# **CENTRAL UNIVERSITY OF HARYANA**

(Established under the Central Universities Act, 2009) (NAAC Accredited 'A' Grade)



# CBCS and LOCF and NEP-2020 Based Curriculum and Syllabi Of <u>M.Sc. Chemistry</u>

(w.e.f. 2021)

## DEPARTMENT OF CHEMISTRY SCHOOL OF BASIC SCIENCES

Approved by : Approval Status : Approval Date : BOS √ 09-09-2021 School Board √ 20-09-2021 Academic Council √ 12-10-2021

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### **VISION AND MISSION**

#### i) Vision and Mission of the University

#### Vision

To develop enlightened citizenship of a knowledge society for peace and prosperity of individuals, nation and the world, through promotion of innovation, creative endeavours, and scholarly inquiry.

#### Mission

To serve as a beacon of change, through multi-disciplinary learning, for creation of knowledge community, by building a strong character and nurturing a value-based transparent work ethics, promoting creative and critical thinking for holistic development and self-sustenance for the people of India. The University seeks to achieve this objective by cultivating an environment of excellence in teaching, research and innovation in pure and applied areas of learning.

#### **ii)** Vision and Mission of the Department

#### Vision

To establish a world-class teaching and research reputation of the department that contributes society through its innovative, creative and scholarly approach.

#### **Mission**

To educate the students by adopting highest academic and professional standards to meet the global competency in the field of chemical sciences. To establish and maintain a high quality of support, research facilities, multidisciplinary and skill-based learning opportunities to our staff, students and researchers to orient them to world class creative and innovative minds.

### 1. BACKGROUND

# i) NEP-2020 and LOCF an integrated Approach

Considering the curricular reforms as instrumental for desired learning outcomes, all the academic departments of Central University of Haryana made a rigorous attempt to revise the curriculum of undergraduate and postgraduate programmes in alignment with National Education Policy-2020 and UGC Quality Mandate for Higher Education Institutions-2021. The process of revising the curriculum could be prompted with the adoption of "Comprehensive Roadmap for Implementation of NEP-2020" in 32<sup>nd</sup> meeting of the Academic Council of the University held on April 23, 2021. The Roadmap identified the key features of the Policy and elucidated the Action Plan with well-defined responsibilities and indicative timeline for major academic reforms.

The process of revamping the curriculum started with the series of webinars and discussions conducted by the University to orient the teachers about the key features of the Policy, enabling them to revise the curriculum in sync with the Policy. Proper orientation of the faculty about the vision and provisions of NEP-2020 made it easier for them to appreciate and incorporate the vital aspects of the Policy in the revised curriculum focused on 'creating holistic, thoughtful, creative and well-rounded individuals equipped with the key 21st century skills' for the 'development of an enlightened, socially conscious, knowledgeable, and skilled nation'.

With NEP-2020 in background, the revised curricula articulate the spirit of the policy by emphasising upon—integrated approach to learning; innovative pedagogies and assessment strategies; multidisciplinary and cross-disciplinary education; creative and critical thinking; ethical and Constitutional values through value-based courses; 21st century capabilities across the range of disciplines through life skills, entrepreneurial and professional skills; community and constructive public engagement; social, moral and environmental awareness; Organic Living and Global Citizenship Education (GCED); holistic, inquiry-based, discovery-based, discussion-based, and analysis-based learning; exposure to Indian knowledge system, cultural traditions and classical literature through relevant courses offering 'Knowledge of India'; fine blend of modern pedagogies with indigenous and traditional ways of learning; flexibility in course choices; student-centric participatory learning; imaginative and flexible curricular structures to enable creative combination of disciplines for study; offering multiple entry and exit points initially in undergraduate programmes; alignment of Vocational courses with the International Standard Classification of Occupations maintained by the International Labour Organization; breaking the silos of disciplines; integration of extra-curricular and curricular aspects; exploring internships with local industry, businesses, artists and crafts persons; closer collaborations between industry and higher education institutions for technical, vocational and science programmes; and formative assessment tools to be aligned with the learning outcomes, capabilities, and dispositions as specified for each course. In case of UG programmes in Engineering and Vocational Studies, it was decided that the departments shall incorporate pertinent NEP recommendations while complying with AICTE, NBA, NSOF, International Standard Classification of Occupations, Sector Skill Council and other relevant agencies/sources. The University has also developed consensus on adoption of Blended Learning with 40% component of online teaching and 60% face to face classes for each programme.

The revised curricula of various programmes could be devised with concerted efforts of the faculty, Heads of the Departments and Deans of Schools of Study. The draft prepared by each department was discussed in series of discussion sessions conducted at Department, School and the University level. The leadership of the University has been a driving force behind the entire exercise of developing the uniform template and structure for the revised curriculum. The Vice Chancellor of the University conducted series of meetings with Heads and Deans to deliberate upon the vital parameters of the revised curriculum to formulate a uniform template featuring Background, Programme Outcomes, Programme Specific Outcomes, Postgraduate Attributes, Structure of Masters Course, Learning Outcome Index, Semester-wise Courses and Credit Distribution, Course-level Learning Outcomes, References

and Appendices. The experts of various Boards of Studies and School Boards contributed to a large extent in giving the final shape to the revised curriculum of each programme.

To ensure the implementation of curricular reforms envisioned in NEP-2020, the University has decided to implement various provisions in a phased manner. Accordingly, the curriculum may be reviewed annually.

# ii) About Chemistry

Chemistry is the science of matter and its transformations. It addresses fundamental questions about the observable matter, ranging from its components, structure, properties and interconversions. As a system of knowledge, Chemistry not only explains the existence and behavior of matter around and within us, but also empowers us to manipulate the matter into new and improved forms for our use. From the ancient practices of rasayan vidya and alchemy, modern chemistry has grown over centuries into a formidable science that touches all aspects of human life. Humanity's progress in the last three centuries is pivoted on the contributions of chemistry, chemical industry and associated endeavors. The range of influence of chemistry in our life spans from essentials such as food (agrochemicals, preservatives), shelter (cement, metals, alloys, polymers) and health (drugs, cosmetics, soap, toothpaste), to advancements such as textiles (polymers, leather), beverages (flavoring and fermentation), crime fighting (forensics), weaponry (explosives), space travel (fuel) and cosmology (element detection). The list can go on endlessly. The most visible contribution of chemistry to civilization is achieved by the advancements in modern medicine that was fuelled by organic chemistry. This led to significant improvements in the living standards, extension of human average life span and fighting of dangerous diseases such as cancer and microbial infections.

Chemistry is placed centrally between the other two major branches of science, namely physics and biology. Therefore, it is often called the *central science*. It influences the developments in these two broad realms of science as much as it is influenced by the discoveries in them. The fundamental importance of chemistry and chemical industry in

sustaining human civilization demands for a steady supply of trained and skilled manpower. Thus, it is unsurprising that it is an essential and integral department in higher education institutions.

Education in chemistry not only imparts the technical know-how about structure, reactions and properties of matter, but also empowers the learner to raise fundamental questions about various natural phenomena, address local issues and come up with sustainable solutions, identify areas of life where intervention of chemistry can bring about progress and imbibe and spread the spirit of free enquiry and scientific temper.

#### iii) About the Programme (Nature, Extent and Aims)

The Post-Graduate Programme in Chemistry will impart advanced knowledge of basic and applied chemical sciences to the graduates. It will prepare the students for taking up challenging assignments in academia and industry and also empower them with skill and knowledge for generating employment for their own and others. The Programme introduces the students to advanced developments in chemical sciences as well as in the field of other allied sciences, by providing them multidisciplinary and interdisciplinary courses. The design of choice-based curriculum can enrich students with analytical and problem-solving capabilities. It is designed to bring out the best of the abilities of each student, allow them to sharpen the scientific temper and be abreast with the contemporary developments in the area.

The programme includes a balanced combination of Core, Electives and Skill based Courses. The courses are designed in such a way to cover the entire spectrum of chemical sciences from fundamentals (that will bring admitted students from various backgrounds to a common level) to most recent advancements in the field (that will make them ready to take up challenging assignments in the real world).

The M.Sc. (Chemistry) Programme is of two years duration which is divided into four semesters. The teaching and learning in the Programme will involve theory (lectures), practicals, tutorial and seminar-based classes. During the whole programme about 40 %

syllabus of each course may be delivered via online mode and with a blended teachinglearning approach.

The curriculum will be taught through formal lectures with the aid of pre-made presentations, audio and video tools whenever necessary. Other teaching aids can also be used as and when required. The additional requirements like industrial visits, summer training and project work are also incorporated into the curriculum.

The Aims of the programme include

- To inculcate basic and advanced knowledge of chemical sciences among students.
- To provide higher education, disciplinary and inter/multi-disciplinary researchoriented knowledge to the students to make them lifelong learners.
- To provide a learned, skilled and creative pool of graduates who are ready to take up challenging assignments in different kinds of chemical industries, research institutions and academia.
- To mould responsible, proactive citizens who are equipped with scientific thinking and skills to address problems of their locality
- Adequate blend of theory, computation and hands-on experiments.
- Modernized lab courses close to recent/current research.

# iv) Qualification Descriptors (possible career pathways)

On successful completion of the M.Sc. Chemistry Programme, students of the department are expected to be ready to take up opportunities all around the world in areas that demand skills in chemical and allied sciences. As the chemical industry is enormously vast and diverse, numerous opportunities and challenges await the graduates. The graduates are expected to satisfactorily address the professional expectations, maintain a work-life balance and lead productive and meaningful lives. Some of the possible career paths for the postgraduate students may be: 1. Teaching and Research in academia

2. Research scientists in pharmaceutical and other chemical and material industries

3. Research scientists in other allied sciences

4. Entrepreneurship in chemical science-based ventures

5. Administrative Assignments in various government and private agencies

6. Chemist/Scientist/Technician assignments in any of the following industries: pharmaceutical, polymers, petrochemicals, materials sciences, nanotechnology, fuels, nonconventional energy, renewable resources, agrochemicals, fermentation and processing, paints and pigments, metallurgy, packaging, cosmetics, cements, natural products, forensics, explosives, and any other various allied branches of chemistry.

# 2. PROGRAMME OUTCOMES (POs)

The overall aims of the programme may be achieved by addressing its various components that are incorporated into the curriculum as described below. Each of these components is designed to lead to specific outcomes that are desired after the successful completion of the programme.

PO-No.	Component	Outcomes
PO-1	Basic Knowledge	Capable of delivering basic disciplinary knowledge
		gained during the programme.
PO-2	In-depth Knowledge	Capable of describing advanced knowledge gained
		during the programme.
PO-3	Critical thinking and	Capable of analyzing the results critically and applying
	Problem-Solving	acquired knowledge to solve the problems.
	abilities	
<b>PO-4</b>	Creativity and	Capable to identify, formulate, investigate and analyze
	innovation	the scientific problems and innovatively to design and
		create products and solutions to real life problems.
PO-5	Research aptitude	Ability to develop a research aptitude and apply
	and global	knowledge to find the solution of burning research
	competency	problems in the concerned and associated fields at
		global level.
PO-6	Holistic and	Ability to gain knowledge with the holistic and

	multidisciplinary	multidisciplinary approach across the fields.		
	education			
<b>PO-7</b>	Skills enhancement	Learn specific sets of disciplinary or multidisciplinary		
		skills and advanced techniques and apply them for		
		betterment of mankind.		
PO-8	Leadership and	Ability to learn and work in a group and capable of		
	Teamwork abilities	leading a team even.		
PO-9	Environmental and	Learn important aspects associated with environmental		
	human health	and human health. Ability to develop eco-friendly		
	awareness	technologies.		
PO-10	Ethical thinking and	Inculcate the professional and ethical attitude and		
	Social awareness	ability to relate with social problems.		
PO-11	lifelong learning	Ability to learn lifelong learning skills which are		
	skills and	important to provide better opportunities and improve		
	Entrepreneurship	quality of life. Capable to establish independent		
		startup/innovation center etc.		

# **3. PROGRAMME SPECIFIC OUTCOMES (PSOs)**

The post graduates shall be able to realise the following specific outcomes by the end of program studies:

Number	Programme Specific Outcomes
PSO-1	To acquire a thorough knowledge about basic theoretical concepts and experimental aspects of chemistry.
PSO-2	To fully develop the skills for using the earned knowledge within different branches of chemistry.
PSO-3	To develop the attitude for identifying and solving problems using chemistry
PSO-4	To develop the capability to search, acquire and apply recent developments in research field of chemical sciences to problems
PSO-5	To develop an overview of the role of chemical sciences and chemical industry in sustaining civilization
PSO-6	To develop the skill to adopt the learned principles in various settings and innovate with the importance of sustainability in mind, if necessary

# 4. Postgraduate Attributes

On completion of the post graduate programme in chemistry, students are expected to be equipped with the skills of creative, critical and rational thinking associated with chemistry and its use for human society. The following attributes are expected from the students of M.Sc. Chemistry:

No.	P.G. Attributes
PGA-1	Disciplinary knowledge and solid foundation
PGA-2	Creative, critical and reflective Thinking
PGA-3	Attitudes and values
PGA-4	Principle and practical aspects of different instruments
PGA-5	Research skills
PGA-6	Think beyond which were never thought before
PGA-7	Information/digital literacy
PGA-8	Team work

## **5. STRUCTURE OF MASTER'S COURSE**

The M.Sc. (Chemistry) Programme is of *two years* duration which is divided into four semesters. The programme under Choice-Based Credit System (CBCS) includes a balanced combination of *Core, Electives* and *Skill Courses* (**Table 1**).

As per P.G. Ordinance of Central University of Haryana, total credit requirement for completion of the programme shall be 96 ( $\pm$ 4).

Total credit requirement of the present P.G. programme is **98**, however, 2 additional credit may be earned by the interested students from six weeks industrial summer training course (Programme Structure).

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Sr. No.	Types of Courses	Nature	Total Credit 98 (2 optional)	% (approx)
1	Core Courses (CC)	Compulsory Courses	48	49
2	Elective Courses (EC)	Discipline Specific Elective Courses	32	33
		Discipline Centric Elective Courses	4	4
		Generic Elective Courses	8	8
3	Skilled-based courses/ Self-study based courses	Discipline Centric Skill Courses	4	4
4	Swachh Bharat Internship at Institute Level	Compulsory	2	2
	1	1	98	100
5	Industrial Summer Training	Optional for interested students	2 (additional)	2

#### **PROGRAMME STRUCTURE**

Choice Based Credit System (CBCS) Based Course Structure of M.Sc. Chemistry Programme (2 Years) in Consonance with NEP-2020 and LOCF

		YE	AR 1			YEAR 2 Specialization will be offered at the beginning of semester-III (Specializations: Inorganic Chemistry/Organic Chemistry/Physical Chemistry)					
Semester-I Semester-II						Semester-			Semester	-IV	
Course	Credit	Hrs.	Course	Credit	Hrs.	Course	Credit	Hrs.	Course	Credit	Hrs.
<mark>C-I</mark> (CC)	4	4	IC-II (CC)	4	4	Molecular Spectroscopy (CC)	4	4	Applications of Spectroscopy (CC)	4	4
CP-I (CC)	2	4	ICP-II (CC)	2	4	Research Methodology and Software Applications (CC)	2	2	Seminar (Research paper based) (CC)	2	2
<mark>0C-I</mark> (CC)	4	4	OC-II (CC)	4	4	IC-III/OC-III/PC-III (DSEC-1)	4	4	DCSC*	2	2
OCP-I (CC)	2	4	OCP-II (CC)	2	4	IC-IV/OC-IV/PC-IV (DSEC -2)	4	4	IC-V/OC-V/PC-1 (DSEC -3)	4	4
<mark>°C-I</mark> (CC)	4	4	PC-II (CC)	4	4	DCEC*	2	2	IC-VI/OC-VI/PC-VI (DSEC -4)	4	4
PCP-I (CC)	2	4	PCP-II (CC)	2	4						
DCEC*	2	2	DCSC*	2	2	Two Options (OPTION 1 a	Two Options (OPTION 1 and OPTION 2) are			continued	in Sem-IV
GEC <sup>§</sup>	4	4	GEC§	4	4	available. Students may cho beginning of Sem-III of second	•	e in the			
						OPTION 1			OPTION 1		
C-I: Inorganic	Chemistry-I		IC-II: Inorganic	Chemistry-	II	ICP-III/OCP-III/PCP-III (DSEP-I)	3	6	ICP-V/OCP-V/PCP-V (DSEP-3)	3	6
CP-I: Inorgan	ic Chemistry		ICP-II: Inorgani	c Chemistry	,	ICP-IV/OCP-IV/PCP-IV (DSEP-2)	3	6	ICP-VI/OCP-VI/PCP-VI (DSEP-4)	3	6
Practical-I DC-I: Organic	Chemistry-I		Practical-II OC-II: Organic	Chemistry-I	I	Seminar	2	2	Scientific Report Writing in Emerging/Advanced Areas	2	2
OCP-I: Organi	c Chemistry		OCP-II: Organic	Chemistry		OPTION 2			OPTION 2		
Practical-I PC-I: Physical PCP-I: Physica	•		Practical-II PC-II: Physical ( PCP-II: Physical			Dissertation—I (To be continued in Sem-IV)	8	14	Dissertation-II (Continued from Sem-III)	8	14
Practical-I       Practical-II         *Can be chosen from the list of courses available       *Can be chosen from the list of courses available         §GEC (Generic elective course)       *GEC (Generic elective course)         will be available for students from other Departments       will be available for students from other Departments				IC-III and IV: Inorganic Chemistr OC-III and IV: Organic Chemistry PC-III and IV: Physical Chemistry ICP-III and IV: Inorganic Chemist OCP-III and IV: Organic Chemist PCP-III and IV: Physical Chemist *Can be chosen from the list of	III and IV III and IV rry Practical-I ry Practical-II ry Practical-II	I and IV I and IV	OCP-V and VI: Organic Chemistry Practical-V and VI				
Total Credit and Hrs.	24	30	Total Credit and Hrs.	24	30	Total Credit and Hrs.	24	30	Total Credit and Hrs.	24	30

Total Marks for M.Sc. Programme = 2400

Total Core Course Credit = 48; Total Elective Course Credit = 50 (including 8 credit from GEC)

CC = Core Course; DCEC = Discipline Centric Elective Course; DSEC = Discipline Specific Elective Course; DSEP = Discipline Specific Elective Practical; DCSC = Discipline Centric Skill-based Course

Note:

- 1) A 02 Credit Summer Training (Optional) Self-study/Skill-based Course of six weeks will be available to interested students at the end of Semester-II.
- 2) A 02 Credit Course on the basis of Swachh Bharat Internship Programme will be available and mandatory to all students. The course will be allotted to the students in a batch-wise manner to earn max 02 credits in the duration of two years.
- 3) Students may choose option 2 in Sem-III on the basis of their interest in consultation with concerned faculty member(s). The students shall continue the dissertation work under the supervision of the same faculty member(s) to carry out second part of the dissertation in semester-IV.

4) Choice Based Credit System (CBCS) based M.Sc. Chemistry programme will be awarded with a minimum of 98 credit (compulsory), although it can be a maximum of 100 credit.

# **6. LEARNING OUTCOME INDEX**

#### 6.1 Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

PSOs ⇒	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
POs ↓						
P01			X	X	X	X
P02			$\checkmark$	$\checkmark$	X	
P03			$\checkmark$	$\checkmark$	$\checkmark$	
P04			$\checkmark$	$\checkmark$	$\checkmark$	
P05			$\checkmark$	$\checkmark$	$\checkmark$	
P06	X			$\checkmark$	$\checkmark$	
P07	X		X			
P08			$\checkmark$		$\checkmark$	
P09		X	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$
P010	X		$\checkmark$	$\checkmark$	$\checkmark$	
P011	X		$\checkmark$	$\checkmark$		

#### 6.2 <u>Core Courses</u> with PSOs

PSOs ⇒	PS01	PSO2	PSO3	PSO4	PSO5	PSO6
Core						
Course						
No. ↓						
CH-01	$\checkmark$	$\checkmark$	$\checkmark$	X	$\checkmark$	$\checkmark$
СН-02	$\checkmark$	$\checkmark$	$\checkmark$	X	$\checkmark$	$\checkmark$
СН-03	$\checkmark$	$\checkmark$	$\checkmark$	X	$\checkmark$	$\checkmark$
СН-04	$\checkmark$	$\checkmark$	$\checkmark$	X	$\checkmark$	$\checkmark$
СН-05	$\checkmark$	$\checkmark$	$\checkmark$	X	$\checkmark$	$\checkmark$
СН-06	$\checkmark$	$\checkmark$	$\checkmark$	X	$\checkmark$	$\checkmark$
CH-07	$\checkmark$	$\checkmark$	$\checkmark$	X	$\checkmark$	$\checkmark$
СН-08	$\checkmark$	$\checkmark$	$\checkmark$	X	$\checkmark$	$\checkmark$
СН-09	$\checkmark$	$\checkmark$	$\checkmark$	X	$\checkmark$	$\checkmark$
CH-10	$\checkmark$	$\checkmark$	$\checkmark$	X	$\checkmark$	$\checkmark$
CH-11	$\checkmark$	$\checkmark$	$\checkmark$	X	$\checkmark$	$\checkmark$
CH-12	$\checkmark$	$\checkmark$	$\checkmark$	X	$\checkmark$	$\checkmark$
СН-13	$\checkmark$	$\checkmark$	$\checkmark$	X	$\checkmark$	$\checkmark$
CH-14	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$
CH-15	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$
СН-16	$\checkmark$	$\checkmark$	X	$\checkmark$	$\checkmark$	$\checkmark$

#### 6.3 <u>Elective and Other Courses</u> with PSOs

PSOs ⇒	PS01	PSO2	PSO3	PSO4	PSO5	PSO6
Course No.						
Û						
CH-17	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$
CH-18	√	$\checkmark$	$\checkmark$	$\checkmark$	√	√
СН-19	√	√	$\checkmark$	X	√	$\checkmark$
СН-20	√	$\checkmark$	$\checkmark$	X	√	$\checkmark$
CH-21	√	$\checkmark$	$\checkmark$	X	$\checkmark$	$\checkmark$
СН-22	$\checkmark$	$\checkmark$	$\checkmark$	X	$\checkmark$	$\checkmark$
СН-23	$\checkmark$	$\checkmark$	$\checkmark$	X	$\checkmark$	$\checkmark$
CH-24	√	$\checkmark$	$\checkmark$	X	$\checkmark$	$\checkmark$
СН-25	√	$\checkmark$	$\checkmark$	X	$\checkmark$	$\checkmark$
СН-26	√	$\checkmark$	$\checkmark$	X	$\checkmark$	$\checkmark$
CH-27	√	$\checkmark$	$\checkmark$	X	$\checkmark$	$\checkmark$
СН-28	√	$\checkmark$	$\checkmark$	X	$\checkmark$	$\checkmark$
СН-29	√	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$
СН-30	√	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$
СН-31	√	$\checkmark$	$\checkmark$	X	$\checkmark$	$\checkmark$
СН-32	√	$\checkmark$	$\checkmark$	X	$\checkmark$	$\checkmark$
СН-33	√	$\checkmark$	$\checkmark$	X	$\checkmark$	$\checkmark$
СН-34	√	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$
СН-35	√	$\checkmark$	$\checkmark$	X	$\checkmark$	$\checkmark$
СН-36	$\checkmark$	$\checkmark$	$\checkmark$	X	$\checkmark$	$\checkmark$

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СН-37	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$
СН-38	√	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$
СН-39	√	$\checkmark$	$\checkmark$	X	$\checkmark$	$\checkmark$
CH-40	√	$\checkmark$	$\checkmark$	X	$\checkmark$	$\checkmark$
CH-41	√	$\checkmark$	$\checkmark$	X	$\checkmark$	$\checkmark$
CH-42	√	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$
CH-43	√	$\checkmark$	$\checkmark$	X	$\checkmark$	$\checkmark$
CH-44	√	$\checkmark$	$\checkmark$	X	$\checkmark$	X
CH-45	√	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$
CH-46	√	$\checkmark$	$\checkmark$	X	$\checkmark$	$\checkmark$
CH-47	√	$\checkmark$	$\checkmark$	X	$\checkmark$	$\checkmark$
CH-48	√	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$
СН-49	√	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$
CH-50	√	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$
CH-51	√	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$
CH-52	√	$\checkmark$	$\checkmark$	X	$\checkmark$	$\checkmark$
CH-53	√	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$
CH-54	√	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$
CH-55A	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$
CH-55B	√	$\checkmark$	$\checkmark$	$\checkmark$	√	$\checkmark$
CH-56	X	$\checkmark$	X	X	$\checkmark$	$\checkmark$
CH-57	√	$\checkmark$	X	X	√	$\checkmark$
CH-58	√	$\checkmark$	$\checkmark$	X	$\checkmark$	$\checkmark$
СН-59	√	$\checkmark$	$\checkmark$	X	$\checkmark$	$\checkmark$

СН-60	$\checkmark$	$\checkmark$	$\checkmark$	X	$\checkmark$	$\checkmark$
CH-61	$\checkmark$	$\checkmark$	$\checkmark$	X	$\checkmark$	$\checkmark$
СН-62	$\checkmark$	$\checkmark$	$\checkmark$	X	$\checkmark$	X

#### 7. SEMESTER-WISE COURSES AND CREDIT DISTRIBUTION

#### A. LIST OF COURSES OFFERED BY DEPARTMENT OF CHEMISTRY

Sr.	Course	Course Name	Course Code	Course	Credit	Semester
No	No			Туре		
		CORE COURSE				
1	CH-01	Inorganic Chemistry-I	SBS CH 010101 C 4004	CC	04	1
2	CH-02	Organic Chemistry-I	SBS CH 010102 C 4004	CC	04	1
3	CH-03	Physical Chemistry-I	SBS CH 010103 C 4004	CC	04	1
4	CH-04	Inorganic Chemistry Practical-I	SBS CH 010104 C 0042	CC	02	1
5	CH-05	Organic Chemistry Practical-I	SBS CH 010105 C 0042	CC	02	1
6	CH-06	Physical Chemistry Practical-I	SBS CH 010106 C 0042	СС	02	1
7	CH-07	Inorganic Chemistry-II	SBS CH 010207 C 4004	СС	04	11
8	CH-08	Organic Chemistry-II	SBS CH 010208 C 4004	СС	04	11
9	CH-09	Physical Chemistry-II	SBS CH 010209 C 4004	CC	04	П
10	CH-10	Inorganic Chemistry Practical-II	SBS CH 010210 C 0042	CC	02	11
11	CH-11	Organic Chemistry Practical-II	SBS CH 010211 C 0042	CC	02	11
12	CH-12	Physical Chemistry Practical-II	SBS CH 010212 C 0042	CC	02	11
13	CH-13	Molecular Spectroscopy	SBS CH 010313 C 4004	CC	04	111
14	CH-14	Research Methodology and Software	SBS CH 010314 C 2002	CC	02	111
		Applications				
15	CH-15	Applications of Spectroscopy	SBS CH 010415 C 4004	СС	04	IV
16	CH-16	Seminar (Research paper based)	SBS CH 010416 C 4004	СС	02	IV
	-	DISCIPLINE SPECIFIC ELECTI	VE COURSES (DSEC)	-	•	·
17	CH-17	Inorganic Chemistry-III	SBS CH 010301 DSE	DSEC	04	111
			4004			
18	CH-18	Inorganic Chemistry –IV	SBS CH 010302 DSE	DSEC	04	111
		(Advanced Inorganic Chemistry)	4004			
19	CH-19	Inorganic Chemistry Practical-III	SBS CH 010303 DSE	DSEC	03	111
			0063			

20	CH-20	Inorganic Chemistry Practical-IV	SBS CH 010304 DSE	DSEC	03	III
			0063			
21	CH-21	Organic Chemistry-III	SBS CH 010305 DSE	DSEC	04	111
		(Heterocycles and Natural Products)	4004			
22	CH-22	Organic Chemistry-IV	SBS CH 010306 DSE	DSEC	04	111
		(Reagents and Reactions)	4004			
23	CH-23	Organic Chemistry Practical-III	SBS CH 010307 DSE	DSEC	03	111
			0063			
24	CH-24	Organic Chemistry Practical-IV	SBS CH 010308 DSE	DSEC	03	111
			0063			
25	CH-25	Physical Chemistry-III	SBS CH 010309 DSE	DSEC	04	111
		(Statistical Mechanics, Surface and	4004			
		Interface Chemistry)				
26	CH-26	Physical Chemistry-IV	SBS CH 010310 DSE	DSEC	04	111
		(Solid State Chemistry & Electro-Analytical	4004			
		Methods)				
27	CH-27	Physical Chemistry Practical-III	SBS CH 010311 DSE	DSEC	03	III
			0063			
28	CH-28	Physical Chemistry Practical-IV	SBS CH 010312 DSE	DSEC	03	111
			0063			
29	CH-29	Inorganic Chemistry-V	SBS CH 010413 DSE	DSEC	04	IV
			4004			
30	CH-30	Inorganic Chemistry-VI	SBS CH 010414 DSE	DSEC	04	IV
		(Frontiers in Inorganic Chemistry)	4004			
31	CH-31	Inorganic Chemistry Practical-V	SBS CH 010415 DSE	DSEC	03	IV
	<u></u>		0063	2050		
32	CH-32	Inorganic Chemistry Practical-VI	SBS CH 010416 DSE	DSEC	03	IV
22	011.00		0063	DOFO	0.1	D./
33	CH-33	Organic Chemistry-V	SBS CH 010417 SE 4004	DSEC	04	IV
24	<u> </u>	(Organic Synthesis)		DCEC	0.4	
34	CH-34	Organic Chemistry-VI	SBS CH 010418 DSE 4004	DSEC	04	IV
25	CH-35	(Medicinal Chemistry)			02	1)/
35	CH-35	Organic Chemistry Practical-III	SBS CH 010419 DSE	DSEC	03	IV
36	CH-36	Organic Chemistry Practical-IV	0063 SBS CH 010420 DSE	DSEC	03	IV
30	СП-30	Organic Chemistry Practical-IV	0063	DSEC	03	IV
37	CH-37	Physical Chomistry V	SBS CH 010421 DSE	DSEC	04	IV
5/	LU-21	Physical Chemistry-V (Polymer & Surface Chemistry)	4004	DSEC	04	IV
20	CH 20	Physical Chemistry-VI			04	IV
38	CH-38		SBS CH 010422 DSE 4004	DSEC	04	IV
20	CH 30	(Applied Electrochemistry)			02	IV
39	CH-39	Physical Chemistry Practical-V	SBS CH 010423 DSE 0063	DSEC	03	IV

