5P**	No. of Credits	**04**
Contact hours	**60 Hours (4 Hours/ week)**	Duration of SEA/Exam	**2 hours**
Formative Assessment Marks	**25**	Summative Assessment Marks	**25**

V Semester Paper I **INORGANIC AND PHYSCIAL CHEMISTRY PRACTICAL**

Part A: Preparation and quantitative analysis of inorganic complexes:

1. Cis- and trans- potassium dioxalatodiaquachromium(III) complex [analysis of oxalate and chromium]
2. Hexamminecobalt(III)chloride [analysis of cobalt]
3. Mercurytetrathiocyanatocobaltate.
4. Preparation of pentamminechlorocobalt (III)chloride.

Part B: PHYSCIAL CHEMISTRY PRACTICAL

Colorimetry

1. Estimation of Fe^{2+} ions concentration in the given solution by titration of FAS versus $KMnO_4$ through colorimetric method.
2. Estimation of Fe^{2+} ions concentration using EDTA through colorimetric method
3. Phase diagram of two component systems and determination of Ec, E_T and the determination of the composition of given unknown.

Potentiometry

1. Determination of single electrode potential of Cu^{2+}/Cu and estimate the given unknown concentration.
2. Determination of single electrode potential of Zn^{2+}/Zn and estimate the given unknown concentration.
3. Titration of $AgNO_3$ versus KCl.
4. Titration of weak acid against a strong base using quinhydrone electrode and calculation of pKa and Ka values of the weak acid.
5. Determination of pH of a buffer by using quinhydrone electrode and comparison of the pH values obtained with glass electrode

Examination

In the practical examination, a batch of maximum 15 (Fifteen) students may be made. Anyone experiment from Part-A or B can be given by selection done by the students based on lots. Viva questions must be asked on any of the experiments prescribed in the practical syllabus only

Part A: Distribution of Marks:

1. Reaction & Mechanism-04 marks,
2. Calculation of theoretical yield – 02 mark,
3. Observed yield -10 marks,
4. M.P- 04 marks,

5. Viva-Voce-5 marks,
Total=25 marks.
Deduction of marks for observed yield: Less than 10% - 10 marks, 11-15% - 8 marks, 16-20% - 6 marks, 21-25 % - 4 marks & above 25% - zero mark.

Part B: Distribution of marks
Accuracy: 12 Marks
Technique and presentation: 03 Marks
Graphs and Calculations: 05 Marks
Viva: 05 Marks
Total 25 Marks
Deduction of marks for accuracy: Error up to 5% - 12 marks, 6 - 10% 09 marks, 11-15% 6 marks, 16 or above 3 marks.

BSc Chemistry-Semester 5

Title of the Course: DSC6 Chemistry Lab-6: Subject code: 21BSC5C5 CHE6P **Paper:2**

Course title	**DSC6:** Chemistry Lab-6		
Course Code	21BSC5C5 CHE6P	No. of Credits	**04**
Contact hours	**60 Hours (4 Hours/ week)**	Duration of SEA/Exam	**2 hours**
Formative Assessment Marks	**25**	Summative Assessment Marks	**25**

V Semester Paper II **ORGANIC CHEMISTRY PRACTICAL**

Part A: Preparation (one stage)

1. Cannizarro reaction: Benzaldehyde.
2. Fries rearrangement: Phenyl acetate.
3. Friedel-Crafts reaction: Benzene and Acetyl chloride.
4. Sandmeyer reaction: 4-Chlorotoluene from 4-toluidine.
5. Pechmann reaction: Resorcinol and ethylacetoacetate.
6. Oxidation of Cyclohexanol.
7. Preparation of S- Benzylisothiuronium chloride.
8. Synthesis of p-iodonitrobenzene
9. Synthesis of N-Phenyl-2, 4-dinitroaniline.
10. Synthesis of 2, 4-dichlorophenoxyacetic acid.

Part B: Quantitative analysis

1. Saponification value of oil.
2. Estimation of glucose by Fehling's method.
3. Estimation of keto group.

Examination
In the practical examination, a batch of maximum 15 (Fifteen) students may be made. Anyone experiment from Part-A or B can be given by selection done by the students based on lots. Viva questions must be asked on any of the experiments prescribed in the practical syllabus only.
Part A: Distribution of Marks:
1. Reaction & Mechanism-04 marks,
2. Calculation of theoretical yield – 02 mark,
3. Observed yield -10 marks,

4. M.P- 04 marks,
5. Viva-Voce-5 marks,
Total=25 marks.
Deduction of marks for observed yield: Less than 10% - 10 marks, 11-15% - 8 marks, 16-20% - 6 marks, 21-25 % - 4 marks & above 25% - zero mark.
Part B: Distribution of Marks:
1. Accuracy: 12 (6+6) Marks
2. Technique and presentation: 03Marks
3. Reactions and Calculations: 05 Marks
4. Viva: 05 Marks
Total 25 marks
Deduction of marks for accuracy: ±0.4 CC – 6 marks, ± 0.6 CC- 04 marks, ±0.8 CC- 02 marks, ±1.0 CC - 01 marks. Above ±1.0 CC - 00 marks

BSc Chemistry-Semester VI

Title of the Course: DSC Chemistry-7: Subject code: 21BSC6C6 CHE7L **Paper:1**

Course title	**DSC7 Chemistry-7**		
Course Code	21BSC6C6 CHE7L	No. of Credits	**04**
Contact hours	**60 Hours (4 Hours/ week)**	Duration of SEA/Exam	**2 hours**
Formative Assessment Marks	**40**	Summative Assessment Marks	**60**

Course Objectives:

Students learn about

1. Crystal field theory (CFT) with reference to octahedral, distorted octahedral (Jahn- Tellar distortion), tetrahedral and square planar complexes
2. Thermodynamic and kinetic stability of metal complexes
3. Structure, classification and properties of natural products
4. Concept of phases, components and degrees of freedom
5. Laws of photochemistry
6. Liquid-liquid mixtures (miscible, immiscible and partially miscible), Raoult's law and Duhem – Margules equation
7. Basic principles of NMR, Instrumentation and working of a NMR spectrometer
8. Different concepts of Acids and Bases
9. Manufacture and cleaning action of soap and detergent

Course outcomes:

After the completion of this course, the student would be able to

1. Calculate of crystal field stabilization energy of inner and outer orbital complexes with coordination numbers 4 and 6
2. Understand Factors affecting the stability of metal complexes
3. Write the interconversions, synthesis of natural products.
4. Write phase diagram for one and two component systems
5. Explain the reasons for high and low quantum yields with examples
6. Explain the differences between Azeotropes, Immiscible liquids and Partially miscible liquids
7. Interpret of PMR structure of simple organic molecules

VI semester
Paper – I

Unit – I **15 hours**

Coordination Chemistry – II 12 hours

Crystal field theory (CFT) with reference to octahedral, distorted octahedral (Jahn- Tellar distortion), tetrahedral and square planar complexes, calculation of crystal field stabilization energy, factors affecting 10Dq, consequences of crystal field splitting on ionic radii of M^{+2} ions, enthalpy of hydration of M^{+2} ions, explanation of colour and magnetic properties of magnetic complexes, limitations of crystal field theory, calculation of magnetic moment using Gouy's method

Metal-ligand Equilibria 3 hours

Stability of metal complexes (thermodynamic and kinetic), stepwise and overall stability constant and their relationship. Factors affecting the stability of metal complexes

Unit – II **15 hours**

Carbohydrates 5 hours

Haworth and conformational formulae of glucose and fructose, mutarotation
and its mechanism, osazone formation, Killani's synthesis, Ruff's degradation, epimers and epimerisation with respect to monosaccharides, interconversions of glucose and fructose.

Vitamins 4 hours

Vitamins: Classification and importance of vitamin-A, B6, B12, C, D and E. Synthesis of Vitamin-C from D(+)-glucose, synthesis of vitamin-A by van Dorp *et al*

Amino acids, Peptides and Proteins 6 hours

Classification, structure and stereochemistry (D and L) of amino acids, acid-base behaviour, iso-electric point and electrophoresis, peptides- nomenclature and structure of peptides, synthesis of a dipeptide(Bergmann synthesis),Classification of proteins, levels of protein structure(primary, secondary and tertiary structure), protein denaturation and renaturation.

Unit – III **15 hours**

Phase Equilibria 5 hours

Concept of phases, components and degrees of freedom, derivation of Gibbs Phase Rule for nonreactive and reactive systems; Clausius-Clapeyron equation and its applications to solid-liquid, liquid-vapor and solid-vapor equilibria, phase diagram for one component systems (H_2O and S) with applications. Phase diagrams for two component systems of solid-liquid equilibria involving eutectic, congruent and incongruent melting points

Photochemistry 5 hours

Absorbance, transmittance, Beer-Lambert's law and its limitations, Calculation of molar extinction coefficient. Laws of photochemistry - Grothus-Draper law, Stark – Einstein' s law of photochemical equivalence, Quantum yield - definition, reasons for high and low quantum yields with examples. Photosensitization with examples. Photophysical process - definition, fluorescence, phosphorescence, Chemiluminescence and bioluminescence with examples,

Solutions 5 hours

Introduction - liquid-liquid mixtures (miscible, immiscible and partially miscible), Raoult's law-definition, equation. Duhem – Margules equation (no derivation) and its applications, Azeotropes - definition, minimum and maximum boiling point azeotropes. Immiscible liquids - definition, Partially miscible liquids-definition, conjugate solutions, CST, types I (phenol-water system), II (triethylamine-water system) and III (nicotine-water system).