2CH-42Scientific Report Writing in Emerging/Advanced Areas2002DSEC02IVDISCIPLINE CENTRIC ELECTVE COURSES (DCEC)3CH-43Reaction Mechanism: Structure and ReactivitySBS CH 010101 DCEC 2002DCEC02I4CH-44Nuclear ChemistrySBS CH 010102 DCEC 2002DCEC02I5CH-45Green ChemistrySBS CH 010303 DCEC 2002DCEC02III6CH-46Carbohydrate Chemistry and its Applications FrontiersSBS CH 010304 DCEC 2002DCEC02III7CH-47Asymmetric Catalysis: Fundamentals to FrontiersSBS CH 010305 DCEC 2002DCEC02III9CH-48Supramolecular Chemistry 2002SBS CH 010307 DCEC 2002DCEC02III9CH-50Molecular Magnetism 2002SBS CH 010201 DCSC 2002DCEC02III9CH-51Computational Chemistry 2002SBS CH 010201 DCSC 2002DCSC02II1CH-51Computational Chemistry Pharmaceutical Ingredients Pharmaceutical Ingredients 2002SBS CH 010403 DCSC 2002DCSC02II2CH-54Chemistry of Industrially Important ProductsSBS CH 010311 SE 2002DCSC02IV4CH-54Dissertation-ISBS CH 01011 SE 2002DSEC8III6CH-558Dissertation-IISBS CH 010311 SE 2002DSEC8IV7 <td< th=""><th>40</th><th>СН-40</th><th>Physical Chemistry Practical-VI</th><th>SBS CH 010424 DSE 0063</th><th>DSEC</th><th>03</th><th>IV</th></td<>	40	СН-40	Physical Chemistry Practical-VI	SBS CH 010424 DSE 0063	DSEC	03	IV
In the Emerging/Advanced Areas2002EditeImage: Constraint of the system of the sys	41	CH-41	Seminar		DSEC	02	
DISCIPLINE CENTRIC ELECTIVE COURSES (DCEC)           3         CH-43         Reaction Mechanism: Structure and Reactivity         SBS         CH 010101         DCEC         02         I           4         CH-44         Nuclear Chemistry         SBS         CH 010102         DCEC         02         I           5         CH-45         Green Chemistry         SBS         CH 010303         DCEC         DCEC         02         III           6         CH-46         Carbohydrate Chemistry and its Applications         SBS         CH 010305         DCEC         DCEC         02         III           7         CH-47         Asymmetric Catalysis: Fundamentals to Frontiers         SBS         CH 010305         DCEC         DCEC         02         III           2002         Supramolecular Chemistry         SBS         CH 010306         DCEC         DCEC         02         III           9         CH-48         Supramolecular Chemistry         SBS         CH 010307         DCEC         DCEC         02         III           00         CH-50         Molecular Magnetism         SBS         CH 010308         DCEC         DCEC         02         III           1         CH-51         Computational Chemistry	42	CH-42	Scientific Report Writing in	SBS CH 010426 DSE	DSEC	02	IV
3       CH-43       Reaction Mechanism: Structure and Reactivity       SBS CH 010101 DCEC 2002       DCEC       02       I         4       CH-44       Nuclear Chemistry       SBS CH 010102 DCEC 2002       DCEC       02       I         5       CH-45       Green Chemistry       SBS CH 010303 DCEC 2002       DCEC       02       III         6       CH-46       Carbohydrate Chemistry and its Applications       SBS CH 010304 DCEC 2002       DCEC       02       III         7       CH-47       Asymmetric Catalysis: Fundamentals to Frontiers       SBS CH 010305 DCEC 2002       DCEC       02       III         9       CH-48       Supramolecular Chemistry       SBS CH 010306 DCEC 2002       DCEC       02       III         9       CH-49       Introduction to Nanomaterials       SBS CH 010307 DCEC 2002       DCEC       02       III         9       CH-50       Molecular Magnetism       SBS CH 010201 DCSC 2002       DCEC       02       III         1       CH-51       Computational Chemistry       SBS CH 010201 DCSC 2002       DCSC       02       II         2       CH-52       Analytical Techniques in Chemistry       SBS CH 010201 DCSC 2002       DCSC       02       I         3       CH-53 <td< th=""><th></th><th></th><th></th><th></th><th></th><th></th><th></th></td<>							
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2002200220025CH-45Green ChemistrySBSCH010303DCECDCEC02III6CH-46Carbohydrate Chemistry and its ApplicationsSBSCH010304DCECDCEC02III7CH-47Asymmetric Catalysis: Fundamentals to FrontiersSBSCH010305DCECDCEC02III8CH-48Supramolecular ChemistrySBSCH010306DCECDCEC02III9CH-49Introduction to NanomaterialsSBSCH010307DCECDCEC02III0CH-50Molecular MagnetismSBSCH010308DCECDCEC02III1CH-51Computational ChemistrySBSCH010202DCSC02II2CH-52Analytical Techniques in ChemistrySBSSBSCH010202DCSC02II2CH-53Process Development of Active Pharmaceutical IngredientsSBSCH010304DCSC02IV3CH-54Chemistry of Industrially Important ProductsSBSCH010314DSCDCSC02IV5CH-55ADissertation-ISBSCH010314SEDSEC8IV001408DCSCDCSC02IV0140801408DSEC02IV7CH-56Activities at Department and UniversitySBSCH010404 D	43	CH-43			DCEC	02	I
And the second	44	CH-44	Nuclear Chemistry		DCEC	02	1
200220027CH-47Asymmetric Catalysis: Fundamentals to FrontiersSBS CH 010305 DCEC 2002DCEC02III8CH-48Supramolecular ChemistrySBS CH 010306 DCEC 2002DCEC02III9CH-49Introduction to NanomaterialsSBS CH 010307 DCEC 2002DCEC02III9CH-49Introduction to NanomaterialsSBS CH 010307 DCEC 2002DCEC02III0CH-50Molecular MagnetismSBS CH 010308 DCEC 2002DCEC02III1CH-51Computational ChemistrySBS CH 010201 DCSC 2002DCSC02II2CH-52Analytical Techniques in Chemistry Pharmaceutical IngredientsSBS CH 010403 DCSC 2002DCSC02II3CH-54Chemistry of Industrially Important ProductsSBS CH 010403 DCSC 2002DCSC02IV5CH-55ADissertation-ISBS CH 010311 SE 001408DSEC8III6CH-55BDissertation-IISBS CH 010412 SE 001408DSEC8IVSWACHH BHARAT INTERNSHIP PROGRAMME (MANDATORY)7CH-56Activities at Department and UniversitySBS CH 010105 DCSCDCSC02I-IV	45	CH-45	Green Chemistry		DCEC	02	111
Frontiers2002Image: constraint of the second	46	CH-46	Carbohydrate Chemistry and its Applications		DCEC	02	III
9CH-49Introduction to Nanomaterials2002DCEC02III9CH-49Introduction to NanomaterialsSBS CH 010307 DCEC 2002DCEC02III0CH-50Molecular MagnetismSBS CH 010308 DCEC 2002DCEC02III1CH-51Computational ChemistrySBS CH 010201 DCSC 2002DCSC02II2CH-52Analytical Techniques in ChemistrySBS CH 010202 DCSC 2002DCSC02II3CH-53Process Development of Active Pharmaceutical IngredientsSBS CH 010403 DCSC 2002DCSC02IV5CH-54Chemistry of Industrially Important ProductsSBS CH 010311 SE 001408DSEC8III6CH-55BDissertation-ISBS CH 010412 SE 001408DSEC8IV7CH-56Activities at Department and UniversitySBS CH 010105 DCSCDCSC02I-IV	47	CH-47			DCEC	02	111
Image: constraint of the system of the sys	48	CH-48	Supramolecular Chemistry		DCEC	02	111
Image: constraint of the state of the sta	49	CH-49	Introduction to Nanomaterials		DCEC	02	111
1CH-51Computational ChemistrySBS CH 010201 DCSC 2002DCSC02II2CH-52Analytical Techniques in ChemistrySBS CH 010202 DCSC 2002DCSC02II3CH-53Process Development of Active Pharmaceutical IngredientsSBS CH 010403 DCSC 2002DCSC02IV4CH-54Chemistry of Industrially Important ProductsSBS CH 010404 DCSC 2002DCSC02IVDISSERTATION5CH-55ADissertation-ISBS CH 010311 SE 001408DSEC8III6CH-55BDissertation-IISBS CH 010412 SE 001408DSEC8IVSWACHH BHARAT INTERNSHIP PROGRAMME (MANDATORY)7CH-56Activities at Department and UniversitySBS CH 010105 DCSCDCSC02I-IV	50	CH-50	Molecular Magnetism		DCEC	02	111
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Pharmaceutical Ingredients2002Image: constraint of the sector of t	52	CH-52	Analytical Techniques in Chemistry		DCSC	02	11
Products       2002       Image: Constraint of the second	53	CH-53	· · · · · · · · · · · · · · · · · · ·		DCSC	02	IV
5       CH-55A       Dissertation-I       SBS CH 010311 SE 001408       DSEC       8       III         6       CH-55B       Dissertation-II       SBS CH 010412 SE 001408       DSEC       8       IV         SWACHH BHARAT INTERNSHIP PROGRAMME (MANDATORY)         7       CH-56       Activities at Department and University       SBS CH 010105 DCSC       DCSC       02       I-IV	54	CH-54	, , , ,		DCSC	02	IV
oldoldoldoldoldCH-55BDissertation-IISBS CH 010412 SE 001408DSEC8IVSWACHH BHARAT INTERNSHIP PROGRAMME (MANDATORY)SWACHH BHARAT INTERNSHIP PROGRAMME (MANDATORY)T CH-56Activities at Department and UniversitySBS CH 010105 DCSCDCSC02I-IV		· 	DISSERTAT	ION			·
6       CH-55B       Dissertation-II       SBS CH 010412 SE 001408       DSEC       8       IV         SWACHH BHARAT INTERNSHIP PROGRAMME (MANDATORY)         7       CH-56       Activities at Department and University       SBS CH 010105 DCSC       DCSC       02       I-IV	55	CH-55A	Dissertation-I		DSEC	8	111
SWACHH BHARAT INTERNSHIP PROGRAMME (MANDATORY)           7         CH-56         Activities at Department and University         SBS CH 010105 DCSC         DCSC         02         I-IV	56	CH-55B	Dissertation-II	SBS CH 010412 SE	DSEC	8	IV
7CH-56Activities at Department and UniversitySBS CH 010105 DCSCDCSC02I-IV			SWACHH BHARAT INTERNSHIP PR		<b>'</b> )		
Level 2002	57	CH-56		•	-	02	I-IV
SUMMER TRAINING (OPTIONAL)			SUMMER TRAINING	(OPTIONAL)		·	

58	CH-57	Summer Training (6 weeks)	SBS CH 010206 DCSC 2002	DCSC	02	At end of Sem-II
		GENERIC ELECTIVE COURSE (GEC) [FOR ST	UDENTS OF OTHER DEPARTMEI	NTS]		
59	CH-58	Chemistry for Biologists	SBS CH 010101 GE 4004	GEC	04	I
60	CH-59	Chemistry of Materials	SBS CH 010102 GE 4004	GEC	04	I
61	CH-60	Medicinal Chemistry	SBS CH 010203 GE 4004	GEC	04	II
62	CH-61	Drug, Design and Discovery	SBS CH 010304 GE 4004	GEC	04	111
63	CH-62	Magneto Nuclear Chemistry	SBS CH 010405 GE 4004	GEC	04	IV

#### **B. GEC COURSE**

• Various available GEC courses can be selected from other Departments.

## **8. COURSE-LEVEL LEARNING OUTCOMES**



### **THEORY COURSES**

Cours	se No:	Course Name:				Course C	ode:		
CH-01	1	Inorganic Chemist	ry-l			SBS CH 0	10101 C 4	1004	
Batch	:	Programme:	Semester:	L	Т	Р	Credit	Contac	t Hrs.
2021								per We	eek: 04
Onwa	rds	M.Sc. Chemistry		4 0	0	4	Total H	lrs.: 60	
Total	Evaluatio	n Marks: 100	Examinatio	n Duration:		3 Hrs.			
CIE:	<b>30</b> Mar		<b>Pre-requisite of course:</b> Basic understanding of coordination chemistry, geometries and bonding models of coordination compounds.						
TEE:	<b>70</b> Mar	1	-						
Cours Objec		To provide students properties of coord		-		•		•	nagnetic
Cours	e	After completing th	is course, stu	dent is expe	cted to le	arn the foll	owing:		
Outco	omes:	CO1: Knowledge of		•		•			
		CO2: Understandin	0 0			•			
		CO3: Application th							ounds
		CO4: Understandin							
		CO5: Introduction t			ls and rel	ated compo	ounds		
		CO6: Scope of inor	ganic compou	nds					
			C	OURSE SYLI	ABUS				
NOTE	:								
i)Ques	stion no.	1 is compulsory and	to be set fron	n the entire s	syllabus. I	t will have	four sub-pa	arts and	students need
to ans	swer any t	two. Each part carrie	s three and ha	alf marks.					
ii) Qu	estion no	s. 2 to 5 are to be s	et from all fo	our units one	from ea	ch. Every q	uestion wi	ll have th	nree sub-parts
	tudents n	eed to answer any tw	vo sub-parts o	of each quest	tion. Each	i part carrie	s three and	d half ma	
Unit				Contents	5				Contact Hrs.
No.									
I		ULAR SYMMETRY, P						<i>.</i>	15
		try elements and s					•		
	-	ic compounds, grou	• • •				•	•	
		molecular symmet		•			-		
		ntations of symme			-	-		gonality	
11		n and its importance NG MODELS	, character ta	bies and the	ie use in s	speciroscop	<i>у</i> у.		15
"		bond theory, elect	roneutrality	nrincinle an	d its limi	tations Cry	ustal field	theory	CT CT
		g of <i>d</i> -orbitals in c						•	
		ments. Ligand field		-	• •			-	
		c (homo & hetero	••					•	
		t of chemical hardnes		•	•	•		,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	
	Loncepi			alagi anis (th	atonnic sy	stemsj.			

		1						
III	CHEMISTRY OF NON-TRANSITION ELEMENTS	15						
	Structures and acidic behaviour of boron halides, Types and nomenclature of boron							
	hydrides (boranes), Wade's polyhedral skeleton electron pair theory (PSEPT). W. N.							
	Lipscomb's STYX rules and semi-topological structures of boranes. Preparation, and							
	properties of boron hydrides, carboranes, metalloboranes and metallocarboranes.							
	Preparation, structure and properties of boron-nitrogen, phosphorous-nitrogen,							
	phosphorus-oxygen, sulphur-nitrogen compounds, silicates, interhalogens,							
	chlorofluorocarbons, pseudohalides and noble gas compounds.							
IV	METAL CARBONYLS, NITROSYLS AND CLUSTERS	15						
	Molecular orbital diagram of carbonyl, classification of metal carbonyls, bonding in metal							
	carbonyl, valence electron count (EAN rules), preparation and properties of mononuclear							
	and polynuclear carbonyl complexes, bond lengths and stretching frequencies, carbonylate							
	ions, carbonyl hydride complexes, isolobal fragments, structure and important reactions of							
	transition metal nitrosyls. Bonding, preparation and properties of dinuclear metal cluster							
	(dirhenium complex [Re <sub>2</sub> Cl <sub>8</sub> ] <sup>2-</sup> ions), trinuclear and hexanuclear metal clusters.							
Sugg	ested Readings:							
	1. G. L. Miessler, P. J. Fischer and D. A. Tarr, Inorganic Chemistry, 5 <sup>th</sup> Edition. <i>Pearson</i> , 2014.							
	2. B. N. Figgis and M. A. Hitchman, Ligand Field Theory and Its Applications, <i>Wiley-India</i> , 2010.							
	3. J. E. House, Inorganic Chemistry, Academic Press, 2008.							
	4. J. E. Huheey, E. A. Keiter, R. L. Keiter, O. K. Medhi, Inorganic Chemistry: Principles of	Structure and						
	Reactivity, 4 <sup>th</sup> Edition. <i>Pearson Education</i> , 2006.							
	5. F. A. Cotton and Wilkinson, Advanced Inorganic Chemistry, 6 <sup>th</sup> Edition. <i>John Wiley</i> , 2006.							
	6. D. F. Shriver, P.W. Atkins and C.H. Landgord, Inorganic Chemistry, 3rd Edition. Oxford Un	niversity Press,						
	1998.	, ,						
	7. N. N. Greenwood and E. A. Earnshaw; Chemistry of elements, 2 <sup>nd</sup> Edition. <i>Butterworth- Heiner</i>	mann, 1997.						
	8. J. D. Lee, Concise Inorganic Chemistry, Chapman & Hall Ltd., 1991.							
	9. F. A. Cotton, Chemical Applications of Group Theory, 3 <sup>rd</sup> edition. <i>John Wiley &amp; Sons</i> , 1990.							
ł	,							

Cours	e No:	Course Name:				Course	Code:					
CH-07	7	Inorganic Chemis	try-ll			SBS CH (	010207 C 4	4004				
Batch:	:	Programme:	Semester:	L	Т	Р	Credit	Contac	t Hrs.			
2021								per We	eek:	04		
Onwai	rds	M.Sc. Chemistry	II	4	0	0	4	Total H	Irs.:	60		
Total I	Evaluatio	Lation Marks: 100 Examination Duration: 3 Hrs.										
CIE:	<b>30</b> Mai	rks	Pre-requisite	Pre-requisite of course: Basic understanding of electronic spectroscopy								
TEE:	<b>70</b> Mai	·ks	magnetic pro				-		-			
Course		To provide an unde	erstanding of	the funda	mentals	of electror	nic spectro	scopy of	coor	dination		
Object	<i>jectives</i> compounds and advanced topics such as, reaction mechanism in complexes. Introd chemistry and its theory will be discussed as well.											
Course		After completing this	•			n the follo	wing:					
Outco		<b>CO1:</b> Understanding		•			-					
		CO2: Knowledge of to	erm symbols ar	nd Orgel dia	agrams							
		CO3: Able to predict	the allowed tra	ansitions be	etween va	rious mole	cular energ	gy levels				
		CO4: Understanding		-								
		<b>CO5:</b> Understanding				•						
		<b>CO6:</b> Understanding	of metal-liganc	l equilibria	in solutio	n in coordi	nation com	pounds				
			CO	URSE SYL	LABUS							
NOTE:	:											
i) Que	stion no	. 1 is compulsory an	d to be set fro	m the enti	re syllabu	is. It will h	ave seven :	sub-parts	and s	tudents		
need t	o answe	r any four. Each part	carries three a	nd half ma	rks.							
ii) Que	estion no	s. 2 to 5 are to be set	t from all four ι	units one fr	om each.	Every ques	stion will ha	ve three	sub-pa	arts and		
studer	nts need	to answer any two su	ub-parts of eac	h question.	Each par	t carries se	ven marks.					
Unit				Content	S				Cont	act Hrs.		
No.												
I		ONIC SPECTROSCOP								15		
		oscopic ground states			-							
		ymbols, splitting of S,										
	-	al, correlation, Orge		-	-							
	-	tates), calculations o	. , .		-	•		•				
	-	netal to ligand and lig	-	•	•	-						
		iration in optically ac				chemical ii	nformation	•		4.5		
II		ONIC SPECTROSCOP						de tra en la C		15		
		eview of different ty			-			-				
_			mperature independence paramagnetism, anomalous magnetic errors and its application to explain magnetic properties of									
			-		-	-						
	frustra	nation compounds.	wagnetic inte	ractions in	i polynu	liear syste	ms, cantin	ig, spin				
111		ON MECHANISMS O		METAL CO						15		
111	_				-		labile com	anloves		12		
	Energy	profile of a reactio	ii, reactivity 0		inpiexes,	mert and		ipiexes,				

	kinetic application of valence bond and crystal field theories, kinetics of octahedral substitution, acid hydrolysis, factors affecting acid hydrolysis, base hydrolysis, conjugate	
	base mechanism, direct and indirect evidences in favour of conjugate mechanism, anation	
	reactions, reactions without metal ligand bond cleavage. Substitution reaction in square	
	planar complexes, trans effect, mechanism of the substitution reactions. Redox reactions,	
	mechanism of inner-outer sphere type reactions, cross reactions and Marcus-Hush theory.	
IV	METAL-LIGAND EQUILIBRIA IN SOLUTION	15
	Stepwise and overall formation constants and their interaction, trends in stepwise	
	constants, factors influencing stability of metal complexes dependent on size and charge,	
	metal class, ligand preference, nature of transition metal ions, basic strength, chelate effect,	
	ring size, steric strain, macrocyclic effect, thermodynamic and kinetic stability,	
	determination of formation constants by pH-metry and spectrophotometry.	
Sugge	sted Readings:	
1.	G. L. Miessler, P. J. Fischer and D. A. Tarr, Inorganic Chemistry, 5 <sup>th</sup> Edition. <i>Pearson</i> , 2014.	
2.		
3.	J. E. House, Inorganic Chemistry, Academic Press, 2008.	
4.		
5.		Structure and
	Reactivity, 4 <sup>th</sup> Edition. <i>Pearson Education</i> , 2006.	
	F. A. Cotton and Wilkinson, Advanced Inorganic Chemistry, 6 <sup>th</sup> Edition. <i>John Wiley</i> , 2006.	
7.		niversity Press,
	1998.	
	N. N. Greenwood and E. A. Earnshaw; Chemistry of elements, 2 <sup>nd</sup> Edition. <i>Butterworth- Heiner</i>	mann, 1997.
9.	J. D. Lee, Concise Inorganic Chemistry, Chapman & Hall Ltd., 1991.	

Course No:	Course Name:					Course C	ode:				
CH-17	Inorganic Chemi	stry-III				SBS CH 0	SBS CH 010301 DSE 4004				
Batch:	atch: Programme: Sen		nester: L		Т	Р	Credit	Contact Hrs.			
2021	M.Sc. Chemistry							per Week:	04		
Onwards		II	I 🗌	4	0	0	4	Total Hrs.:	60		
Total Evaluati	on Marks:100		Exami	nation Duratio	n: 3	Hrs.					
CIE: 30 Ma TEE: 70 Ma	-	-	<b>Pre-requisite of course:</b> To provide basic theory of various spectroscopic techniques (IR, Raman, ESR, Mossbauer, NQR) and photophysical processes involved in molecules.								
Course	To provide expos	sure wit	ith various spectroscopic techniques required to characterize inorganic complexes and								
Objectives	coordination components			•		•		-			
Course	After completing	this cou	rse, stu	dent is expecte	ed to learn the f	following:					
Outcomes:	<b>CO1</b> : Basic unders	standing	g of IR, F	Raman, ESR, M	ossbauer, NQR	Ū.					
	<b>CO2</b> : Basic theory	O2: Basic theory of photophysical processes									
	CO3: To understand spin orbit coupling										
	CO4: To get insight of bond strength										
	CO5: Mechanistic	CO5: Mechanistic phenomenon									
	<b>CO6</b> : Application of	of IR, Ra	Raman, ESR, Mossbauer, NQR								

#### **COURSE SYLLABUS**

NOTE:

i)Question no. 1 is compulsory and to be set from the entire syllabus. It will have seven sub-parts and students need to answer any four. Each part carries three and half marks.

ii) Question nos. 2 to 5 are to be set from all four units one from each. Every question will have three sub-parts and students need to answer any two sub-parts of each question. Each part carries seven marks.

Unit No.	Contents	Contact Hrs.
I	INFRARED AND RAMAN SPECTROSCOPY	15
	Molecular vibrations, force constants, molecular vibrations and absorption of Infrared	
	radiations. Raman spectroscopy, polarized Raman lines. Use of symmetry considerations to	
	determine the number of lines in IR and Raman Spectra. Structural studies involving IR and	
	Raman Spectroscopy of coordination compounds containing the following molecules/ions and	
	ligands: NH <sub>3</sub> , H <sub>2</sub> O, OH, SO <sub>4</sub> <sup>2-</sup> , ClO <sub>4</sub> <sup>-</sup> , COO <sup>-</sup> , NO <sub>2</sub> , CN <sup>-</sup> , SCN <sup>-</sup> , NO, O <sub>2</sub> , halides, acetylacetone.	
	Hydrogen bonding and infrared spectra, metal ligand and related vibrations. Application of	
	resonance Raman spectroscopy to structural elucidation of the active sites of heme and non-	
	heme oxygen carriers.	
II	ELECTRON SPIN RESONANCE SPECTROSCOPY	15
	Basic principle, selection rules, presentation of spectra, origin and interpretation of Lande's	
	factor(g), factor affecting 'g-value', isotropic and anisotropic hyperfine coupling, super	
	hyperfine coupling, spin-orbit coupling, line shape, zero field splitting, Kramer's degeneracy,	

	quadrupolar interactions, ESR analysis of organic compounds, transition metal complexes of	
	vanadium, chromium, manganese, iron, copper, cobalt and iron.	
	Application of ESR spectroscopy: structure determination, interpretation of ESR spectra of	
	simple organic radicals like benzene, naphthalene, toluene and xylene radical ions, study of	
	unstable paramagnetic species.	
III	MÖSSEBAUER AND NUCLEAR QUADRUPOLE RESONANCE SPECTROSCOPY	15
	Mössebauer Spectroscopy: Introduction to Mössebauer effect-Basic principles, recoilless	
	emission & absorption of $\gamma$ -rays. Mössebauer experiment - Instrumentation, scheme of	
	Mössebauer spectrometer, Mössebauer spectrum. Isomer shift, quadrapole splitting and	
	hyperfine interactions, application of Mössebauer effect to the investigations of compounds	
	of iron and tin.	
	Nuclear Quadrupole Resonance Spectroscopy: Principle, nuclear quadrupole resonance	
	experiment, structural information from NQR spectra, Interpretation of nuclear quadrupole	
	coupling constants.	
IV	PHOTOINORGANIC PHENOMANON	15
	Interaction of electromagnetic radiation with matter, Grotthus-Draper law, Stark-Einstein law of photochemical equivalence and Lambert-Beer's law, quantum yield, photodissociation, predissociation, photochemical reactions: photoreduction, photooxidation, photodimerization, photochemical substitution, photoisomerization, photosensitized reaction. Electronic transition, Frank-Condon principle, selection rules, electronically excited singlet states, life time of electronically excited state, construction of Jablonski diagram, electronic	
	transitions and intensity of absorption bands, photophysical pathways of excited molecular	
	system (radiative and non-radiative), chemiluminescence, phosphorescence and	
	fluorescence.	
Sugges	sted Readings:	
1.	D. L. Pavia, G. M. Lampman, G. S. Kriz and J. R. Vyvyan; Introduction to Spectroscopy, 5 <sup>th</sup> Edition. Ceng	<i>age</i> India, 2015.
2.		
3.	N. J. Turro, V. Ramamurthy and J. C. Scaiano; Modern Molecular Photochemistry of Organic I University Science, 2010.	Molecules, 1 <sup>st</sup> Edition.
4.	K. Nakamoto; Infrared and Raman Spectra of Inorganic and Coordination Compounds, Part A and 2008.	B, 6 <sup>th</sup> Edition. <i>Wiley</i>

5. J. R. Lakowicz, Principles of Fluorescence Spectroscopy, 3<sup>rd</sup>Edition. *Springer*, New York, 2006.

6. C. N. Banwell and E. M. McCash; Fundamentals of Molecular Spectroscopy, 4<sup>th</sup>Edition. *Tata McGraw Hill*, 1994.

7. I. Ninomiya and T. Naito; Photochemical Synthesis, 1<sup>st</sup>Edition. *Academic Press*, New York, 1989.

Course	No: Co	urse Name:				Course	Code:			
CH-18	Inc	organic Chemis	try–IV			SBS CH (	010302 DS	E 4004		
	(Ac	dvanced Inorga	nic Chemistr	·y)						
Batch:	Pro	gramme:	Semester:	L	Т	Р	Credit	Contact Hrs.		
2021								per Week:	04	
Onward	ds M.S	Sc. Chemistry	111	4	0	0	4	Total Hrs.:	60	
Total Ev	otal Evaluation Marks: 100		Examination	n Duration:		3 Hrs.				
	<b>30</b> Marks <b>70</b> Marks		Pre-requisit bioinorganic				•	ordination ch	emistry	
Course		provide exposi	ure of (i) var	ious hiomo	lecules co	ntainina r	netal ions	that comprise	s man	
Objectiv	<b>ves</b> imp ber lev	portant proteins neficial for stude el.	and enzymes ents who had	; (ii) supram minimal exp	olecular c posure of l	hemistry o bioinorgan	f life. This o ic chemistry	course would b	e highl	
Course		er completing th	-	•	cted to le	arn the fol	lowing:			
Outcom		1: Importance o		0,						
		2: Understandin	•	•		nctions				
		3: Knowledge of	•							
			olications of bioinorganic chemistry with regard to energy applications							
			ng of supramolecular chemistry of life f supramolecular accessories in biological systems							
	CO	6: Knowledge of	r supramolecu	lar accessor	ies in biol	ogical syste	ems			
			C	OURSE SYL	LABUS					
IOTE:										
)Questic	on no. 1 is co	ompulsory and t	o be set from	the entire sy	yllabus. It	will have s	even sub-pa	arts and studer	nts need	
o answe	er any four. I	Each part carries	s three and ha	lf marks.						
ii) Ques	stion nos. 2	to 5 are to be s	set from all fo	ur units one	e from ea	ch. Every c	uestion wi	ll have three s	ub-part	
and stu	dents need	to answer any ty	wo sub-parts o	of each ques	tion. Each	n part carrie	es seven ma	arks.		
Unit				Contents	5			Cont	act Hrs.	
No.										
I	BIOINORGA	NIC CHEMISTRY	<b>/-I</b>						15	
	Mineral orig	gin of life. Arch	aeal, Eucarial	and Bacter	rial doma	in. Transiti	on metal i	ons in		
	•••	etallobiomolecu					•			
	examples: H	lemoglobin, My	oglobin, Hemo	ocyanin, Her	nrythrin,	Cytochrom	es, Fe-S pro	oteins,		
(	Cytochrome	P-450, Nitroph	orin, Ferritin,	blue copper	r proteins	, di- and ti	ricopper pro	oteins,		
(	ceruloplasm	in.								
II	BIOINORGA	NIC CHEMISTRY	/-11						15	
1	•	e, peroxidase,		•			•			
	hydrogenas	e, methane	monooxygen	ase, dioxy	genases,	dehydra	tase, nitrog	enase,		
							10.	·		
	molybdenur	n containing o	xidase and re	eductase cla	ass of en	izymes like	e sulfite o	kidase,		
1	-	n containing o dase, nitrate re				-				

III	DEVELOPING FACETS OF MODERN INORGANIC CHEMISTRY	15
	Oxidative generation of molecular oxygen from water during photosynthesis, Its	
	importance from the standpoint of non-conventional energy research, Reductive cleavage	
	of the dioxygen bond, Reductive cleavage of dioxygen bond and novel organic	
	transformations including methane to methanol performed by a large number of Fe	
	containing metalloenzymes.	
IV	SUPRAMOLECULAR CHEMISTRY OF LIFE	15
	Biological Inspiration for Supramolecular Chemistry; Alkali Metal Cations in Biochemistry;	
	Membrane Potentials; Membrane Transport; Rhodopsin: A Supramolecular Photonic	
	Device; Porphyrins and Tetrapyrrole Macrocycles; Supramolecular Features of Plant	
	Photosynthesis; The Role of Magnesium Tetrapyrrole Complexes; Neurotransmitters and	
	Hormones; Semiochemistry in the Natural World; Structure of DNA and its Function; Site-	
	Directed Mutagenesis; Biochemical Self-Assembly.	
Sugges	sted Readings:	
1.	J. W. Steed, Supramolecular Chemistry: From Molecules to Nanomaterials, 8 Volume Se Wiley & Sons, 2012.	t Edition. <i>John</i>
2.		
	F. A. Cotton and Wilkinson, Advanced Inorganic Chemistry, 6 <sup>th</sup> Edition. <i>John Wiley</i> , 2006.	
	J. E. Huheey, E. A. Keiter, R. L. Keiter, O. K. Medhi, Inorganic Chemistry: Principles of	Structure and
	Reactivity, 4 <sup>th</sup> Edition. <i>Pearson Education</i> , 2006.	
6.	JM. Lehn, Supramolecular Chemistry: Concepts and Perspectives. <i>Wiley</i> , 2006.	
	D. F. Shriver, P.W. Atkins and C.H. Landgord, Inorganic Chemistry, 3 <sup>rd</sup> Edition. Oxford U 1998.	niversity Press,
8.	S. J. Lippard and J. M. Berg, Principles of Bioinorganic Chemistry. University Science Book, M	ill Valley, 1994.
9.	I. Bertini, H.B. Gray, S. J. Lippard and J.S. Valentne, Bioinorganic Chemistry. University Scie Valley, 1994.	nce Books, Mill

Course	Course Name:				Course	Code:				
No:	Inorganic Chemistry-V					SBS CH 010413 DSE 4004				
CH-29										
Batch:	Programme:	Semester:	L	Т	Р	Credit	Contact Hrs. per Week:	04		
2021 Onwards	M.Sc. Chemistry	IV	4	0	0	4	Total Hrs.:	60		
Total Evalua	tion Marks:100	Examination Duration:		3 Hrs	5.	1				
	1arks 1arks	<b>Pre-requisite of course</b> of various types of orgoin oxidation levels will be characterization tech applications of metal of	anometa e discu niques	allic com ssed. Sy and ut	nplexes. M Inthesis a ility or T	etal compl nd stability M-comple	exes of carbon 7, precautions xes will be s	ns at various in handling,		
Course Objectives	Fundamental understanding		•					r usefulness.		
Course Outcomes :	After completing this course CO1: Basic understanding of CO2: Synthesis of organome CO3: Structural analysis of o CO4: To understand fluxiona CO5: To understand mechar CO6: Scope of organometall	organometallic compour tallic compounds rganometallic compound Il behavior in organometa istic study involved in org	nds s allic com	ipounds	-					
		COURSE S	YLLABU	S						
any four. Ea ii) Question	no. 1 is compulsory and to be ch part carries three and half nos. 2 to 5 are to be set from ny two sub-parts of each ques	marks. all four units one from e	ach. Eve	ery quest						
Unit No.		Con	tents				C	Contact Hrs.		
1	METAL-ALKYLS, ARYLS, CAR Synthesis, structure and decomposition pathways or lithium; synthesis and reacti Metal carbenes: preparation Schrock carbene complexes synthesis, reactivity, struct complexes.	bonding considerations forganocopper in organ vity of organozinc compo on, reactivity, structure f, Tebbe's reagent, Grub	iic synth unds. and bc b's reag	nesis; sy onding c gent, Pet	nthesis ar considerat casis reage	nd reactivit ions of Fis ent, Metal	y of alkyl cher and carbynes:	15		
11	TRANSITION METAL PI-CYCI Half and bent sandwich cyclopentadienyl compound aromatic behaviour of Ferr sulphonation, nitration, ha metallocenes (with Cr, Ni an	compounds, molecula s, covalent versus ionic b ocene, reactions such as logenations reactions,	oonding, metalla	, 18 elec ation, Fr	tron rule, iedel Craf	synthesis, s t, Mannich	structure, reaction,	15		

III	FLUXIONAL ORGANOMETALLIC COMPOUNDS AND COUPLING REACTIONSRates of rearrangement and techniques of study, NMR study of Fluxional behavior, Classification of fluxional organometallic Compounds, Mechanism of fluxionality in compounds of η1- cyclopentadienyls and η3-allyls. Stereochemical non-rigidity in case of coordination numbers- 4 & 5 ( <i>cis-trans</i> , atomic inversion, Berry Pseudorotation).	15
	Tsuji-Trost, Mizoroki-Heck, Miyaura-Suzuki, Stille, Negishi, Sonogashira, Kumada, Hiyama, Buchwald-Hartwigamination or coupling reactions.	
IV	CATALYTIC PROCESSES INVOLVING TRANSITION METAL ORGANOMETALLIC COMPOUNDS Oxidative addition, reductive elimination, insertion-migration reactions, C-H bond activation catalytic mechanism of hydrogenation, hydroformylation, oxidation and isomerization of alkenes, Monsanto acetic acid synthesis, olefin metathesis, Fischer-Tropsch synthesis and Ziegler-Natta polymerization of alkenes, water gas shift reaction, asymmetric and supported organometallic catalysis.	15
Suggeste	ed Readings:	
1. (	G. L. Miessler and D. A. Tarr, Inorganic Chemistry, 3 <sup>rd</sup> Edition. <i>Pearson</i> , 2018.	

- 2. R. H. Crabtree, The Organometallic Chemistry of the Transition Metals, 5<sup>th</sup>Edition. *John Wiley*, 2009.
- 3. R. C. Mehrotra and A. Singh, Organometallic Chemistry, 2<sup>nd</sup> Edition. *New Age International*, 2007.
- 4. R. B. Jordan, Reaction Mechanism of Inorganic and Organometallic systems; 3<sup>rd</sup>Edition.*Oxford University Press*, 2007
- 5. J. E. Huheey, E. A. Keiter, R. L. Keiter and O. K. Medhi, Inorganic Chemistry: Principles of Structure and Reactivity, 4<sup>th</sup>Edition.*Pearson Education*, 2006.

<u></u>	se No:	Course Name:				Course	Code:			
CH-30	C	Inorganic Chemistry-VI SBS CH 010414 DSE 4004						E 4004		
		(Frontiers in Inor	ganic Chemis	try)						
Batch: 2021	:	Programme:	Semester:	L	Т	Р	Credit	Conta per W		04
Onwa	Onwards M.Sc. Chemistry		IV	4	0	0	4	Total		60
Total	Evaluatio	on Marks: 100	Examinatior	Duration:		3 Hrs.				
CIE:	<b>30</b> Mar	ks	Pre-requisit		Basic ide	a of coordi	nation cher	nistry, b	onding	models
TEE:	<b>70</b> Mar	ks	and lanthan	ides.						
Course	е	To impart knowled	lge about adva	nced applic	ation of ir	norganic co	mpounds a	s semico	nducto	rs, in
Object	tives	imaging technique	s, as solid adso	orbents for e	energy ap	plications.				
Course	e	After completing t	his course, stu	dent is expe	cted to le	arn the fol	owing:			
Outco	omes:	CO1: Knowledge o		-		-	odels			
		CO2: Application of	-	•	•					
		<b>CO3:</b> Application of								
		<b>CO4:</b> Preliminary k	-				determinat	lion		
			hybrid materials or coordination polymers ation polymers in catalysis and energy applications							
				DURSE SYL			5115			
NOTE:										
		1 is compulsory and	to be set from	n the entire	svllahus	It will have	four sub-pa	arts and	student	ts need
		two. Each part carrie								LJ IICCU
to ans			es unree and na	alf marks.	synabas.					is need
	estion no	os. 2 to 5 are to be			-		-		hree su	
ii) Que		•	set from all fo	ur units one	e from ea	ch. Every c	uestion wi	ll have t		
ii) Que and st Unit		os. 2 to 5 are to be	set from all fo	ur units one	e from ea tion. Each	ch. Every c	uestion wi	ll have t	arks.	
ii) Que and st	udents n	os. 2 to 5 are to be	set from all fo	ur units one of each ques	e from ea tion. Each	ch. Every c	uestion wi	ll have t	arks. Conta	b-parts
ii) Que and st Unit No.	udents n	os. 2 to 5 are to be eed to answer any t	set from all fo wo sub-parts c	ur units one of each ques Contents	e from ea tion. Each	ch. Every c n part carrie	uestion wil	ll have t d half ma	arks. Conta	b-parts <b>ct Hrs.</b>
ii) Que and st Unit No.	udents n INORGA Brief in	os. 2 to 5 are to be a eed to answer any t	set from all fo wo sub-parts c state, metallic	ur units one of each ques <b>Contents</b> bond, Band	e from ea tion. Each theory (2	ch. Every c n part carrie Zone mode	uestion wil es three and l, Brillouin	ll have t d half ma	arks. Conta	b-parts <b>ct Hrs.</b>
ii) Que and st Unit No.	INORG Brief in Limitat semico	ANIC MATERIALS troduction of solid stores of the Zone nductors, its use in the conservation of the conserv	set from all fo wo sub-parts o state, metallic model); Def transistors, IC,	ur units one of each ques Contents bond, Band ects in so etc.; Prope	theory (2 lids, p-ty	ch. Every c n part carrie Zone mode vpe and r organic ma	uestion will three and besthree and l, Brillouin h-type; Ino terials: Elec	ll have t d half ma Zones, organic ctrical,	arks. Conta	b-parts <b>ct Hrs.</b>
ii) Que and st Unit No.	INORG Brief in Limitat Semico Optical	ANIC MATERIALS troduction of solid stores of the Zone nductors, its use in the America and The	set from all fo wo sub-parts c state, metallic model); Def transistors, IC, rmal. Supercor	ur units one of each ques Contents bond, Band ects in so etc.; Prope nductors, w	theory (2 lids, p-ty	ch. Every c n part carrie Zone mode vpe and r organic ma	uestion will three and besthree and l, Brillouin h-type; Ino terials: Elec	ll have t d half ma Zones, organic ctrical,	arks. Conta	b-parts <b>ct Hrs.</b>
ii) Que and st Unit No. I	INORG Brief in Limitat Semico Optical and str	ANIC MATERIALS troduction of solid s ions of the Zone nductors, its use in t , Magnetic and The ucture of high tempe	set from all fo wo sub-parts o state, metallic model); Def transistors, IC, rmal. Supercor erature superc	ur units one of each ques <b>Contents</b> bond, Band ects in so etc.; Prope nductors, w onductors.	theory (2 lids, p-ty	ch. Every c n part carrie Zone mode vpe and r organic ma	uestion will three and besthree and l, Brillouin h-type; Ino terials: Elec	ll have t d half ma Zones, organic ctrical,	arks. Conta 1	b-parts <b>ct Hrs.</b> .5
ii) Que and st Unit No. I	INORG Brief in Limitat semico Optical and str ADVAN	ANIC MATERIALS troduction of solid s ions of the Zone nductors, its use in t Magnetic and The ucture of high tempe ICED APPLICATION (	set from all fo wo sub-parts o state, metallic model); Def transistors, IC, rmal. Supercor erature superc <b>DF LANTHANIC</b>	ur units one of each ques Contents bond, Band ects in so etc.; Prope nductors, w onductors.	theory (2 tids, p-ty ties of in th specia	ch. Every c n part carrie Zone mode pe and r organic ma l emphasis	uestion will the sthree and betype; Inco terials: Elec on the syr	II have t d half ma Zones, organic ctrical, othesis	arks. Conta 1	b-parts <b>ct Hrs.</b>
ii) Que and st Unit No. I	INORG Brief in Limitati semico Optical and str ADVAN Lumine	ANIC MATERIALS troduction of solid s ions of the Zone nductors, its use in t Magnetic and The ucture of high tempe (CED APPLICATION C escence-based C	set from all fo wo sub-parts o state, metallic model); Def transistors, IC, rmal. Supercor erature superc <b>DF LANTHANIC</b> hemosensors	ur units one of each quest Contents bond, Band ects in so etc.; Prope nductors, w onductors. ES and	theory (2 ids, p-ty th specia	ch. Every c n part carrie Zone mode vpe and r organic ma l emphasis ing wit	uestion will tes three and l, Brillouin h-type; Ino terials: Elec on the syr h Lanth	ll have t d half ma Zones, organic ctrical, othesis	arks. Conta 1	b-parts <b>ct Hrs.</b> .5
ii) Que and st Unit No.	INORG Brief in Limitati semico Optical and str ADVAN Lumine Comple	ANIC MATERIALS troduction of solid s ions of the Zone nductors, its use in f Magnetic and The ucture of high tempe ICED APPLICATION C scence-based C exes: Modulation of	set from all fo wo sub-parts o state, metallic model); Def transistors, IC, rmal. Supercor erature superc <b>DF LANTHANIC</b> hemosensors lanthanide lur	bond, Band ects in so etc.; Prope nductors, w onductors. eES and minescence	theory (Z ids, p-ty ths of in th specia <b>Bio-imag</b> and quer	ch. Every c n part carrie Zone mode rpe and r organic ma l emphasis ing wit nching, Che	uestion will the sthree and the sthree and the strillouin is the strillouin is the strillouin is the strillouin is the strillouin is the s	II have t d half ma Zones, organic ctrical, nthesis <b>nanide</b> design	arks. Conta 1	b-parts <b>ct Hrs.</b> .5
ii) Que and st Unit No. I	INORGA Brief in Limitat semico Optical and str ADVAN Lumine Comple principl	ANIC MATERIALS troduction of solid s ions of the Zone nductors, its use in t Magnetic and The ucture of high tempe ICED APPLICATION ( excence-based C exes: Modulation of le, Time-resolved lur	set from all fo wo sub-parts o state, metallic model); Def transistors, IC, rmal. Supercor erature superc <b>DF LANTHANIC</b> hemosensors lanthanide lur ninescence, Ln	ur units one of each quest Contents bond, Band ects in so etc.; Prope nductors, w onductors. ES and minescence -based bioin	theory (Z theory (Z lids, p-ty ties of in th specia <b>Bio-imag</b> and quer naging, co	ch. Every c n part carrie Zone mode pe and r organic ma l emphasis ing wit nching, Che ellular imag	uestion will the sthree and the sthree and the string best the string probes.	Il have t d half ma Zones, organic ctrical, othesis <b>nanide</b> design	arks. Conta 1	b-parts <b>ct Hrs.</b> .5
ii) Que and st Unit No. I	INORG Brief in Limitati semico Optical and str ADVAN Lumine Comple principl Lantha	ANIC MATERIALS troduction of solid sions of the Zone nductors, its use in the Magnetic and The ucture of high temper (CED APPLICATION C escence-based C exes: Modulation of le, Time-resolved lur nide-base MRI Con	set from all fo wo sub-parts o state, metallic model); Def transistors, IC, rmal. Supercor erature superc <b>DF LANTHANIC</b> hemosensors lanthanide lur ninescence, Ln <b>trast Agents</b> :	ur units one of each quest Contents bond, Band ects in so etc.; Prope nductors, w onductors. ES and minescence -based bioin Principles o	e from ea tion. Each theory (2 lids, p-ty rties of in th specia <b>Bio-imag</b> and quer naging, co f MRI, Co	ch. Every c part carrie Zone mode pe and r organic ma l emphasis ing wit nching, Che ellular imag ontrast age	uestion will the three and the type; Ino terials: Elec on the syr <b>h Lanth</b> mosensor ing probes.	Il have t d half ma Zones, organic ctrical, nthesis <b>nanide</b> design inium-	arks. Conta 1	b-parts <b>ct Hrs.</b> .5
ii) Que and st Unit No. I	INORG, Brief in Limitati semico Optical and str ADVAN Lumine Comple principl Lantha chelate	ANIC MATERIALS troduction of solid s ions of the Zone nductors, its use in t Magnetic and The ucture of high tempe ICED APPLICATION ( excence-based C exes: Modulation of le, Time-resolved lur	set from all fo wo sub-parts o state, metallic model); Def transistors, IC, rmal. Supercor erature superc <b>DF LANTHANIC</b> hemosensors lanthanide lur ninescence, Ln trast Agents: agents, wate	ur units one of each quest Contents bond, Band ects in so etc.; Prope nductors, w onductors. ES and ninescence -based bioin Principles o r-exchange	theory (2 ids, p-ty ties of in th specia <b>Bio-imag</b> and quer naging, co f MRI, Co kinetics,	ch. Every c <u>part carrie</u> Zone mode pe and r organic ma l emphasis <b>ing wit</b> nching, Che ellular image ntrast age Relaxivity,	uestion will the sthree and the sthree and the strike terials: Election terials: Ele	Il have t d half ma Zones, organic ctrical, nthesis <b>nanide</b> design inium- time,	arks. Conta 1	b-parts <b>ct Hrs.</b> .5

III		<b>CRYSTAL AND MOLECULAR STRUCTURE DETERMINATION</b> Generation of X-rays, monochromators, safety, Concept of direct and reciprocal lattices, Bragg's law of X-ray diffraction in direct and reciprocal lattice, crystal systems, point groups, Bravais lattices, Rotational axes of symmetry, screw axes, glide planes, equivalent points, systematic absences, space groups.	15
IV		<b>COORDINATION POLYMERS</b> Introduction, Classification of Coordination Polymers, Design Strategies of Coordination Polymers-Metal Nodes and Linkers, Secondary Building Unit Concept, Topology and Interpenetration, Synthesis of Coordination Polymers-Solvothermal/Hydrothermal, Sonochemical, Microwave, Mechanochemical. Characterization: Diffraction and Spectroscopic Methods. Applications of Coordination Polymers in Gas Storage, Gas Separation, Catalysis and Drug Delivery.	15
Sugg	ges	ted Readings:	
	1.	P. Martin-Ramos, M. Ramos-Silva, Lanthanide-Based Multifunctional Materials. Elsevier, 201	8.
	2.	A. de Bettencourt–Dias, Luminescence of Lanthanide Ions in Coordination Compounds and John Wiley and Sons, 2014.	Nanomaterials.
	3.	P. Hänninen, H. Härmä, Lanthanide Luminescence: Photophysical, Analytical and Biolo Springer, 2011.	ogical Aspects.
	4.	S. R. Batten, S. M. Neville and D. R. Turner, Coordination Polymers: Design, Analysis and A <i>Publishing</i> , 2009.	pplication. RSC
	5.	MC. Hong and L. Chen, design and Construction of Coordination Polymers. Wiley, 2009.	
	6.	S. Cotton, Lanthanide and Actinide Chemistry. John Wiley & Sons, 2006.	
	7.	M. Ladd and R. Palmer, Structure Determination by X-ray Crystallography. <i>Kluwer Academic</i> 2003.	c/Plenum, N.Y.,
	8.	H. V. Keer, Principles of the Solid State. Wiley Eastern Ltd.: New Delhi, 1993.	
	9.	A. R. West, Solid State Chemistry and its Applications. John Wiley & Sons, 1987.	
	10.	J. P. Glusker and K. N. Trueblood, Crystal Structure Analysis- A Primer. OUP, N.Y., 1985.	
	11.	N. Hannay, Treatise on Solid State Chemistry. Plenum, 1976.	
	12.	G. H. Stout and H. L. Jensen, X-ray Structure Determination- A Practical Guide. Macmillan, N.	Y., 1968.

## PRACTICAL COURSES

	se No:	Course Name:				Course (	Code:		
CH-04	4	Inorganic Chemist	istry Practical-I SBS CH			SBS CH C	)10104 C 0(	042	
Batch	:	Programme:	Semester:	L	Т	Р	Credit	Contact Hrs.	
2021								per Week:	04
Onwa	rds	M.Sc. Chemistry	I	0	0	4	2	<b>Total Hours:</b>	60
Total	Evaluatio	on Marks: 50	Examinatio	n Duration:		6 Hrs.	- <b>·</b> · · ·		
015	45.84								
CIE:	15 Ma	ſKS	Pre-requisit	e of cours	e: Knowl	edge of b	onding mo	dels in coor	dination
<b></b>	35 Mai		compounds			-	-		
TEE:			a about wata	r analysis ar	daranar	ntion of no	nular coordi	nation comple	was
Objec		To impart knowledg	le about wate	a unuiysis ur	u prepur	πιση οι ροι		nution comple	xes.
Objec	lives								
Cours	e	After completing th	is course stu	dent is exner	ted to lea	arn the foll	-wing:		
Outco		<b>CO1:</b> Analysis of wa		•					
		<b>CO2:</b> Determination	•		•	25			
		<b>CO3:</b> Determination			•		er samples		
		CO4: Preparation of			/		p		
		CO5: Appreciate the		•	coordina	tion comp	exes		
		CO6: Basic knowled				•			
		I	C	OURSE SYL	ABUS				
Unit	luestions	will be set, one from	each of the l	JNII. The car	ndidates a	are require	d to attempt	t all the quest	ions.
				Contents	5			Cont	act Hrs.
No.	14/ATE			Contents	6				
NO. I		R ANALYSIS				or complo			act Hrs. 25
	1.	Determination of d		en, DO of a g	iven wate	•	cample		
	1. 2.	Determination of d Determination of cl	nemical oxyge	en, DO of a g in demand, (	iven wate	given water	•		
	1. 2. 3.	Determination of d Determination of cl Determination of b	nemical oxyge iological oxyg	en, DO of a g n demand, ( en demand,	iven wate COD of a g BOD of a	given water given wate	r sample.		
	1. 2. 3. 4.	Determination of d Determination of cl Determination of b Determination of to	nemical oxyge iological oxyge otal suspende	en, DO of a g n demand, ( en demand, d solids and	iven wate COD of a g BOD of a total diss	given water given wate plved solids	r sample.		
	1. 2. 3. 4.	Determination of d Determination of cl Determination of b Determination of to Determination of to	nemical oxyge iological oxyge otal suspende urbidity of a w	en, DO of a g en demand, ( en demand, d solids and vater sample	iven wate COD of a g BOD of a total diss	given water given wate olved solids ometer.	r sample. S.		
	1. 2. 3. 4. 5.	Determination of d Determination of cl Determination of b Determination of to Determination of to	nemical oxyge iological oxyge otal suspende urbidity of a w	en, DO of a g en demand, ( en demand, d solids and vater sample	iven wate COD of a g BOD of a total diss	given water given wate olved solids ometer.	r sample. S.		
	1. 2. 3. 4. 5. 6.	Determination of d Determination of cl Determination of b Determination of to Determination of to Determination of	nemical oxyge iological oxyg otal suspende urbidity of a w presence of	en, DO of a g en demand, ( en demand, d solids and vater sample Ca <sup>2+</sup> , Mg <sup>2+</sup> ,	iven wate COD of a g BOD of a total disso by nephl Fe <sup>3+</sup> and	given water given water olved solids ometer. Fe <sup>2+</sup> ions	r sample. S.	water	
1	1. 2. 3. 4. 5. 6. <b>PREPA</b>	Determination of d Determination of cl Determination of b Determination of to Determination of to Determination of sample.	nemical oxyge iological oxyg otal suspende urbidity of a w presence of	en, DO of a g en demand, ( en demand, d solids and vater sample Ca <sup>2+</sup> , Mg <sup>2+</sup> ,	iven wate COD of a g BOD of a total disso by nephl Fe <sup>3+</sup> and	given water given water olved solids ometer. Fe <sup>2+</sup> ions	r sample. S.	water	25
1	1. 2. 3. 4. 5. 6. <b>PREPA</b> 1. R	Determination of d Determination of cl Determination of b Determination of to Determination of to Determination of sample. RATIONS AND RELAT	nemical oxyge iological oxyg otal suspende urbidity of a w presence of	en, DO of a g en demand, ( en demand, d solids and vater sample Ca <sup>2+</sup> , Mg <sup>2+</sup> ,	iven wate COD of a g BOD of a total disso by nephl Fe <sup>3+</sup> and	given water given water olved solids ometer. Fe <sup>2+</sup> ions	r sample. S.	water	25
1	1. 2. 3. 4. 5. 6. <b>PREPA</b> 1. R 2. V	Determination of d Determination of cl Determination of b Determination of to Determination of to Determination of sample. RATIONS AND RELAT einecke Salt	nemical oxyge iological oxyg otal suspende urbidity of a w presence of	en, DO of a g en demand, ( en demand, d solids and vater sample Ca <sup>2+</sup> , Mg <sup>2+</sup> ,	iven wate COD of a g BOD of a total disso by nephl Fe <sup>3+</sup> and	given water given water olved solids ometer. Fe <sup>2+</sup> ions	r sample. S.	water	25
1	1. 2. 3. 4. 5. 6. <b>PREPA</b> 1. R 2. V 3. N 4. P	Determination of d Determination of cl Determination of b Determination of to Determination of to Determination of sample. RATIONS AND RELAT einecke Salt O(acac) <sub>2</sub>	nemical oxyge iological oxyge otal suspende urbidity of a w presence of	en, DO of a g en demand, ( en demand, d solids and vater sample Ca <sup>2+</sup> , Mg <sup>2+</sup> ,	iven wate COD of a g BOD of a total disso by nephl Fe <sup>3+</sup> and	given water given water olved solids ometer. Fe <sup>2+</sup> ions	r sample. S.	water	25
1	1. 2. 3. 4. 5. 6. <b>PREPA</b> 1. R 2. V 3. N 4. P 5. H	Determination of d Determination of cl Determination of b Determination of to Determination of to Determination of sample. RATIONS AND RELAT einecke Salt O(acac) <sub>2</sub> In(acac) <sub>3</sub> russian Blue/Turnbul g[Co(NCS) <sub>4</sub> ]	nemical oxyge iological oxyge otal suspende urbidity of a w presence of <b>TED COMPLEN</b> I's Blue	en, DO of a g en demand, ( en demand, d solids and vater sample Ca <sup>2+</sup> , Mg <sup>2+</sup> , <b>MENTARY W</b>	iven wate COD of a g BOD of a total disso by nephl Fe <sup>3+</sup> and	given water given water olved solids ometer. Fe <sup>2+</sup> ions	r sample. S.	water	25
1	1. 2. 3. 4. 5. 6. <b>PREPA</b> 1. 8. V 3. N 4. P 5. H 6. P	Determination of d Determination of cl Determination of b Determination of to Determination of to Determination of sample. <b>RATIONS AND RELAT</b> einecke Salt O(acac) <sub>2</sub> In(acac) <sub>3</sub> russian Blue/Turnbul g[Co(NCS) <sub>4</sub> ] otassium trioxalatofe	nemical oxyge iological oxyg otal suspende urbidity of a w presence of <b>FED COMPLE</b> I's Blue erate (III) Trihy	en, DO of a g en demand, ( en demand, d solids and vater sample Ca <sup>2+</sup> , Mg <sup>2+</sup> , <b>MENTARY W</b>	iven wate COD of a g BOD of a total disso by nephl Fe <sup>3+</sup> and	given water given water olved solids ometer. Fe <sup>2+</sup> ions	r sample. S.	water	25
1	1. 2. 3. 4. 5. 6. <b>PREPA</b> 1. <b>R</b> 2. V 3. <b>N</b> 4. P 5. H 6. P	Determination of d Determination of cl Determination of b Determination of to Determination of to Determination of sample. RATIONS AND RELAT einecke Salt O(acac) <sub>2</sub> In(acac) <sub>3</sub> russian Blue/Turnbul g[Co(NCS) <sub>4</sub> ]	nemical oxyge iological oxyge otal suspende urbidity of a w presence of <b>FED COMPLE</b> I's Blue erate (III) Trihy romate (III)	en, DO of a g en demand, ( en demand, d solids and vater sample Ca <sup>2+</sup> , Mg <sup>2+</sup> , MENTARY W	iven wate COD of a g BOD of a total diss by nephl Fe <sup>3+</sup> and <b>ORK (AN</b> )	given water given water olved solids ometer. Fe <sup>2+</sup> ions o	r sample. S.	water	25

#### Suggested Readings:

- 1. J. Bassett, R. C. Denney, G. H. Jeffery and J. Mendham, Vogel's Textbook of Quantitative Analysis, revised, 5<sup>th</sup>Edition.*ELBS*, 1989.
- 2. G. Svehla, Vogel's Textbook of Macro and Semimicro Qualitative Inorganic Analysis, revised, 5<sup>th</sup>Edition.Longman, 1979.
- 3. Marr and Rocket, Practical Inorganic Chemistry, Van Nostrand Reinhold, 1972.

- · ·	ourse No: Course Name: Course Code:										
CH-10	C	Inorganic Chemis	try Practical-l			SBS CH C	010210 C 004	42			
Batch: 2021	:	Programme:	Semester:	L	Т	Р		Contact Hrs. per Week:	04		
Onwa	rds	M.Sc. Chemistry	<b>I</b>	0	0	4		Total Hrs.:	60		
Total I	Evaluatio	n Marks: 50	Examination	Duration:	1	6 Hrs.					
CIE:	<b>15</b> Mar	ks				•	of quantitat	tive estimat	ion and		
TEE:	<b>35</b> Mar	ks	radical analy	sis gained d	uring und	lergraduate	e courses.				
Course	е	To impart knowled	ge of volumeti	ric-redox and	d complex	xometric es	timations and	analysis of	mixture		
Objec	tives	of radicals, both a	cidic and basic.								
Course Outco	ourseAfter completing this course, student is expected to learn the following:outcomes:CO1: Detailed understanding of quantitative estimationsCO2: Knowledge of volumetric-redox titrationsCO3: Knowledge of complexometric titrationsCO3: Knowledge of complexometric titrationsCO4: Advanced knowledge of qualitative analysisCO5: Analysis of acidic and basic radicals from mixture of radicalsCO6: Analysis of interfering radicals present in a mixture of ions										
				DURSE SYLI							
NOTE: Two a		will be set, one fron	a cach of the U								
		win be set, one non		init. The car	ndidates a	are required	d to attempt a	all the quest	ons.		
Unit				Contents		are required	d to attempt a		ons. act Hrs.		
	Quanti	<b>FITATIVE ESTIMATIC</b> tative estimation (ir	DN Ivolving volum	Contents	5			Cont			
Unit No.	Quanti in two		<b>)N</b> Ivolving volum nt mixtures.	Contents	5			ents	act Hrs.		
Unit No. I	Quanti in two SEMIM Comple	TITATIVE ESTIMATIC tative estimation (in and three compone	DN Ivolving volum nt mixtures. ANALYSIS	Contents	and com	plexometry	/) of constitu	ents	act Hrs. 30		
Unit No. I	Quanti in two SEMIM Comple	TITATIVE ESTIMATIC tative estimation (in and three compone IICRO QUALITATIVE ete systematic ana ring radicals.	DN Ivolving volum nt mixtures. ANALYSIS	Contents	and com	plexometry	/) of constitu	ents	act Hrs. 30		
Unit No. I I Sugges 1.	Quanti in two SEMIM Comple interfe sted Readi J. Basso 5 <sup>th</sup> Editi	TITATIVE ESTIMATIC tative estimation (ir and three compone IICRO QUALITATIVE ete systematic ana ring radicals. ings: ett, R. C. Denney, G. on. <i>ELBS</i> , 1989.	DN nvolving volum nt mixtures. ANALYSIS lysis of Inorga	Contents netric-redox anic mixture I J. Mendhar	and com es contai m, Vogel'	plexometry ning six io s Textbook	<ul> <li>of constitu</li> <li>of constitu</li> <li>of constitution</li> <li>of Quantitation</li> </ul>	Cont ents the ive Analysis,	act Hrs. 30 30 revised,		
Unit No. I I Sugges 1.	Quanti in two SEMIM Comple interfe sted Readi J. Basse 5 <sup>th</sup> Editi G. Svel	TITATIVE ESTIMATIC tative estimation (ir and three compone IICRO QUALITATIVE ete systematic ana ring radicals. ings: ett, R. C. Denney, G.	DN nvolving volum nt mixtures. ANALYSIS lysis of Inorga	Contents netric-redox anic mixture I J. Mendhar	and com es contai m, Vogel'	plexometry ning six io s Textbook	<ul> <li>of constitu</li> <li>of constitu</li> <li>of constitution</li> <li>of Quantitation</li> </ul>	Cont ents the ive Analysis,	act Hrs. 30 30 revised,		

Course N	course Name: Cou			Course	Code:				
CH-19	Inorganic Che	emistry Practical-	III		SBS CH	010210 DS	E 0063		
Batch:	Programme:	Semester:	L	Т	Р	Credit	Contact	Hrs	
2021							per Wee	ek:	06
Onwards			0	0	6	3	Total Hr	s.:	90
	M.Sc. Chemist	ry III							
Total Eval	uation Marks: 75	Examination	Duration:		8 Hrs.				
	2.5 Marks	Pre-requisit inorganic co						n pi	rocess in
	S2.5 MIARS								
Course Objective	To impart knowledge of experimental spectroscopic techniques and oxidation-re in coordination complexes. The students will also be introduced about sin synthesis and characterization.								
Course	,	ng this course, stu	dent is exne	cted to le	earn the fol	lowing.			
Outcome		ental knowledge of							
	•	of characterizing c			•		s		
		ental knowledge of		•		•		und	s
		and quantify inorga							
		understanding abo	•	-					
		and characterizat	-	•					
		C	OURSE SYL						
<b>NOTE:</b> Three que	estions will be set, one	e from each of the	UNIT. The c	andidate	s are requii	red to atten	npt all the	que	stions.
Unit			Conten	ts				Cont	tact Hrs.
No.									
I	SPECTROSCOPIC STL	JDIES							30
	Measurement of FTI	R and UV-Visible S	pectra of co	ordinatio	on compoui	nds, data pl	otting,		
	analysis and character	erization of coordi	nation com	plexes/cc	ompounds ι	using Infrare	ed and		
	UV-Visible Spectrosc	сору.							
II	<b>OXIDATION-REDUCT</b>	TION TITRATIONS							30
	(i) Preparation of 0.		ulphate and	its stan	dardization	with amm	ionium		
	iron(II) sulphate or se								
	(ii) To determine th		of the nitri	te ions ir	n the samp	ole solution	using		
	standardized cerium								
	(iii) To determine th	ne percentage pur	ity of the N	laNO <sub>2</sub> us	ing standar	dized ceriu	ım (IV)		
	sulphate.								
111	SINGLE-CRYSTALS		(1) = : : : : :						30
	Methods of growin				iod; (ii) H	ydrotherma	al and		
	Solvothermal metho						.		
	To grow single-crysta		-	-	-		-		
	higher dimensional o	compounds. Identi	TICATION OF S	single-cry	stals under	polarizing	optical		
	microscope.								

- 1. J. Bassett, R. C. Denney, G. H. Jeffery and J. Mendham, Vogel's Textbook of Quantitative Analysis, revised, 5<sup>th</sup> Edition. *ELBS*, 1989.
- 2. Marr and Rocket, Practical Inorganic Chemistry. Van Nostrand Reinhold, 1972.
- 3. K. Nakamoto; Infrared and Raman Spectra of Inorganic and Coordination Compounds, Part A and B, 6<sup>th</sup> Edition. *Wiley*, 2008.
- 4. D. L. Pavia, G. M. Lampman, G. S. Kriz and J. R. Vyvyan; Introduction to Spectroscopy, 5<sup>th</sup>Edition. *Cengage India*, 2015.

Course No:	Course Name:				Course	Code:			
CH-20	Inorganic Chemistry	/ Practical-IV			SBS CH 010304 DSE 0063				
Batch:	Programme:	Semester:	L	Т	Р	Credit	Contact Hrs.		
2021							per Week:	06	
Onwards	M.Sc. Chemistry	111	0	0	6	3	Total Hrs.:	90	
Fotal Evaluation Marks:75		Examinatio	n Duration:		8 Hrs.				
CIE: 22.5 № TEE: 52.5 M		•	e of cour			knowledge	of electroch	emistry	
Course Objectives	To gain knowledge compounds throug		•	for the c	haracteriza	ition of inor	ganic and coor	dinatior	
Course	After completing th	is course, stu	dent is expe	cted to le	earn the fol	lowing:			
Outcomes:	CO1: Basic understa	anding of chro	omatography	/		-			
	<b>CO2</b> : Development	of experimer	ntal skills to s	eparate i	ions from n	nixtures			
	CO3: Basic understa	anding of volu	umetric and ${ m g}$	gravimeti	ric method	S			
	CO4: Characterizati	on of compo	unds						
	CO5: Estimation of	metals from s	samples						
	CO6: Interpretation	of outcomes	5						
		~							

# **COURSE SYLLABUS**

# NOTE:

Three questions will be set, one from each of the UNIT. The candidates are required to attempt all the questions.

Unit No.	Contents	Contact Hrs.
I	CHROMATOGRAPHY	30
	Separation of binary mixtures in the given solution by paper chromatography, visualizing	
	solution: concentrated ammonia, ascending chromatography.	
II	GRAVIMETRY	30
	To prepare solutions of different metal ions and estimate the metal ions gravimetrically.	
	Three component metal ion analysis (one volumetric and two gravimetric method).	
III	IODIMETRIC TITRATIONS	30
	Estimation of Cu(II) and K <sub>2</sub> Cr <sub>2</sub> O <sub>7</sub> using sodium thiosulphate solution (Iodimetrically).	
	Estimation of (i) arsenite and (ii) antimony iodimetrically	
	Estimation of available chlorine in bleaching powder iodometrically	

## Suggested Readings:

- 1. J. A. I. Mendham, Vogel's Quantitative Chemical Analysis, 6<sup>th</sup>Edition. *Pearson*, 2009.
- 2. J. Bassett, R. C. Denney, G. H. Jeffery and J. Mendham, Vogel's Textbook of Quantitative Analysis, revised, 5<sup>th</sup>Edition. *ELBS*, 1989.
- 3. G. Svehla, Vogel's Textbook of Macro and Semimicro Qualitative Inorganic Analysis, revised, 5<sup>th</sup>Edition. *Longman*, 1979.

4. Marr and Rocket, Practical Inorganic Chemistry, Van Nostrand Reinhold, 1972.

Course No:	Course Name:				Course	Code:				
CH-31	Inorganic Chemist	ry Practical-V			SBS CH 010415 DSE 0063					
Batch:	Programme:	Semester:	L	Т	Р	Credit	Contact Hrs.			
							per Week:	06		
2021 Onwards	M.Sc. Chemistry	IV	IV 0 0 6 3 Total Hrs.: 9							
Total Evaluation Marks: 75		Examination Dur	ation:	8 Hrs.						
CIE: 22.5 Ma		Pre-requisite of of of inorganic comp		knowledg	e of prepar	ation, estim	ation and chara	cterizatio		
TEE: 52.5 Ma Course		analyse and charact	ariza tha aiv	n inoraa	nic cample	with knowl	adae of spectro			
Objectives	titrations.	unuryse unu churuch	enze ine give	in morgu	inc sumple	WILLI KIIUWI	euge of spectro	iscopy ui		
Course	After completing th	is course, student is expected to learn the following:								
Outcomes:	CO1: Determination	n of absorbance of an	inorganic sar	nple						
	CO2: Determine the	e concentration of san	nple with the	help of a	bsorbance					
	CO3: Knowledge of	precipitation titration	าร							
	CO4: Determination	n of chloride in neutra	l solution usi	ng precipi	itation titra	ations				
	CO5: Knowledge of	titrations								
	CO6: Interpretation	of electronic and ma	gnetic prope	rties of in	organic con	nplexes				
	1	<u> </u>								

# **COURSE SYLLABUS**

NOTE:

Three questions will be set, one from each of the UNIT. The candidates are required to attempt all the questions.