Unit – IV **15 hours**

^{1}H NMR Spectroscopy 7 hours

Basic principles of NMR. Instrumentation and working of a NMR spectrometer, nuclear shielding and deshielding, chemical shift and molecular structure, spin-spin splitting and coupling constant, areas of signals. Interpretation of PMR structure of simple organic molecules such as ethanol, ethyl bromide, 2-chloroethanol, acetaldehyde, ethyl acetate, propanamide, acetophenone and acetanilide

Acids and Bases 4 hours

Arrhenius, Bronsted-Lowry, Lux-Flood, solvent system and Lewis concepts of acids and bases. Hard and soft acids and bases (HSAB) - classification of acids and bases as hard and soft, Pearson's HSAB concept

Soaps and Detergents 4 hours

Soaps: Introduction, manufacture by modern process, cleaning action of soap. Detergents: anionic, cationic, nonionic, with suitable examples, distinction between soaps and detergents, emulsifiers, stabilisers and builders

BSc Chemistry-Semester VI

Title of the Course: DSC8 Chemistry-8: Subject code: 21BSC6C6 CHE8L **Paper:2**

Course title	**DSC8 Chemistry -8**		
Course Code	21BSC6C6 CHE8L	No. of Credits	**04**
Contact hours	**60 Hours (4 Hours/ week)**	Duration of SEA/Exam	**2 hours**
Formative Assessment Marks	**40**	Summative Assessment Marks	**60**

Course Objectives:

Students learn about

1. Nuclear particles, nuclear instability, nuclear fission and fusion, nuclear reactors
2. Essential and trace elements in biological process
3. Solvent properties and typical reactions in liquid ammonia and liquid sulphur dioxide
4. Retrosynthetic analysis, synthons, synthetic equivalents, functional group interconversions
5. Various named rearrangements
6. Sources, classification and general characteristics of terpenes
7. Principles of quantum chemistry
8. Comparison of transition state theory and collision theory
9. Classification, synthesis and requirement of an ideal synthetic drug,
10. Classification of organotransition metal complexes and 18 electron rule

Course outcomes:

After the completion of this course, the student would be able to

1. Explain different types of nuclear reactors, nuclear reactions
2. Explain the biological role of Na, K, Fe and Zn.
3. Write the retrosynthesis of benzocaine and 4-methoxy acetophenone
4. Write the constitution of citral, synthesis of α and β ionones, α-terpeniol
5. Explain Schrödinger' s wave equation, wave function and its significance
6. Explain the chemical kinetics of complex reactions
7. Write the synthesis and uses of antipyrine, novacaine ,chlorpheniramine maleate (CPM) paludrine, tetracyclin. Benedict's reagent and Barfoed reagent.

VI semester
Paper – II

Unit – I **15 hours**

Nuclear Chemistry 8 hours

Nuclear particles (positron, neutrino, mesons, pions, and quarks), nuclear instability, nuclear fission and fusion, nuclear reactors, Different types of nuclear reactors, nuclear reactions (α, n), (n, α), (α, p), (p, α), (p, n) and (n, p). Applications of radioisotopes in tracer technique, neutron activation analysis and carbon dating

Bioinorganic Chemistry 4 hours

Essential and trace elements in biological process, metalloporphyrins with respect to haemoglobin and chlorophyll (structure and function), biological role of Na, K, Fe and Zn.

Non-aqueous solvents 3 hours

Solvent properties and typical reactions studied in liquid ammonia and liquid sulphur dioxide

Unit – II **15 hours**

Retrosynthesis 5 hours

Introduction to retrosynthetic analysis, synthons, synthetic equivalents, functional group interconversions, one and two group C-X disconnection (definitions and examples only). Retrosynthesis of benzocaine and 4-methoxy acetophenone

Rearrangements 6 hours

Wagner-Meerwein, Fries, Wolff, Beckmann, Arndt-Eistert reaction, Wittig and Favorskii rearrangements, Baker-Venkatraman rearrangement. Baeyer-Villiger oxidation. Benzidine rearrangement.

Terpenoids 4 hours

Introduction, classification of terpenes, Ingold's isoprene rule, constitution of citral with synthesis, synthesis of α and β ionones, synthesis of α-terpeniol

Unit – III **15 hours**

Quantum Chemistry 6 hours

Black body radiation, Plank's theory, photoelectric effect, Einstein's photoelectric equation, Compton effect, wave nature of electron, Schrödinger' s wave equation, wave function and its significance, wave particle duality, Eigen function and Eigen values, Equation of motion for a particle, elementary wave motion, particle in one dimension box

Kinetics 6 hours

Derivation of rate constants of unimolecular (Lindemann hypothesis) and bimolecular reaction rates, limitations of collision theory. Transition state theory, Comparison of transition state theory and collision theory, steric factor.

Chemical kinetics of complex reactions-first order reaction, opposing, consecutive and parallel reactions

Micelles (Colloids) 3 hours

Emulsions, micro emulsions or micellar emulsions, and its stability, properties of micro emulsions: electro kinetic effects. Colloidal electrolytes or association colloids, types of colloidal electrolytes. Micelles: surface-active agents or surfactants

Unit – IV **15 hours**

Chemotherapy and Drugs 7 hours

Introduction, requirement of an ideal synthetic drug, classification, synthesis

and uses of the following- Antipyretics–antipyrine, Anaesthetics-novacaine (local) and pentothal sodium(general) Antihistamines–chlorpheniramine maleate (CPM) Antimalarials–paludrine, Antibiotics- tetracyclin. Para pharmaceutical reagents–Benedict's reagent, Barfoed reagent.

Organic reagents in inorganic analysis 3 hours

Sensitivity, selectivity and specificity, advantages of organic reagents over inorganic reagents - Dimethyl glyoxime, 8-hydroxyquinoline(oxime)

Organometallic compounds 5 hours

Introduction, classification of organotransition metal complexes, 18 electron rule with respect to $[Fe(CO)_5]$, $[Ni(CO)_4]$, $[Mn(CO)_5]+$, ferrocene, structure and

bonding in metal olefins (Zeise's Salt)

BSc Chemistry-Semester VI

Title of the Course: DSC7 Chemistry Lab-7: Subject code: 21BSC6C6 CHE7P **Paper:1**

Course title	**DSC7:** Chemistry Lab-7		
Course Code	21BSC6C6 CHE7P	No. of Credits	**04**
Contact hours	**60 Hours (4 Hours/ week)**	Duration of SEA/Exam	**2 hours**
Formative Assessment Marks	**25**	Summative Assessment Marks	**25**

VI Semester Paper I **INORGANIC AND PHYSICAL CHEMISTRY PRACTICAL**

INORGANIC CHEMISTRY PRACTICAL

Part A1: Gravimetric analysis

1. Gravimetric determination of Fe in Fe and Cr solution.
2. Gravimetric estimation of Cu in Cu and Fe solution.

Part A2: Volumetric analysis

3. Volumetric estimation of Ca and Mg in Dolomite solution.
4. Volumetric estimation of Cu in Cu and Ni (German Silver).
5. Volumetric estimation of Fe in Cu and Fe solution.
6. Volumetric estimation of Zn in Cu and Zn solution.

Part B:PHYSICAL CHEMISTRY PRACTICAL

1. Study of variation of viscosity of a liquid with temperature, determine the constant A and B.
2. Determination of pH of acetic acid with sodium acetate buffer by pH metry method.
3. Determination of pKa value of phosphoric acid by pH meter.
4. Evaluation of Arrehenius parameter for the reaction between $K_2S_2O_8$ versus KI (first order)

Conductometry

5. Acid mixture versus NaOH
6. Weak acid with salt versus NaOH
7. Strong acid with salt versus NaOH

Potentiometry

8. Acid mixture versus NaOH
9. $KMnO_4$ versus FAS

Examination

In the practical examination, a batch of maximum 15 (Fifteen) students may be made. Anyone experiment from Part-A or B can be given by selection done by the students based on lots. Viva questions must be asked on any of the experiments prescribed in the practical syllabus only

Part A1: Distribution of marks

1. Accuracy: 12 (6+6) Marks
2. Technique and presentation: 03Marks
3. Reactions and Calculations: 05 Marks
4. Viva: 05 Marks

Total 25 marks

Deduction of marks for accuracy: ±0.4 CC – 6 marks, ± 0.6 CC- 04 marks,
±0.8 CC- 02 marks, ±1.0 CC - 01 marks. Above ±1.0 CC - 00 marks

Part A2: Distribution of marks
1. Accuracy: 12 Marks
2. Technique and presentation: 03Marks
3. Reactions and Calculations: 05 Marks
4. Viva: 05 Marks
Total 25 marks
Deduction of marks for accuracy: ±6mg – 12 marks, ± 7 mg- 10 marks, ±8mg - 08 marks, ±10 mg - 06 marks. Above 10mg - 00 marks

Part B: Distribution of marks
1. Accuracy: 12 Marks
2. Technique and presentation: 03marks
3. Graphs and Calculations: 05 Marks
4. Viva: 05 Marks
Total 25 marks

Deduction of marks for accuracy: Error up to 5% - 12 marks, 6 - 10% 09 marks, 11-15% 6 marks, 16 % or above 3 marks.

BSc Chemistry-Semester VI

Title of the Course: DSC8 Chemistry Lab-8: Subject code: 21BSC6C6 CHE8P **Paper:2**

Course title	**DSC8:** Chemistry Lab-8		
Course Code	21BSC6C6 CHE8P	No. of Credits	**04**
Contact hours	**60 Hours (4 Hours/ week)**	Duration of SEA/Exam	**2 hours**
Formative Assessment Marks	**25**	Summative Assessment Marks	**25**

VI Semester Paper II

ORGANIC CHEMISTRY AND SPECTROSCOPY PRACTICAL

Part A: Preparation (Two and three stages)

1. 2,4-Dinitrophenylhydrazine from chloronitrobenzene.
2. Anthranilic acid from phthalic acid.
3. Benzanilide from benzophenone.
4. Benzilic acid from benzoin.
5. Synthesis of Acridone.
6. Synthesis of Hydantoin.
7. Recording/predicting/downloading from websites the UV, IR,NMR spectra of the compounds prepared in organic chemistry practical

Part B: Quantitative analysis

8. Titrimetric estimation of amino acids.
9. Estimation of phenols.
10. Iodine value of oil (chloramine-T method).

Examination

In the practical examination, a batch of maximum 15 (Fifteen) students may be made. Anyone experiment from Part-A or B can be given by selection done by the students based on lots. Viva questions must be asked on any of the experiments prescribed in the practical syllabus only

Part A: Distribution of Marks:

1. Reaction & Mechanism-04 marks,
2. Calculation of theoretical yield – 02 mark,
3. Observed yield -10 marks,
4. M.P- 04 marks,
5. Viva-Voce-5 marks,

Total=25 marks.