Unit No.	Contents	Contact Hrs.
I	EXPERIMENTAL DETERMINATIONS WITH ULTRAVIOLET /VISIBLESPECTROPHOTOMETERS(i) Determination of the absorption curve and concentration of a Substance (potassium nitrate)(ii) Simultaneous spectrophotometric determination (chromium and manganese)	30
II	PRECIPITATION TITRATIONS         (i) Preparation of 0.1M silver nitrate and its standardization with Mohr's method using potassium chromate/adsorption indicator.         (ii) Determination of chloride in neutral solution by titration with standard 0.1 M silver nitrate.	30
Ш	<ul> <li>PREPARATION, CHARACTERIZATION AND ESTIMATION (ANY TWO)</li> <li>(i) Preparation of hexamminecobalt(III) chloride and determine the percentage of cobalt in the product iodimetrically.</li> <li>(ii) Preparation of chloropentaammine cobalt (III) chloride and interpretation of electronic spectrum and magnetic properties.</li> <li>(iii) Preparation of [Co(acac)<sub>3</sub>] and interpretation of electronic spectrum and magnetic properties.</li> </ul>	30

- 1. J. Bassett, R. C. Denney, G. H. Jeffery and J. Mendham, Vogel's Textbook of Quantitative Analysis, revised, 5<sup>th</sup>Edition. *ELBS*, 1989.
- 2. G. Svehla, Vogel's Textbook of Macro and Semimicro Qualitative Inorganic Analysis, revised, 5<sup>th</sup>Edition. *Longman*, 1979.
- 3. Marr and Rocket, Practical Inorganic Chemistry. Van Nostrand Reinhold, 1972.
- 4. Pass, G.; Sutcliffe Practical Inorganic Chemistry, 1<sup>st</sup>Edition. *Chapmann and Hall Ltd.*, 1968.
- 5. Jolly, W.L. Synthetic Inorganic Chemistry, 2<sup>nd</sup>Edition.*Prentice Hall, Inc.*, 1961.

cours	se No:	Course Name:				Course C	Code:							
CH-3	2	Inorganic Chemis	try Practical-	VI		SBS CH C	)10416 DS	E 0063	63 ntact Hrs.					
Batch	:	Programme:	Semester:	L	Т	Р	Credit	Contact	: Hrs.					
2021								per We	ek:	06				
Onwa	rds	M.Sc. Chemistry	IV	0	0	6	3	Total H	rs.:	90				
Total	Evaluatio	on Marks: 75	Examinatior	n Duration:		8 Hrs.								
CIE:	<b>22.5</b> M	arks	Pre-requisit			-		•	d rare	earth				
TEE:	52.5 M	arks	elements. Ki	nowledge of	qualitativ	/e and quai	ntitative an	aiysis.						
Cours	e	To train students to	o analyse ores	and alloys a	nd extrac	t/separate	rare earth	elements.	Also ir	mpart				
Objec	ctives knowledge to analyse and estimate selected inorganic compounds.													
Cours		After completing th		•		arn the foll	owing:							
Outco	omes:	CO1: Knowledge of	•											
		<b>CO2</b> : Practical anal	• •		•									
	<b>CO3</b> : Analysis of selected inorganic complexes <b>CO4</b> : Knowledge of purification and structural elucidation													
		CO4: Knowledge of CO5: Knowledge of	-		ai elucidat	.1011								
		<b>CO6</b> : Extraction and			from the	given samr	nles							
						given samp	163							
			C	OURSE SYLI	LABUS									
		will be set, one from e	ach of the UNI		ates are re	quired to att	empt all the	e questions						
Unit		will be set, one from e	ach of the UNI			quired to att	empt all the	-	Conta	ct Hrs.				
Three Unit No.	questions			T. The candida	5	·		-	Conta					
Three Unit	questions ANALY	SIS OF ORES, ALLOYS	BY QUALITAT	Content:	s JANTITAT		ODS		Conta	<b>ct Hrs.</b> 0				
Three Unit No.	questions ANALYS Chemic	SIS OF ORES, ALLOYS al methods for analy	BY QUALITAT	T. The candida Contents FIVE AND QU nd alloys by	s JANTITAT		ODS		Conta					
Three Unit No.	questions ANALYS Chemic like gra	SIS OF ORES, ALLOYS	BY QUALITAT ysis of ores an ysis, titrimetri	T. The candida Contents FIVE AND QU nd alloys by ic	s JANTITAT		ODS		Conta					
Three Unit No.	questions ANALY Chemic like gra Ore Ana	SIS OF ORES, ALLOYS al methods for analy vimetric, radical anal	BY QUALITAT ysis of ores an ysis, titrimetri f the following	T. The candida Contents FIVE AND QU nd alloys by ic ():	s JANTITA1 qualitativ		ODS		Conta					
Three Unit No.	questions ANALY Chemic like gra Ore Ana	SIS OF ORES, ALLOYS al methods for analy vimetric, radical anal alysis (At least two of	<b>BY QUALITA</b> ysis of ores an ysis, titrimetri f the following lica and Mang	T. The candida Contents FIVE AND QU and alloys by ic s): anese in pyr	s JANTITA1 qualitativ olusite		ODS		Conta					
Three Unit No.	questions ANALY Chemic like gra Ore Ana	SIS OF ORES, ALLOYS al methods for analy vimetric, radical anal alysis (At least two of Determination of Sil	BY QUALITAT ysis of ores an ysis, titrimetri f the following lica and Mang opper and iror	T. The candida <b>Contents</b> <b>FIVE AND QU</b> and alloys by ic (): anese in pyr from chalco	s JANTITA1 qualitativ olusite		ODS		Conta					
Three Unit No.	ANALY Chemic like gra Ore An	SIS OF ORES, ALLOYS al methods for analy vimetric, radical anal alysis (At least two of Determination of Sil Determination of Co Determination of iro nalysis (At least two o	<b>BY QUALITA</b> ysis of ores an ysis, titrimetri f the following lica and Mang opper and iror on from hema of the followir	T. The candida Contents TIVE AND QU and alloys by ic g): anese in pyr from chalco tite ng):	s JANTITA1 qualitativ olusite		ODS		Conta					
Three Unit No.	ANALY Chemic like gra Ore An	SIS OF ORES, ALLOYS al methods for analy vimetric, radical anal alysis (At least two of Determination of Sil Determination of for Determination of iro nalysis (At least two of Determination of tir	BY QUALITAT ysis of ores an ysis, titrimetri f the following lica and Mang opper and iror on from hema of the followir n & lead from	T. The candida <b>Contents</b> <b>FIVE AND QU</b> and alloys by ic (): anese in pyr a from chalco tite ng): solder	s qualitativ olusite opyrite		ODS		Conta					
Three Unit No.	ANALY Chemic like gra Ore Ana Alloy A	SIS OF ORES, ALLOYS al methods for analy vimetric, radical anal alysis (At least two of Determination of Sil Determination of Co Determination of iro nalysis (At least two of Determination of tir Determination of tir	BY QUALITAT ysis of ores an ysis, titrimetri f the following lica and Mang opper and iror on from hema of the followir h & lead from on & chromiur	T. The candida Contents TIVE AND QU and alloys by ic g): anese in pyr a from chalco tite ng): solder m from mild	s JANTITAT qualitativ olusite opyrite steel		ODS		Conta					
Three Unit No.	ANALY Chemic like gra Ore Ana Alloy A	SIS OF ORES, ALLOYS al methods for analy vimetric, radical anal alysis (At least two of Determination of Sil Determination of for Determination of iro Determination of tir Determination of tiro Determination of iro Determination of co	<b>BY QUALITA</b> ysis of ores any ysis, titrimetri f the following pica and Mang opper and iror on from hema of the followir the followir the followir the chromiur opper and nick	T. The candida Contents FIVE AND QU and alloys by ic g): anese in pyr from chalco tite ng): solder m from mild el from cupr	s JANTITAT qualitativ olusite opyrite steel ronickel	ve and qua	DDS ntitative m	nethods	Conta 3	0				
Three Unit No.	ANALY Chemic like gra Ore Ana Alloy An ANALY	SIS OF ORES, ALLOYS al methods for analy vimetric, radical anal alysis (At least two of Determination of Sil Determination of Co Determination of iro nalysis (At least two of Determination of tir Determination of iro Determination of co SIS OF INORGANIC SI	BY QUALITAT ysis of ores an ysis, titrimetri f the following lica and Mang opper and iron on from hema of the followin the followin on & lead from on & chromiun opper and nick UBSTANCES B	T. The candida Contents FIVE AND QU and alloys by ic g): anese in pyr from chalco tite ng): solder n from mild el from cupr Y QUALITAT	s JANTITAT qualitativ olusite opyrite steel steel ronickel	TIVE METHO ve and qua	ODS ntitative m	nethods	Conta 3					
Three Unit No.	ANALY: Chemic like gra Ore Ana Alloy An Alloy An Prepara	SIS OF ORES, ALLOYS al methods for analy vimetric, radical anal alysis (At least two of Determination of Sil Determination of fro Determination of iro Determination of tir Determination of tir Determination of iro Determination of co SIS OF INORGANIC SI ation, purification ar	BY QUALITAT ysis of ores an ysis, titrimetri f the following lica and Mang opper and iror on from hema of the followin the	T. The candida Contents FIVE AND QU and alloys by ic g): anese in pyr a from chalco tite ng): solder m from mild el from cupr Y QUALITAT elucidation	s qualitativ olusite opyrite steel ronickel IVE AND of some	<b>QUANTITA</b> of the co	DDS ntitative m TIVE METH mplexes fro	nethods IODS om the	Conta 3	0				
Three Unit No.	ANALY Chemic like gra Ore Ana Alloy An Alloy An Prepara followin	SIS OF ORES, ALLOYS al methods for analy vimetric, radical anal alysis (At least two of Determination of Sil Determination of Co Determination of tir Determination of tir Determination of tir Determination of tir Determination of co SIS OF INORGANIC SI ation, purification ar ng by available physi	BY QUALITAT ysis of ores an ysis, titrimetri f the following lica and Mang opper and iron on from hema of the followin a & lead from on & chromiun opper and nick UBSTANCES B nd structural icochemical a	T. The candida Contents FIVE AND QU and alloys by ic g): anese in pyr from chalco tite ng): solder m from mild el from cupr Y QUALITAT elucidation nd spectral	s JANTITAT qualitativ olusite opyrite steel conickel iVE AND of some methods:	<b>QUANTITA</b> of the cor (i) [Co(Py)	DDS ntitative m TIVE METH mplexes fro 2Cl <sub>2</sub> ]; (ii) [N	nethods IODS om the Ni(NH <sub>3</sub> ) <sub>6</sub>	Conta 3	0				
Three Unit No.	ANALY Chemic like gra Ore Ana Alloy An Alloy An Prepara followin ]Cl <sub>2</sub> ; (iii	SIS OF ORES, ALLOYS al methods for analy vimetric, radical anal alysis (At least two of Determination of Sil Determination of fro Determination of iro Determination of tir Determination of tir Determination of iro Determination of co SIS OF INORGANIC SI ation, purification ar	<b>BY QUALITAT</b> ysis of ores any ysis, titrimetric f the following pica and Mang opper and iror on from hema of the followir the followir	T. The candida Contents FIVE AND QU and alloys by ic g): anese in pyr from chalco tite ng): solder m from mild el from cupr Y QUALITAT elucidation nd spectral	s JANTITAT qualitativ olusite opyrite steel conickel iVE AND of some methods:	<b>QUANTITA</b> of the cor (i) [Co(Py)	DDS ntitative m TIVE METH mplexes fro 2Cl <sub>2</sub> ]; (ii) [N	nethods IODS om the Ni(NH <sub>3</sub> ) <sub>6</sub>	Conta 3	0				
Three Unit No.	ANALY Chemic like gra Ore Ana Alloy An Alloy An Prepara followin ]Cl <sub>2</sub> ; (iii (vii) Fe-	SIS OF ORES, ALLOYS al methods for analy vimetric, radical anal alysis (At least two of Determination of Sil Determination of fire Determination of ire Determination of tire Determination of tire Determination of tire Determination of co SIS OF INORGANIC SI ation, purification ar ng by available physis ) Ni(dmg) <sub>2</sub> ; (iv) [Cu(N	<b>BY QUALITA</b> ysis of ores any ysis, titrimetric f the following lica and Mang opper and iror on from hema of the following the following on & chromium opper and nick <b>UBSTANCES B</b> nd structural icochemical any NH <sub>3</sub> ) <sub>4</sub> ]SO <sub>4</sub> .H <sub>2</sub> C plex.	T. The candida Contents FIVE AND QU and alloys by ic g): anese in pyr from chalco tite ng): solder m from mild el from cupr Y QUALITAT elucidation nd spectral b; (v) Bis (cyc	s JANTITAT qualitativ olusite opyrite steel conickel iVE AND of some methods:	<b>QUANTITA</b> of the cor (i) [Co(Py)	DDS ntitative m TIVE METH mplexes fro 2Cl <sub>2</sub> ]; (ii) [N	nethods IODS om the Ni(NH <sub>3</sub> ) <sub>6</sub>	Conta 3	0				

copper, iron(III) and nickel by direct titration.

- 1. G. Marr and B. W. Rockett, Practical Inorganic Chemistry. Van Nostrand Reinhold, 2019.
- 2. T.Dutta, K. H. Kim, M. Uchimiya, E. E. Kwon, B. H. Jeon, A. Deep and S. T. Yun, Global demand for rare earth resources and strategies for green mining. *Environ. Res.* 2016, 150, 182-190.
- 3. J. Derek Woolins, Inorganic Experiments. *Wiley VCH*, 2014.

# ORGANIC CHEMISTRY COURSES

# **THEORY COURSES**

Course N	o: Course Name:				Course C	Code:					
CH-02	Organic Chemistr	y-l			SBS CH C	10102 C 4	004				
Batch:	Programme:	Semester:	L	Т	Р	Credit	Contac	t Hrs.			
2021							per We	ek:	04		
Onwards	M.Sc. Chemistry	I	4	0	0	4	Total H	rs.:	60		
Total Eval	uation Marks: 100	Examinatio	n Duration:		3 Hrs.						
<b>CIE:</b> 30	Marks	Pre-requisit	e of course:	Basic kno	wledge of	chemical b	onding, th	neories	s of		
<b>TEE:</b> 70	Marks	bonding, ste	bonding, stereochemistry, reaction mechanisms and reactive intermediates.								
Course	To provide the bas	sics in Organi	c Chemistry	at the be	ginning of	the semes	ter. At th	he end	of this		
Objective	course, students w delocalized chem configuration, RS c substitution and el	ical bonding, Ind EZ notatio	, aromatici ns and mech	ty, stere nanistic a	ochemistry spects of a	r, such a liphatic and	is confo d aromati	rmatio	n and		
Course	After completing t	nis course, stu	dent is expe	cted to le	arn the foll	owing:					
Outcomes	<b>CO1:</b> Advanced un	derstanding or	f the concep	ts delocal	isation, cor	njugation a	nd aroma	ticity			
	CO2: Advanced kno	owledge of su	pramolecula	r chemist	ry and non-	-covalent b	onding				
	CO3: Advanced kn	owledge of co	onformation	al analysis	s, dynamic	stereochei	mistry an	d asyn	nmetric		
	synthesis	-		-	•						
	<b>CO4</b> : In-depth und	erstanding of a	all classes of	nucleoph	ilic substitu	ution reacti	ons				
	<b>CO5</b> : Fundamental	-		-				nical as	spects		
	<b>CO6</b> : Detailed mec		-								
			OURSE SYLI								
NOTE:											
i) Questio	n no. 1 is compulsory an	d to be set fr	om the enti	re syllabu	s. It will ha	ave seven s	sub-parts	and st	tudents		
need to ar	nswer any four. Each part	carries three	and half mai	rks.							
-	n nos. 2 to 5 are to be se				• •		ve three	sub-pa	irts and		
	eed to answer any two s			Each par	t carries sev	ven marks.					
Unit			Contents					Conta	ct Hrs.		
No.								-			
	ATURE OF BONDING IN C				• · · · ·			1	.5		
	elocalized chemical bo										
	sonance, effect on rea			-	-	0,					
	olecular orbitals, Aromand non-alternant hydro	•			•	-					
	omaticity; bonding in fu					-					
	eaker than covalent- a					-					
	clusion compounds, cyclo				•	, and cryp					
				e taxaries.				1	5		
	onformational analysis	: Simple	alkanes,	cycloalkar	nes, A v	alues, de	calins,	-			
	onformational lock, ring s	•		-	-, •	,	· ···,				

	-	
	<b>Chirality:</b> Basic principles, molecules with more than one chiral center, threo and erythroisomers, Optical activity in the absence of chiral carbon (biphenyls, allenes and spiranes); Stereochemistry of the compounds containing nitrogen, sulphur and phosphorus. Methods of resolution, optical purity, enantiotopic and diastereotopic atoms, groups and faces, stereospecific and stereoselective synthesis. Asymmetric synthesis: basic principles, chiral pool, auxiliary, substrate, reagent and catalyst controlled.	
III	ALIPHATIC NUCLEOPHILIC SUBSTITUTION AND ELIMINATION REACTIONS	15
	a) Aliphatic Nucleophilic Substitution Reactions:	
	The $S_N 2$ , $S_N 1$ , mixed $S_N 1$ and $S_N 2$ and SET Mechanisms. The neighbouring group mechanism, neighbouring group participation by $\pi$ and $\sigma$ bonds. Classical and nonclassicalcarbocations, phenonium ions, norbornyl system, common carbocation rearrangements. The $S_N^i$ mechanism. Nucleophilic substitution at an allylic, aliphatic trigonal and a vinylic carbon. Reactivity effects of substrate structure, attacking nucleophile, leaving group and reaction medium, phase transfer catalysis and ultrasound, ambident nucleophile, regioselectivity. <b>b</b> ) Elimination Reactions:	
	The E2, E1 and E1cB mechanisms. Orientation of the double bond. Reactivity – effects of	
	substrate structures, attacking base, the leaving group and the medium.	
IV	AROMATIC SUBSTITUTION REACTIONS	15
	a) Aromatic Electrophilic Substitution:	15
	The arenium ion mechanism, orientation and reactivity. The <i>ortho/para</i> ratio, <i>ipso</i> attack,	
	orientation in other ring systems. Friedel-Crafts reaction, Diazonium coupling, Vilsmeir	
	reaction, Gattermann-Koch reaction.	
	b) Aromatic Nucleophilic Substitution:	
	The $S_N^{Ar}$ , diazonium salts and benzyne mechanisms. Reactivity–effect of substrate structure, leaving group and attacking nucleophile. The <i>von</i> Richter, Sommelet-Hauser and Smiles rearrangements.	
Sugges	ted Readings:	
	S. M. Mukherji and S. P. Singh, Reaction Mechanism in Organic Chemistry, Revised Edition P. Singh and Om Prakash). <i>TRINITY Press</i> , An Imprint of Laxmi Publications Pvt. Ltd., 2015.	. ,
	R. N. Boyd, R. T. Morrison and S. K. Bhattcharjee, Organic Chemistry, 7 <sup>th</sup> Edition. <i>Pearson</i> , 202	
3.	M. B. Smith, March's Advanced Organic Chemistry: Reactions, Mechanisms and Struct <i>Wiley</i> , 2013.	ure, 7 <sup>th</sup> Edition.
4.	J. Clayden, N. Geeves and S. Warren, Organic Chemistry, <i>Oxford University Press</i> , 2012.	
5.	E. L. Eliel and S. H. Wilen, Stereochemistry of Organic Compounds, <i>Wiley India</i> , 2008.	
6.	F. A. Carey and R. J. Sundburg, Advanced Organic Chemistry PART A, <i>Springer</i> 2007.	
7.	P. Y. Bruice, Organic Chemistry, 7 <sup>th</sup> Edition. <i>Pearson</i> , 2007.	
8.	D. Nasipuri, Stereochemistry of Organic Compounds, Second Edition. New Age International	, 2005.
0.	P. Sykes, A Guidebook to Mechanism in Organic Chemistry, <i>Longman</i> , 1985.	•

Course	e No:	Course Name:				Course	Code:					
CH-08		Organic Chemistr	y-ll			SBS CH (	010208 C 4	004				
Batch: 2021		Programme:	Semester:	L	Т	Р	Credits	Contact		04		
Onwar	de	M.Sc. Chemistry	II	4	0	0	4	per We Total H		60		
			••	4	0	U	4	Total H	5	00		
Total E	valuatio	on Marks: 100	Examination	n Duration:		3 Hrs.						
CIE:	30 Mar	'ks	Pre-requisit	e of course:	Basic kno	owledge ab	out the stru	cture and	d reac	tions o		
TEE:	70 Mar	ks	of free rad	various alkenes and carbonyl compounds; formation, stability and reaction of free radicals; fundamentals of interaction of light with matter; basi knowledge of conjugation and molecular orbital diagrams.								
Course	•	To provide advance	e knowledge	of organic	chemistr	y reactions	such as a	ddition re	actio	ns, free		
Objecti	ive		-							-		
-	in solving the problems related to addition reactions, free radical reactions, photoch											
Course	<u> </u>	pericyclic reactions After completing the		dent is over	cted to la	arn tha fall	owing:					
Outcon		<b>CO1</b> : In-depth und					-	kunos and	ممالحة	00		
Outcon	nes.	CO2: Thorough kn	-	•				•				
		compounds	owieuge of ti	ie audition,	substitut		nuensation	reaction	5 01 0	arbony		
		CO3: Advanced kno	wledge of for	mation stal	hility and	reactions o	f free radic	als				
		<b>CO4</b> : In-depth know	-									
		<b>CO5</b> : Ability to un	-	•			-	•	tions	such as		
		electrocyclic reacti					,					
		CO6: Theoretical	•		ons of si	gmatropic	rearrangen	nents and	d chel	otropio		
		reactions				0 1	0			•		
		·	CO	URSE SYL	LABUS							
NOTE:												
i) Ques	tion no.	1 is compulsory and	to be set from	n the entire	syllabus.	It will have	seven sub-	parts and	stude	nts		
		r any four. Each part			-							
		s. 2 to 5 are to be se				Every ques	tion will ha	ve three s	sub-pa	irts and		
		to answer any two s			onn cacin.							
Unit				ch question		rt carries se	ven marks.		-	at Ura		
				Contents		t carries se	Ven marks.		Conta			
						t carries se	ven marks.		Conta			
No.	ADDIT	ION REACTIONS O		Contents	. Each par			JLTIPLE		15		
No.	ADDIT BOND			Contents	. Each par			JLTIPLE				
No.	BOND	S	F CARBON-C/	Contents ARBON AN	. Each par D CARBC			JLTIPLE				
No.	BOND a) Pole	S ar addition to Carbo	F CARBON-CA	Contents ARBON AN tiple Bonds:	. Each par D CARBC	DN-HETERC	ATOM MU					
No.	BOND a) Polo Mecha	<b>S</b> ar addition to Carbon anistic and stereoch	F CARBON-C/ n-Carbon Mula emical aspec	Contents ARBON AN tiple Bonds: ts of follow	Each par CARBC	DN-HETERC trophilic a	DATOM MU	ictions:				
No.	BOND a) Pole Mecha hydrol	S ar addition to Carbo anistic and stereoch nalogenation, hydra	F CARBON-C/ n-Carbon Mula emical aspec tion, epoxida	Contents ARBON AN tiple Bonds: ts of follow tion, Wood	Each par CARBC	<b>DN-HETERC</b> trophilic a nd Prevost	DATOM ML ddition rea dihydroxy	i <b>ctions</b> : lations,				
No.	BOND a) Pole Mecha hydrol haloge	S ar addition to Carbon anistic and stereoch nalogenation, hydra anation, halocycliza	F CARBON-CA n-Carbon Mula emical aspec tion, epoxida tions, oxyme	Contents ARBON AN tiple Bonds: ts of follow tion, Wood ercuration,	Each par CARBC ving elec dward ar hydroge	DN-HETERC trophilic a nd Prevost nation, hy	ATOM ML ddition rea dihydroxy vdroboratio	<b>ictions</b> : lations, n and				
No.	BOND a) Pole Mecha hydrol haloge carber Additio	S an addition to Carbon anistic and stereoch nalogenation, hydra anation, halocycliza ne cyclopropanation on of nucleophiles	F CARBON-C/ n-Carbon Mula emical aspec tion, epoxida tions, oxyme General aspe	Contents ARBON AN tiple Bonds: ts of follow tion, Wood ercuration, ects of addi	Each par D CARBO Ving elec dward ar hydroge tion reac	<b>DN-HETERC</b> trophilic a nd Prevost nation, hy tions of all	ATOM MU ddition rea dihydroxy /droboratio <ynes a<="" and="" td=""><td><b>ictions</b>: lations, n and allenes.</td><td></td><td></td></ynes>	<b>ictions</b> : lations, n and allenes.				
No.	BOND a) Pole Mecha hydrol haloge carber Additio cyclop	S an addition to Carbon anistic and stereoch nalogenation, hydra anation, halocycliza ne cyclopropanation	F CARBON-CA <b>n-Carbon Mul</b> a temical aspec tion, epoxida tions, oxyme General aspector to alkenes,	Contents ARBON AN tiple Bonds: ts of follow tion, Wood ercuration, ects of addi Michael re	Each par D CARBO Ving elec dward ar hydroge tion reac	<b>DN-HETERC</b> trophilic a nd Prevost nation, hy tions of all	ATOM MU ddition rea dihydroxy /droboratio <ynes a<="" and="" td=""><td><b>ictions</b>: lations, n and allenes.</td><td></td><td></td></ynes>	<b>ictions</b> : lations, n and allenes.				

	following nucleophilic addition reactions to carbonyl compounds: hydration, acetalization, imine and enamine formation, Grignard, organozinc and organolithium reagents, Aldol, Knoevenagel, Claisen, Mannich, Benzoin, Perkin and Stobbe reactions, Addition of ylides (Wittig, Julia and Peterson reactions), hydride reductions of various carbonyl compounds. Hydrolysis of acetals, esters, amides and nitriles.	
II	<ul> <li>FREE RADICAL REACTIONS AND ORGANIC PHOTOCHEMISTRY</li> <li>a) Free radicals: Generation of free radicals, structure and stability, persistent radicals, common initiators and uses (peroxides, UV light, AIBN-tin hydride), radical anions and cations (One electron redox reactions), radical chain reactions, radical scavengers, Types of free radical reactions: substitution (halogenation, Sandmeyer reaction), addition (to unsaturated systems, radical cyclization), fragmentation (Hunsdiecker reaction), intramolecular H-abstraction (Hofmann-Loeffler and Barton reactions), oxidation (auto-oxidation of aldehydes) and dimerization (Pinacol, McMurry, acyloin and Glaser reactions)</li> <li>b) Organic Photochemistry: Fundamentals of organic photochemistry, Photochemical reactions of alkenes: photo-cycloaddition, Paterno-Buchi reaction, di-pi-methane rearrangement) Photochemical reactions of carbonyl compounds: Norrish type I and II reactions, di-pi methane and oxa-di-pi methane rearrangements. Basics of visible light photocatalysis.</li> </ul>	15
III	<ul> <li>PERICYCLIC REACTIONS I- ELECTROCYCLIC AND CYCLOADDITION REACTIONS</li> <li>Molecular orbital symmetry, Frontier orbitals of ethylene, 1,3-butadiene, 1,3,5-hexatriene, allyl and pentadienyl systems. Classification of pericyclic reactions. FMO approach.</li> <li>Electrocyclic reactions: conrotatory and disrotatory modes and effect on stereochemistry, 4n, 4n+2, allyl and pentadienyl systems, Nazarov cyclization. Cycloaddition reactions: antarafacial and suprafacial additions, 4n and 4n+2 systems, 2+2 addition of ketenes, Detailed treatment of Diels-Alder reactions (types of Diels-Alder reactions, common dienes and dienophiles, endo/exo selectivity, catalysis, synthetic applications, intramolecular and hetero Diels-Alder reactions), 1,3-dipolar cycloadditions: structure, methods of preparation andsynthetic applications of nitrones, nitrile oxides and azides.</li> </ul>	15
IV	PERICYCLIC REACTIONS II- SIGMATROPIC, ENE AND CHELOTROPIC REACTIONS Sigmatropic rearrangements: General considerations, suprafacial and antarafacial shifts of H and alkyl groups, 1,3, 1,5, 3,3 and 2,3-sigmatropic rearrangements. Valence tautomerism (divinylcyclopropane and bullvalene), Detailed treatment of Claisen (Eschenmoser, Johnson, Ireland and aromatic variants), Cope (oxy-Cope and anionic oxy-Cope) rearrangements. Wittig, aza-Wittig and Sommelet-Hauser rearrangements, concerted syn- eliminations. Ene reactions: General features, carbonyl and oxy-ene reactions, intramolecular ene reactions. Chelotropic eliminations: Definition, examples involving nitrogen, sulfur dioxide and carbon monoxide extrusions.	15

- 1. S. Kumar, V. Kumar and S. P. Singh, Pericyclic Reactions, A Mechanistic and Problem-Solving Approach, I<sup>st</sup> Edition. *Elsevier*, 2015.
- 2. S. M. Mukherji and S. P. Singh, Reaction Mechanism in Organic Chemistry, Revised Edition. (Revised by S. P. Singh and Om Prakash). *TRINITY Press*, An Imprint of Laxmi Publications Pvt. Ltd., 2015.
- Michael B. Smith, March's Advanced Organic Chemistry: Reactions, Mechanisms, and Structure, 7<sup>th</sup> Edition. Wiley, 2013.
- 4. J. Clayden, N. Geeves and S. Warren, Organic Chemistry, Oxford University Press, 2012.
- 5. Morrison, Boyd and Bhattacharjee, Organic Chemistry, 7<sup>th</sup>Edition. *Pearson*, 2010.
- 6. F. A. Carey and R. J. Sundburg, Advanced Organic Chemistry PART A and PART B, Springer 2007.
- 7. S. Sankararaman, Pericyclic reactions-A Textbook, 1<sup>st</sup> Edition. *Wiley-VCH, Weinheim*, 2005.
- 8. R. Bruckner, Advanced Organic Chemistry: Reaction Mechanism, Harcourt (India) Pvt. Ltd., 2001.
- 9. P. Sykes, A Guidebook to Mechanism in Organic Chemistry, Longman, 1985.

Course	No:	Course Name:				Course	Code:			
CH-14		Research Method	ology and So	ftware App	lications	SBS CH (	010314 C	2002		
Batch: 2021		Programme:	Semester:	L	Т	Р	Credit	Contac per We		02
Onward	ds	M.Sc. Chemistry	Ш	2	0	0	2	Total H	lrs.:	30
Total Ev	valuatio	on Marks: 50	Examination	mination Duration: 2 Hrs.						
CIE: 2	15 Mar	ks	Pre-requisite research, lite			-				
TEE:	35 Mar	ks	various softv	vare used to	conduct r	esearch sr	noothly.			
Course		Guiding philosophy	of knowledg	e creation	and disse	mination	will be dis	cussed ir	n this	course.
Objectiv	ve	Features of various	approaches to	o research, d	data collec	ction, anal	ysis and inj	ference v	vill be	taught.
	Principles of formulating research problems, designing experiments and documentation will form a									
		major part of the co	ourse. Specific	objectives d	and techni	ques of ch	emical scie	nces rese	earch v	vill also
		be presented.								
	tion no.	After completing th <b>CO1</b> : Basic understa <b>CO2</b> : Basic idea of li <b>CO3</b> : Basic knowled <b>CO4</b> : Basic knowled <b>CO5</b> : Skills for writir <b>CO6</b> : Basic knowled 1 is compulsory and	anding of vario terature revie ge of working ge of various s ng a research r ge for writing <b>CO</b> to be set from	bus types of in w and defini- hypothesis. software use report dissertation <b>URSE SYL</b>	methodolo ing proble ed during r LABUS	ogies used ms esearch	during reso		tudent	s need
to answ	ver any	two. Each part carrie	s three and ha	lf marks.						
		s. 2 to 5 are to be set							sub-pa	rts and
	ts need	to answer any two su	•		Each part	carries thr	ee and hal	f marks.	<u> </u>	
Unit No.			(	Contents					Conta	ct Hrs.
1	METH	ODS AND TYPES OF F								7
	Resear vs. Fu	rch methods vs Meth undamental, Quantii sals- design and comp	nodology. Type tative vs. Qu							,
II		ATURE REVIEW							ŝ	8
	review	tance of literature re vs, treatise, monogra ing the Problems, Dev	phs-patents,	Defining and	d formulat	•				

III	SCIENTIFIC SOFTWARES IN RESEARCH DESIGN Data Analysis using Tools like MS Excel, ChemDraw and MATLAB, google scholar, chemspider, scifinder, scopus, reaxys, research gate; using advanced search techniques, web resources, e-journals, e-books, journal access, subscribing TOC alerts, hot articles, citation index, h-index and i-index, Impact factor	7
IV	<b>REPORTING, DOCUMENTATION AND PRESENTATION</b> Scientific Document; Organization and writing of research papers, short communications, review articles, monographs, peer reviewing, ethics in publishing, predatory journals and publishers, technical and survey reports, authored book and edited books and dissertation.	8
Sugges	ted Readings:	
1.	A. Fink, Conducting Research Literature Reviews: From the Internet to Paper, Sage Publicati	ons, 2009.
2.	M. Graziano, A.M. Anthony and M. L. Raulin, Research Methods: A Process of Inquiry, <i>Al.</i> 2009.	lyn and Bacon.,
3.	W. M. K. Trochim, Research Methods: the concise knowledge base, Atomic Dog Publishing, 2	2005.
4.	P. D. Leedy and J. E. Ormrod, Practical Research: Planning and Design, Prentice Hall, 2004.	
5.	B. L. Garg, R. Karadia, F. Agarwal and U. K. Agarwal, An introduction to Research Meth <i>Publishers</i> , 2002.	odology, RBSA
6.	R. A. Day, How to Write and Publish a Scientific Paper, Cambridge University Press, 1992.	
7.	C. R. Kothari, Research Methodology: Methods and Techniques, New Age International, 199	0.
8.	S. M. Coley and C. A. Scheinberg, Proposal Writing, Sage Publications, 1990.	

Course N	No: Course Name:				Course	Code:				
CH-21	Organic Chemist									
	(Heterocycles an	d Natural Pro	ducts)							
Batch: 2021	Programme:	Semester:	L	Т	Р	Credit	Contact Hr per Week:	s. 04		
Onwards	M.Sc. Chemistry	III	4	0	0	4	Total Hrs.:	60		
Total Eva	luation Marks: 100	Examinatior	n Duration:	1	3 Hrs.					
<b>CIE:</b> 3	0 Marks	Pre-requisite				d knowled	ge of the ch	emistry of		
<b>TEE:</b> 7	0 Marks									
Course Objective	member heterocy its structure deter development proc	ncluding heterc cles and their i mination, synt ess.	ocycle reacti importance hesis and bi	ivity, synt in the fie iosynthes	hesis and cl ld of medic is and its u	hemical rea ine, natura ses during	ictions of smo I product iso	all to large lation and		
CourseAfter completing this course, student is expected to learn the following:Outcomes:CO1: Basic and advance knowledge of understanding heterocylic chemistry: the synthesi chemical transformation and reaction mechanism										
		vance knowledge about different class of natural products lyzing and developing new sustainable methods								
		eloping industrially important methods								
		of alternate and new eco-friendly synthetic pathways to chemicals								
	<b>CO6</b> : Application a			•		•				
		CO	URSE SYL	LABUS						
NOTE:										
	on no. 1 is compulsory and			-	It will have	seven sub-	parts and stu	dents		
	inswer any four. Each par				<b>F</b>					
-	on nos. 2 to 5 are to be se need to answer any two s				•••			-parts and		
Unit	need to answer any two s		Contents	. сасп ра	it carries se	ven marks.		ntact Hrs.		
No.			contents							
I I	NTRODUCTION AND CHE	MISTRY OF SM	IALL RING H	ETEROCY	<b>CLES</b>			15		
1	ntroduction, nomenclat	duction, nomenclature, spectral characteristics, reactivity of heterocyclic								
c	compounds. Synthesis and reactions of three, four and five membered heterocycles									
(	aziridines, oxiranes, thiira	nes, azetidines	s, oxetanes a	and thieta	anes, pyrro	re, thiophe	ne and			
f	uran).									
II (	HEMISTRY OF SIX MEMB	ERED AND BE	NZOFUSED I	HETEROC	YCLES			15		
۲ ۲	ynthesis and reactions yridinium&thiopyrirylium heteroatom. Benzofused f penzofuran, benzothiop	n salts. Chemist	try of bicycli mbered ring	ic compoi gs: synthe	unds contai esis and rea	ning one of in	r more ndoles,			
	penzotriazoles, quinolinizi	•	•			,				
	· 1	- 1	• •							

III	CHEMISTRY OF NATURAL PRODUCTS: TERPENOIDS, CAROTENOIDS AND STEROIDS	15
	Terpenoids and Carotenoids: Classification, nomenclature, occurrence, isolation, general	
	methods of structure determination, isoprene rule. Stereochemistry, Synthesis	
	(chemical/biosynthesis) of the following representative molecules: Citral, $\alpha$ -Terpeneol,	
	Farnesol, Santonin, Phytol and $\beta$ -carotene.	
	Steroids: Occurrence, nomenclature, basic skeleton, Diel's hydrocarbon and	
	stereochemistry. Isolation and biosynthesis of Cholesterol. Synthesis of Testorosterone,	
	Progesterone, Oestrone.	
IV	CHEMISTRY OF NATURAL PRODUCTS: ALKANOIDS AND FLAFONOIDS	15
	Alkaloids: Definition, nomenclature, occurrence, isolation, general methods of structure	
	elucidation, classification based on nitrogen heterocyclic ring. Stereochemistry, synthesis	
	and biosynthesis of the following: Ephedrine, Nicotine, Atropine and Quinine.	
	Flavonoids: Introduction, isolation and purification of flavonoids, General methods of	
	structural determination of flavonoids, Biosynthesis of flavonols and related polyphenols.	
Sugge	sted Readings:	I
1.	J. Clayden, B. Greeves and S. Warren, Organic Chemistry, Second Edition, Oxford University	Press, 2012.
2.	B. A. Bohm, Introduction to Flavonoids, Harwood Academic Publishers, 2011.	
3.	I. L. Finar, Organic Chemistry, Vol. 2, ELBS., 2009	
4.	Atta-ur-Rahman and Choudhary, Chemistry, Harwood Academic Publishers, 2008.	
5.	E. S. Coffey, Rodd's Chemistry of Carbon Compounds, Elsevier, 2005	
6.	J. A. Joule, Heterocyclic Chemistry, <i>ELBS</i> , 2005	
7.	Mann, Davidson, Hobbs, Banthrope and Harborne, Natural products: Chemistry and Biologic Longman, Essex., 2004.	al Significance,
8.	T. Eicher and S. Hauptmann, The Chemistry of Heterocycles, Thieme, 2002.	
9.	G. R. Newkome and W. W. Paudler, Contemporary Heterocyclic Chemistry, Wiley-Interscient	ce, 1995.
10	. T. L. Gilchrist, Heterocyclic Chemistry, Longman Scientific Technical, 1990.	
11	. R. M. Acheson, An Introduction to Heterocyclic Chemistry, John Wiley, 1980	
12	. A. R. Katritzky and C. W. Rees, Comprehensive Heterocyclic Chemistry, Pergamon Press, 197	0.

Course	e No:	Course Name:				Course	Code:		
CH-22		Organic Chemistr	y-IV			SBS CH 010306 DSE 4004			
		(Reagents and Re	actions)						
Batch: 2021		Programme:	Semester:	L	Т	Р	Credit	Contact H per Week	
Onward	ds	M.Sc. Chemistry	Ш	4	0	0	4	Total Hrs.	60
Total Ev	valuatio	n Marks: 100	Examinatio	n Duration:	1	3 Hrs.	1		
CIE:	30 Mar	ks	Pre-requisite			-		lassical rea	gents and
TEE:	70 Mar	ks	reactions us	ea common	iy in orga	nic synthes	IS		
Course Objecti		To provide the ad reagents and meth and common m rearrangement rea reagents and condi	ods in synthe netal-based i nctions will be	sis in particu reagents, c gained. At t	ilar. In-de oxidation- he end oj	epth knowl reduction f the course	edge of me reactions	tal-mediate and reag	d reactions ients and
Course		After completing th	nis course, stu	dent is expe	cted to le	arn the foll	owing:		
Outcom	nes:	CO1: Advanced k	nowledge of	modern m	ethods o	of manipu	ations of	carbonyl co	ompounds,
		theoretical explana	itions of and r	eactivity incl	uding ste	reochemis	try		
		CO2: In-depth une	derstanding o	of the use of	various	transition	metal-base	d catalysts i	n coupling
		reactions							
		CO3: Modern, class	sical and greer	n methods o	f oxidatio	n of variou	s functiona	l groups	
		CO4: Common redu	uction method	ds in organic	synthesis	5			
		CO5: Environmenta	ally friendly ar	nd stereosele	ective mo	dern proce	sses in orga	nic synthesi	S
		CO6: Thorough u	nderstanding	of various	rearrang	ement rea	ctions and	their appl	ications in
		synthesis							
			CO	URSE SYL	LABUS				
NOTE:									
-		1 is compulsory and r any four. Each part			•	It will have	seven sub-	parts and st	udents
-		s. 2 to 5 are to be set				• •			parts and
	ts need	to answer any two si	•	ch question. Contents	Each par	t carries se	ven marks.		into at Ilira
Unit No.				contents					ntact Hrs.
I	USE OF	METALS IN ORGAN	IC SYNTHESIS						15
	Selecti boron, Gilman reactio	ve enolate generatio and titanium enola cuprates, Samariun n, Stille coupling, S ald-Hartwig aminatio	on using LDA, tes), Zimmern n Iodide, Palla Suzuki coupli	LHMDS, KHN nan-Traxler <sup>-</sup> adium media	TS; McMi ated reac	urry and Te tions <u>:</u> Wac	ebbe olefin ker process	ations; , Heck	
		alu-naltwig allillati	on.						
11		TION REACTIONS	on.						15

	modern catalytic oxidations using TEMPO) for oxidation of alcohols, ketones and aldehydes; Oxidation of C-C bonds [ozone, KMnO <sub>4</sub> , Pb(OAc) <sub>4</sub> , dimethyldioxirane, Ce(IV) andMn(III)] and saturated carbons, hypervalent iodine reagents, DDQ, Major methods for asymmetric epoxidations and dihydroxylations.	
111	REDUCTION REACTIONS	15
	Common reducing agents such as dissolving metal reductions (Birch reduction), various Aluminum and Boron derived hydrides, catalytic/transfer hydrogenations (Homogeneous and Heterogeneous), diimide, Bu <sub>3</sub> SnH, low valent Ti species, and Wolf-Kishner reduction. Asymmetric reduction using Corey's oxazaborolidine (CBS catalyst) and Noyori's hydrogenation.	
IV	REARRANGEMENT REACTIONS	15
	General mechanistic considerations, nature of migration, migratory aptitude and mechanistic study of the following rearrangements: Pinacol-pinacolone, Wagner- Meerwin, Benzil-Benzilic acid, Favorskii, Arndt-Ester synthesis, Demyanov, Beckmann, Hofmann, Curtius, Schmidt, Baeyer-Villiger, Shapiro reaction, Dienone-Phenol, Pummerer, Smiles, Sommelet-Hauser and Achmatowicz rearrangements.	
Sugges	ted Readings:	
	S. M. Mukherji and S. P. Singh, Reaction Mechanism in Organic Chemistry, Revised Edition. P. Singh and Om Prakash). <i>TRINITY Press, An Imprint of Laxmi Publications Pvt. Ltd.</i> , 2015. F. A. Carey and R. J. Sundberg, Advanced Organic Chemistry, Part A and Part B: Reaction	
n	5 <sup>th</sup> Edition. <i>Springer Verlag</i> , 2012.	
	<ul> <li>V. K. Ahluwalia, Oxidation in Organic Synthesis, <i>CRC press</i>, 2012.</li> <li>J. H. Hartwig, Organotransition Metal Chemistry: From Bonding to Catalysis, 1<sup>st</sup>Edition. <i>Un Books</i>, 2009.</li> </ul>	iversity Sciend
5.	L. Kurti and B. Czako, Strategic Applications of Name Reactions in Organic Synthesis, <i>Else Press</i> , 2005.	evier Academ
	L. Kurti and B. Czako, Strategic Applications of Name Reactions in Organic Synthesis, Else	evier Academ
6. 7.	<ul> <li>L. Kurti and B. Czako, Strategic Applications of Name Reactions in Organic Synthesis, <i>Else Press</i>, 2005.</li> <li>R. H. Crabtree, The Organometallic chemistry of the transition metals, <i>John Wiley</i>, 2005.</li> <li>W. Carruthers and Iain Coldham, Modern Methods of Organic Chemistry, 4<sup>th</sup>Edition. <i>Cambr Press</i>, 2004.</li> </ul>	idge Universi
6. 7.	<ul> <li>L. Kurti and B. Czako, Strategic Applications of Name Reactions in Organic Synthesis, <i>Else Press</i>, 2005.</li> <li>R. H. Crabtree, The Organometallic chemistry of the transition metals, <i>John Wiley</i>, 2005.</li> <li>W. Carruthers and Iain Coldham, Modern Methods of Organic Chemistry, 4<sup>th</sup>Edition. <i>Cambr.</i></li> </ul>	idge Universit
6. 7. 8.	<ul> <li>L. Kurti and B. Czako, Strategic Applications of Name Reactions in Organic Synthesis, <i>Else Press</i>, 2005.</li> <li>R. H. Crabtree, The Organometallic chemistry of the transition metals, <i>John Wiley</i>, 2005.</li> <li>W. Carruthers and Iain Coldham, Modern Methods of Organic Chemistry, 4<sup>th</sup>Edition. <i>Cambr Press</i>, 2004.</li> <li>Warren, S.; Greeves, N.; J. Clayden and P. Wothers, Organic Chemistry, 2<sup>nd</sup>Edition. <i>Oxford U</i></li> </ul>	idge Universit

Course No:	Course Name:				Course (	Code:				
CH-15	Applications of Sp	pectroscopy			SBS CH C	)10415 C 4	1004			
Batch: 2021	Programme:	Semester:	L	т	Р	Credit	Contac per W		04	
Onwards	M.Sc. Chemistry	IV	4	0	0	4	Total H		60	
Total Evaluati	on Marks: 100	Examinatio	n Duration:		3 Hrs.					
<b>CIE:</b> 30 Ma	rks	Pre-requisit	e of course:	An adva	nced knowle	edge of cor	nmon an	d impo	ortant	
		<b>Pre-requisite of course</b> : An advanced knowledge of common and important reactions and reagents used in functional group transformations in organic								
<b>TEE:</b> 70 Ma	rks	synthesis. An ability to analyse complex chemical structures and find out key								
		-	structural features.							
Course	To provide the adv	unce knowlea	lge and und	erstandin	a of organi	c spectrosc	copy. At t	the end	d of this	
Objective	course, students w		-			•			-	
	techniques (UV-Vi	sible, IR, NMI	R spectrosc	opy and	mass spec	trometry)	to the s	olve pi	roblems	
	related to structure determination of organic compounds.									
Course	After completing t	-	•			•				
Outcomes:	<b>CO1</b> : An uptodate	e knowledge o	of modern	reagents	used in sy	nthesis for	r FGIs ar	nd mad	crocycle	
	formation	f								
	<b>CO2</b> : Understandi	-		•	is such as	multicomp	onent n	eaction	IS, CIIC	
		ration and organocatalysis t of ability to consider and analyze the sustainability, economics, safety and								
	toxicity aspects of			nu analy.	ze the sust	amabinty,	economi	cs, san	cty and	
		lyse complex molecular structures to identify key structural features and devis							d devise	
	, ways of constructin									
	<b>CO5</b> : Understandir	-	s and tactics	of organ	ic synthesis	such as pr	otection,	depro	tection	
	umpolung, order o	f events etc.								
	CO6: Ability to rea	•	•		•					
	various aspects suc		-		esign. Ability	/ to design	synthetio	c route	S	
		CO	URSE SYL	LABUS						
NOTE:										
i) Question no	. 1 is compulsory and	l to be set fron	n the entire	syllabus.	It will have	seven sub-	parts and	d stude	ents	
	er any four. Each part									
-	os. 2 to 5 are to be se							sub-pa	arts and	
	I to answer any two s	ub-parts of ea		. Each pai	rt carries se	ven marks.				
Unit			Contents					Cont	act Hrs.	
No.	AVIOLET AND VISIBLE			ACC CDEC.					15	
_	isible spectroscopy: \				-		ectrum		13	
	our, effect of solve					•				
	ounds, unsaturated			-			•			
	lward rules for conju		•							
	atic and heterocyclic	-		· ·		•				
Mass	spectrometry: Intro	duction, ion	production-	-EI, CI, FI	D and FAB	, factors a	ffecting			
fragm	entation, ion analys	sis, ion abun	dance. Mas	ss spectr	al fragmen	tation of	organic			

	compounds, common functional groups, molecular ion peak, metastable peak, McLafferty	
	rearrangement. Nitrogen rule. High resolution mass spectrometry (HRMS).	
II	INFRARED SPECTROSCOPY	15
	Instrumentation and sample handling. Characteristic vibrational frequencies of alkanes,	
	alkenes, alkynes, aromatic compounds, alcohols, ethers, phenols and amines. Detailed	
	study of vibrational frequencies of carbonyl compounds (ketones, aldehydes, esters,	
	amides, acids, anhydrides, lactones, lactams and conjugated carbonyl compounds). Effect	
	of hydrogen bonding and solvent effect on vibrational frequencies, overtones, combination	
	bands and Fermi resonance	4 5
		15
	General introduction and definition, theory of NMR, chemical shift, shielding and	
	deshielding mechanism, magnetic anisotropy, chemical shift values and correlation for	
	protons bonded to carbon (aliphatic, olefinic, aldehydic and aromatic) and other nuclei	
	(alcohols, phenols, enols, carboxylic acids, amines, amides & mercapto), spin-spin	
	interaction, Spin systems, Pople notation, complex spin-spin interaction between two,	
	three and four nuclei (first order spectra), virtual coupling. chemical exchange, effect of	
	deuteration, Stereochemistry, hindered rotation, Karplus curve-variation of coupling	
	constant with dihedral angle. Simplification of complex spectra, nuclear magnetic double	
	resonance, contact shift reagents. Fourier transform technique, nuclear Overhauser effect	
:) /		4 -
iV	CARBON-13 NMR SPECTROSCOPY AND COMBINED APPLICATIONS	15
	<b>Carbon-13 NMR Spectroscopy:</b> General considerations, chemical shift (aliphatic, olefinic,	
	alkyne, aromatic, heteroarmatic and carbonyl carbon), coupling constants and DEPT <sup>13</sup> C	
	NMR spectra. General introduction to two-dimensional NMR spectroscopy- HETCOR and	
	NOESY. Resonance of other nuclei-F, P.	
	<b>Combined problems:</b> Combined problems relating to structure elucidation by UV, IR, NMR	
Suggo	Spectroscopy and Mass Spectrometry. sted Readings:	
	D. L. Pavia, G. M. Lampman, G. S. Kriz and J. R. Vyvyan, Introduction to Spectroscopy, 5 <sup>th</sup> Edi	tion Congago
	India, 2015.	
2.	R. Kakkar, Atomic and Molecule Spectroscopy: Basic Concepts and Applications, <i>Cambrid Press</i> , 2015.	lge University
3.	W. Kemp, Organic Spectroscopy, 3 <sup>rd</sup> Edition. <i>Mac publishers</i> , 2011.	
4.	D. H. Williams, I. Fleming, Spectroscopic Methods in Organic Chemistry, Tata McGraw-Hill, 20	)10.
5.	J. R. Dyer, Application of Spectroscopy of Organic Compounds, Prentice Hall, 2009.	
6.	R. J. Abraham, J. Fisher and P. Loftus, Introduction to NMR Spectroscopy, Wiley, 2005.	
7.	J. Mohan, Organic Spectroscopy, Narosa Publishers, New Delhi, 2002.	
8.	R. M. Silverstein, G. C. Bassler and T. C. Morrill, Spectrometric Identification of Organic Con <i>Wiley</i> , 1995.	pounds <i>, John</i>
9.	C. N. Banwell and E. M. McCash; Fundamentals of Molecular Spectroscopy, 4 <sup>th</sup> Edition, <i>Tata</i> 1994.	McGraw Hill,

Course	e No:	Course Name:				Course C	Code:					
CH-33		Organic Chemistr	y-V (Organic	Synthesis)		SBS CH C	10417 DS	E 4004				
Batch:		Programme:	Semester:	L	Т	Р	Credit	Contact	Hrs.			
2021								per Wee	k:	04		
Onward	ds	M.Sc. Chemistry	IV	4	0	0	4	Total Hrs	5.:	60		
Total Ev	valuatio	on Marks: 100	Examination	Examination Duration: 3 Hrs.								
CIE:	30 Mar	ks	Pre-requisit	e of course:	An advar	nced knowle	edge of con	nmon and i	impor	rtant		
			reactions an	d reagents ι	used in fu	nctional gro	oup transfo	rmations ir	n orga	anic		
TEE:	70 Mar	ks	synthesis. A	synthesis. An ability to analyse complex chemical structures and find out key								
			structural fe	atures.								
Course		To gain an in-dep			ious func	tional arou	n transfor	mations c	Inssin	al and		
Objecti		modern techniques			-	-						
		molecules. Detailed		•	•		-	•	-	•		
		gained. Using thi	•		-	•	•					
		targets will be ca			•		-	•				
		synthesis will be le		-	•			-	-	-		
		of synthetic metho	-		-							
		design retrosynthe	sis and forwar	s and forward synthesis of complex targets at the end of the course.								
Course		After completing th	his course, stu	dent is expe	cted to le	earn the foll	owing:					
Outcom	nes:	CO1: An uptodate knowledge of modern reagents used in synthesis for FGIs and macrocycle										
		formation										
		CO2: Understanding of modern trends in synthesis such as multicomponent reactions, click										
		chemistry, CH activation and organocatalysis										
		CO3: Development of ability to consider and analyze the sustainability, economics, safety and										
		toxicity aspects of organic synthesis										
		<b>CO4</b> : Ability to analyse complex molecular structures to identify key structural features and devise										
		ways of constructing them										
		<b>CO5</b> : Understanding of strategies and tactics of organic synthesis such as protection, deprotection										
		umpolung, order of events etc. <b>CO6</b> : Ability to read and independently understand modern synthetic endeavours and appreciate										
			•	•		•						
		various aspects suc		URSE SYL		Sign. Ability	to design	synthetic h	outes			
NOTE:												
	tion no	1 is compulsory and	to be set from	n the entire	syllahus	It will have	seven sub-	parts and s	tuder	nts		
-		r any four. Each part			•				cuuci			
		s. 2 to 5 are to be se				Everv aues	tion will ha	ive three su	ıb-pa	rts and		
-		to answer any two s										
Unit		,		Contents	I -				Co	ntact		
No.										Hrs.		
I	FUNCT	IONAL GROUP T	RANSFORMAT	IONS USIN	IG MISC	ELLANEOUS	<b>REAGEN</b>	ITS AND		15		
	REACT	IONS										
	Amide	coupling reagents	(DCC, DIC,	EDC, BOP,	HOBt),	macrolacto	nization, N	/lukiyama				
	reager	nt; Mitsunobu reac	tion; Silyl an	d stannyl l	hydrides,	Burgess r	eagent, La	wesson's				

	reagent.	
II	CLASSICAL AND MODERN METHODS IN SYNTHESIS Illustration of the following concepts with examples; Multicomponent reactions (Strecker, Mannich, Biginelli, Passerini and Ugi reactions), click chemistry, cascade and domino processes for multiple C-C bond forming reactions (radical cyclisations, electrocyclic cascades, polyenecyclizations), CH-activation and remote functionalisation, asymmetric organocatalysis (proline, NHCs), biocatalysis, Reusable reagents, biomimetic synthesis	15
111	<b>RETROSYNTHESIS AND DISCONNECTION APPROACH</b> Concept of retrosynthesis, disconnection approach, introduction to synthons and synthetic equivalents, linear and convergent synthesis, types of transforms, functional group inter- conversions, classification of disconnections, chemoselectivity, control of stereochemistry, reversal of polarity (umploung), common building blocks, the importance of the order of events in organic synthesis, applications of alkynes, aliphatic nitro compounds, bifunctional compounds, Protecting groups, representative examples for O, N, COOH and carbonyl protection/deprotections.	15
iV	CASE STUDIES-TOTAL SYNTHESIS Total synthesis, Semi synthesis, formal synthesis, overall yield, concept of ideal synthesis, Detailed case study of the following classical/modern total syntheses: Periplanone B (W. C. Still), Estrone (K. P. C. Vollhardt), Quinine (G. Stork).	15
1. 2. 3. 4. 5. 6. 7. 8.	<ul> <li>ted Readings:</li> <li>S. Caron, Practical Synthetic Organic Chemistry: reactions, Principles and Technique, 2<sup>nd</sup> Edi 2020.</li> <li>S. Warren, Designing Organic Synthesis, <i>Wiley</i>, 2011.</li> <li>F. A. Carey and R. J. Sandburg, Advanced Organic Chemistry Part B, <i>Plenum Press</i>, 2009.</li> <li>T. Hudlický and J. W. Reed, The Way of Synthesis, <i>Wiley VCH-Weinheim</i> 2007.</li> <li>G. S. Zweifel and M. H. Nantz, Modern Organic Synthesis- An Introduction, <i>W. H. Freeman &amp; Co.</i> J. March, Advanced Organic Chemistry, Reactions Mechanisms and Structure, <i>John Wiley</i>, 2005.</li> <li>R. O. C. Norman and J. M. Coxon, Principles of Organic Synthesis, <i>Wiley VCH-Weinheim</i>, 1996.</li> </ul>	<i>,</i> 2007.
	<ul> <li>W. Carruthers, Some Modern Methods of Organic Synthesis, <i>Foundation Books</i>, 1995.</li> <li>Fieser and Fieser, Reagents in Organic Synthesis, <i>Wiley</i>, 1993.</li> <li>H. O. House, W.A. Benjamin, Modern Synthetic Reactions, 1990.</li> </ul>	

Course	No:	Course Name:				Course C	Code:					
CH-34		Organic Chemistry-	VI (Medicinal	Chemistry)		SBS CH C	)10418 DS	E 4004				
Batch:		Programme:	Semester:	L	Т	Р	Credit	Contact I	Hrs.			
2021								per Wee	k:	04		
Onward	S	M.Sc. Chemistry	IV	4	0	0	4	Total Hrs	.:	60		
Total Ev	aluatio	n Marks: 100	Examination	n Duration:	1	3 Hrs.						
CIE:	30 Mar	ks	Pre-requisit	<b>Pre-requisite of course</b> : Basic understanding of non-covalent interactions,								
TEE:	70 Marl	ks	biomolecule	es and bioche	emical pr	ocesses						
Course Objectiv Course Outcom	<ul> <li>This course will provide a basic understanding and fundamentals of Medicinal Chemistry. At end of this course, students will learn about the various stages involved in drug discover development process and challenges encounter during the course of development of new of which finally comes into the market, various biological drug targets, drug-target binding, mod actions of anticancer, antibiotics, psychoactive drugs and its chemical synthesis.</li> <li>Se After completing this course, student is expected to learn the following:</li> </ul>								very & w drug hode oj ical nas NA nt, nts; :hesis.			
		<b>CO6</b> : Approaches for of drugs acting on the second	•	oment of ant	ibiotics, t	their classifi	ication, syn	thesis, dev	elopn	nent		
		of drugs deting of t		URSE SYL	LABUS							
need to ii) Quest	answei tion nos	1 is compulsory and r any four. Each part s. 2 to 5 are to be se to answer any two s	carries three t from all four	and half ma units one fr	rks. om each.	Every ques	tion will ha	ve three su				
Unit		•	·	Contents	•				Со	ntact		
No.									ŀ	Irs.		
		TARGETS								15		
	drug t proteo interac neurot	action to medicinal cargets; Proteins- mics; Enzymes- cata ctions, isozymes, ransmitters, hormo y and secondary stru	primary, seco lytic role, acti co-factors; mes, recepto	ondary and ive site, allo Receptors- r activation	tertiary steric bin types and re	structure ding, feedb of recep	, protein ack contro tors, thei	function, I, binding ir roles,				
11		TARGET BINDING								15		
	Introdu	uction to Pharmacod	•	•		•						
1	enzym	e inhibitors, medici	nal use of en	izyme inhibi	tors with	n examples;	; Receptors	s as drug				

	targets- agonists, antagonists, allosteric modulators, partial agonists, inverse agonists,	
	desensitization, tolerance and dependence, affinity and efficacy; Nucleic acids as drug	
	targets- Intercalating agents, topoisomerase poisons, alkylating/metallating agents, chain	
	cutters, chain terminators, examples of medicinal use. Miscellaneous drug targets (tubulin)	
11	DRUG DESIGN AND DEVELOPMENT	15
	Development of new drugs, concept of lead compounds and lead modifications, structure- activity relationship (SAR), factors affecting bioactivity, resonance, inductive effect, isosterism, bioisosterism. Theories of drug activity, Quantitative structure activity relationship, Concepts of drugs receptor, Elementary treatment of drug receptor interactions, Physico-chemical parameters: lipophilicity, partition coefficient, electronic ionization constants, steric factors.	
IV	MODE OF ACTION AND SYNTHESIS	15
	Anticancer Agents: Introductory Idea of antineoplastic agents, cancer chemotherapy, common targets in cancer chemotherapy, role of alkylating agents and antimetabolites in treatment of cancer.	
	Antiinfective Drugs (antibiotics): Cell wall biosynthesis, inhibitors, $\beta$ -lactam rings, antibiotics inhibiting protein synthesis, Synthesis of penicillin G, amoxicillin, Introductory idea of tetracycline and streptomycin.	
	Psychoactive Drugs: Introductory idea of CNS depressants, general anaesthetics, hypnotics, sedatives, anti-anxiety drugs.	
	Anti-fertility Drugs: Introductory idea of anti-fertility drugs and mode of action.	
Sugges	ted Readings:	
1.	R. B. Silverman, The Organic Chemistry of Drug Design and Drug Action, 3 <sup>rd</sup> Edition. Academic Plan	ress, 2014.
2.	G. L. Patrick, An Introduction to Medicinal Chemistry, 5th Edition. Oxford University Press, 2013.	
3.	D. Van Vranken and G. Weiss, Introduction to Bioorganic Chemistry and Chemical Biology, <i>Garl</i> 2013.	land Scienc
4.	D. Sriram and P. Yogeshwari, Medicinal Chemistry, 2 <sup>nd</sup> Edition. Pearson, 2012.	
5.	Ed Robert F Dorge, Wilson and <i>Gisvold's TextBook</i> of Organic Medicinal and Pharmaceutica 12 <sup>th</sup> Edition. 2010.	l Chemistr
6.	Ed. M E Wolff, Burger's Medicinal Chemistry and Drug Discovery, Vol. 1, 7 <sup>th</sup> Edition. John Wiley,	2010
	G. Thomas, Medicinal Chemistry, 2 <sup>nd</sup> Edition, John Wiley & Sons, 2007.	
	S. Warren, N. Greeves, J. Clayden and P. Wothers, Organic Chemistry, 2 <sup>nd</sup> Edition. Oxford Univ	versity Pres
0.	2001.	

# PRACTICAL COURSES

Course N	o: Course Name:				Course	Code:				
CH-05	Organic Chemist	ry Practical-I			SBS CH (	010105 C (	0042			
Batch:	Programme:	Semester:	L	Т	Р	Credit	Contact Hrs.			
2021							per Week:	04		
Onwards	M.Sc. Chemistry	I	0	0	4	2	Total Hours:	60		
Total Eval	uation Marks: 50	Examinatio	n Duration	1: 6H	Irs.					
<b>CIE:</b> 15	Marks		<b>Pre-requisite of course:</b> Basic idea of chemical laboratory safety and goo practices; basic skills such as weighing, measuring, titrating, cleaning etc.							
<b>TEE:</b> 35	Marks	practices, ba	asic skills s	uch as wei	gning, meas	uning, titra	ting, cleaning et			
CourseTo acquire experinObjectivefunctional group idewill learn the varieorganic compoundStudents would bepercentage of given		dentification a rious purificat ids, solvent d	ind drying ion metho Irying ana with quan	of organic ods, chrom functione	solvents. A atographic al group d	t the end o separation etection in	of this course, st a and identificat a organic comp	udents tion of ounds.		
Course	After completing	, ,		pected to l	earn the fol	lowing:				
Outcomes: CO1: Safe laborato CO2: Purification te CO3: Purification te CO4: Qualitative ar CO5: Tests to deter		techniques for techniques for nalysis of unkr ermine the vari	solids such liquids such nown samp ous eleme	n as crystal ch as distill ples to dete ents presen	ation and ch ermine the f t in an orga	iromatogra unctional g nic compou	phy groups	bhy		
		CO	URSE S	(LLABUS						
NOTE:										
	ons will be set, one from e	ach of the UNIT.			uired to atte	empt all the				
Unit No.			Conter	its				ntact Irs.		
I	ISOLATION AND PURIF Laboratory Safety Crystallization, recrysta Distillation: Simple, Ste Solvent Extraction	Illization and so am and Vacuu	ublimation m	1				30		
	Drying of ethanol/ acet Paper Chromatography Thin Layer Chromatogr	1	ner/ m							

Estimation of alcoholic/phenolic/amino groups in the given organic compound

- 1. K. L. Williamson and K. M., Masters Macroscale and Microscale Organic Experiments, 7<sup>th</sup> Edition. *Cengage Learning*, 2017.
- 2. R. K. Bansal, Laboratory Manual in Organic Chemistry, *Wiley*, 2006.
- 3. B. S. Furniss and others, Vogel's Text Book of Practical Organic Chemistry, 5e Paperback, *Pearson*, 2003.
- 4. D. Pasto, C. Johnson and M. Miller, Experiments and Techniques in Organic Chemistry, *Prentice Hall*, Instructor's Edition, 1992.
- 5. H. T. Clarke revised by B. Haynee, A Hand book of Organic Analysis-Qualitative and Quantitative, *Edward Arnold, London*, 1975.
- 6. H. Middleton, Systematic Qualitative Organic Analysis, *Edward Arnold, London*, 1959.

Course No:	Course Name:				Course C	Course Code:					
CH-11	Organic Chemistr	y Practical-II			SBS CH 0	10211 C (	0042				
Batch:	Programme:	Semester:	L	Т	Р	Credit	Contact	: Hrs.			
2021							per We	ek:	04		
Onwards	M.Sc. Chemistry	II	0	0	4	2	Total He	ours:	60		
Total Evalua	tion Marks: 50	Examinatio	n Duration:	6 Hrs.							
<b>CIE:</b> 15 M	larks	Pre-requisit	e of cours	e: Skills t	o handle	solvent ex	tractions,	distilla	ations,		
			crystallisations simple chromatographic experiments independently. Ability to								
TEE: 35 Marks		set up read				uire heatir	ng/cooling	g, set-u	p and		
		execute filtr									
Course	To acquire the skill	•	•	•	-		•				
Objective	of solvent-solvent				-	-		•			
	derivative preparat					-	•	-			
	set-up the reactio				purijy the	product.	релеюр к	nowied	iye of		
	proper und suje wi	iste uisposui il	i these ope	rutions.							
Course	After completing th	his course, stu	dent is exp	ected to le	arn the foll	owing:					
Outcomes:	CO1: To analyse a	ind separate	binary mixt	ures of so	lids using a	solvent ex	traction, t	o puri	fy and		
	identify the isolate	d component	s via derivat	ive prepar	ration						
		CO2: To analyse and separate binary mixtures of solid and liquid using solvent extraction, to purify									
		and identify the isolated components via derivative preparation									
		CO3: To analyse and separate binary mixtures of liquids using solvent extraction, to purify and									
		identify the isolated components via derivative preparation									
		<b>CO4:</b> To plan and carry out single-step preparation of organic compounds									
		<b>CO5:</b> To work-up, isolate and purify, determine the purity of the prepared compound and safe									
	treatment and disp										
	CO6: To develop a	•			perations vi	a a visit					
			URSE SY	LLABUS							
NOTE:											
· · ·	ns will be set, one from	n each of the l			are required	d to attemp		•			
Unit No.			Contents					Contac			
	QUALITATIVE ANALY	SIS OF BINA	ARY ORGA	ΝΙΟ ΜΙΧΊ	URES BY	A SYSTE	MATIC	30	)		
		PPROACH									
	•	nemical separation using H <sub>2</sub> O, NaHCO <sub>3</sub> , NaOH, HCl, Ether or any other reagent as									
		r required conditions of solid-solid, solid-liquid and liquid-liquid mixtures									
	derivative of each.	stematic identification of the components and preparation of at least one									
	A. ORGANIC SYNTHESI	c						20	<u> </u>		
	A. ORGANIC SYNTHESIS 30 Preparation of organic compound involving one-step reaction. (Prepare at least three								)		
		compound in	volving one	-step read	поп. (Ргера	are at least	unee				
	compounds) [ <b>Important <i>Note:</i> Gre</b>	oonor protoc	ols to be	used who	rovor norci	ihla Suhm	oit the				
	recrystallised sample of	•			•						
	melting points.]	j the synthesh				Surry by T					
	B. INDUSTRIAL VISIT										

	In order to get an exposure on how chemical industries function, department will	
	arrange an industrial visit.	
	Students to prepare a report on the industrial visit.	
Sugges	ted Readings:	
1.	K. L. Williamson and K. M., Masters Macroscale and Microscale Organic Experiments, 7 <sup>th</sup> learning, 2017.	Edition. <i>Cengage</i>
2.	H.A. Shally, Green Chemistry Laboratory Manual for General Chemistry, 1 <sup>st</sup> Edition CRC Pres	ss, 2015.
3.	R. K. Bansal, Laboratory Manual in Organic Chemistry, Wiley, 2006.	
4.	B. S. Furniss and others, Vogel's Text Book of Practical Organic Chemistry, 5 <sup>th</sup> Edition Pap 2003.	erback, Pearson
5.	D. Pasto, C. Johnson and M. Miller, Experiments and Techniques in Organic Chemistr Instructor's Edition, 1992.	y, Prentice Hali
6.	H. T. Clarke revised by B. Haynee, A Hand book of Organic Analysis-Qualitative and Quar <i>Arnold, London</i> , 1975.	ntitative, Edward
7.	H. Middleton, Systematic Qualitative Organic Analysis, Edward Arnold, London, 1959.	

Course N	lo:	Course Name:				Course C	ode:			
CH-23		Organic Chemistr	y Practical-III	l		SBS CH 0	10307 DSE	0063		
Batch:		Programme:	Semester:	L	Т	Р	Credit	Contact H	rs.	
2021								per Week	: 06	
Onwards		M.Sc. Chemistry	Ш	0	0	6	3	Total Hou	rs: 90	
Total Eval	luatio	n Marks:75	Examinatio	n Duration:		8 Hrs.	· · · · ·			
CIE: 22.5 I	Marks		Pre-requisit				•			
<b>TEE</b> • 52 5	TEE: 52.5 Marks			isolation of samples, safe distillation of solvents and ability to purify samples by recrystallization from suitable solvents. Knowledge of various common						
122.5	I VIULING	,	reagents an				-			
			environmen			-	S. KIIOWICUS			
Course		To gain the knowle					ortant comr	onents fro	om natural	
Objective		sources. To learn th	•	-				-		
		from plant and anii							-	
						or synthesi	2 ng u turyet	t compoun	u III u 100-	
<b>C</b>		step procedure and				+le - f - II				
Course Outcomes	<b>.</b> .	After completing th		•			-	courcos		
Outcomes	5.	<b>CO1:</b> General aspects of extraction of natural products from plant and animal sources								
		<ul><li>CO2: Specific methods for the extraction and purification of alkaloids/phenols of plant origin</li><li>CO3: Specific methods for the extraction of terpenoids, carotenoids and milk protein from the</li></ul>								
		natural sources								
		<b>CO4:</b> Planning of a two-step synthesis of a given target								
		<b>CO5:</b> Execution of the planned synthesis by minimizing waste and environmental impact								
		CO6: Isolation, puri	fication and c	onformatio	n of the st	ructure of a	all the synthe	esized com	pounds	
			CO	URSE SY	LLABUS					
NOTE:										
Unit No.	stions v	vill be set, one from e	ach of the UNI	Contents	lates are rec	quired to att	empt all the c		ontact Hrs.	
1	EXT	RACTION OF NATUR	AL PRODUCT	S (Alkaloids	and natu	ral phenols	)		30	
	EXTRACTION OF NATURAL PRODUCTS (Alkaloids and natural phenols)     Caffeine from tea leaves									
	<ul> <li>Nicotine from tobacco</li> </ul>									
	Piperine from black pepper									
	Curcumin from turmeric									
II	EXT	RACTION OF NATUR	AL PRODUCT	S (Terpenoi	ids, Carote	noids and	Protein)		30	
		Limonene from citrus rind								
	Lycopene from tomatoes									
	<ul> <li>β-Carotene from carrot</li> </ul>									
		<ul> <li>Casein from mill</li> </ul>	ĸ							
III	ORG	ANIC SYNTHESIS IN	VOLVING TW	O-STEP PRO	OCEDURE				30	
	Preparation of organic compound involving two-step reaction. (Prepare at least three									
	compounds)									
	[Important Note: To use greener protocols wherever possible. Submit the recrystallised							lised		
	sam	ple of the synthesize	d compound	after checki	ng its puri	ty by TLC ar	nd melting			

points.]