Deduction of marks for observed yield: Less than 10% - 10 marks, 11-15% - 8 marks, 16-20% - 6 marks, 21-25 % - 4 marks & above 25% - zero mark.

1. Accuracy: 12 (6+6) Marks
2. Technique and presentation: 03Marks
3. Reactions and Calculations: 05 Marks
4. Viva: 05 Marks

Total 25 marks
Deduction of marks for accuracy: ±0.4 CC – 6 marks, ± 0.6 CC- 04 marks,
±0.8 CC- 02 marks, ±1.0 CC - 01 marks. Above ±1.0 CC - 00 marks

BSc Chemistry-Semester VI
Title of the Course: INT1 (Project work/Industrial visit and report)
Subject code: 21BSC6 INT1L

Course title	**INT1(Project work/Industrial visit and report)**		
Course Code	21BSC6 INT1L	No. of Credits	**02**
Contact hours	**32 Hours or 2 Hours/ week**	Duration of SEA/Exam	**2 hours**
Formative Assessment Marks	**25**	Summative Assessment Marks	**25**

Project work on various topics pertaining the entire B.Sc Chemistry syllabus can be given. A batch of maximum 5 students can be given a single topic for project.

Alternatively the students can be taken to visit different industries/ research institutes and detailed report incorporating the salient features of the visit to be submitted by students. Ideally the visit can be undertaken in between 6^{th} to 8^{th} week of the semester to enable the students to prepare the report before the semester end exam.

RANI CHANNAMMA UNIVERSITY, BELAGAVI

PROGRAM /COURSE STRUCTURE AND SYLLABUS

As per the Choice Based Credit System (CBCS) designed in accordance with Learning Outcomes-Based Curriculum Framework (LOCF) of National Education Policy (NEP) 2020

for

Bachelor of Science (Basic/Hons)
Chemistry (Revised)

Effective from Academic Year 2021-22 and onwards

RANI CHANNAMMA UNIVERSITY, BELAGAVI

BSc (Basic / Hons) Chemistry program-2021-22

BoS Committee-NEP-BSc (Hons) Chemistry

S.No.	Name & Address	Designation
1	Prof. K. Kantharaju Chairman & Professor, Dept. of Chemistry RCUB	**Chairman**
2	Dr. Abhay Kulkarni B.K. College, Belagavi.	**Member**
3	Dr. Vasulkar B.K. College, Belagavi.	**Member**
4	Dr. A.S. Jaganure KLEs, GIBASC college Nippani-37.	**Co-opted Members**
5	Dr. S.M.Deshpande GSS College, Tilakwadi Belagavi-06.	**Co-opted Members**

PREAMBLE

The objective of any programme at Higher Education Institute is to prepare their students for the society at large. The Rani Channamma University envisions all its programmes in the best interest of their students and in this endeavour, it offers a new vision to all its Under-Graduate courses. It embedded Learning Outcome-based Curriculum Framework (LOCF) for all its Under Graduate programmes.

The LOCF approach is envisioned to provide a focused, outcome-based syllabus at the undergraduate level with an agenda to structure the teaching-learning experiences in a more student-centric manner. The LOCF approach has been adopted to strengthen students' experiences as they engage themselves in the programme of their choice. The Under-Graduate Programmes will prepare the students for both, academia and employability.

Each programme vividly elaborates its nature and promises the outcomes that are to be accomplished by studying the courses. The programmes also state the attributes that it offers to inculcate at the graduation level. The graduate attributes encompass values related to well-being, emotional stability, critical thinking, social justice and also skills for employability. In short, each programme prepares students for sustainability and life-long learning.

The new curriculum of BSc (Hons) Chemistry offer courses in the areas of inorganic, organic, physical, industrial, materials and analytical. All the courses are having defined objectives and Learning Outcomes, which will help prospective students in choosing the elective courses to broaden their skills in the field of chemistry and interdisciplinary areas. The courses will train students with sound theoretical and experimental knowledge that suits the need of academics and industry. The course also offers ample of skills to pursue research as career in the field of chemistry and allied areas. As usual, B.Sc (Hons) Chemistry programme offered will continue to produce best minds to meet the demands of society.

The Rani Channamma University hopes the LOCF approach of the programme BSc (Hons) Chemistry will help students in making an informed decision regarding the goals that they wish to pursue in further education and life, at large.

Syllabus & Regulations Governing the Choice-Based Credit System (CBCS) for the Four-Year (Eight Semesters) B.Sc (Hons) Chemistry Program

Introduction to B.Sc (Hons.) Chemistry

The Choice Based Credit System (CBCS) provides an opportunity to a student to choose courses from the syllabus comprising Core, Elective, Vocational and Skill based courses. It offers a flexibility of programme structure while ensuring that the student gets a strong foundation in the subject and gains in-depth knowledge. The learning outcome based curriculum framework (LOCF) will provide students with a clear purpose to focus their learning efforts and enable them to make a well judged choice regarding the course they wish to study. This will suit the present day needs of students in terms of securing their paths towards higher studies or employment.

Programme Structure

Discipline Specific Core (DSC) Courses: First, second, third and fourth semesters will have one DSC course in each semester. Every DSC course has 6 credits and a practical component (4 credits for theory and 2 credits for practical).

Fifth and sixth semesters will have two Discipline Specific Core (DSC) courses in each semester. Every DSC course has 5 credits and has practical component (3 credits for theory and 2 credits for practical).

Seventh and eighth semesters will have three Discipline Specific Core (DSC) courses in each semester, three DSC courses have 6 credits each (4 credits for theory and 2 credits for practical).

Open Elective (OE) Courses: First, second, third and fourth semesters will have one OE course in each semester. Every OE course has 3 credits and with no practical component. OE courses are for other subject students (other than major and minor), and the candidate has to choose one OE from the each semester.

Vocational Courses: Fifth and sixth semester will have one each vocational courses of each 3 credits. In sixth semester students have 2 credits internship course (usually on research related work (basic knowledge about research, how to start, literature, journals, reviews and more can be taught and ask students to do and submit a final report for assessment). These courses can enable students to obtain the required basic research insights knowledge along with online resource or practical skills.

Discipline Specific Elective (DSE) Courses: Seventh and eighth semesters will have two DSE courses. In seventh semester will have one research methodology (3 credits) and another spectroscopy to meet the equivalence of first year master degree (4 credits).

In eighth semester again one DSE 4 credits theory and another research project for 4 credits need to perform one semester project work by selecting suitable problems by the mentors.

PROGRAMME OUTCOME from B.Sc (Hons.) Chemistry

The B.Sc.(Hons) programme in Chemistry is designed to develop in students in depth knowledge of the core concepts and principles that are central to the understanding of this core science discipline. Undergraduates pursuing this programme of study go through laboratory work that specifically develops their quantitative and qualitative skills, provides opportunities for critical thinking and team work, and exposes them to techniques useful for applied areas of scientific study.

- **Knowledge: Width and depth:**

  Students acquire theoretical knowledge and understanding of the fundamental concepts, principles and processes in main branches of chemistry, namely, organic, inorganic, physical, spectroscopy, analytical and biochemistry. In depth understanding is the outcome of transactional effectiveness and treatment of specialized course contents. Width results from the choice of electives that students are offered.

- **Laboratory Skills: Quantitative, analytical and instrument based:**

  A much valued learning outcome of this programme is the laboratory skills that students develop during the course. Quantitative techniques gained through hands on methods opens choice of joining the industrial laboratory work force early on. The programme also provides ample training in handling basic chemical laboratory instruments and their use in analytical and biochemical determinations. Undergraduates on completion of this programme can cross branches to join analytical, pharmaceutical, material testing and biochemical labs besides standard chemical laboratories.

- **Communication:**

  Communication is a highly desirable attribute to possess. Opportunities to enhance students' ability to write methodical, logical and precise reports are inherent to the structure of the programme. Techniques that effectively communicate scientific chemical content to large audiences are acquired through oral and poster presentations and regular laboratory report writing.

- **Capacity Enhancement:**

  Modern day scientific environment requires students to possess ability to think independently as well as be able to work productively in groups. This requires some degree of balancing. The chemistry honours programme course is designed to take care of this important aspect of student development through effective teaching learning process.

- **Portable Skills:**

  Besides communication skills, the programme develops a range of portable or transferable skills in students that they can carry with them to their new work environment after completion of chemistry honours programme. These are problem solving, numeracy and mathematical skills- error analysis, units and conversions, information retrieval skills, IT skills and rganizational skills. These are valued across work environments.

Structure of the Programme in B.Sc (Hons.) Chemistry

The programme includes Core Courses and Elective Courses. The Core Courses are all compulsory courses (DSC). There are three types of Elective Courses – Discipline Specific Elective (DSE), Open Elective (OE), and Skill Enhancement Courses (SEC), have sub skill based and value based. In addition there are two compulsory Ability Enhancement Courses (AECC). The Core, DSE and GE Courses are six credit courses; the SEC, AEC are four credit courses.