- 1. K. L. Williamson and K. M., Masters Macroscale and Microscale Organic Experiments, 7<sup>th</sup> Edition. *Cengage learning*, 2017.
- 2. H.A. Shally, Green Chemistry Laboratory Manual for General Chemistry, *CRC Press*, 1<sup>st</sup>Edition, 2015.
- 3. D. L. Pavia, G. M. Lampman, G. S. Kriz and J. R. Vyvyan, Introduction to Spectroscopy, 5<sup>th</sup>Edition. *Cengage India*, 2015.
- 4. R. M. Silverstein, G. C. Bassler and T. C. Morrill, Spectrometric Identification of Organic Compounds, 8<sup>th</sup> Edition, *Wiley India*, 2015.
- 5. William Kemp, Organic Spectroscopy, 3<sup>rd</sup> Edition. *Mac publishers*, 2011.
- 6. R. K. Bansal, Laboratory Manual in Organic Chemistry, *Wiley*, 2006.
- 7. Jag Mohan, Organic Spectroscopy, 2<sup>nd</sup> Edition. *CRC Press*, 2004.
- 8. B. S. Furniss and others, Vogel's Text Book of Practical Organic Chemistry, 5e Paperback, *Pearson*, 2003.
- 9. D. Pasto, C. Johnson and M. Miller, Experiments and Techniques in Organic Chemistry, *Prentice Hall*, Instructor's Edition, 1992.
- 10. H. T. Clarke revised by B. Haynee, A Hand book of Organic Analysis-Qualitative and Quantitative, *Edward Arnold*, London, 1975.
- 11. H. Middleton, Systematic Qualitative Organic Analysis, Edward Arnold, London, 1959.

Course No:	Course Name:				Course	rse Code:				
CH-24	Organic Chemist	ry Practical-IV	/		SBS CH (	010308 DS	E 0063			
Batch:	Programme:	Semester:	L	Т	Р	Credit	Contact Hrs.			
2021							per Week:	06		
Onwards	M.Sc. Chemistry	III	0	0	6	3	Total Hours:	90		
Total Evalua	tion Marks:75	Examination	n Duration:	8 I	Hrs.					
CIE:         22.5 Marks           TEE:         52.5 Marks		out quantit	ative estim	ations. Kı	nowledge	of the wo	setting up and ca rking principle o acquired in pr	of UV-		
Course	To acquire hands-		in organic s	unthosis r	articularly	involvina r	nultisten reactio	ns and		
Objective		•	-			-	•			
Objective	to gain knowledge	•	-		•		•			
	At the end of this of				•	-				
	parameters used	-						-		
		would be able to characterize the synthesized compounds on the basis of their spectral data.								
	Students would also learn the spectrophotometric methods used for quantitative analysis of									
	organic compound									
Course	After completing t	-	•			•				
Outcomes:	<b>CO1:</b> General principles and skill of quantitative analysis using spectroscopic methods									
	<b>CO2:</b> Specific skills of estimating important molecules by UV-visible spectroscopy									
	<b>CO3:</b> Methods to analyse the amount of carbohydrates, vitamin C, proteins, steroids, urea and drugs like aspirin in samples									
	<b>CO4:</b> Synthetic skills to plan and execute multi step protocols									
	<b>CO5:</b> Monitoring of reaction progress and purification and identification of intermediates									
	CO6: Conformatio									
		СО	URSE SYL	LABUS						
NOTE:										
-	ns will be set, one from o	each of the UNI			quired to at	tempt all the				
Unit No.			Contents				Contac	ct Hrs.		
I	QUANTITATIVE ANALYSIS 30									
	UV-vis spectrophoto		ions of the f	ollowings	:					
	Carbohydrates									
	Ascorbic acid     Amine acids									
11	Amino acids							0		
	QUANTITATIVE ANALYSIS30Estimations of the followings:30									
	Proteins									
	Cholesterol									
	Urea									
	Aspirin									

111	MULTI-STEP ORGANIC SYNTHESIS	30
	Prepare at least any two organic compounds by three or more step reaction.	
	[Important Note: Prefer to use greener protocols wherever possible. Monitor the	
	progress of reaction by TLC and submit the recrystallised sample of the synthesized	
	compound after checking its purity by TLC at each step]	
Sugges	ted Readings:	
1.	K. L. Williamson and K. M., Masters Macroscale and Microscale Organic Experiments, 7 <sup>th</sup> Edearning, 2017.	dition. <i>Cengage</i>
2.	H.A. Shally, Green Chemistry Laboratory Manual for General Chemistry, 1st Edition. CRC Pres.	s, 2015.
3.	D. L. Pavia, G. M. Lampman, G. S. Kriz and J. R. Vyvyan, Introduction to Spectroscopy, 5 <sup>th</sup> Ec. <i>India</i> , 2015.	lition. <i>Cengage</i>
4.	R. M. Silverstein, G. C. Bassler and T. C. Morrill, Spectrometric Identification of Organic C Edition, <i>Wiley India</i> , 2015.	Compounds, 8 <sup>t</sup>
5.	William Kemp, Organic Spectroscopy, 3 <sup>rd</sup> Edition. <i>Mac publishers</i> , 2011.	
6.	R. K. Bansal, Laboratory Manual in Organic Chemistry, Wiley, 2006.	
7.	Jag Mohan, Organic Spectroscopy, 2 <sup>nd</sup> Edition. CRC Press, 2004.	
8.	B. S. Furniss and others, Vogel's Text Book of Practical Organic Chemistry, 5e Paperback, Ped	arson, 2003.
9.	D. Pasto, C. Johnson and M. Miller, Experiments and Techniques in Organic Chemistry, Instructor's Edition, 1992.	, Prentice Hall
10.	H. T. Clarke revised by B. Haynee, A Hand book of Organic Analysis-Qualitative and Quant <i>Arnold</i> , London, 1975.	itative, Edward

Course N	o: Course Name:				Course C	e Code:						
CH-35	Organic Chemist	try Practical-V			SBS CH 0	10419 DS	E 0063					
Batch:	Programme:	Semester:	L	Т	Р	Credit	Contact Hrs					
2021							per Week:	06				
Onwards	M.Sc. Chemistry	IV	0	0	6	3	Total Hours	: 90				
Total Eval	uation Marks:75	Examinatio	n Duration:		8 Hrs.							
<b>CIE:</b> 22	2.5 Marks	Pre-requisit	e of course	: General	and basic	skill of th	e working pri	nciple of				
		FTIR and N	MR spectros	copy and	d mass spe	ctrometry	by analysing	samples.				
<b>TEE:</b> 52	.5 Marks	General syr organic synt		using n	nicrowave-r	mediated a	and mechano	chemical				
Course	To acquire know	ledge and skill	for the ide	entificatio	n of samp	les of puri	fied unknowr	n organic				
Objective	compounds by	measuring an	d analysing	various	spectra.	Ability to	handle spec	troscopy				
	equipment such	as FTIR, UV-vis	ible, NMR a	nd MS. A	bility to pro	ocess and	interpret the	obtained				
	spectral data and						•					
		•	-									
		nformation to arrive at a possible structure and molecular formula. Learn to execute modern green methods such as microwave and mechanochemical methods in targeted synthesis.										
Course	-											
Outcomes		After completing this course, student is expected to learn the following: <b>CO1:</b> Theoretical and practical knowledge about various spectroscopic techniques										
		<b>CO2:</b> Hands on skills with FTIR and UV-visible spectrophotometers										
	CO3: Process, and	CO3: Process, analyse and report IR and UV spectral data and use it in structure determination										
		CO4: Skills to process, analyse and report NMR and MS data output and apply it for structure										
		determination										
		CO5: Plan and execute microwave mediated synthesis										
	CO6: Plan and exe	ecute mechano	cute mechanochemical organic synthesis									
		CO	URSE SYL	LABUS								
NOTE:	stions will be set, one fr	om oach of the		andidator	aro roquir	od to attan	ant all the que	stions				
Unit No.			Contents	anuluates	are require			tact Hrs.				
I	SPECTROSCOPIC IDEN	SPECTROSCOPIC IDENTIFICATION OF FUNCTIONAL GROUPS OF ORGANIC										
	COMPOUNDS											
	Determine the functional groups present in the compound by measuring and analysing											
		the FTIR and UV-visible spectra. Report the spectral data in a standard format.										
II	SPECTROSCOPIC ANAL	MS	30									
	TECHNIQUES											
	Obtain and interpret the NMR spectra (H, C and F if necessary), process the spectra,											
	report it based on conventions. Obtain the mass spectra and report it in a standard											
	format. Analyse all the available data and arrive at a possible structure and molecular formula.											
	Analyse all the availab	ie uata anu arri	ve at a possi	Die Struct	ure and mo	necularior	muld.					

	MICROWAVE-MEDIATED AND MECHANOCHEMICAL ORGANIC SYNTHESIS Synthesis of target compounds by using non-conventional energy sources such as microwave, grinding, ball milling or sonochemical methods. Identification and purity determination of the synthesized compounds.	30
Suggest	ted Readings:	
1.	K. L. Williamson and K. M., Masters Macroscale and Microscale Organic Experiments, 7 <sup>th</sup> Ed learning, 2017.	dition. <i>Cengage</i>
2.	H.A. Shally, Green Chemistry Laboratory Manual for General Chemistry, 1st Edition. CRC Press	s, 2015.
3.	D. L. Pavia, G. M. Lampman, G. S. Kriz and J. R. Vyvyan, Introduction to Spectroscopy, 5 <sup>th</sup> Ec. <i>India</i> , 2015.	dition. <i>Cengage</i>
4.	R. M. Silverstein, G. C. Bassler and T. C. Morrill, Spectrometric Identification of Organic C Edition, <i>Wiley India</i> , 2015.	Compounds, 8 <sup>th</sup>
5.	William Kemp, Organic Spectroscopy, 3 <sup>rd</sup> Edition. <i>Mac publishers</i> , 2011.	
6.	R. K. Bansal, Laboratory Manual in Organic Chemistry, Wiley, 2006.	
7.	Jag Mohan, Organic Spectroscopy, 2 <sup>nd</sup> Edition. CRC Press, 2004.	
8.	B. S. Furniss and others, Vogel's Text Book of Practical Organic Chemistry, 5e Paperback, Per	arson, 2003.
9.	D. Pasto, C. Johnson and M. Miller, Experiments and Techniques in Organic Chemistry Instructor's Edition, 1992.	, Prentice Hall,
10.	H. T. Clarke revised by B. Haynee, A Hand book of Organic Analysis-Qualitative and Quant <i>Arnold</i> , London, 1975.	itative, Edward

<u></u>	Course Name:				Course C	ode:			
CH-36	Organic Chemistr	y Practical-V	I		SBS CH 0	10420 DS	E 0063		
Batch:	Programme:	Semester:	L	Т	Р	Credit	Contact	Hrs.	
2021							per Wee	ek:	6
Onwards	M.Sc. Chemistry	IV	0	0	6	3	Total Ho	ours:	90
Total Evaluati	on Marks:75	Examinatio	n Duration:	8 Hrs.					
<b>CIE:</b> 22.5 N	1arks	Pre-requisit				•			-
<b>TEE:</b> 52.5 M	larks	synthesizing intermediat	•	-	•	-	eir charact	erizatio	on of
Course	To analyse a com						v structur	al elem	ents.
Objective	stereochemical fea		•						
	and execute the		-	-	-	-			
	intermediates. Cha	•				•••	• •	-	
	of the final compou			•				, <b>.</b> p	,
Course	After completing th				arn the foll	owing:			
Outcomes:	CO1: Ability to ana					-			
<b>CO2:</b> Design the strategy and tactics of a possible synthesis									
<b>CO3:</b> Decide on the best possible approach by considering protecting group free, gree					, green	and			
	economically viable	e routes		•	0.1	0.0			
	CO4: Execute the s	ynthesis step	by step, isola	ate and a	nalyse each	intermedia	ate		
	CO5: Troubleshoot	and innovate	when faced	with road	blocks				
	CO6: Isolate, purify	and conform	the structur	e of final	target with	all availab	le means		
		CO	URSE SYL	LABUS					
NOTE:									
Three question	ons will be set, one fr		e UNIT. The		es are requi	red to atter	mpt all the	•	
	ons will be set, one fr				es are requi	red to atter	mpt all the	Cont	act
Three question Unit No.		om each of th	e UNIT. The Contents	candidate	· · ·			•	act 5.
Three question Unit No.	ons will be set, one fro TROSYNTHETIC ANAI L INTERMEDIATES AN	om each of th .YSIS, SYNTHE	e UNIT. The Contents SIS, AND SP	candidate ECTROSC	· · ·			Conta Hrs	act 5.
Three question Unit No.	TROSYNTHETIC ANAI L INTERMEDIATES AN	om each of th LYSIS, SYNTHE	e UNIT. The Contents SIS, AND SP T COMPOU	candidate ECTROSC ND	OPIC CHAR	ACTERISAT		Conta Hrs	act 5.
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Three question Unit No.	TROSYNTHETIC ANAI L INTERMEDIATES AN pportant Note: Pref crystallised sample of pts.]	om each of th LYSIS, SYNTHE ND THE TARGI	e UNIT. The Contents SIS, AND SP T COMPOU reener prot	candidate ECTROSC ND ocols wh	OPIC CHAR	<mark>ACTERISAT</mark> sible. Subl	FION OF mit the	Conta Hrs	act 5.
Three question Unit No.	TROSYNTHETIC ANAI L INTERMEDIATES AN pportant Note: Pref crystallised sample of pts.]	om each of th LYSIS, SYNTHE ND THE TARGI fer to use g f the synthesiz	e UNIT. The Contents SIS, AND SP T COMPOU reener protected compour	candidate ECTROSC ND ocols wh nd after c	<b>OPIC CHAR</b> erever pos hecking its	ACTERISAT sible. Subl purity by T	TION OF mit the TLC and	Cont Hrs 90	act s.
Three question Unit No. I-III RE AL [In rec m. Suggested Res 1. K. L. V	TROSYNTHETIC ANAI L INTERMEDIATES AN pportant Note: Pref crystallised sample of pts.] adings:	om each of th LYSIS, SYNTHE ND THE TARGI fer to use g f the synthesiz	e UNIT. The Contents SIS, AND SP T COMPOU reener protected compour	candidate ECTROSC ND ocols wh nd after c	<b>OPIC CHAR</b> erever pos hecking its	ACTERISAT sible. Subl purity by T	TION OF mit the TLC and	Cont Hrs 90	act s.
Three question Unit No. I-III RE AL [In red m. Suggested Res 1. K. L. V <i>learni</i>	TROSYNTHETIC ANAI L INTERMEDIATES AN pportant Note: Pref crystallised sample of pts.] adings: Villiamson and K. M.,	om each of th LYSIS, SYNTHE ND THE TARGI fer to use g the synthesiz Masters Mac	e UNIT. The Contents SIS, AND SP T COMPOU reener proto reed compour	candidate ECTROSC ND ocols wh nd after c Microscal	OPIC CHAR erever pos hecking its e Organic E	ACTERISAT sible. Subi purity by T Experiment	TION OF mit the TLC and s, 7 <sup>th</sup> Editio	Conta Hrs 90 on. Cen	act s.
Three question Unit No. I-III RE AL [In rec m. Suggested Rea 1. K. L. V learni 2. H.A. S	TROSYNTHETIC ANAI L INTERMEDIATES An aportant Note: Pref crystallised sample of pts.] adings: Villiamson and K. M., ng, 2017.	om each of th LYSIS, SYNTHE ND THE TARGI fer to use g f the synthesiz Masters Mac	e UNIT. The Contents SIS, AND SP T COMPOU reener protected compount roscale and Manual for (	ECTROSC ND ocols wh nd after c Microscal	OPIC CHAR erever pos hecking its e Organic E hemistry, 1	ACTERISAT sible. Subl purity by T Experiment	FION OF mit the TLC and rs, 7 <sup>th</sup> Edition RC Press, 2	Cont Hrs 90 on. <i>Cen</i> 2015.	act 5. gage
Three question Unit No. I-III RE AL [In red m. Suggested Rea 1. K. L. V learni 2. H.A. S 3. D. L. F India,	TROSYNTHETIC ANAI L INTERMEDIATES AN portant Note: Pref crystallised sample of pts.] adings: Villiamson and K. M., ng, 2017. hally, Green Chemisti Pavia, G. M. Lampmai 2015.	om each of th LYSIS, SYNTHE ND THE TARGI fer to use g the synthesiz Masters Mac Masters Mac ry Laboratory n, G. S. Kriz ar	e UNIT. The Contents SIS, AND SP T COMPOU reener protection rescale and Manual for C d J. R. Vyvy	ECTROSC ND ocols wh nd after c Microscal General C an, Introc	OPIC CHAR erever pos hecking its e Organic E hemistry, 1 <sup>4</sup> luction to S	ACTERISAT sible. Subi purity by T Experiment stEdition. Cl pectroscop	FION OF mit the TLC and rs, 7 <sup>th</sup> Edition RC Press, 2 by, 5 <sup>th</sup> Edition	Cont: Hrs 90 on. Cen 2015. on. Cen	gage
Three question Unit No. I-III RE AL [In rea m. Suggested Rea 1. K. L. V learni 2. H.A. S 3. D. L. F India, 4. R. M.	TROSYNTHETIC ANAI L INTERMEDIATES AN portant Note: Pref crystallised sample of pts.] adings: Villiamson and K. M., ng, 2017. hally, Green Chemistr Pavia, G. M. Lampmar 2015. Silverstein, G. C. Bas	om each of th LYSIS, SYNTHE ND THE TARGI fer to use g the synthesiz Masters Mac Masters Mac ry Laboratory n, G. S. Kriz ar	e UNIT. The Contents SIS, AND SP T COMPOU reener protection rescale and Manual for C d J. R. Vyvy	ECTROSC ND ocols wh nd after c Microscal General C an, Introc	OPIC CHAR erever pos hecking its e Organic E hemistry, 1 <sup>4</sup> luction to S	ACTERISAT sible. Subi purity by T Experiment stEdition. Cl pectroscop	FION OF mit the TLC and rs, 7 <sup>th</sup> Edition RC Press, 2 by, 5 <sup>th</sup> Edition	Cont: Hrs 90 on. Cen 2015. on. Cen	gage
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Three question Unit No. I-III RE AL [In red m. Suggested Rea 1. K. L. V learni 2. H.A. S 3. D. L. F India, 4. R. M. Editio 5. Willia	TROSYNTHETIC ANAI L INTERMEDIATES AN portant Note: Pref crystallised sample of pts.] adings: Villiamson and K. M., ng, 2017. hally, Green Chemisti Pavia, G. M. Lampmai 2015. Silverstein, G. C. Bas n, Wiley India, 2015. m Kemp, Organic Spe	om each of th LYSIS, SYNTHE ND THE TARGI Fer to use g the synthesiz Masters Mac ry Laboratory n, G. S. Kriz ar csler and T. C.	e UNIT. The Contents SIS, AND SP T COMPOU reener protection roscale and Manual for C nd J. R. Vyvy Morrill, Spe Edition. Ma	ECTROSC ND ocols wh nd after c Microscal General C an, Introc ectrometr	OPIC CHAR erever pos hecking its e Organic E hemistry, 1 <sup>s</sup> luction to S ric Identifica	ACTERISAT sible. Subi purity by T Experiment stEdition. Cl pectroscop	FION OF mit the TLC and rs, 7 <sup>th</sup> Edition RC Press, 2 by, 5 <sup>th</sup> Edition	Cont: Hrs 90 on. Cen 2015. on. Cen	gage
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- 9. D. Pasto, C. Johnson and M. Miller, Experiments and Techniques in Organic Chemistry, *Prentice Hall*, Instructor's Edition, 1992.
- 10. H. T. Clarke revised by B. Haynee, A Hand book of Organic Analysis-Qualitative and Quantitative, *Edward Arnold*, London, 1975.



## **THEORY COURSES**

Course	Course Name:				Course	Code:		
No:	Physical Chemistry-I				SBS CH (	010103 C 4	004	
CH-03								
Batch:	Programme:	Semester:	L	Т	Р	Credit	Contact Hrs	
2021			_	-			per Week:	04
Onwards	M.Sc. Chemistry	I	4	0	0	4	Total Hrs.:	60
Total Evalua	tion Marks: 100	Examination Dura	ation:	<b>3</b> Hrs		-1	1	
CIE: 30 M	larks							
		Pre-requisite of c	ourse: Knov	vledge of b	basic chem	istry up to L	JG level.	
TEE: 70 M	arks	·		U U				
Course	To provide students with	a basic understan	nding of the	rmodynar	nics, fugac	ity, phase	rule, essential	s of chemical
Objectives	kinetics and principle of q			se will str	engthen th	e fundame	ntals of Physic	cal Chemistry,
	especially thermodynamics							
Course	After completing this cours	•		the follow	wing:			
Outcomes:	<b>CO1</b> : Basic understanding		•					
	<b>CO2</b> : Use of thermodynam			•				
	<b>CO3</b> : Skills for analyzing an							
	<b>CO4</b> : Skills for developing i <b>CO5</b> : Development of alter							
	<b>CO6</b> : Use of advanced and				N			
		0			у.			
		COL	JRSE SYLLA	BUS				
NOTE:								
	<ol> <li>1 is compulsory and to be</li> </ol>		e syllabus. I	t will have	e seven sub	-parts. Eacl	n part carries	3.5 marks and
	to answer any four sub-par							
-	os. 2 to 9 are to be set from				ery questio	n will have	two sub-parts	and students
	er any one question from ea	ich unit. Each quest						Country at 11
Unit No.			Conter					Contact Hrs.
I	INTRODUCTION TO PHYSI						с I	15
	Logarithmic relations, Cur	-	• •					
	median, Precision and acc	curacy in chemical	analysis, ty	pes of err	ror, standa	rd deviatio	n, Numerical	
	Problems.							
	Classical Thermodynamics							
	Its Laws, Maxwell's relation	•	•	•			•	
	thermodynamic quantities	•••				•	on; Clausius-	
	Clapeyron equation, Nerns		nemical pote	ential and	Work Func	tion.		4-
II	ACTIVITY, FUGACITY, PHA							15
	Concepts of fugacity, fuga					-	cient, choice	
	of standard states, determ	ination of activity of	coefficient fo	or solute a	nd solvent			
	Phase Rule:							
	Phase Rule and its deterr	nination, application	on, Phase d	iagram foi	r one com	ponent syst	em, for two	
	completely miscible comp	onents systems lil	ke Pb-Ag sy	stem, KI+	H <sub>2</sub> O syste	m, Bi-Cd sy	/stem, Ferric	

	chloride + water system, Sodium chloride + water system, Na <sub>2</sub> SO <sub>4</sub> -H <sub>2</sub> O system.	
Ш	CHEMICAL KINETICS-I	15
	Introduction to Chemical Kinetics: Methods of determining rate laws, Arrhenius equation and its	
	theory, Collision theory, and activated complex theory.	
	Chain Reactions: Hydrogen-bromine reaction, Pyrolysis of acetaldehyde, Decompositions of ethane.	
	Photochemical reactions (hydrogen-bromine and hydrogen-chlorine reactions). General treatment of	
	chain reaction (hydrogen- bromine reactions), Apparent activation energy of chain reactions, Chain	
IV	length, Rice-Herzfeld mechanism of organic molecules decomposition (acetaldehyde).         PRINCIPLES OF QUANTUM MECHANICS	15
ĨV	Introduction to Quantum Mechanical Approach, Quantum Mechanical operators, Eigenvalues of	15
	Quantum Mechanical operators, Hermitian operator, Ladder operator, commutation relations,	
	postulates of quantum mechanics and Uncertainty Principle. Dirac delta function, Uncertainty in	
	position and momentum, Schrödinger equation for finding wave function of a particle, Energy of a	
	particle in One-Dimension box, Extension to Schrödinger equation for finding wave function in a	
	three-dimensional box, Energy of a particle in Three-Dimension box, Energy levels, Eigenvalue,	
	concept of degeneracy and selection rules.	
uggested	Readings:	
	. Lowe, and K. Peterson, Quantum Chemistry, <i>Academic Press</i> , 2019.	
	K. Moudgil, Textbook of Physical Chemistry, <i>PHI Publication House</i> , New Delhi, 2015.	
	Atkins and J. Paula, Atkins' Physical Chemistry, 10 <sup>th</sup> Edition. <i>Oxford University Press,</i> 2014	
	I. Levine, Quantum Chemistry, 7 <sup>th</sup> Edition. <i>Pearson Education</i> , 2013.	
	I. Levine, Physical Chemistry, 6 <sup>th E</sup> dition. <i>Tata Mcgraw-Hill Education</i> , 2011.	
6. D.	Mcquarie and J. Simon, Physical Chemistry-A molecular approach, 1 <sup>st</sup> Edition. <i>Viva</i> , 2010.	
7. R.I	K. Prasad, Quantum Chemistry, New Age International, 2010.	
8. A.I	K. Chandra, Introductory Quantum Chemistry, Tata McGraw-Hill, 2008.	
9. K.J	I. Laidler, Chemical Kinetics, 3 <sup>rd</sup> Edition. <i>Pearson Education</i> , 2007.	
10 F K	reyszig, Advanced Engg. Mathematics, John Wiley & Sons, Inc. 2006.	

Course No:	Course Name:				Course	e Code:		
CH-09	Physical Chemistr	Chemistry-II (Quantum Chemistry & SBS CH 010209 C 4004						
	Group Theory)							
Batch:	Programme:	Semester:	L	Т	Р	Credit	Contact Hrs.	
2021 Onwards							per Week:	04
	M.Sc. Chemistry	II	4	0	0	4	Total Hrs.:	60
Total Evaluation Mark	<b>s:</b> 100	Examinatior	n Duratio	on:	3 ⊦	Irs.		
CIE: 30 Marks				K	1. 1			
TEE: 70 Marks		Pre-requisit	e of coui	rse: Knov	wiedge c	of basic ph	ysical chemistry	up to UG level.
Course Objectives	To provide studen	ts with an u	nderstan	ding of	physica	l chemistr	ry like quantun	n approach, enzyme
	kinetics, unimolec	ular reactions	s, princi	ples of	symme	try and g	group theory d	and non-equilibriun
	thermodynamics.	This course w	vill stren	gthen th	ne esser	ntials of P	hysical Chemist	try, especially group
	theory and quantu	n chemistry.						
Course Outcomes:	After completing th	is course, stu	dent is e	xpected	to learn	the follow	ing:	
	CO1: Basic underst	anding of phys	sical che	mistry.				
	CO2: Use of symme	etry and enzyn	ne kineti	cs in dai	ly life.			
	CO3: Skills for analy	zing and deve	eloping n	ew susta	ainable r	nethods.		
	CO4: Skills for deve	loping industr	ially imp	ortant n	nethods.			
	CO5: Development	of alternate a	nd new	theoreti	cal meth	ods.		
	CO6: Use of advance	ed and recent	t technol	logies in	Physical	Chemistry	/.	
	I	0						

### COURSE SYLLABUS

NOTE:

i) Question no. 1 is compulsory and to be set from the entire syllabus. It will have seven sub-parts. Each part carries 3.5 marks and students need to answer any four sub-parts.

ii) Question nos. 2 to 9 are to be set from all four units, two from each unit. Every question will have two sub-parts and students need to answer any one question from each unit. Each question carries 14 marks.

Unit	Contents	Contact Hrs.
No.		
I	QUANTUM APPROACH AND APPROXIMATION METHODS	15
	Harmonic oscillator: Application to diatomic molecules and Energy levels. Properties of Legendre	
	polynomials, Rodrigues formula, Recursion formulae, Associated Legendre polynomials, Laguerre and	
	associated Laguerre polynomials.	
	Rigid rotator: Model for a rotating diatomic molecule and Energy level. Solution of spherical eigen-	
	functions, Recursion formulae, Derivation of Legendre polynomial equation.	
	The Hydrogen atom: Schrödinger equation for hydrogen atom. Solution of radial wave function. Radial	
	distribution curves and shapes of atomic orbitals.	
	<b>Approximate Methods:</b> The linear variation principle, First order time-independent Perturbation theory for non-degenerate states. Variation theorem and variation methods. Use of these methods illustrated	
	with some examples like particle in a box with finite barrier, anharmonic oscillator, approximation functions for particle in a box and hydrogen atom.	
II	ENZYME KINETICS AND THEORY OF UNIMOLECULAR REACTIONS	15
	Enzyme Kinetics: Kinetics of (one intermediate) enzymatic reaction: Michaelis-Menton treatment,	

	Evaluation of Michaelis's constant for enzyme-substrate binding by line weaver-Burk plot by Dixon and	
	by Eadie-Hofstee methods. Competitive and non-competitive inhibition.	
	Unimolecular reactions: Dynamics of unimolecular reactions (Lindemann-Hinshelwood and Rice-	
	Ramsperger-Kassel-Marcus [RRKM] theories of unimolecular reactions.	
III	PRINCIPLES OF SYMMETRY AND GROUP THEORY	15
	Symmetry elements and Symmetry operations; Definitions of groups, subgroups, and classes; Symmetry	
	elements in Allene, H <sub>2</sub> O <sub>2</sub> , Benzene and Ferrocene; Determination of point groups of small molecules and	
	Schönfliesand Hermann-Mauguin Notations; The Great Orthogonality theorem. Character table for point	
	group $C_n$ ( $C_2v$ and $C_3v$ ), $D_n$ , (n=2 and 3), $T_d$ and $O_h$ .	
IV	NON EQUILIBRIUM THERMODYNAMICS	15
	General theory of non-equilibrium processes, Entropy production and entropy flow; Thermodynamic	
	criteria for non-equilibrium states, Entropy production in heat flow, Mass flow, Electric current,	
	Chemical reactions, Saxen's relation, Onsager's reciprocity relation, Thermomolecular pressure	
	difference, Electro kinetic phenomenon, Coupled reactions.	
Suggest	ed Readings:	
1.	F. A. Cotton, Chemical Application of Group Theory, 3 <sup>rd</sup> Edition. John Willey & Sons, 2018.	
2.	H. K. Moudgil, Textbook of Physical Chemistry, PHI Publication House, New Delhi, 2015.	
3.	P. Atkins and J. Paula, Atkins' Physical Chemistry, 10 <sup>th</sup> Edition. Oxford University Press, 2014.	
4.	I. N. Levine, Quantum Chemistry, 7 <sup>th</sup> Edition. <i>Pearson Education</i> , 2013.	
5.	C. Kalidas and M. V. Sangaranarayanan, Non-Equilibrium Thermodynamics: Principles & Applications, Macmil	lan India Ltd.
	2012.	
6.	R. K. Prasad, Quantum Chemistry, New Age International, 2011.	
7.	A. K. Chandra, Introductory Quantum Chemistry, <i>Tata McGraw-Hill</i> , 2008.	
8.	K. J. Laidler, Chemical Kinetics, 3 <sup>rd</sup> Edition. <i>Pearson Education</i> , 2007.	
	. Katchalsky and P. F. Curren, Non-Equilibrium Thermodynamics in Biophysics, Harvard University ress, Cambridge, 1995.	
10	C. Devideore Crown theory for Chamist Manuallan Dhusical Colores 1001	

10. G. Davidson, Group theory for Chemist, Macmillan Physical Science, 1991.

Course	Course Name:				Course	e Code:		
No:	Molecular Spectroscop	ру			SBS CH	1010313	C 4004	
CH-13		-						
Batch: 2021	Programme:	Semester:	L	Т	Р	Credit	Contact Hrs. per Week:	04
Onwards	M.Sc. Chemistry		4	0	0	4	Total Hrs.:	60
Total Evalu	ation Marks: 100	Examination Dura	ation:	<b>3</b> Hr	rs.	·		
CIE: 30	Marks							
		Pre-requisite of c	ourse: Know	ledge of	basic of	molecular	spectroscopy up	to UG level.
	Marks							
Course	To provide students with		•		•			
Objective s	electronic and solid st		• •		e will st	rengtnen	the essentials	of molecular
s Course	<i>spectroscopy, especially</i> After completing this co	-			ז <u>ס</u> י			
Outcome	<b>CO1</b> : Basic understandin	· · · · ·		101101011	ıg.			
s:	<b>CO2</b> : Use of spectroscop	-						
	<b>CO3</b> : Skills for analyzing		tainable met	nods.				
	CO4: Skills for developin	<b>e</b> , ,	• •					
	<b>CO5</b> : Development of all	•	•			ods.		
	CO6: Use of advanced ar	nd recent technologies ir	n molecular s	pectroso	сору.			
		COUF	RSE SYLLABU	JS				
NOTE:								
i) Question	no. 1 is compulsory and to	o be set from the entire	syllabus. It v	ill have	seven su	b-parts. Ea	ach part carries	3.5 marks and
	ed to answer any four sub	-						
-	nos. 2 to 9 are to be set				ry questic	on will hav	e two sub-parts	and students
unit No.	wer any one question fror	n each unit. Each questic	Contents	marks.				Contact Hrs.
			Contents					
I	ROTATIONAL SPECTROS							15
	Basics of Molecular Spece Electromagnetic radiation		sontation of	spectra	a cignal	to noise r	atio recolving	
	power, width and intens			spectra			atio, resolving	
	Rotational (Microwave)	• •						
	Rotational Spectroscopy		r, Selection	rule for	rotation	al/microw	ave spectrum,	
	determination of bond-l	-						
	rigid rotator, Stark effec	t, Rotational spectra of I	inear polyato	omic mo	lecules, A	Application	of microwave	
	spectroscopy.							
II	VIBRATIONAL AND RAM							15
	Infrared (Vibrational) Sp Vibration in Diatomic m		nic Oscillator	Madal	Anharm	onic Occill	ator Solaction	
		olecules, simple narmol	nic Oscillator	iviouei,				
		rational Energy level Di		ting Rot	tator P_C	I-R Branch	IPC OT SUPCTER	
	•	rational Energy level, Di openheimer Approxima	atomic Vibra	-			•	
	Breakdown of Born O	ppenheimer Approxima	atomic Vibra ation, Funda	mental	Vibratio		•	
	•	ppenheimer Approxima	atomic Vibra ation, Funda	mental	Vibratio		•	

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	Raman spectra.Selection rules. Rule of Mutual Exclusion. Polarization of light, Raman Effect,Application of Raman and Infra-red spectroscopy in structure determination	
111	<b>ELECTRONIC SPECTROSCOPY</b> Principle of electronic spectroscopy, Total electronic angular momentum, Term symbol. Vibrational Coarse Structure: Progressions, Franck-Condon Principle, Dissociation energy and dissociation products, Rotational fine structure of electronic-vibration transitions, Fortrat diagram, Pre-dissociation.	15
IV	SOLID STATE AND SURFACE SPECTROSCOPY Electronic Energy loss Spectroscopy (EELS), Reflection-Absorption Infrared Spectroscopy (RAIRS), Photoelectron spectroscopy (PES): X-ray PES and Ultra-violet PES, Auger Electron Spectroscopy (AES) and X-ray Fluorescence (XRF).	15
Suggest	ted Readings:	
	C. N. Banwell and E. M. McCash, Fundamental of Molecular Spectroscopy, 4 <sup>th</sup> Edition. <i>Tata McGraw-H Company Ltd.</i> , New Delhi, 2017.	ill Publishing
2	D. N. Satvanaravana, Handbook of Molecular Spectroscopy: From radio waves to gamma rays, J. K. Internation	al Publishina

- 2. D. N. Satyanarayana, Handbook of Molecular Spectroscopy: From radio waves to gamma rays, *I. K. International Publishing House*, New Delhi, 2015.
- 3. R. Kakkar, Atomic & Molecular Spectroscopy, *Cambridge University Press*, 2015.
- 4. J. M. Hollas, Modern Spectroscopy, 4<sup>th</sup> Edition. *John Wiley & Sons*, 2014.
- 5. G. E. Bacon, Fifty Years of Neutron Diffraction, Hilger, 2007.
- 6. B. E. Warren, X-Ray Diffraction, *Dover Publications*, 1999.
- 7. J. C. D. Brand and J. C. Speakman, Molecular Structure: The Physical Approach, 2<sup>nd</sup> Edition. *Edward Arnold*, London, 1995.
- 8. W. J. Moore, Physical Chemistry, 4<sup>th</sup> Edition. *Prentice-Hall*, 1992.
- 9. R. Chang, Basic Principles of Spectroscopy, *McGraw-Hill*, New York, 1990.

Course No:	Course Name:				Course	e Code:		
CH-25	Physical Chemistry-III (Statis	stical Mechanics, Surfa	ace and Inter	face		1 010309 DSE 4	004	
	Chemistry)							
Batch: 2021	Programme:	Semester:	L	Т	Р	Credit	Contact Hr per Week:	s. 04
Onwards	M.Sc. Chemistry	III	4	0	0	4	Total Hrs.:	60
Total Evaluati	on Marks: 100	Examination Durati	on:	<b>3</b> Hr	Ś.			
<b>CIE: 30</b> Ma	rks							
		Pre-requisite of cou	<b>irse:</b> Knowle	dge of	basic ph	ysical chemistry	up to UG lev	el.
<b>TEE: 70</b> Mai		_						
Course	To provide students with a			•		•		
Objectives	thermodynamics, photochemi		-	is coui	rse will s	trengthen the e	ssentials of	Physical
	Chemistry, statistical mechanic		,					
Course	After completing this course, s	•		llowin	g:			
Outcomes:	<b>CO1</b> : Basic understanding of a		•	۲ <u>م</u>				
	<b>CO2</b> : Use of statistical mechan <b>CO3</b> : Skills for analyzing and d	•	• •					
	<b>CO4</b> : Skills for developing indu			us.				
	<b>CO5</b> : Development of alternat							
	<b>CO6</b> : Use of advanced and rec			nistry.				
		COURSE SY						
NOTE:								
	1 is compulsory and to be set f	from the entire cullab			on sub-n	arts Each part s	arriac 2 E m	arks and
	to answer any four sub-parts.		us It will ha	VA SAV				
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		four units, two from nit. Each question carr	each unit. E	very q	-	-	p-parts and s	
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III		PHOTOCHEMISTRY	15
		Transitions between states (Chemical, classical and quantum dynamics, vibronic states). Potential	
		energy surfaces, transitions between potential energy surfaces. The Franck-Condon principle and	
		radiative transitions. Spin-orbit coupling and spin forbidden radiative transitions, delayed	
		fluorescence and phosphorescence. Triplet-triplet, triplet-singlet, singlet-triplet energy transfer.	
		Multiphoton energy transfer processes. Photoelectric effect, Compton effect. Energy transfer:	
		theory of radiation less energy transfer, energy transfer by electron exchange.	
IV		ELECTRIFIED INTERFACES	15
		Thermodynamics of electrified interfaces, Electrocapillary thermodynamics, Non-polarizable	
		interface and Thermodynamic equilibrium. Fundamental thermodynamic equation of polarizable	
		interfaces. Determination of excess charge density on the electrode, electrical capacitance and	
		surface excess of the interface, potential of zero charge, Helmholtz-Perrin model, Gouy-Chapman	
		model, Stern and Devanathan model.	
Sugges	ted Rea	adings:	
1.	B. Bag	chi, Statistical Mechanics for Chemistry and Material Science, CRC Press, 2018.	
2.	T. L. H	ill, An Introduction to Statistical Thermodynamics, Dover Publication, 2018.	
3.	R. K. P	athria and Paul D. Beal, Statistical Mechanics, 3rd Edition. Elsevier, 2016.	
4.	L. D. La	andau and E. M. Lifshitz, Statistical Mechanics, Part I, Butterworth-Heinemann, 3 <sup>rd</sup> ed., 2015.	
5.	P. Atki	ns and J. P. Atkins' Physical Chemistry, 10 <sup>th</sup> Edition. Oxford University Press, 2014.	
6.	D. Mc	Quarie and J. Simon, Physical Chemistry-A molecular approach, 1 <sup>st</sup> Edition. <i>Viva</i> , 2010.	
7.	D. A. N	AcQuarrie, Statistical Mechanics, Viva Books Pvt. Ltd., New Delhi, 2003.	

- 8. A. Gilbert and J. Baggot, Essentials of Molecular Photochemistry, *Blackwell Scientific*, 1999.
- 9. N. J. Turro, Modern Molecular Photochemistry, *Univ. Science Books*, 1991.

Course	Course Name: Physical	Chemistry-IV			Course	Code:				
<b>No:</b> CH-26	(Solid State & Electroanal	ytical methods)			SBS CH	010310 DSE 4	4004			
Batch: 2021	Programme:	Semester:	L	Т	P	Credit		tact Hrs. Week:	04	
Onwards	M.Sc. Chemistry		4	0	0	4		al Hrs.:	60	
Total Evalua	ation Marks: 100	Examination Dura	tion:	3	Hrs.		I			
CIE: 30 N	Лarks									
TEE: 70 N	Лarks	Pre-requisite of co	ourse: Kno	wledge	e of basic p	hysical chemis	try up to	o UG level		
Course Objectives	To provide students with and potentiometric metho i.e., electrochemistry and	ods and solid-state chemis	•		•					
Course	After completing this cou		learn the	follow	ing:					
Outcomes:	CO1: Basic understanding		•							
	<b>CO2</b> : Use of electroanalyt	•		•	fe.					
	<b>CO3</b> : Skills for analyzing a <b>CO4</b> : Skills for developing			noas.						
	<b>CO5</b> : Development of alte									
	CO6: Use of advanced and	•		nistry.						
		COURSE								
NOTE:										
	o. 1 is compulsory and to b	e set from the entire syll	abus. It w	ill have	seven sub	-parts. Each pa	art carri	es 3.5 mai	rks and	
	ed to answer any four sub-pa									
	nos. 2 to 9 are to be set fro				ry questio	n will have two	o sub-pa	arts and st	udents	
Unit No.	ver any one question from e		arries 14 r ntents	narks.				Contact	Hrc	
		CO	ments							
I	ELECTROCHEMISTRY-II							15		
	Contact adsorption on the adsorption and the meas				-	-				
	on the capacity of the		•				•			
	constant capacity, The ca				•					
	with electrode charge, T	with electrode charge, The lateral-repulsion model and the water Flip-Flop model of contact								
	adsorption, The contribut			e capac	city of the i	nterface.				
II	ELECTRO-ANALYTICAL &							15		
	Polarization phenomenor				-		-			
	Liquid Junction potentia			-	-					
	indicator electrode: Mem									
		·	chronoam	•	•	ilse voltamr	metry.			
	Electrocatalysis: Influence		n water sp	litting,	HER and O	ER.				
III	SOLID STATE CHEMISTRY							15		
	Classification of solids, La of nucleation: Laws, Fund		•							

	nucleation and growth-controlled reactions. Perfect and imperfect crystals, Point defects, Line and	
	plane defects, Vacancies: Schottky and Frenkel defects, Thermodynamics of Schottky and Frenkel	
	defect formation, Color center, non-stoichiometric defects.	
IV	SOLID STATE CHEMISTRY-II	15
	Evaluation of Madelung constant (NaCl), Calculation of repulsive potential exponent: Lattice heat	
	capacity. Einstein and Debye model of lattice heat capacity, Debye T <sup>3</sup> law.	
	X-ray diffraction: Bragg condition, Miller indices, Laue method, Debye-Scherrer method of X-ray	
	structural analysis of crystals, index reflections, structure of simple lattices and X-ray intensities.	
	JCPDS card file for corelating structure.	
Suggested R	Readings:	
1. H.K	. Moudgil, Textbook of Physical Chemistry, PHI Publication House, New Delhi, 2015.	
2. P.A	tkins and J. Paula, Atkins Physical Chemistry, 10 <sup>th</sup> Edition. Oxford University Press, 2014.	
3. D.N	/Icquarie and J. Simon, Physical Chemistry-A Molecular Approach, 1 <sup>st</sup> Edition. Viva, 2010.	
4. J.M	I. Bockris and A. K. N. Reddy, Modern Electrochemistry-I (Ionics), Springer, 2006.	
5. J.O.	. M. Bockris and A. K. N. Reddy, Modern Electrochemistry-II, Springer, 2006.	
6. L.E.	. Smart, E. A. Moore, Solid State Chemistry-An Introduction, 3 <sup>rd</sup> Edition. <i>CRC Press</i> , 2005.	
7. A.R.	. West, Basic Solid-State Chemistry, 2 <sup>nd</sup> Edition. <i>John Wiley &amp; Sons</i> , 2005.	

	Course Name:				Course	Code:		
<b>No:</b> CH-37	Physical Chemistry-V (P	olymer & Surface Chemistry)			SBS CH	010421 DSE	4004	
Batch: 2021	Programme:	Semester:	L	Т	Р	Credit	Contact Hrs per Week:	04
Onwards	M.Sc. Chemistry	IV	4	0	0	4	Total Hrs.:	60
Total Evalua	ation Marks: 100	Examination Duration:	-	<b>3</b> Hrs.	<u> </u>			
	Marks Marks	Pre-requisite of course:	Knowle	dge of b	asic physic	cal chemistry	up to UG level	
Course Objectives	To provide students with characterization and che	th an understanding of adv mistry of surfactants. This co stry and chemistry of surfacta	urse wil	•			•	
Course Outcomes:	<b>CO1</b> : Basic understanding <b>CO2</b> : Use of polymer cher <b>CO3</b> : Skills for analyzing a <b>CO4</b> : Skills for developing	rse, student is expected to lea g of advanced physical chemist mistry and chemistry of surfac and developing new sustainabl industrially important metho ernate analytical methods. d recent technologies in polyn	try. tants in e methc ds.	daily life ods.				
NOTE:		COURSE SYL	LABUS					
) Question n students nee i) Question	ed to answer any four sub-p nos. 2 to 9 are to be set fro	COURSE SYL be set from the entire syllabus arts. om all four units, two from ea	LABUS s. It will ach unit	have sev . Every c				
) Question n students nee i) Question	ed to answer any four sub-p nos. 2 to 9 are to be set fro	COURSE SYL	LABUS s. It will ach unit es 14 ma	have sev . Every c			sub-parts and	
) Question n students nee i) Question need to ansv	ed to answer any four sub-p nos. 2 to 9 are to be set fro ver any one question from e POLYMER CHEMISTRY Classification of polymers and Co-polymerization. homogeneous and hete molecular weight concep and molecular weight dis	COURSE SYL be set from the entire syllabus arts. om all four units, two from ea each unit. Each question carrie	LABUS s. It will ach unit es 14 ma ents on, Addin and po s of po sity aver cransitio	have sev . Every o irks. tion, Rac olymer olymeriza age mol n tempe	lical chain reactions. ation. Pol ecular we rature, Tg	vill have two , Ionic, Coord Polymerizat ydispersion-a ights. Polydis	sub-parts and Cont lination tion in average spersity	students

	superconductors and magnetism in organic materials.	
	CHEMISTRY OF SURFACTANTS-I	15
	Adsorption of surface-active agents at Solid/Liquid, Liquid/Gas and Liquid/Liquid interfaces.	
	Mechanism of adsorption, adsorption isotherm, effects of adsorption from aqueous solution on the	
	surface properties of solid adsorbent, adsorption from non-aqueous solution. Determination of	
	surface areas of solids. Gibb's and BET adsorption equation and its utilization to calculate surface	
	concentration and surface area per molecule.	
	<i>Thin films and Langmuir-Blodgett films:</i> Preparation techniques, evaporating/sputtering, chemical process, MOCVD, Sol-gel, Langmuir-Blodgett (LB) film, growth techniques, properties and applications of LB films.	
IV	CHEMISTRY OF SURFACTANTS-II	15
	Surface active agents, classification, Critical micelle concentration (CMC), Methods of determining	
	CMC, Factors affecting CMC, Micellar structure and shape, Micellar aggregation. CMC in non-	
	aqueous media. hydrophobic interaction, Krafft temperature, Thermodynamic parameters of	
	micellization. Counterion binding to micelles, solubilization, microemulsions, reverse micelles,	
	surface films (electro kinetic phenomenon), catalytic activity at surfaces.	
	Effectiveness of adsorption at Liquid/Gas and Liquid/Liquid interfaces, Szyszkiwski, Langmuir,	
	Temkin, and Frumkin adsorption equations. Derivation of thermodynamics parameters of adsorption	
	at the Liquid/Gas and Liquid/Liquid interfaces.	
Suggested	Readings:	
1. V.F	R. Gowariker, N. V. Viswanathan and J. Sreedhar, Polymer Science, New Age Internat. Pvt. Ltd., 2015.	
2. F.V	V. Billmeyer Jr., Textbook of Polymer Science, Wiley India Pvt. Ltd., 2014.	
3. M.	J. Rosen, Surfactants and Interfacial Phenomenon, 4 <sup>th</sup> Edition. Wiley, 2012.	
4. P.E	Becher, Emulsions: Theory and Practice, American Chemical Society, 2019.	
5. H.I	R Alcock and F. W. Lamb, Contemporary Polymer Chemistry, Prentice Hall, 2017.	
6. J.N	1. G. Cowie, Physics and Chemistry of Polymers, Blackie Academic and Professional, 2014.	
7. F.V	Vold, Macromolecules: Structure and Function, Prentice Hall of India, 2001.	
8. K.1	akemoto, R. M. Ottanbrite and M. Kamachi, 2 <sup>nd</sup> Edition. Functional Monomers and Polymers, <i>CRC press</i> , 1	997.
9. P.C.	Hiemenz, R. Rajagopalan, Principles of Colloid and Surface Chemistry, Revised and	
Expa	anded (Undergraduate Chemistry: A Series of Textbooks, 3 <sup>rd</sup> Edition. <i>CRC Press</i> , 2007.	
10. <u>G. A.</u>	Somorjai, Y. Li, Introduction to Surface Chemistry and Catalysis, 2nd Edition. Wiley, 2010.	

Course	Course Name:	Course Code:						
No:	Physical Chemistry-VI (Fro	SBS CH 010422 DSE 4004						
CH-38								
Batch:	Programme:	Semester:	L	Т	Р	Credit	Contact Hrs.	
2021							per Week:	04
Onwards	M.Sc. Chemistry	IV	4	0	0	4	Total Hrs.:	60
Total Evalua	ation Marks: 100	Examination Duration	on:	<b>3</b> Hrs	5.			
CIE: 30 N	Лarks							
		Pre-requisite of cou	rse: Knowle	dge of	basic phys	ical chemistry	up to UG level.	
TEE: 70 N	Лarks			U				
Course	To provide students with a	n understanding of ap	oplied physi	cal che	mistry like	e Electrodics, I	uel cell, Supercap	pacitor
Objectives	and rechargeable Batteries	s, current potential la	ws and Coi	rrosion	of metals	and their all	oys, Liquid crysta	ls. Thi
	course will strengthen the a	pplications of Physical	Chemistry,	especia	illy Fuel ce	lls and Batteri	es and Corrosion.	
Course	After completing this course	e, student is expected	to learn the	followi	ing:			
Outcomes:	<b>CO1</b> : An understanding of a	dvanced Physical Cher	nistry.					
	CO2: Use of Fuel cells and B	atteries and Corrosion	in daily life					
	CO3: Skills for analyzing and	developing new susta	ainable metl	hods.				
	CO4: Skills for developing ir	dustrially important m	nethods.					
	CO5: Development of alterr	nate analytical method	s.					
	CO6: Use of advanced and r	ecent technologies in	Batteries ar	nd Corro	osion.			
	1			c				

**COURSE SYLLABUS** 

NOTE:

i) Question no. 1 is compulsory and to be set from the entire syllabus. It will have seven sub-parts. Each part carries 3.5 marks and students need to answer any four sub-parts.

ii) Question nos. 2 to 9 are to be set from all four units, two from each unit. Every question will have two sub-parts and students need to answer any one question from each unit. Each question carries 14 marks.

Unit No.	Contents	Contact Hrs.
I	<b>ELECTRODICS</b> Rate of charge transfer reactions under zero field, under the influence of an electric field. The equilibrium exchange current density, the non-equilibrium drift-current density (Butler-Volmer) equation. High-field and low-field approximations. Physical meaning of the symmetry factor (β), A simple picture of the symmetry factor and its dependence on over potential. Polarizable and nonpolarizable interfaces.	15
II	<b>FUEL CELLS, SUPERCAPACITORS AND BATTERIES</b> The maximum intrinsic efficiency, Actual efficiency and Current-Potential relation in an electrochemical energy converter. Factors influencing the electrochemical energy conversion, The power output of an electrochemical energy converter. Electrochemical electricity generators (fuel cells). Brief idea about H <sub>2</sub> -O <sub>2</sub> fuel cell, Hydrocarbon-air fuel cells, and Natural gas, CO-air fuel cells, Supercapacitors, and Lithium ion batteries. Electricity storage: Some important quantities in electricity storage (like electricity storage density, energy density and power), Desirable conditions for an ideal storrer, Storage of electricity using the lead-acid battery, Dry cell, Silver-Zinc cell and	15

	Sodium-Sulfur cell.	
111	<b>CORROSION</b> Electrochemistry of corrosion of metals, Factors affecting corrosion, Electrochemical cell formation, Polarization of metal electrode <i>i.e.</i> Concentration, Resistance and Activation polarization. Anodic and cathodic polarization curves (Evan's diagram). Electrochemical measurement of corrosion current density, corrosion potential and mixed potential theory and Tafel slope. Impedance spectroscopy technique, Anodic passivation and passivation potential. Passivity theory. Methods of protecting metal and their alloys from corrosion (anodic protection, cathodic protection, sacrificial protection, barrier protection, use of chemical inhibitors, environment modifiers).	15
IV	CURRENT POTENTIAL LAWS AND LIQUID CRYSTALS Comparison of electrolytic interface to other type of charged interfaces <i>i.e.</i> semiconductors <i>p-n</i> junctions. The current across biological membranes, Hot and cold emission of electrons from a metal into vacuum. Dye sensitized solar cells. Liquid crystals: Mesomorphic behavior, thermotropic liquid crystals, positional order, bond orientational order, nematic and smetic mesophases, Smectic-nematic transition, twisted nematics, chiral nematics, optical properties of liquid crystals.	15
Suggested I		
	G. Fontana, Corrosion Engineering, <i>McGraw Hill</i> , 2017.	
	K. Moudgil, Textbook of Physical Chemistry, PHI Publication House, New Delhi, 2015. Glasstone, An introduction to Electrochemistry, Est West Press Ltd., 2016.	
	M. Bockris and A. K. N. Reddy, Modern Electrochemistry-I, <i>Springer</i> , 2009.	
	Jarain, An Introduction to Metallic Corrosion, <i>Oxford and IBH Pub Co.</i> , 1993.	
	Atkins and J. Paula, Atkins' Physical Chemistry, <i>Oxford University Press</i> , 10 <sup>th</sup> ed., 2014.	
	Acquarie and J. Simon, Physical Chemistry-A Molecular Approach, 1 <sup>st</sup> Edition. <i>Viva</i> , 2010.	
	• M. Bockris and A. K. N. Reddy, Modern Electrochemistry-I (Ionics), <i>Springer</i> , 2006.	
	M. Bockris and A. K. N. Reddy, Modern Electrochemistry-II, <i>Springer</i> , 2016.	

# **PRACTICAL COURSES**

Course	Course Name:				Co	ourse Code:			
No:	Physical Chemistry Practical-I			I Chemistry Practical-I SBS CH 010106 C 0042					
CH-06									
Batch:	Programme:	Semester:	L	Т	Ρ	Credit	Contact Hrs.		
2021							per Week:	04	
Onwards	M.Sc. Chemistry	I	0	0	4	2	Total Hrs.:	60	
Total Evalua	ition Marks: 50	Examination	Dura	tior	<b>ı</b> :	6 Hrs.			
CIE: 15 №	1arks	•				Knowledge of solution preparation, safety pasic practical knowledge up to UG level.	measure in che	emistry	
TEE: 35 №	1arks	practical labor	מנטו	y ai		basic practical knowledge up to OG level.			
Course Objectives			-			mistry practical like adsorption, saponifice stribution law and thermochemistry.	ation value, mo	olecular	
Course	After completing this co	urse, student is	expe	ecte	d to	b learn the following:			
Outcomes:	CO1: Basic understandin		•			•			
	CO2: Use of surface tens			•		-			
	<b>CO3</b> : Skills for analyzing								
	<b>CO4</b> : Skills for developin	• ,	•		•				
	<b>CO5</b> : Development of all <b>CO6</b> : Use of advanced ar	•							
						SYLLABUS			
NOTE					JL	STELABOS			
NOTE: Depending c	on availability of time and	equipment som	ne ex	per	ime	ents may be added/deleted.			
Unit No.				C	onte	ents	Contact H	rs.	
1	HANDS ON TRAINING IN Partial Molar Quantities		MIS	TRY	EXI	PERIMENTS	30		
		e partial molar	volu	me	of ι	urea and ethanol in aqueous solution from			
	Adsorption								
		-		erm	s of	f acetic acid from aqueous solution and $I_2$			
				oval	ic a	acid from aqueous solution by activated			
	-	of Freundlich & Langmuir's adsorption							
	isotherms.	s examine the valuery of freehalter & Earginan's ausorption							
	Acid and Saponification	Value							
	• To find out the a		iven	sam	nnle				
	<b>– ( – – – –</b>	0			•				
	• To find out the s Molecular Weight of Pol	•	aiue	UB	ivel				
	••••		sf a	aire	on	nolymoric colution by viscosity and Post			
L	To determine the mole	eculai weight (	лd	8IV6	211	polymeric solution by viscosity and Rast			

	method.	
	BASICS PHYSICAL CHEMISTRY EXPERIMENTS	30
	Surface Tension/Interfacial Tension	
	<ul> <li>To find surface tension/interfacial tension between two immiscible liquids.</li> </ul>	
	• To determine the percentage composition of a given mixture of two liquids say CCl <sub>4</sub>	
	and Toluene by surface tension method.	
	Viscosity	
	<ul> <li>To find viscosity and coefficient of viscosity of unknown liquids by Ostwald's viscometer method.</li> </ul>	
	<ul> <li>To determine the percentage composition of given unknown mixture by viscosity method.</li> </ul>	
	Distribution Law	
	• To study the distribution of benzoic acid, I <sub>2</sub> , succinic acid between organic liquid and	
	water at room temperature and show that whether BA, $I_2$ , Succinic acid dimerizes in	
	organic liquid or water.	
	Thermochemistry	
	• To determine the heat of neutralization of sulphuric acid using Dewar's vacuum flask	
	as the calorimeter.	
	• To determine the heat of ionization of a weak base i.e. NH <sub>4</sub> OH using calorimeter.	
uggested	l Readings:	
1. B.	Viswanathan and P. S. Raghavan, Practical Physical Chemistry, M V Learning, 2017.	
2. Sł	noemaker and Garland, Experiments in Physical Chemistry, McGraw Hill, 2015.	
3. B.	D. Khosla, V. C. Garg and Adarsh Gulati, Senior Practical Physical Chemistry, R. Chand & Co., New D	elhi, 2014.
4. Sa	aroj Kumar Maity, Naba Kumar Ghosh, Physical Chemistry Practical, New Central book Agency, 2012	
5. G	. P. Mathews, Experimental Physical Chemistry, 1 <sup>st</sup> Edition. Oxford University Press, 1995.	
6. A.	. M. James and F. E. Prichard, Practical Physical Chemistry, Lomgman, 1994.	
7. B.	P. Levitt, Findley's Practical Physical Chemistry, 9 <sup>th</sup> Edition. Longman Group Ltd., 1993.	
8. J.	B. Yadav, Advanced Practical Physical Chemistry, Goel Publishing House, 1991.	
9. R.	C. Das and B. Behara, Experimental Physical Chemistry, Tata McGraw Hill, 1984.	

Course	Course Name:				Course Code:					
No:	Physical Chemistry F	Practical-II			SBS CH 010212 C 0042					
CH-12										
Batch:	Programme:	Semester:	L	Т	Ρ	Credit	Contact Hrs.			
2021							per Week:	04		
Onwards	M.Sc. Chemistry	II	0	0	4	2	Total Hrs.:	60		
Total Evalua	ation Marks: 50	tion Marks: 50 Examination Duration: 6 Hrs.								
CIE: 15 N	Лarks	Pre-requisite	of co	urco	۰Kn	owledge of solution preparation, safe	aty measure in c	hemistry		
TEE: 35 N	<b>Narks</b>	-				sic practical knowledge up to UG level.	•			
Course	1	exposure of refro	ictome	otrv	che	emical kinetics, solution chemistry,	turhidity metry	and nH		
Objectives	potentio and conductometry will be	uctometry experim e carried out. First-l	nents. hand e	Ad expe	vano rieno	ced experiments such as pH me ce of turbidity meter studies will be pr ntal analysis at the research level.	try, potentiom	etry and		
Course	After completing this									
Outcomes:	<b>CO1</b> : Basic understand		-			-				
• • • • • • • • • • • • • • • • • • • •	<b>CO2</b> : Use of pH meter	• • •	•			•				
	<b>CO3</b> : Skills for analyzi					•				
	<b>CO4</b> : Skills for develop									
	-									
		<b>CO5</b> : Development of alternate analytical methods.								
	<b>CO6</b> : Use of advanced	and recent technic				mental chemistry.				
	CO6: Use of advanced	and recent technic	ques ir	n ex	perir	nental chemistry.				
NOTE:	<b>CO6</b> : Use of advanced	and recent technic	ques ir	n ex	perir	•				
Depending			ques in <b>COU</b> aborat	n ex <b>RSE</b> ory,	oerin <b>SYI</b> few	LABUS experiments may be added/deleted.				
	on availability of time a	nd instruments in la	ques ir COU aborat	n ex RSE ory, onte	few sents	LABUS experiments may be added/deleted.	Contact	Hrs.		
Depending of Unit No.		nd instruments in la	ques ir COU aborat	n ex RSE ory, onte	few sents	LABUS experiments may be added/deleted.	Contact 30	Hrs.		
Depending of Unit No.	on availability of time a	nd instruments in la	ques ir COU aborat	n ex RSE ory, onte	few sents	LABUS experiments may be added/deleted.		Hrs.		
Depending	on availability of time an CHEMICAL KINETICS A Chemical Kinetics	nd instruments in la AND pH METRY EXI	ques in COU aborat C	n ex RSE ory, onte	few syl	LABUS experiments may be added/deleted.	30	Hrs.		
Depending of Unit No.	on availability of time an CHEMICAL KINETICS A Chemical Kinetics • Determinatio	nd instruments in la AND pH METRY EXI n of the effect	ques in COU aborat Ca PERIM of (a	n ex RSE ory, onte ENT ) cl	few few ents S	LABUS experiments may be added/deleted.	30	Hrs.		
Depending of Unit No.	on availability of time an <b>CHEMICAL KINETICS</b> <i>Chemical Kinetics</i> • Determination concentration	nd instruments in la AND pH METRY EXE n of the effect n of reactants and c	aborat COU aborat C PERIM of (a catalys	n ex RSE ory, onte ENT ) cl	few few ents S	LABUS experiments may be added/deleted. ge in temperature, (b) change in	30	Hrs.		
Depending of Unit No.	CHEMICAL KINETICS A CHEMICAL KINETICS A Chemical Kinetics • Determination concentration constant of hy	nd instruments in la AND pH METRY EXI n of the effect n of reactants and o ydrolysis of an este	aborat cou aborat co PERIM of (a catalys r.	n ex RSE ory, onte ENT ) cl sts (	serin SYL few ents S nang c) io	LABUS experiments may be added/deleted. ge in temperature, (b) change in nic strength of the media on velocity	30	Hrs.		
Depending of Unit No.	on availability of time an <b>CHEMICAL KINETICS</b> <i>Chemical Kinetics</i> • Determination concentration constant of hy • Determine the	nd instruments in la AND pH METRY EXI n of the effect n of reactants and o ydrolysis of an este e velocity constant	aborat cou aborat co PERIM of (a catalys r.	n ex RSE ory, onte ENT ) cl sts (	serin SYL few ents S nang c) io	LABUS experiments may be added/deleted. ge in temperature, (b) change in	30	Hrs.		
Depending of Unit No.	CHEMICAL KINETICS A CHEMICAL KINETICS A Chemical Kinetics • Determination concentration constant of hy • Determine the and NaOH sol	nd instruments in la AND pH METRY EXI n of the effect n of reactants and o ydrolysis of an este e velocity constant	aborat cou aborat co PERIM of (a catalys r.	n ex RSE ory, onte ENT ) cl sts (	serin SYL few ents S nang c) io	LABUS experiments may be added/deleted. ge in temperature, (b) change in nic strength of the media on velocity	30	Hrs.		
Depending of Unit No.	CHEMICAL KINETICS A CHEMICAL KINETICS A Chemical Kinetics • Determination concentration constant of hy • Determine the and NaOH sol Solution Chemistry	nd instruments in la AND pH METRY EXI n of the effect n of reactants and o ydrolysis of an este e velocity constant lution.	aborat COU aborat C PERIM of (a catalys r. of hyc	n ex RSE ory, onte ENT ) cl sts ( droly	syl syl ents s nang c) io	LABUS experiments may be added/deleted. ge in temperature, (b) change in nic strength of the media on velocity of ethyl acetate catalyzed by an acid	30	Hrs.		
Depending of Unit No.	CHEMICAL KINETICS A Chemical Kinetics Chemical Kinetics Determination concentration constant of hy Determine the and NaOH sol Solution Chemistry To determine	nd instruments in la AND pH METRY EXI n of the effect n of reactants and o ydrolysis of an este e velocity constant lution.	aborat cou aborat co PERIM of (a catalys r. of hyc	n ex RSE ory, onte ENT ) cl sts (r droly anic	serin SYI few ents S nang c) io vsis c salt	LABUS experiments may be added/deleted. ge in temperature, (b) change in nic strength of the media on velocity of ethyl acetate catalyzed by an acid	30	Hrs.		
Depending of Unit No.	CHEMICAL KINETICS A CHEMICAL KINETICS A Chemical Kinetics Determination concentration constant of hy Determine the and NaOH sol Solution Chemistry To determine water at diffe	nd instruments in la AND pH METRY EXE n of the effect n of reactants and o ydrolysis of an este e velocity constant lution.	aborat cou aborat co PERIM of (a catalys r. of hyc of hyc	n ex RSE ory, onte ENT ) cl sts ( droly anic nce	serin SYI few ents S nang c) io vsis c salt to o	LABUS experiments may be added/deleted. ge in temperature, (b) change in nic strength of the media on velocity of ethyl acetate catalyzed by an acid f like KCl, NaCl, KNO <sub>3</sub> , NaNO <sub>3</sub> , K <sub>2</sub> SO <sub>4</sub> in btain the solubility curve.	30	Hrs.		
Depending of Unit No.	CHEMICAL KINETICS A Chemical Kinetics Chemical Kinetics Determination concentration constant of hy Determine the and NaOH sol Solution Chemistry To determine water at diffe To determine	nd instruments in la AND pH METRY EXI n of the effect n of reactants and o ydrolysis of an este e velocity constant lution. the solubility of an erent temperature a e the heat of soluti	aborat cou aborat co PERIM of (a catalys r. of hyc of hyc	n ex RSE ory, onte ENT ) cl sts ( droly anic nce	serin SYI few ents S nang c) io vsis c salt to o	LABUS experiments may be added/deleted. ge in temperature, (b) change in nic strength of the media on velocity of ethyl acetate catalyzed by an acid	30	Hrs.		
Depending of Unit No.	CHEMICAL KINETICS A CHEMICAL KINETICS A Chemical Kinetics Determination concentration constant of hy Determine the and NaOH sol Solution Chemistry To determine water at diffe	nd instruments in la AND pH METRY EXI n of the effect n of reactants and o ydrolysis of an este e velocity constant lution. the solubility of an erent temperature a e the heat of soluti	aborat cou aborat co PERIM of (a catalys r. of hyc of hyc	n ex RSE ory, onte ENT ) cl sts ( droly anic nce	serin SYI few ents S nang c) io vsis c salt to o	LABUS experiments may be added/deleted. ge in temperature, (b) change in nic strength of the media on velocity of ethyl acetate catalyzed by an acid f like KCl, NaCl, KNO <sub>3</sub> , NaNO <sub>3</sub> , K <sub>2</sub> SO <sub>4</sub> in btain the solubility curve.	30	Hrs.		
Depending of Unit No.	CHEMICAL KINETICS A Chemical Kinetics Chemical Kinetics Determination concentration constant of hy Determine the and NaOH sol Solution Chemistry To determine water at diffe To determine	nd instruments in la AND pH METRY EXI n of the effect n of reactants and o ydrolysis of an este e velocity constant lution. the solubility of an erent temperature a e the heat of soluti	aborat cou aborat co PERIM of (a catalys r. of hyc of hyc	n ex RSE ory, onte ENT ) cl sts ( droly anic nce	serin SYI few ents S nang c) io vsis c salt to o	LABUS experiments may be added/deleted. ge in temperature, (b) change in nic strength of the media on velocity of ethyl acetate catalyzed by an acid f like KCl, NaCl, KNO <sub>3</sub> , NaNO <sub>3</sub> , K <sub>2</sub> SO <sub>4</sub> in btain the solubility curve.	30	Hrs.		
Depending of Unit No.	CHEMICAL KINETICS A Chemical Kinetics Chemical Kinetics Chemical Kinetics Chemical Kinetics Chemical Kinetics Chemical Kinetics Concentration concentration constant of hy Determine the and NaOH sol Solution Chemistry To determine water at diffe To determine acid by solubi pH metric	nd instruments in la AND pH METRY EXE n of the effect n of reactants and o ydrolysis of an ester e velocity constant lution. the solubility of an erent temperature a e the heat of soluti ility method.	aborat COU aborat Co PERIM of (a catalys r. of hyc n inorg ind he on of	n ex RSE ory, onte ENT ) cl tsts ( droly anic nce give	syl few ents S nang c) io vsis c salt to o en su	LABUS experiments may be added/deleted. ge in temperature, (b) change in nic strength of the media on velocity of ethyl acetate catalyzed by an acid f like KCl, NaCl, KNO <sub>3</sub> , NaNO <sub>3</sub> , K <sub>2</sub> SO <sub>4</sub> in btain the solubility curve.	30	Hrs.		

	weak base, strong acid versus weak base using a pH meter.	
	<ul> <li>To determine the concentration of a reductant or an oxidant i.e. Ferrous</li> </ul>	
	• To determine the concentration of a reductant or an oxidant i.e. Ferrous ammonium sulphate, $K_2Cr_2O_7$ and $KMnO_4$ by a pH metric titration method.	
	POTENTIOMETRY AND CONDUCTOMETRY EXPERIMENTS	30
	Potentiometry	50
	• To determine the strength of strong acid versus strong base, weak acid versus	
	strong base, mixture of strong and weak acids versus strong base, weak acid versus	
	weak base, strong acid versus weak base using a potentiometer.	
	<ul> <li>To prepare and test the standard reference electrode i.e., calomel electrode or silver- silver chloride electrode.</li> </ul>	
	• Titrate Mohr's salt against KMnO <sub>4</sub> potentiometrically and carry out the titration in	
	reverse order.	
	Turbidimetry	
	• To find the turbidity of given solution by using Nephthalo turbidity meter.	
	Conductometry	
	• Study of conductometric titration of NH <sub>4</sub> Cl versus NaOH solution, CH <sub>3</sub> COONa versus	
	HCl, MgSO <sub>4</sub> versus Ba(OH) <sub>2</sub> , BaCl <sub>2</sub> and $K_2SO_4$ and comment on the nature of graph.	
	• To study stepwise neutralization of polybasic acid like oxalic acid, citric acid,	
	phosphoric acid by conductometric titration and explain the variation in the graph.	
uggested	Readings:	
1. B.V	Viswanathan and P. S. Raghavan, Practical Physical Chemistry, M V Learning, 2017.	
2. Sho	pemaker and Garland, Experiments in Physical Chemistry, McGraw Hill, 2015.	
3. B.I	D. Khosla, V. C. Garg and Adarsh Gulati, Senior Practical Physical Chemistry, R. Chand & Co., New	Delhi, 2014.
4. S.k	K. Maity and N. K. Ghosh, Physical Chemistry Practical, New Central book Agency, 2012.	
5. G.	P. Mathews, Experimental Physical Chemistry, 1 <sup>st</sup> Edition. Oxford University Press, 1995.	
6. A.I	M. James and F. E. Prichard, Practical Physical Chemistry, Lomgman, 1994.	
7. B.F	P. Levitt, Findley's Practical Physical Chemistry, 9 <sup>th</sup> Edition. <i>Longman Group Ltd.</i> , 1993.	
8. J.B	3. Yadav, Advanced Practical Physical Chemistry, Goel Publishing House, 1991.	
9. R.(	C. Das and B. Behara, Experimental Physical Chemistry, Tata McGraw Hill, 1984.	