RANI CHANNAMMA UNIVERSITY

Vidyasangama, P-B, NH-4, Belagavi. -591156

Proposed Curricular and Credits Structure under Choice Based Credit System [CBCS] of Chemistry Major& One Minor Discipline Scheme for the Four Years Chemistry B.Sc. Undergraduate Honors Programme with effect from 2021-22

SEMESTER-I										
Category	**Course code**	**Title of the Paper**	**Marks**			**Teaching hours/week**			**Credit**	**Duration of exams (Hrs)**
			IA	**SEE**	**Total**	**L**	**T**	**P**		
L1	21BSC1L1LK1	Kannada	40	60	100	4	-	-	3	2
	21BSC1L1LFK1	Functional Kannada								
L2	21BSC1L2LEN2	English	40	60	100	4	-	-	3	2
	21BSC1L2LHI2	Hindi								
	21BSC1L2LSN2	Sanskrit								
	21BSC1L2LTE2	Telugu								
	21BSC1L2LUR2	Urdu								
DSC1	21BSC1C1CHE1L	Chemistry-1	40	60	100	4	-	-	4	2
	21BSC1C1CHE1P	Chemistry Lab-1	25	25	50	-	-	4	2	4
DSC1	Another Department Code	Another Department Course Title	40	60	100	4	-	-	4	2
			25	25	50	-	-	4	2	4
SEC1	21BSC1S1CS1	Digital Fluency	25	25	50	1	-	2	2	2
VBC1	21BSC1V1PE1	Physical Education-Yoga	25	-	25	-	-	2	1	-
VBC2	21BSC1V2HW1	Health & Wellness	25	-	25	-	-	2	1	-
OEC1	21BSC1O1CHE1	Chemistry in daily life	40	60	100	3	-	-	3	2
		Total Marks			**700**	**Semester Credits**			**25**	
Note: *All skill enhancement course (SEC) syllabus and title should be selected time to time notice from the university and/ or NEP committee accordingly.*										

SEMESTER-II										
Category	**Course code**	**Title of the Paper**	**Marks**			**Teaching hours/week**			**Credit**	**Duration of exams (Hrs)**
			IA	**SEE**	**Total**	**L**	**T**	**P**		
L3	21BSC2L3LK2	Kannada	40	60	100	4	-	-	3	2
	21BSC2L3FKL2	Functional Kannada								
L4	21BSC2L4EN2	English	40	60	100	4	-	-	3	2
	21BSC2L4HI2	Hindi								
	21BSC2L4SN2	Sanskrit								
	21BSC2L4TE2	Telugu								
	21BSC2L4UR2	Urdu								
DSC2	21BSC2C2CHE2L	Chemistry-2	40	60	100	4	-	-	4	2
	21BSC2C2CHE2P	Chemistry Lab-2	25	25	50	-	-	4	2	4
DSC2	Another Department Code	Another Department Course Title	40	60	100	4	-	-	4	2
			25	25	50	-	-	4	2	4
AECC 1	21BSC2AE1ES	Environmental Studies	20	30	50	1	-	2	2	2
VBC3	21BSC2V3PE2	Physical Education- Sports	25	-	25	-	-	2	1	-
VBC4	21BSC2V4NC1	NCC/NSS/R&R(S &G) / Cultural	25	-	25	-	-	2	1	-
OEC2	21BSC2O2CHE2	Molecules of life	40	60	100	3	-	-	3	2
Total Marks					**700**	**Semester Credits**			**25**	

Exit option with Certificate (50 credits)

SECOND YEAR; SEMESTER-III										
Category	**Course code**	**Title of the Paper**	**Marks**			**Teaching hours/week**			**Credit**	**Duration of exams (Hrs)**
			IA	**SEE**	**Total**	**L**	**T**	**P**		
L5	21BSC3L5LK3	Kannada	40	60	100	4	-	-	3	2
	21BSC3L5LFK3	Functional Kannada								
L6	21BSC3L6EN3	English	40	60	100	4	-	-	3	2
	21BSC3L6HI3	Hindi								
	21BSC3L6SN3	Sanskrit								
	21BSC3L6TE3	Telugu								
	21BSC3L6UR3	Urdu								
DSC3	21BSC3CHE3L	Chemistry-3	40	60	100	4	-	-	4	2
	21BSC3CHE3P	Chemistry Lab-3	25	25	50	-	-	4	2	4
DSC3	Another Department Code	Another Department Course Title	40	60	100	4	-	-	4	2
			25	25	50	-	-	4	2	4
SEC2	21BSC3S2AI	Artificial Intelligence	25	25	50	1	-	2	2	2
VBC5	21BSC3V5PE3	Physical Education- Sports	25	-	50	-	-	2	1	-
VBC6	21BSC3V6NC2	NCC/NSS/R&R (S&G) / Cultural	25	-	50	-	-	2	1	-
OEC3	21BSC3O3CHE3	Atomic structure, bonding and concepts in organic chemistry	40	60	100	3	-	-	3	2
Total Marks					**700**	**Semester Credits**			**25**	

SEMESTER-IV										
Category	**Course code**	**Title of the Paper**	**Marks**			**Teaching hours/week**			**Credit**	**Duration of exams (Hrs)**
			IA	**SEE**	**Total**	**L**	**T**	**P**		
L7	21BSC4L7LK4	Kannada	40	60	100	4	-	-	3	2
	21BSC4L7LFK4	Functional Kannada								
L8	21BSC4L8EN4	English	40	60	100	4	-	-	3	2
	21BSC4L8HI4	Hindi								
	21BSC4L8SN4	Sanskrit								
	21BSC4L8TE4	Telugu								
	21BSC4L8UR4	Urdu								
DSC4	21BSC4C4CHE4L	Chemistry-4	40	60	100	4	-	-	4	2
	21BSC4C4CHE4P	Chemistry Lab-4	25	25	50	-	-	4	2	4
DSC4	Another Department Code	Another Department Course Title	40	60	100	4	-	-	4	2
			25	25	50	-	-	4	2	4
AECC 2	21BSC4AE2CI	Constitution of India	20	30	50	1	-	2	2	2
VBC7	21BSC4V5PE4	Physical Education-Sports	25	-	25	-	-	2	1	-
VBC8	21BSC4V6NC3	NCC/NSS/ R&R(S&G) / Cultural	25	-	25	-	-	2	1	-
OEC4	21BSC4O4CHE4	Electrochemistry, corrosion and Metallurgy	40	60	100	3	-	-	3	2
			Total Marks		**700**	**Semester Credits**			**25**	

Exit option with Diploma (100 credits)

SEMESTER-V										
Category	**Course code**	**Title of the Paper**	**Marks**			**Teaching hours/week**			**Credit**	**Duration of exams (Hrs)**
			IA	**SEE**	**Total**	**L**	**T**	**P**		
Chemistry **as Major Discipline**										
DSC5	21BSC5C5CHE5L	Chemistry-5	40	60	100	3	-	-	3	2
	21BSC5C5CHE5P	Chemistry Lab-5	25	25	50	-	-	4	2	4
DSC6	21BSC5C5CHE6L	Chemistry-6	40	60	100	3	-	-	3	2
	21BSC5C5CHE6P	Chemistry Lab-6	25	25	50	-	-	4	2	4
DSC5	Another Department Code as a Minor Subject	Another Department Course Title	40	60	100	3	-	-	3	2
			25	25	50	-	-	4	2	4
VC1	21BSC5VC1	Vocational-I	40	60	100	3	-	-	3	2
VBC9	21BSC5V5PE5	Physical Education-Sports	25	-	25	-	-	2	1	-
VBC10	21BSC5V6NC4	NCC/NSS/R&R(S&G) / Cultural	25	-	25	-	-	2	1	-
SEC3	21BSC5S3CS	Cyber security	25	25	50	1	-	2	2	2
Total Marks					**650**	**Semester Credits**			**22**	

SEMESTER-VI										
Category	**Course code**	**Title of the Paper**	**Marks**			**Teaching hours/week**			**Credit**	**Duration of exams (Hrs)**
			IA	**SEE**	**Total**	**L**	**T**	**P**		
Chemistry **as Major Discipline**										
DSC7	21BSC6C6CHE7L	Chemistry-7	40	60	100	3	-	-	3	2
	21BSC6C6CHE7P	Chemistry Lab-7	25	25	50	-	-	4	2	4
DSC8	21BSC6C6CHE8L	Chemistry-8	40	60	100	3	-	-	3	2
	21BSC6C6CHE8P	Chemistry Lab-8	25	25	50	-	-	4	2	4
DSC6	Another Department Code as a Minor Subject	Another Department Course Title	40	60	100	3	-	-	3	2
			25	25	50	-	-	4	2	4
VC2	21BSC6VC2	Vocational-II	40	60	100	3	-	-	3	2
INT1	21BSC6 INT1L	Internship	25	50	75	-	-	2	2	2
VBC1	21BSC6V5PE5	Physical Education-Sports	25	-	25	-	-	2	1	-
VBC2	21BSC6V6NC4	NCC/NSS/R&R (S&G) / Cultural	25	-	25	-	-	2	1	-
SEC4	21BSC6S4PC	Professional communication	25	25	50	1	-	2	2	2
Total Marks					**700**	**Semester Credits**			**24**	
Total Marks for BSC Program					**-**	**Total Credits for BSC Program**			**146**	

*Internship between 5th and 6th semester with 3-4 weeks

Chemistry Subject as a Minor Discipline

SEMESTER-V										
Category	**Course code**	**Title of the Paper**	**Marks**			**Teaching hours/week**			**Credit**	**Duration of exams (Hrs)**
			IA	**SEE**	**Total**	**L**	**T**	**P**		
DSC5 As a Minor Subject	21BSC5C5CHE5L	Chemistry -5	40	60	100	3	-	-	3	2
	21BSC5C5CHE5P	Chemistry lab-5	25	25	50	-	-	4	2	4

SEMESTER-VI										
Category	**Course code**	**Title of the Paper**	**Marks**			**Teaching hours/week**			**Credit**	**Duration of exams (Hrs)**
			IA	**SEE**	**Total**	**L**	**T**	**P**		
DSC7 As a Minor Subject	21BSC6C6CHE7L	Chemistry -7	40	60	100	3	-	-	3	2
	21BSC6C6CHE7P	Chemistry Lab-7	25	25	50	-	-	4	2	4

Exit option with Bachelor of Science, B. Sc. Basic Degree (146 credits)

SEMESTER-VII										
Category	**Course code**	**Title of the Paper**	**Marks**			**Teaching hours/week**			**Credit**	**Duration of exams (Hrs)**
			IA	**SEE**	**Total**	**L**	**T**	**P**		
Chemistry **(General) as Major Discipline**										
DSC9	21BSC7C9CHE9L	Chemistry-9	40	60	100	4	-	-	4	2
	21BSC7C9CHE9P	Chemistry Lab-9	25	25	50	-	-	4	2	4
DSC10	21BSC7C10CHE10L	Chemistry-10	40	60	100	4	-	-	4	2
	21BSC7C10CHE10P	Chemistry Lab-10	25	25	50	-	-	4	2	4
DSC11	21BSC7C11CHE11L	Chemistry-11	40	60	100	4	-	-	4	2
	21BSC7C11CHE11P	Chemistry Lab-11	25	-	25	-	-	4	2	4
DSE1	21BSC7E1CHE1L	Spectroscopy-1	40	60	100	4	-	-	4	4
DSE2	21BSC7E2CHE2L	Research Methodology	40	60	100	3	-	-	3	4
Total Marks					**650**	**Semester Credits**			**25**	

SEMESTER-VIII										
Category	**Course code**	**Title of the Paper**	**Marks**			**Teaching hours/week**			**Credit**	**Duration of exams (Hrs)**
			IA	**SEE**	**Total**	**L**	**T**	**P**		
Chemistry **(General) as Major Discipline**										
DSC12	21BSC8C12CHE12L	Chemistry-9	40	60	100	4	-	-	4	2
	21BSC8C12CHE12P	Chemistry Lab-9	25	25	50	-	-	4	2	2
DSC13	21BSC8C13CHE13L	Chemistry-10	40	60	100	4	-	-	4	2
	21BSC7C13CHE13P	Chemistry Lab-10	25	25	50	-	-	4	2	2
DSC14	21BSC7C14CHE14L	Chemistry-11	40	60	100	4	-	-	4	2
	21BSC7C14CHE14P	Chemistry Lab-11	25	25	50	-	-	4	2	2
DSE3	21BSC8E3CHE3L	Spectroscopy-II	40	60	100	4	-	-	4	2
DSE4	21BSC8E4CHE4L	Research Project	50	100	150	-	-	8	4	2
Total Marks					**700**	**Semester Credits**			**26**	

Award of Bachelor of Science (Hons) degree in a Chemistry (197 credits)

Concept Note, Abbreviation Explanation and Coding:

Concept Note:

1. **CBCS** is a mode of learning in higher education which facilitates a student to have some freedom in selecting his/her own choices, across various disciplines for completing a UG/PG program.
2. A credit is a unit of study of a fixed duration. For the purpose of computation of workload as per UGC norms the following is mechanism be adopted in the University:
   One credit (01) = One Theory Lecture (L) period of one (1) hour.
   One credit (01) = One Tutorial (T) period of one (1) hour.
   One credit (01) = One practical (P) period of two (2) hours.
3. Course: paper/subject associated with AECC, DSC, DSEC, SEC, VBC, OEC, VC, IC and MIL
4. In case of **B.Sc**. **Once a candidate chose two courses/subjects of a particular two department in the beginning, he/she shall continue the same till the end of the degree/Hons, then there is no provision to change the course(s) and Department(s) in between.**
5. A candidate shall choose **one of the Department's courses as major and other Department course as minor in fifth and sixth semester and major course will get continued in higher semester.**
6. Wherever there is a practical there will be no tutorial and vice-versa
7. A major subject is the subject that's the main focus of Core degree/concerned.
8. A minor is a secondary choice of subject that complements core major/ concerned.
9. Vocational course is a course that enables individual to acquire skills set that are required for a particular job.
10. Internship is a designated activity that carries some credits involving more than **25 days** of working in an organization (either in same organization or outside) under the guidance of an identified mentor. Internship shall be an integral part of the curriculum.
11. **OEC: For non- chemistry students. Chemistry students have to opt for OEC from departments other than major and minor disciplines.**

Abbreviation Explanations:

1. AECC: Ability Enhancement Compulsory Course.
2. DSC: Discipline Specific Core Course.
3. DSEC: Discipline Specific Elective Course.
4. SEC: Skill Enhancement Course.
5. VBC: Value Based Course.
6. OEC: Open/Generic Elective Course
7. VC: Vocational Course.
8. IC: Internship Course
9. L1: Language One
10. L2: MIL
11. L= Lecture; T= Tutorial; P=Practical.
12. MIL= Modern Indian Language; English or Hindi or Telugu or Sanskrit or Urdu

Program Coding:

1. Code 21: Year of Implementation
2. Code BSC: BSC Program under the faculty of Applied Science of the University
3. Code 1: First Semester of the Program, (2 to 6 represent higher semesters)
4. Code AE: AECC, (C for DSC, S for SEC, V for VBC and O for OEC)
5. Code 1: First "AECC" Course in semester, similarly in remaining semester for such other courses
6. Code LK: Language Kannada, similarly Language English, Language Hindi, Language Telugu, Language Sanskrit, &Language Urdu
7. Code 1: Course in that semester.
8. CHE: Chemistry

Note: *All skill enhancement course (SEC) syllabus and title should be selected time to time notice from the university and/ or NEP committee accordingly.*

ASSESSMENT METHODS
Evaluation Scheme for Internal Assessment:

Theory:

Assessment Criteria	40 marks
1st Internal Assessment Test for30 marks 1 hr after 8 weeks and 2nd Internal Assessment Test for 30 marks 1 hr after 15 weeks. Average of two tests should be considered.	30
Assignment	10
Total	**40**

Assessment Criteria	25 marks
1st Internal Assessment Test for 20 marks 1 hr after 8 weeks and 2nd Internal Assessment Test for 20 marks 1 hr after 15 weeks. Average of two tests should be considered.	20
Assignment	05
Total	**25**

Practical:

Assessment Criteria	25 marks
Semester End Internal Assessment Test for 20 marks 2 hrs	20
Journal (Practical Record)	05
Total	**25**

Question Paper Pattern:

RANI CHANNAMMA UNIVERSITY
Department of Chemistry

Duration: 2hr ***I Semester B.Sc (****Chemistry****)***
Sub: **Code:** **Maximum Marks: 60**

a. Answer any SIX Questions from Question 1

b. Answer any Three in each Question from 2,3,4 and 5 questions.

Q.No.1.	**Answer any SIX Questions (Two question from each Unit)** **a.** **b.** **c.** **d,** **e.** **f.** **g.** **h.**	**2X6=12**
Q.No.2.	**(Should cover entire unit-I)** **a.** **b.** **c.** **d.**	**4X3=12**
Q.No.3.	**(Should cover Entire Unit-II)** **a.** **b.** **c.** **d.**	**4X3=12**
Q.No.4.	**(Should cover Entire Unit-III)** **a.** **b.** **c.** **d.**	**4X3=12**
Q.No.5.	**(Should cover Entire Unit-IV)** **a.** **b.** **c.** **d.**	**4X3=12**

SYLLABUS

BSc (Hons) Chemistry-Semester 1

Title of the Course: DSC-1: Subject code: 21BSC1C1CHE1L Paper: Chemistry – 1

Number of Theory Credits	**Number of lecture hours/ semester**	**Number of practical credits**	**Number of practical hours / semesters**	
4	**56**	**2**	**56**	
Content of Theory Course 1				**56hr**
Unit – 1 Analytical chemistry:				14
Definitions of analysis, determination, measurement, techniques and methods. Classification of analytical techniques. Choice of an analytical method - accuracy, precision, sensitivity, selectivity, method validation. Figures of merit of analytical methods and limit of detection (LOD), Limit of quantification (LOQ), linear dynamic range (working range). Errors and treatment of analytical data: Limitations of analytical methods – Errors: Determinate and indeterminate errors, absolute error, relative error, minimization of errors. Statistical treatment of finite samples -mean, median, range, standard deviation and variance. External standard calibration - regression equation (least squares method), correlation coefficient (R^2). Numerical problems **Titrimetric analysis:** Basic principle of titrimetric analysis. Classification, Preparation and dilution of reagents/solutions. Normality, Molarity and Mole fraction. Use of N1V1= N2V2 formula, Preparation of ppm level solutions from source materials (salts), conversion factors. **Acid-base titrimetry**: Theory, Titration curves for all type of acid- base titrations. Quantitative applications – selecting and standardizing a titrant, inorganic analysis - alkalinity, acidity. **Complexometric titrimetry**: Indicators for EDTA titrations - theory of metal ion indicators, titration methods employing EDTA - direct, back, displacement and indirect determinations, Application determination of hardness of water. **Redox titrimetry**: Balancing redox equations, calculation of the equilibrium constant of redox reactions, titration curves, Theory of redox indicators, calculation of standard potentials using Nernst equation. Applications. **Precipitation titrimetry**: Titration curves, titrants and standards, indicators for precipitation titrations involving silver nitrate- Volhard's and Mohr's methods and their differences.				
Unit - 2 ATOMIC STRUCTURE & PERIODICITY OF ELEMENTS **Atomic Structure:** Review of Rutherford's atomic model, Bohr's theory, Hydrogen atomic spectra. Derivation of radius and energy of an electron in hydrogen atom, limitations of Bohr's theory, dual behavior of matter and radiation, de Broglie's equations, Heisenberg Uncertainty principle and their related problems. Quantum mechanics. Derivation of Schrodinger's wave equation for hydrogen atom and				14

meanings of various terms in it. Significance of ψ and ψ^2. Radial and angular wave functions (atomic orbitals) and their distribution curves for 1*s*, 2*s*, 2*p*, 3*s*, 3*p* and 3*d* orbitals (Only graphical representation). Radial and angular nodes and their significance. Quantum numbers and their significance. Orbital s h a p e s of *s, p, d and f* atomic orbitals, nodal planes. Rules for filling electrons in various orbitals, Electronic configurations of the atoms (atomic number up to 54). Concept of exchange energy. Anomalous electronic configurations. IUPAC nomenclature of elements with atomic number greater than hundred. **(10 Lectures)** **Periodicity of elements:** Brief account on the following properties of elements with reference to s and p-block and trends in groups and periods. Effective nuclear charge, screening effect, Slater rules, atomic and ionic radii, ionization enthalpy, electron gain enthalpy, and electronegativity, Pauling / Allred-Rochow scales**.** Numerical problems are to be solved wherever applicable. **(04 Lectures)**	
Unit - 3 Bonding in Organic Molecules and Mechanism of Organic reactions	14
Classification and nomenclature of organic compounds, Hybridization, Shapes of organic molecules m Influence of hybridization on bond properties. **Nature of bonding in Organic molecules** Formation of Covalent bond, Types of chemical bonding, localized and delocalized, conjugation and cross conjugation, concept of resonance, electronic displacements: Inductive effect, Electromeric effect, Resonance and Hyper conjugation, cross conjugation explanation with examples. Concept of resonance, aromaticity, Huckel rule, anti-aromaticity explanation with examples. **(04 Lectures)**	
Mechanisms of Organic Reactions Notations used to represent electron movements and directions of reactions- curly arrows, formal charges. Types of bonds breaking- homolytic and heterolytic. Types of reagents-Electrophiles, nucleophiles, nucleophilicity and basicity. Types of organic reactions- substitution, addition, elimination, rearrangement and pericyclic reactions, explanation with examples. **Chemistry of Aliphatic hydrocarbons: Carbon-Carbon Sigma bonds** Chemistry of alkanes: Formation of alkanes, Wurtz reaction, Wurtz-Fittig reaction, Free radical substitutions Mechanism of Halogenation- relative reactivity and selectivity **Carbon-carbon pi bonds:** Formation of alkenes and alkynes by elimination reaction. Mechanism of E1, E2, E1cb reaction. Saytzeff and Hofmann eliminations. Addition of HBr to propene, Free radical addition of HBr to propene. Addition of halogens to alkenes-carbocation and halonium ion mechanism. Stereo-specificity of halogen addition. Ozonolysis mechanism - ozonolysis of propene. Diel –Alder reaction and Mechanism of Allylic and benzylic bromination and mechanism in propene,1-butene,1-toluene and ethylbenzebe **(05 Lectures)** **Nucleophilic substitution at saturated carbon.** Mechanism of S_N^1 and S_N^2reactions with suitable examples. Energy profile diagrams, Stereochemistry and factors effecting S_N^1 and S_N^2reactions. **Aromatic Electrophilic substitution reactions**, Mechanisms, σ and π complexes, Halogenation, Nitration, Sulphonation, Friedel Crafts alkylation and acylation with their mechanism. Activating and deactivating groups. Orientation influence, Ortho-para ratio. Aromatic nucleophilic substitution reaction: S_N^{Ar} and Benzyne mechanism with suitable examples. **(05 Lectures)**	

Unit - 4 GASES & LIQUIDS **Gaseous state:** Review of kinetic theory of gases, van der Waals equation of state Boyle temperature. Molecular velocity: Maxwell's Boltzmann distribution law of molecular velocities (most probable, average and root mean square velocities). Relation between RMS, average and most probable velocity and average kinetic energies (derivation not required), law of equipartition of energy. Collision frequency, collision diameter, Collision cross-section, collision number and mean free path and coefficient of viscosity, calculation of σ and η , variation of viscosity with temperature and pressure. Critical phenomena: Andrews isotherms of CO_2, critical constants and their determination Relation between critical constants and van der Waals equation (Derivation), continuity of states, law of corresponding states. Numerical problems are to be solved wherever applicable. **(7 Lectures)** **Solids** **Forms of solids:** Unit cell and space lattice, anisotropy of crystals, size and shape of crystals, Laws of Crystallography: Law of constancy of interfacial angles, Law of rational indices, Law of symmetry (Symmetry elements), Crystal systems, Bravais lattice types and identification of lattice planes. Miller indices and its calculation, X–Ray diffraction by crystals: Bragg's law and derivation of Bragg's equation, Single crystal and powder diffraction methods. Defects in crystals, glasses and liquid crystals. Numerical problems. **Distribution Law** Nernst Distribution Law - Statement and its derivation. Distribution constant, factors affecting distribution constant, validity of Distribution Law, Modification of distribution law when molecules undergo a) Association b) Dissociation. Application of Distribution Law in Solvent extraction. Derivation for simple and multiple extraction. Principles of distribution law in Parkes Process of desilverisation of lead. Numerical Problems. **(7 Lectures)**	14

LEARNING OUTCOMES / COURSE OUTCOMES:

Chemistry as Discipline Specific Course (DSC)

B.Sc. Semester – I; CHEMISTRY-1

After successful completion of three year degree program in Chemistry a student should be able to;

1. Describe the dual nature of radiation and matter; dual behaviour of matter and radiation, de Broglie's equations, Heisenberg Uncertainty principle and their related problems.
2. Quantum mechanics. Derivation of Schrodinger's wave equation. Orbital shapes of *s, p, d and f* atomic orbitals, nodal planes. Electronic configurations of the atoms.
3. Define periodicity, explain the cause of periodicity in properties, and classify the elements into four categories according to their electronic configuration.
4. Define atomic radii, ionisation energy, electron affinity and electronegativity, discuss the factors affecting atomic radii, describe the relationship of atomic radii with ionisation energy and electron affinity, describe the periodicity in atomic radii, ionization energy, electron affinity and electronegativity.
5. Explain bond properties, electron displacement effects (inductive effect, electrometric effect, resonance effect and Hyper conjugation effect). Steric effect and their applications in explaining acidic strength of carboxylic acids, basicity of amines.
6. Understand basic concept of organic reaction mechanism, types of organic reactions, structure, stability and reactivity of reactive intermediates.
7. Describe important characteristics of configurationally and conformational isomers. Practice and write conformational isomers of ethane, butane and cyclohexane.
8. Understand the various concepts of geometrical isomerism and optical isomerism. Describe CIP rules to assign E,Z notations and R& S notations. Explain D and L configuration and *threo* and *erythro* nomenclature.
9. Explain racemic mixture and racemisation, resolution of racemic mixture through mechanical separation, formation of diastereomers, and biochemical methods, biological significance of chirality.
10. Explain the existence of different states of matter in terms of balance between intermolecular forces and thermal energy of the particles. Explain the laws governing behavior of ideal gases and real gases. Understand cooling effect of gas on adiabatic expansion.
11. Describe the conditions required for liquefaction of gases. Realise that there is continuity in gaseous and liquid state.
12. Explain properties of liquids in terms of intermolecular attractions.
13. Understand principles of titrimetric analysis.
14. Understand principles of different type's titrations. Titration curves for all types of acids – base titrations.
15. Gain knowledge about balancing redox equations, titration curves, theory of redox indicators and applications.
16. Understand titration curves, indicators for precipitation titrations involving silver nitrate-Volhard's and Mohr's methods and their differences.
17. Indicators for EDTA titrations - theory of metal ion indicators. Determination of hardness of water.

CHEMISTRY LAB (Inorganic and Organic Analyses)

After studying this course and performing the experiments set in it student will be able to:

1. Understand and practice the calibration of glasswares (burette, pipette, volumetric flask).
2. Basic concepts involved in titrimetric analysis, primary standard substances, preparation of standard solutions.
3. Explain the principles of acid-base, redox and iodometric titrations.
4. Work out the stoichiometric relations based on the reactions involved in the titrimetric analysis.
5. Based on principles of titrimetric analysis student can perform
6. Describe the significance of organic quantitative analysiss.
7. Determine the amount of phenol, aniline, amide, ester and formaldehyde in a given solution by performing blank titration and main titrations.
8. Determine aspirin in the tablet by hydrolysis method.

References

1. Vogel's Textbook of Quantitative Chemical Analysis, J. Mendham, R.C. Denney, J.D.Barnes and M.J.K. Thomas, 6th edition, Third Indian Reprint, Pearson Education Pvt.Ltd.(2007).
2. Fundamentals of Analytical Chemistry, D.A. Skoog, D.M. West, Holler and Crouch, 8th edition, Saunders College Publishing, New York (2005).
3. Analytical Chemistry, G.D. Christian, 6th edition, Wiley-India (2007).
4. Practical Volumetric Analysis, Peter A C McPherson, Royal Society of Chemistry, Cambridge, UK (2015).
5. Morrison, R. N. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education)
6. Finar, I. L. *Organic Chemistry (Volume I),* Dorling Kindersley (India) Pvt. Ltd. (Pearson Education)
7. McMurry, J. E. *Fundamentals of Organic Chemistry,* 7th Ed. Cengage Learning India Edition, 2013
8. Organic Reaction mechanism by V. K. AhIuwalia and K. Parashar (Narosa Publishers).
9. Organic Chemistry by S. M. Mukherji, S. P. Singh and R. K. Kapoor. (Narosa Publishers)
10. A Guide book to mechanism in Organic Chemistry by Peter sykes. Pearson.

Chemistry Lab-1: List of experiments to be conducted
Course code: 21BSC1C1CHE1P; Paper: Chemistry Lab-1

PART-A Analytical Chemistry

1. Calibration of glassware, pipette, burette and volumetric flask.
2. Determination of sodium carbonate and sodium bicarbonate in a mixture.
3. Determination of alkali present in soaps/detergents
4. Determination of iron(II) using potassium dichromate
5. Determination of oxalic acid using potassium permanganate solution
6. Standardization of EDTA solution and determination of hardness of water
7. Determination of phenol by bromination method
8. Determination of aniline by bromination method.
9. Determination of acetamide by hydrolysis method.
10. Determination of ethyl benzoate by hydrolysis method.
11. Determination of aspirin in the tablet by hydrolysis method.

PART-B Organic Chemistry

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

- Standard solution is to be prepared by students for both in regular and in practical examination.

Examination

In the practical examination, in a batch at least 15 (Fifteen) students may be made. At least two experiments one from inorganic and one from organic experiments is given. Selection of experiments may be done by the students based on lots. Viva questions may be asked on any of the experiments prescribed in the practical syllabus**.** *Manual is not allowed in the examination.*

Deduction of marks for accuracy: : ±0.2 CC -15 marks, ± 0.4 CC- 12 marks, ±0.6 CC- 09 marks, ±0.8 CC- 06 marks, ±0.9 CC- 03 marks, above ±0.9 – zero marks.

Deduction of marks for accuracy: : ±0.2 CC -15 marks, ± 0.4 CC- 12 marks, ±0.6 CC- 09 marks, ±0.8 CC- 06 marks, ±0.9 CC- 03 marks, above ±0.9 – zero marks.

Final semester examination: one experiment from PART-A and PART-B given as a major and minor with 20 +15 marks allotment and subdivision made accordingly by the examiners.

BSc Semester 1 – B.Sc (Hons) Chemistry

Title of the Course: Open Elective (OE-1): CHEMISTRY IN DAILY LIFE

Course code: 21BSC1O1CHE1

Courses	Credits	No. of Classes/Week	Total No. of Lectures/ Hours	Duration of Exam in hrs	Internal Assessment Marks	Semester End Exam Marks	Total Marks
Theory	03	03	42	2	40	60	100

Content of Theory Course 1	**42 Hrs**
Unit – 1	14
Dairy Products: Composition of milk and milk products. Analysis of fat content, minerals in milk and butter. Estimation of added water in milk. Beverages: Analysis of caffeine in coffee and tea, detection of chicory in coffee, chloral hydrate in toddy, determination of methyl alcohol in alcoholic beverages. **Food additives, adulterants, and contaminants**- Food preservatives like benzoates, propionates, sorbates, disulphites. Artificial sweeteners: Aspartame, saccharin, dulcin, sucralose, and sodium cyclamate. Flavors: Vanillin, alkyl esters (fruit flavors), and monosodium glutamate. **Artificial food colorants:** Coal tar dyes and non-permitted colors and metallic salts. Analysis of pesticide residues in food.	
Unit - 2	14
Vitamins: Classification and Nomenclature. Sources, deficiency diseases, and structures of Vitamin A1, Vitamin B1, Vitamin C, Vitamin D, Vitamin E & Vitamin K1. **Oils and fats**: Composition of edible oils, detection of purity, rancidity of fats and oil. Tests for adulterants like argemone oil and mineral oils. Halphen test. **Soaps & Detergents**: Definition, classification, manufacturing of soaps and detergents, composition and uses	
Unit - 3	14
Chemical and Renewable Energy Sources: Principles and applications of primary & secondary batteries and fuel cells. Basics of solar energy, future energy storer. **Polymers:** Basic concept of polymers, classification and characteristics of polymers. Applications of polymers as plastics in electronic, automobile components, medical fields, and aerospace materials. Problems of plastic waste management. Strategies for the development of environment-friendly polymers.	

COURSE OUTCOMES: OEC-1 Chemistry

On completion of the course students will be able to:

- Understand the chemical constituents in various day to day materials using by a common man.
- Understand the chemical constituents in fertilizers, insecticides and pesticides, chemical explosives etc.
- Understand the chemical constituents in polymers, surface coatings etc.

References Text Books

1. B. K. Sharma: Introduction to Industrial Chemistry, Goel Publishing, Meerut (1998)
2. Medicinal Chemistry- Ashtoush Kar.
3. Analysis of Foods – H.E. Cox: 13.
4. Chemical Analysis of Foods – H.E. Cox and Pearson.
5. Foods: Facts and Principles. N. Shakuntala Many and S. Swamy, 4thed. New Age International (1998)
6. Physical Chemistry – P l Atkins and J. de Paula – 7thEd. 2002, Oxford University Press.

SKILL ENHANCEMENT COURSE IN CHEMISTRY

Title of the Course: SEC: Course code: 21BSC1E1CS1
Paper name : Digital Fluency

Courses	Credits	No. of Classes/Week	Total No. of Lectures/Hours	Duration of Exam in hrs	Internal Assessment Marks	Semester End Exam Marks	Total Marks
Theory	02	01	11	---	---	10	10
Practical		02	22	2	25	15	40
				Total	25	25	50

BSc Semester 2 – Chemistry (Hons)

Title of the Course: DSC-2: Subject code: 21BSC1C1CHE2L Paper: Chemistry – 2

Number of Theory Credits	**Number of lecture hrs/semester**	**Number of practical Credits**	**Number of practical hrs/ sem**
4	56	**2**	**56**
Content of Theory Course 2			**56Hrs**
Unit – 1 Chemical bonding, molecular structure & Periodicity of elements.			14
Ionic Bonding: General characteristics of ionic compounds. Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Born-Landé equation and calculation of lattice energy. Born-Haber cycle and its applications. **Polarizing power and polarizability:** Fajan's rules, ionic character in covalent compounds and percentage of ionic character. **Covalent bonding:** General characteristics of covalent compounds. VB approach, shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements. Concept of resonance and resonating structures of NO3 - , CO3 2- and SO4 2- . **Molecular Orbital Theory:** LCAO method, bonding and antibonding MOs and their characteristics for s-s, s-p and p-p combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules and ions of 1st and 2 nd periods and heteronuclear diatomic molecules such as CO, NO and NO + . Comparison of VB and MO approaches. Numerical problems are to be solved wherever applicable. (**14 Lectures**)			

Unit - 2 Acidic Strengths of Organic compounds and Stereochemistry:	14
Strengths of Organic acid and bases: Comparative study with emphasis on factors effecting pK values. Relative strength of aliphatic and aromatic carboxylic acids- Acetic acid and chloroacetic acid, acetic acid and propionic acid, acetic acid and Benzoic acid. Steric effect- Relative stability of trans and cis-2-butene. Concept of Confirmation analysis with referee to Ethane & n-Butane with staggered & eclipsed confirmations & energy profile diagrams. (**04 Lectures)** **Stereoisomersim**: Definition of stereoisomerism, conformational isomers and configurational isomers (distinction between conformation and configuration). Newman, Sawhorse and Fischer projection formulae and their interconversions. **Geometrical isomerism:** Definition, reason for geometrical isomerism, E and Z notation -CIP rules and examples, determination of configuration of geometric isomers by dipole moment method and anhydride formation method, *syn* and *anti* isomers in compounds containing C=N. **Optical isomerism:** Chirality/asymmetry, enantiomerism, diastereomerism and meso compounds. R and S notations (compounds with two asymmetric centers), D and L configurations and *threo* and *erythro* nomenclature, racemic mixture and racemization, **Resolution:** Definition, Resolution of racemic mixture by: i) Mechanical separation ii) Formation of diastereomers iii) Biochemical methods. Biological significance of chirality. Problems are to be solved wherever applicable. **(10 Lectures)**	
Unit - 3 Solids & Liquid crystals	14
Solids: Types of solids. Symmetry elements, unit cells, crystal systems, Bravais lattice types and identification of lattice planes. Laws of Crystallography - Law of constancy of interfacial angles, Law of rational indices. Miller indices. X-Ray diffraction by crystals, Bragg's law. Structures of NaCl, KCl and CsCl. Defects in crystals. **Liquid Crystals:** Explanation, classification with examples- Smetic, nematic, cholesteric, disc shaped and polymeric. Structures of nematic and cholesteric phasesmolecular arrangements in nematic and cholesteric liquid crystals. Applications of liquid crystals in LCDs and thermal sensing. Numerical problems are to be solved wherever applicable. (**7 Lectures**) **Chemical Kinetics:** Review of reaction rates, order and molecularity. Factors affecting rates of reaction: concentration pressure, temperature, catalyst, etc. Examples for different orders of reactions. Derivation of integrated rate equations for zero and second order reactions (both for equal and unequal concentrations of reactants). Half–life of a reaction (numerical problems). Methods for determination of order of a reaction by half life period and differential equation method. Effect of temperature on reaction rates,	

temperature coefficient, Concept of activation energy and its calculation from Arrhenius equation. Theories of Reaction Rates: Collision theory and Activated Complex theory of bimolecular reactions. Comparison of the two theories (qualitative treatment only). Numerical problems are to be solved wherever required. (**7 Lectures**)	
Unit - 4 ANALYTICAL CHEMISTRY	14
Liquid state: Molecular forces and general properties of liquids. **Surface tension:** surface tension, surface energy, effect of temperature on surface tension, shapes of liquid drops and soap bubbles, capillary action, determination of surface tension by capillary rise method, drop weight and drop number methods using stalagmometer. Effect of temperature on surface tension. Parachor, Additive and constitutive properties: atomic and structural parachor. Elucidation of structure of benzene and benzoquinone. **Viscosity:** Definition, viscosity coefficient, fluidity, molecular viscosity, relative viscosity and absolute viscosity, determination of coefficient of viscosity using Ostwald viscometer. Effect of temperature, size, weight, shape of molecules and intermolecular forces. **Refractive index:** Definition, Specific and molar refraction. Determination of refractive index using Abbe's refractometer. Additive and constitutive properties: Elucidation of structure of molecules. Numerical problems are to be solved wherever applicable. (**8 Lectures**) **Gravimetric Analysis:** Stages in gravimetric analysis, requisites of precipitation, theories of precipitation, factors influencing precipitation, co-precipitation and postprecipitation. Structure, specificity, conditions and applications of organic reagents such as salcylaldoxime, oxine, dimethyl glyoxime, cupron and cupferron in inorganic analysis. Advantages of organic reagents over inorganic reagents. (**6 Lectures**)	

Reference Books

1. **Inorganic Chemistry**

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: Principles of Structure and Reactivity*, Pearson Education India, 2006.
5. Shriver, D.F. & Atkins, P.W. *Inorganic Chemistry*, Oxford University Press.
6. Wulfsberg, G. *Inorganic Chemistry*, Viva Books Pvt. Ltd.
7. Rodgers, G. E. *Inorganic & Solid State Chemistry*, Cengage Learning India Ltd.,2008.
8. Mark Weller and Fraser Armstrong, 5th Edition, Oxford University Press (2011-2012) Adam, D.M. *Inorganic Solids: An introduction to concepts in solid-state structural chemistry*. John Wiley & Sons, 1974.
9. G.L. Miessler & Donald A. Tarr: *Inorganic Chemistry*, Pearson Publication.
10. Mahan, B.H. *University Chemistry* 3rd Ed. Narosa (1998).
11. Petrucci, R.H. *General Chemistry* 5th Ed. Macmillan Publishing Co.: New York(1985).

Organic Chemistry

1. Organic Chemistry-P. Y. Bruice, 7th Edition, Pearson Education Pvt. Ltd., New Delhi (2013).
2. Heterocyclic Chemistry- R. K. Bansal, 3rd Edition, New- Age International, New Delhi,2004
3. McMurry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India Edition, 2013.
4. Sykes, P. *A Guidebook to Mechanism in Organic Chemistry*, Orient Longman, New Delhi (1988).
5. Stereochemistry-Conformation and Mechanism-P. S. Kalsi, Wiley-Eastern Ltd, New Delhi.
6. Morrison, R.T. & Boyd, R.N. *Organic Chemistry*, Pearson, 2010.
7. Bahl, A. & Bahl, B.S. *Advanced Organic Chemistry*, S. Chand, 2010.
8. Graham Solomons, T. W., Fryhle, C.B. & Snyder, S.A. *Organic Chemistry*, John Wiley & Sons (2014).
9. Organic Chemistry Volume-I, II- I. L. Finar, 6th Edition, ELBS London (2004).
10. Organic Chemistry-F.A. Carey, 4th Edition, McGraw Hill (2000).
11. Modern Organic Chemistry - R.O.C. Norman and D.J. Waddington, ELBS, 1983
12. Understanding Organic reaction mechanisms - A. Jacobs, Cambridge Univ. Press, 1998
13. Organic Chemistry - L. Ferguson, Von Nostrand, 1985
14. Organic Chemistry - M. K. Jain, Nagin & Co., 1987
15. Organic Chemistry- Mehta and Mehta.

Physical Chemistry

1. Barrow, G.M. *Physical Chemistry* Tata McGraw-Hill (2007).
2. Castellan, G.W. *Physical Chemistry* 4th Ed. Narosa (2004).
3. Kotz, J.C., Treichel, P.M. & Townsend, J.R. *General Chemistry* Cengage Learning India Pvt. Ltd., New Delhi (2009).
4. P.W. Atkins: Physical Chemistry.
5. W.J. Moore: Physical Chemistry
6. Text Book of Physical Chemistry - P.L. Soni, S. Chand & Co.,1993
7. Text Book of physical chemistry - S. Glasstone, Mackmillan India Ltd., 1982
8. Principles of Physical Chemistry - B. R. Puri, L.R. Sharma and M.S.Patania, S.L.N. Chand & Co. 1987

9. Physical Chemistry - Alberty R. A. and Silbey, R.J.John Wiley and sons, 1992
10. Physical Chemistry - G.M.Barrow, Mc Graw Hill, 1986
11. Physical Chemistry(3rd Edition) - Gilbert W. Castilian, Narosa Publishing House,1985
12. Chemical Kinetics by K. J. Laidler, Tata McGraw Hill Publishing Co., New Delhi.
13. Kinetics and Reaction Mechanisms by Frost and Pearson, Wiley, New York.

Analytical Chemistry

1. Jeffery, G.H., Bassett, J., Mendham, J. & Denney, R.C. *Vogel's Textbook of Quantitative Chemical Analysis*, John Wiley & Sons, 1989.
2. Willard, H. H., Merritt, L.L., Dean, J. & Settle, F.A. *Instrumental Methods of Analysis*, 7th Ed. Wadsworth Publishing Company Ltd., Belmont, California, USA, 1988.
3. Christian, G.D; *Analytical Chemistry*, VI Ed. John Wiley & Sons, New York, 2004.
4. Harris, D. C. *Exploring Chemical Analysis*, Ed. New York, W.H. Freeman, 2001.
5. Skoog, D. A. Holler F.J. & Nieman, T.A. *Principles of Instrumental Analysis*, Cengage Learning India Ed.

Content of Chemistry Lab-2: List of Experiments to be conducted

Title of the Course: DSC-2: Subject code: 21BSC1C1CHE2P; Paper: Chemistry Lab-2

PART-A Inorganic Chemistry

TITRIMETRY

1. Determination of carbonate and hydroxide present in a mixture.
2. Determination of oxalic acid and sodium oxalate in a given mixture using standard $KMnO_4$/NaOH solution
3. Standardization of potassium permanganate solution and determination of nitrite in a water sample
4. Standardization of silver nitrate and determination of chloride in a water sample (demonstration)
5. Determination of alkali content in antacids
6. Determination of chlorine in bleaching powder using iodometric method.

GRAVIMETRY

1. Determination of Ba^{2+} as BaSO4
2. Determination of Cu^{2+} as CuSCN

PART-B Physical Chemistry

1. Safety Practices in the Chemistry Laboratory, Knowledge about common toxic chemicals and safety measures in their handling, cleaning and drying of glassware's
2. Determination of density using specific gravity bottle and viscosity of liquids using Ostwald's viscometer (Ethyl acetate, Toluene, Chloroform, Chlorobenzene or any other non-hazardous liquids).
3. Study of the variation of viscosity of sucrose solution with the concentration of a solute.
4. Determination of the density using specific gravity bottle and surface tension of liquids using Stalagmometer (Ethyl acetate, Toluene, Chlorobenzene, any other non-hazardous liquids.
5. Study of variation of surface tension of detergent solution with concentration.
6. Determination of specific and molar refraction by Abbes Refractometer. (Ethyl acetate, Methyl acetate, Ethylene Chloride).
7. Determination of the composition of liquid mixture by refractometry. (Toluene & Alcohol, Water & Sucrose).
8. Determination of partition/distribution coefficient - i) Acetic acid in water and cyclohexane.
   ii) Acetic acid in Water and Butanol. iii) Benzoic acid in water and toluene.

** Standard solution is to be prepared by students for both in regular and in practical examination.

Examination

In the practical examination, in a batch at least 15 (Fifteen) students may be made. At least two experiments one from inorganic and one from organic experiments is given. Selection of experiments may be done by the students based on lots. Viva questions may be asked on any of the experiments prescribed in the practical syllabus**.** *Manual is not allowed in the examination.*

Deduction of marks for accuracy: : ±0.2 CC -15 marks, ± 0.4 CC- 12 marks, ±0.6 CC- 09 marks, ±0.8 CC- 06 marks, ±0.9 CC- 03 marks, above ±0.9 – zero marks.

Deduction of marks for accuracy: : ±0.2 CC -15 marks, ± 0.4 CC- 12 marks, ±0.6 CC- 09 marks, ±0.8 CC- 06 marks, ±0.9 CC- 03 marks, above ±0.9 – zero marks.

Final semester examination: one experiment from PART-A and PART-B given as a major and minor with 20 +15 marks allotment and subdivision made accordingly by the examiners.

Open Elective Course-Chemistry

Title of the Course: OEC-2: Subject code: 21BSC1O2CHE2; Paper: Molecules of Life
B.Sc. Semester – II

Courses	Credits	No. of Classes/Week	Total No. of Lectures/Hours	Duration of Exam in hrs	Internal Assessment Marks	Semester End Exam Marks	Total Marks
Theory	03	03	42	2	40	60	100

UNIT I

Carbohydrates

Sugars, non-sugars, reducing and non-reducing sugars. Occurrence and general properties of glucose and fructose. Open chain and Haworth ring structures of glucose and fructose. Epimers, mutarotation and anomers.

Disaccaharides: Occurance of disaacharides (Sucrose, Maltose and Lactose). Glycosidic linkage in disaccharides. Ring structures of sucrose, maltose and lactose.

Polysaccharides: Starch – monomer units, glycosidic linkage, components-difference in their structure (explanation only) and solubility in water. Cellulose and glycogen– monosaccharide, glycosidic linkage, structure (explanation only). Biological importance of carbohydrates. **(8 Lecturers)**

Amino Acids, Peptides and Proteins

α- amino acids , general formula, zwitter ion form of α- amino acid, general formula. Isoelectric point and its importance. Classification of amino acids as essential and non-essential- examples. Configuration of optically active α-amino acids (found in proteins). Peptide bond. Proteins: classification based molecular shape –fibrous and globular, examples. Structure of protein – qualitative idea about primary, secondary, tertiary, and quaternary structures (diagrams not required). Denaturation of protein. **(6 lecturers)**

UNIT II

Enzymes and correlation with drug action

Mechanism of enzyme action, factors affecting enzyme action, Co-enzymes and cofactors and their role in biological reactions, Specificity of enzyme action (including stereospecificity),Enzyme inhibitors and their importance, phenomenon of inhibition (Competitive and Noncompetitive inhibition including allosteric inhibition). **(7 lecturers)**

Drug action- Receptor theory. Structure–activity relationships of drug molecules, binding role of –OH group, -NH_2 group, double bond and aromatic ring. **(4 lecturers)**

Oils and fats

Biological Importance of oils and fats. Fatty acids (saturated, unsaturated fatty acids, formation of triglycerides and general formula of triglycerides. Chemical nature of oils and fats-saponification, acid hydrolysis, rancidity and its prevention methods, refining of oils, hydrogenation of oils, drying of oils. Iodine value.

Introduction to lipids, classification. Biological importance of triglycerides, phospholipids, glycolipids, and steroids (cholesterol). **(6 lecturers)**

UNIT III

Nucleic Acids

Components of nucleic acids: Adenine, guanine, thymine and cytosine (Structure only), other components of nucleic acids, Nucleosides and nucleotides (nomenclature), Structure of polynucleotides; Structure of DNA (Watson-Crick model) and RNA (types of RNA), Genetic Code, Biological roles of DNA and RNA: Replication, Transcription and Translation. **(6 lecturers)**

Vitamins and Hormones

Classification and biological significance, source and structure of Vitamin A, B1(thiamine), B2(riboflavin), B6(pyridoxine), a-tocopherol, K1 (phylloquinone), C(ascorbic acid). Deficiency diseases of vitamins,

Hormones: definition, classification with examples, functions and deficiency diseases of hormones. **(5 lecturers)**

Course Outcome / Learning Outcome:

After studying this paper the student would be able to

1. Acquire knowledge about different types of sugars and their chemical structures.
2. Identify different types of amino acids and determine the structure of peptides.
3. Explain the actions of enzymes in our body and interpret enzyme inhibition.
4. Predict action of drugs. Depict the biological importance of oils and fats. Importance of lipids in the metabolism Differentiate RNA and DNA and their replication. Explain production of energy in our body.

Reference Books:

1. Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Finar, I. L. *Organic Chemistry* (*Volume 1*), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
3. Finar, I. L. *Organic Chemistry* (*Volume 2)*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
4. Nelson, D. L. & Cox, M. M. *Lehninger's Principles of Biochemistry 7th Ed.*,
5. W. H. Freeman. Berg, J.M., Tymoczko, J.L. & Stryer, L. *Biochemistry*, 2002.