Course	Course Name:				Course Code:				
No:	Physical Chemistry Pra	ctical-III			SB	S CH 010311 DSE 0063			
CH-27									
Batch:	Programme:	Semester:	L	Т	Ρ	Credit	Contact Hrs.		
2021 Onunanda	M.C. Chamistry				6	2	per Week:	06	
Onwards	M.Sc. Chemistry		0	0	6	3	Total Hrs.:	90	
TOLAI EVAIUA		Examination D	urati	on:		8 Hrs.			
	Marks					owledge of solution preparation, safety ic practical knowledge up to UG level.	y measure in c	hemistry	
TEE: 52.5 Course	Marks	-				ry, phase rule, spectrophotometry,	nolarimetry y	Itraconic	
Objectives	interferometry and pH ultrasonic interferometer	metry, potention and spectrophot	netry omet	/ ar ter v	nd d vill E	conductometry experiments. Advanced be carried out. First-hand experience of p e equipped to carry out instrumental c	l experiments polarimetric stu	such as udies will	
Course Outcomes:	After completing this cou CO1: Basic understandin CO2: Use of pH meter, po CO3: Skills for analyzing a CO4: Skills for developing CO5: Development of alt CO6: Use of advanced ar	g of practical phys otentiometer, con and developing ne g industrially impo ernate analytical i	ical d duct w su ortan meth	cher ivity istai t pra iods	nist v me nab actio	ry. eter in daily life. le methods. cal methods.			
		(	OU	RSE	SYI	LABUS			
NOTE:	on availability of time and	nstrumonts in Joh	orati	201	fou	experiments may be added/deleted.			
Unit No.	on availability of time and			onte			Contact	Hrs.	
1	CONDUCTOMETRY AN	D pH METRY					30		
	Conductometry	•							
	HCl, KCl, KNO₃,	AgNO <sub>3</sub> and NaC	and	the	e va	ance of strong electrolytes such as lidity of Onsager equation. ate and silver halides.			
			-			. strong base, weak acid vs. strong d vs. weak base using conductivity			
	pH metric								
	•	ion of a non-aqu	eou	s m	edia	a using pH meter.			
	Determination	-	onst	ant		acetic acid in DMSO, DMF, acetone			
	-	-			rid	versus weak base (NH <sub>4</sub> OH), weak			
		-		-		acid mixture against a weak base			

	using a pH meter.	
	• To determine the degree of hydrolysis and hydrolysis constant of aniline,	
	acetic acid by pH metrically.	
II	SPECTROPHOTOMETRY AND POLARIMETERY	30
	Spectrophotometry	
	• Determine the concentration of Crystal violet and Aurine in mixture of	
	(Crystal violet + Aurine) solution.	
	• To determine the dissociation constant (K <sub>a</sub> )of Methyl red using UV-visible	
	absorption spectrophotometer.	
	• Verification of Beer law using solutions such as I <sub>2</sub> in CCl <sub>4</sub> , and CuSO <sub>4</sub> in water,	
	$K_2Cr_2O_7$ and KMnO <sub>4</sub> in sulphuric acid medium.	
III	Polarimetry	30
	• To determine the concentration of an optically active substance using	
	polarimeter.	
	• To determine the percentage of two optically active substances in a given	
	mixture.	
	Solution Chemistry	
	<ul> <li>Determination of Solubility by evaporation and gravimetric method.</li> </ul>	
	• Determination of transition temperature by thermometric method.	
Suggeste	d Readings:	
1. B	. Viswanathan, P. S. Raghavan, Practical Physical Chemistry, M V Learning, 2017.	
2. S	hoemaker and Garland, Experiments in Physical Chemistry, McGraw Hill, 2015.	
3. B	. D. Khosla, V. C. Garg and Adarsh Gulati, Senior Practical Physical Chemistry, R. Chand & Co., New	Delhi, 2014.
4. S	. K. Maity and N. K. Ghosh, Physical Chemistry Practical, New Central book Agency, 2012.	
5. G	. P. Mathews, Experimental Physical Chemistry, 1 <sup>st</sup> Edition. Oxford University Press, 1995.	
6. A	. M. James and F. E. Prichard, Practical Physical Chemistry, Lomgman, 1994.	
7. B	. P. Levitt, Findley's Practical Physical Chemistry, 9 <sup>th</sup> Edition. Longman Group Ltd., 1993.	
8. J.	B. Yadav, Advanced Practical Physical Chemistry, Goel Publishing House, 1991.	
0 P	C. Das and P. Bohara, Experimental Physical Chemistry, Tata McGraw Hill, 1084	

9. R. C. Das and B. Behara, Experimental Physical Chemistry, Tata McGraw Hill, 1984.

Course	Course Name:				Course Code:				
No:	Physical Chemistry Practical-IV				SBS CH 010312 DSE 0063				
CH-28									
Batch:	Programme:	Semester:	L	Т	Ρ	Credit	Contact Hrs.		
2021							per Week:	06	
Onwards	M.Sc. Chemistry		0	0	6	3	Total Hrs.:	90	
Total Evalua	ation Marks: 75	Examination	Durati	on:		8 Hrs.			
	Marks					owledge of solution preparation, safety ic practical knowledge up to UG level.	measure in ch	emistry	
	Marks		-			· · · · ·			
Course Objectives	conductometry exper carried out. First-han equipped to carry out	iments. Advanced e ad experience of pol t instrumental analy	experir arime sis at	nent tric : the i	ts su stud rese		ctrophotometer	will be	
Course	After completing this		•			÷			
Outcomes:	CO1: Basic understan	• • •	•						
						ductivity meter in daily life.			
	<b>CO3</b> : Skills for analyzi	• • •							
	<b>CO4</b> : Skills for develo <b>CO5</b> : Development of			•		ai methous.			
	<b>CO6</b> : Use of advanced	•				nental chemistry			
			•	-		•			
			00	KSE	SYL	LABUS			
<b>NOTE:</b> Depending of	on availability of time a	nd instruments in la	borat	ory,	few	experiments may be added/deleted.			
Unit No.				-	ents		Contact H	lrs.	
I	PHASE RULE AND UL Phase Rule	TRASONIC INTERFE	ROME	TER			30		
		nhase rule for a give	an two	and	1 thr	ee component Azeotropic mixtures.			
						iven salt hydrate like Sodium sulphate,			
		lphate or Sodium th	•		-				
	Ultrasonic Interferom	•	losuip	natt					
	-		aivon	ora	onic	hipppy liquid mixtures of different			
			given	org	anic	binary liquid mixtures of different			
	composition.								
		•	re on	ultra	ison	ic speed of given organic mixture.			
II	POTENTIOMETRY-I E	XPERIMENTS					30		
	Potentiometry								
	To determine	e the pH of a series of the pH of a series of the solubility proc	of buff	er so	oluti	for a reaction from EMF measurement. ons by potentiometric method. nd to determine instability constant of			
	//6(1113/2 001	iipiez.							
		•	rogen	ion	in a	cid medium using hydrogen electrode,			

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	acetate.	
	• To determine the degree of hydrolysis and hydrolysis constant of weak acid by	
	potentiometry.	
III	MAGNETIC MOMENT AND MAGNETIC SUSCEPTIBILITY	30
	• Determine the magnetic susceptibility of a paramagnetic substance using Gouy's	
	Balance.	
	• To study the change in weight of a substance after passing magnetic lines of force.	
	POTENTIOMETRY-II EXPERIMENTS	
	• To determine the concentration of a reductant or an oxidant i.e. Ferrous ammonium	
	sulphate and Ceric sulphate by a potentiometric redox titration.	
	<ul> <li>To determine the amount of KI and KCI present in a mixture by potentiometric</li> </ul>	
	titration.	
Suggested R	eadings:	
1. B. Vi	iswanathan and P. S. Raghavan, Practical Physical Chemistry, M V Learning, 2017.	
2. Shoe	emaker and Garland, Experiments in Physical Chemistry, McGraw Hill, 2015.	
3. B.D.	. Khosla, V. C. Garg and Adarsh Gulati, Senior Practical Physical Chemistry, R. Chand & Co., New D	elhi, 2014.
4. S.K.	Maity and N. K. Ghosh, Physical Chemistry Practical, New Central book Agency, 2012.	
5. G.P.	. Mathews, Experimental Physical Chemistry, 1 <sup>st</sup> Edition. Oxford University Press, 1995.	
6. A. N	I. James and F. E. Prichard, Practical Physical Chemistry, Lomgman, 1994.	
7. B. P.	Levitt, Findley's Practical Physical Chemistry, 9 <sup>th</sup> Edition. Longman Group Ltd., 1993.	
8. J.B.	Yadav, Advanced Practical Physical Chemistry, Goel Publishing House, 1991.	
9. R.C.	. Das and B. Behara, Experimental Physical Chemistry, Tata McGraw Hill, 1984.	

	Course Name:					Course Code:						
No:	Physical Chemistry Practical-V			SBS CH 010423 DSE 0063								
CH-39												
Batch:	Programme:	Semester:	L	Т	Ρ	Credit	Contact Hrs.					
2021							per Week:	06				
Onwards	M.Sc. Chemistry	IV	0	0	6	3	Total Hrs.:	90				
Total Evalua	ation Marks: 75	Examination [	Durati	on:		8 Hrs.						
CIE: 22.5	Marks	Pre-requisite	of co	urse	: Kn	owledge of solution preparation, safety	measure in che	emistry				
	Marks					ic practical knowledge up to UG level.						
Course Objectives			•			ν, theoretical (computational) techniques, s. Advanced experiments such as chro	•					
						ence of chronopotentiometry will be provi ental analysis at the research level.	ided. At the end	of this				
Course	After completing this					,						
Outcomes:	<b>CO1</b> : Basic understar		•			-						
	CO2: Use of flame pl	notometer, compu	tation	nal te	echn	iques, chronopotentiometry in daily life.						
	CO3: Skills for analyz		-									
	CO4: Skills for develo		-			tical methods.						
	<b>CO5</b> : Development of <b>CO6</b> : Use of advance					vice entrol of environment						
		о апо гесепі теспі										
			•			•						
			•			YLLABUS						
	g on availability of ti		CO	UR	SE S	•	ıy be					
	g on availability of ti		CO	our: ava	SE S	YLLABUS le in laboratory, few experiments ma	y be Contact H	Irs.				
Depending added/del	g on availability of ti	ime and instrum	co	OUR: ava Co	SE S ilab	YLLABUS le in laboratory, few experiments ma nts	-	Irs.				
Depending added/del Unit No.	g on availability of ti eted. FLAME PHOTOMETR	ime and instrum	CO ents	OUR ava Co AL T	SE S ilab nter ECHI	YLLABUS le in laboratory, few experiments ma nts NIQUES	Contact H	Irs.				
Depending added/del Unit No.	g on availability of ti eted. FLAME PHOTOMETR • Determinatio	ime and instrum	CO ients TION/	OUR: ava Co AL T	SE S ilab nter ECHI	YLLABUS le in laboratory, few experiments ma nts NIQUES ent together.	Contact H	Irs.				
Depending added/del Unit No.	g on availability of ti eted. FLAME PHOTOMETR • Determinatio • Determinatio	ime and instrum <b>RY AND COMPUTA</b> on of Na <sup>+</sup> and K <sup>+</sup> io on of Li/Ca/Ba/Sr in	CO ients TION/	OUR: ava Co AL T	SE S ilab nter ECHI	YLLABUS le in laboratory, few experiments ma nts NIQUES ent together.	Contact H	Irs.				
Depending added/del Unit No.	g on availability of ti eted. FLAME PHOTOMETR • Determinatio • Determinatio <i>Computational Tec</i>	ime and instrum <b>RY AND COMPUTA</b> on of Na <sup>+</sup> and K <sup>+</sup> io on of Li/Ca/Ba/Sr io <i>hniques</i>	CO nents TION/ ons wh ons pr	OUR: ava Co AL T ien p resei	SE S ilab nter ECHI orese	YLLABUS le in laboratory, few experiments ma nts NIQUES ent together. any analyte.	Contact H 30	Irs.				
Depending added/del Unit No.	g on availability of ti eted. FLAME PHOTOMETR Determination Determination Computational Tec Elementary	ime and instrum <b>RY AND COMPUTA</b> on of Na <sup>+</sup> and K <sup>+</sup> io on of Li/Ca/Ba/Sr io <i>hniques</i> exercise in comp	CO nents TION/ ons wh ons pr	OUR: ava Co AL T ien p resei	SE S ilab nter ECHI orese	YLLABUS le in laboratory, few experiments ma nts NIQUES ent together.	Contact H 30	Irs.				
Depending added/del Unit No.	g on availability of ti eted. FLAME PHOTOMETR • Determination • Determination Computational Tec • Elementary interactive e	ime and instrum <b>RY AND COMPUTA</b> on of Na <sup>+</sup> and K <sup>+</sup> io on of Li/Ca/Ba/Sr io <i>hniques</i> exercise in comp quation.	CO nents TION/ ons wh ons pr	OUR: ava Co AL T ien p resei	SE S ilab nter ECHI orese	YLLABUS le in laboratory, few experiments ma nts NIQUES ent together. any analyte.	Contact H 30	Irs.				
Depending added/del Unit No.	g on availability of ti eted. FLAME PHOTOMETR Determination Determination Computational Tec Elementary interactive e Plotting a gra	ime and instrum <b>RY AND COMPUTA</b> on of Na⁺ and K⁺ io on of Li/Ca/Ba/Sr io <i>hniques</i> exercise in comp quation. aph in origin.	CO ments TION/ ons wh ons pr	ava Co AL T reser	SE S ilab nter ECHI prese nt in	YLLABUS le in laboratory, few experiments maints NIQUES ent together. any analyte. an illustrative experiment solving the	Contact H 30	Irs.				
Depending added/del Unit No.	g on availability of ti eted. FLAME PHOTOMETR Determination Determination Computational Tec Elementary interactive e Plotting a gra Drawing a st	ime and instrum <b>RY AND COMPUTA</b> on of Na <sup>+</sup> and K <sup>+</sup> io on of Li/Ca/Ba/Sr io <i>hniques</i> exercise in comp quation. aph in origin. ructure of molecul	CO TION/ ons wh ons pr outer	DUR: ava Co AL T een p resei grap	SE S ilab nter ECHI prese nt in	YLLABUS le in laboratory, few experiments ma nts NIQUES ent together. any analyte.	Contact H 30	Irs.				
Depending added/del Unit No.	g on availability of ti eted. FLAME PHOTOMETR Determination Determination Computational Tecc Elementary interactive e Plotting a gra Drawing a st CHROMATOGRAPHY	ime and instrum <b>RY AND COMPUTA</b> on of Na <sup>+</sup> and K <sup>+</sup> io on of Li/Ca/Ba/Sr io <i>hniques</i> exercise in comp quation. aph in origin. ructure of molecul <b>Y AND CONDUCTO</b>	CO ments TION/ ons wh ons pr outer les in /	ava Co AL T rese grap	SE S ilab nter ECHI prese nt in bhics	YLLABUS le in laboratory, few experiments maints NIQUES ent together. any analyte. an illustrative experiment solving the o software and molecular modelling.	Contact H 30	Irs.				
Depending added/del Unit No.	g on availability of ti eted. FLAME PHOTOMETR Determination Determination Computational Tec Elementary interactive e Plotting a gra Drawing a st CHROMATOGRAPHY To prepare	ime and instrum <b>RY AND COMPUTA</b> on of Na <sup>+</sup> and K <sup>+</sup> io on of Li/Ca/Ba/Sr io <i>hniques</i> exercise in comp quation. aph in origin. ructure of molecul <b>( AND CONDUCTO</b> citric acid from s	CO nents TION/ ons wh ons pr outer les in / METR odium	OUR: ava Co AL T hen p reser grap Avog KY	SE S ilab nter ECHI prese nt in bhics	YLLABUS le in laboratory, few experiments maints NIQUES ent together. any analyte. an illustrative experiment solving the	Contact H 30	Irs.				
Depending added/del Unit No.	g on availability of ti eted. FLAME PHOTOMETR Determination Determination Computational Tecc Elementary interactive e Plotting a gra Drawing a st CHROMATOGRAPHY To prepare using cationi	ime and instrum <b>RY AND COMPUTA</b> on of Na <sup>+</sup> and K <sup>+</sup> io on of Li/Ca/Ba/Sr io <i>hniques</i> exercise in comp quation. aph in origin. ructure of molecul <b>Y AND CONDUCTO</b> citric acid from s ic and anionic exch	CO nents TION/ ons wh ons pr outer les in / METR odium	DUR ava Co AL T ien p resei grap grap Avog XY n cit	SE S ilab nter ECHI prese nt in bhics gadro	YLLABUS le in laboratory, few experiments maints NIQUES ent together. any analyte. an illustrative experiment solving the o software and molecular modelling. and aniline from aniline hydrochloride	Contact H 30	Irs.				
Depending added/del Unit No.	g on availability of ti eted. FLAME PHOTOMETR Determination Determination Computational Tec Elementary interactive e Plotting a gra Drawing a st CHROMATOGRAPHY To prepare using cationi To differenti	ime and instrum <b>RY AND COMPUTA</b> on of Na <sup>+</sup> and K <sup>+</sup> io on of Li/Ca/Ba/Sr io <i>hniques</i> exercise in comp quation. aph in origin. ructure of molecul <b>Y AND CONDUCTO</b> citric acid from s ic and anionic exch	CO nents TION/ ons wh ons pr outer les in / METR odium	DUR ava Co AL T ien p resei grap grap Avog XY n cit	SE S ilab nter ECHI prese nt in bhics gadro	YLLABUS le in laboratory, few experiments maints NIQUES ent together. any analyte. an illustrative experiment solving the o software and molecular modelling.	Contact H 30	Irs.				
Depending added/del Unit No.	g on availability of ti eted. FLAME PHOTOMETR Determination Determination Computational Tecc Elementary interactive e Plotting a gra Drawing a st CHROMATOGRAPHY To prepare using cationi To differenti Conductometry	ime and instrum <b>RY AND COMPUTA</b> on of Na <sup>+</sup> and K <sup>+</sup> io on of Li/Ca/Ba/Sr io <i>hniques</i> exercise in comp quation. aph in origin. ructure of molecul <b>CAND CONDUCTO</b> citric acid from s ic and anionic exch ate common sugar	CO nents TION/ ons wh ons pr outer les in / METR odium nanger rs/ami	DUR: ava Co AL T ien p resel grap grap resel grap	SE S ilab nter ECHI present in phics gadro rate	YLLABUS le in laboratory, few experiments maints NIQUES ent together. any analyte. an illustrative experiment solving the o software and molecular modelling. and aniline from aniline hydrochloride	Contact H 30	Irs.				

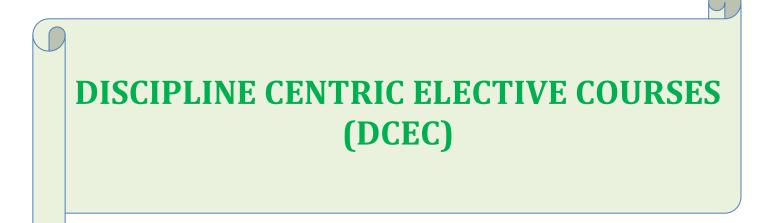
	• Titrate a mixture of copper sulphate, acetic acid and sulphuric acid with sodium	
	hydroxide.	
	• Titrate magnesium sulphate against BaCl <sub>2</sub> and its reverse reaction.	
111	CHRONOPOTENTIOMETRY TECHNIQUES	30
	• Determine the extent of catalytic activity of Pt and Cu electrode by H <sub>2</sub> evolution reaction (HER).	
	• Determine the extent of catalytic activity of Pt and Cu electrode by O <sub>2</sub> evolution reaction (OER).	
	• Determine the area and roughness factor of the electrode by H-adsorption and H- desorption.	
Suggested F	leadings:	
1. B.V	iswanathan and P. S. Raghavan, Practical Physical Chemistry, M V Learning, 2017.	
2. Sho	emaker and Garland, Experiments in Physical Chemistry, McGraw Hill, 2015.	
3. B.D	. Khosla, V. C. Garg and Adarsh Gulati, Senior Practical Physical Chemistry, R. Chand & Co., New De	elhi, 2014.
4. S.K	Maity and N. K. Ghosh, Physical Chemistry Practical, New Central book Agency, 2012.	

- G. P. Mathews, Experimental Physical Chemistry, 1<sup>st</sup>Edition. *Oxford University Press*, 1995.
- 6. A. M. James and F. E. Prichard, Practical Physical Chemistry, *Lomgman*, 1994.
- 7. B. P. Levitt, Findley's Practical Physical Chemistry, 9<sup>th</sup>Edition. *Longman Group Ltd.*, 1993.
- 8. J. B. Yadav, Advanced Practical Physical Chemistry, *Goel Publishing House*, 1991.
- 9. R. C. Das and B. Behara, Experimental Physical Chemistry, Tata McGraw Hill, 1984.

Course	Course Name:					Course Code:					
No:	Physical Chemistry Practic	al-VI			SE	SBS CH 010424 DSE 0063					
CH-40											
Batch: 2021	Programme:	Semester:	L		TP	Credit	Contact Hrs. per Week:	06			
Onwards	M.Sc. Chemistry	IV	0	(	0 6	3	Total Hrs.:	90			
Total Evalua	ition Marks: 75	Examination Duration	on:			8 Hrs.					
	Marks	•				owledge of solution preparation and basic practical knowledge up	· ·	sure in			
Course	1	ure of nanotechnolo	av	e	xperin	nents. Advanced experiments s	uch as electroc	hemical			
Objectives	methods and sol-gel, co-pre	cipitation method w	ill b	е	carrie	ed out. First-hand experience of to carry out instrumental analysis	nanotechnology	will be			
Course Outcomes:	After completing this course <b>CO1</b> : Basic understanding of <b>CO2</b> : Use of electrochemical <b>CO3</b> : Skills for analyzing and <b>CO4</b> : Skills for developing in <b>CO5</b> : Development of altern <b>CO6</b> : Use of advanced and re										
		COURS				•					
NOTE:											
-	on availability of time and inst	ruments available in t	he l	ał	horato	ory, few experiments may be add	ed/deleted				
Unit No.		Con					Contact H	lrs.			
1	SYNTHESIS OF NANOPARTIC	LES					30				
	Synthesize metal na	noparticles by sol-gel	met	th	od.						
	<ul> <li>Synthesize metal na</li> </ul>	noparticles by co-pred									
	<ul> <li>Synthesize metal na</li> </ul>	noparticles by reverse	e mi	ce	elle te	chnique.					
	<ul> <li>Extract metal nanop</li> </ul>	articles from plants a	nd t	he	eir pro	oducts like Mg from chlorophyll.					
II	ELECTROCHEMICAL TECHNI	QUES					30				
	<ul> <li>Record anodic and c</li> </ul>	athodic polarization c	of m	et	tal ele	ctrode in acidic medium.					
	<ul> <li>Find corrosion rate f</li> </ul>	rom Tafel plots using	Ster	rn	n-Gerr	y equation.					
	Record Nyquist and	Bode plots for MS ele	ctro	bd	le dipp	ped in acidic medium.					
	Record cyclic Voltan	mogram and find and	odic	а	nd ca	thodic oxidative peak.					
	Verify Cottrell equat	ion using potential st	ер с	h	ronoa	mperometry.					
III	CHARACTERIZATION TECHN	IQUES					30				
	techniques.					visible and FTIR spectroscopy					
	<ul> <li>Estimate direct and visible spectroscopy</li> </ul>		gy b	a	nd ga	p of metal nanoparticles by UV-					

### Suggested Readings:

- 1. B. Viswanathan and P. S. Raghavan, Practical Physical Chemistry, *M V Learning*, 2017.
- 2. Shoemaker and Garland, Experiments in Physical Chemistry, *McGraw Hill*, 2015.
- 3. B. D. Khosla, V. C. Garg and Adarsh Gulati, Senior Practical Physical Chemistry, R. Chand & Co., New Delhi, 2014.
- 4. S. K. Maity and N. K. Ghosh, Physical Chemistry Practical, New Central book Agency, 2012.
- 5. G. P. Mathews, Experimental Physical Chemistry, 1<sup>st</sup>Edition. *Oxford University Press*, 1995.
- 6. A. M. James and F. E. Prichard, Practical Physical Chemistry, *Lomgman*, 1994.
- 7. B. P. Levitt, Findley's Practical Physical Chemistry, 9<sup>th</sup>Edition. *Longman Group Ltd.*, 1993.
- 8. J. B. Yadav, Advanced Practical Physical Chemistry, Goel Publishing House, 1991.
- 9. R. C. Das and B. Behara, Experimental Physical Chemistry, Tata McGraw Hill, 1984.



Course	Course Name: Course Code:								
No:	Reaction Mechanism:	02							
CH-43									
Batch:	Programme:	Semester:	L	Т	Р	Credit	Contact Hrs.		
2021 Onwards	M.S. Chamistry		2		0	2	per Week:	02	
	M.Sc. Chemistry	I	2	0	0	2	Total Hrs.:	30	
Total Evalua	ation Marks: 50	Examination Duration	on:	2Hrs.					
<b>CIE:</b> 15 M	1arks								
		Pre-requisite of cou	r <b>se:</b> Basic a	nd adva	nce knowl	edge of Physical	Organic Chem	nistry.	
	Aarks								
Course	-	advanced knowledge of p				-			
Objective	-	netic and non-kinetic metho kinetic and thermodynamica			-		es mvolved d	uring u	
Course		urse, student is expected to	-						
Outcomes:		erstanding of a reaction med							
		ctive intermediate involved		emical r	eaction.				
		f a kinetic and thermodynar	-			tion.			
	CO4: Basic knowledge of	f kinetics and non-kinetics n	nethod to s	tudy a re	eaction me	echanism.			
		relation of stereochemistry							
	CO6: Advanced knowled	lge about general physical c	organic cher	nistry pr	inciples				
		COURSE	SYLLABU	S					
NOTE:									
i) Question	no. 1 is compulsory and to	be set from the entire sylla	bus. It will	have fou	ur sub-par	ts and students	need to answe	r any	
two. Each p	art carries three and half r	marks.							
-		rom all four units one from		•		e three sub-parts	and students	need	
	ny two sub-parts of each o	question. Each part carries t		alf marks	5.				
Unit No.		Conter	nts				Contact	: Hrs.	
I	FUNDAMENTALS OF REA						7		
	Fundamentals of stereoelectronic effects and reactivity, acids and bases, reaction types,								
	intermediates and trans	ition state, effect of temper	ature and o	atalysts	•				
II	REACTIVE INTERMEDIATES								
	Introduction to structure, formation, stability and reactions of carbocations, carbanions, free								
	radicals radical anions		d reactions	of car	bocations,	carbanions, fro	e		
	radicals, radical amons,				bocations,	carbanions, fro	e		
111	CHEMICAL EQUILIBRIA	re, formation, stability an radical cations, arynes, carb	enes and n	itrenes.			7		
111	CHEMICAL EQUILIBRIA	re, formation, stability an radical cations, arynes, carb AND REACTIVITY netic control of reactions,	enes and n Correlation	itrenes. of read	tivity with		7		
III	CHEMICAL EQUILIBRIA	re, formation, stability an radical cations, arynes, carb	enes and n Correlation	itrenes. of read	tivity with		7		
III IV	CHEMICAL EQUILIBRIA A Thermodynamic and kin free energy relationship	re, formation, stability an radical cations, arynes, carb AND REACTIVITY netic control of reactions,	enes and n Correlation urtin-Hamm	itrenes. of reac lett princ	tivity with		7		
	CHEMICAL EQUILIBRIA A Thermodynamic and kin free energy relationship KINETICS AND NON-KIN	re, formation, stability an radical cations, arynes, carb AND REACTIVITY netic control of reactions, s, Hammond's postulate, Cu	enes and n Correlation urtin-Hamm MECHANIS	of reac of reac ett princ	tivity with ciple.	n structure, line	ar 7 8		
	CHEMICAL EQUILIBRIA A Thermodynamic and kin free energy relationship KINETICS AND NON-KIN Kinetic methods: prima	re, formation, stability an radical cations, arynes, carb AND REACTIVITY netic control of reactions, s, Hammond's postulate, Cu IETIC METHODS TO STUDY ary and secondary kinetic	enes and n Correlation urtin-Hamm MECHANISI isotopic eff	of reac of reac ett princ VI fects, isc	ctivity with ciple. otopic lab	n structure, line eling; non-kine	ar 7 ic		
	CHEMICAL EQUILIBRIA A Thermodynamic and kin free energy relationship KINETICS AND NON-KIN Kinetic methods: prima methods: detection a	re, formation, stability an radical cations, arynes, carb AND REACTIVITY netic control of reactions, s, Hammond's postulate, Cu	enes and n Correlation urtin-Hamm MECHANISI isotopic effermediates,	of reac of reac ett princ VI fects, isc	ctivity with ciple. otopic lab	n structure, line eling; non-kine	ar 7 ic		

### Suggested Readings:

- 1. F. A. Carey and R. J. Sundberg, Advanced Organic Chemistry, Part A, 5<sup>th</sup>Edition, Springer, 2012.
- 2. E. V. Anslyn and D. A. Dougherty, Modern Physical Organic Chemistry, University Science Books, 2005.
- 3. Warren, S.; Greeves, N.; J. Clayden and P. Wothers, Organic Chemistry, 2<sup>nd</sup>Edition, Oxford University Press, 2001.
- 4. J. March, Advanced Organic Chemistry, Reactions, Mechanisms and Structure, 4<sup>th</sup>Edition, John-wiley, 1999.
- 5. N. S. Isaacs, Physical Organic Chemistry, 2<sup>nd</sup>Edition, Longman Scientific & Technical, 1995.
- 6. P. Sykes, A guidebook to Mechanism in Organic Chemistry, 5<sup>th</sup>Edition, Longman Scientific Technical, 1985.
- 7. P. Deslongchamps, Stereoelectronic Effects in Organic Chemistry, Pergamon, 1983.

Course	Course Name:			Course Code:						
No:	Nuclear Chemistry				SBS CH 010102 DCE 2002					
CH-44										
Batch:	Programme:	Semester:	L	Т	Р	Credit	Contact Hrs.			
2021							per Week:	02		
Onwards	M.Sc. Chemistry	I	2	0	0	2	Total Hrs.:	30		
Total Evalua	tion Marks:50	Examination Durat	ion:	2	Hrs.					
CIE: 15 №	larks	Pre-requisite of a		•	de the l	basic knowledge	e of nuclear s	tructures		
TEE: 35 Ⅳ	larks	radioactivity and ap	plicatio	15.						
Course	To provide the basics of nu		tions, ar	tificial r	adioactiv	ity and application	ons of nuclear o	chemistry		
Objectives	radiopharmacy and chelatio	n therapy.								
Course	After completing this course	e, student is expected t	o learn t	he follo	wing:					
Outcomes:	CO1: Basic understanding of									
	CO2: To identify and unders		eactions							
	<b>CO3</b> : Measurement of radio	activity								
	<b>CO4</b> : Artificial radioactivity									
	<b>CO5</b> : To understand chelatic									
	CO6: Applications of nuclear	chemistry	CO6: Applications of nuclear chemistry							
		COURSE	SYLLA	BUS						
NOTE:		COURSE	SYLLA	BUS						
-	o. 1 is compulsory and to be				ve four su	b-parts and stud	ents need to a	nswer an		
Question no wo. Each par	t carries three and half marks	set from the entire syl	labus. It	will hav						
Question no wo. Each par Question n	t carries three and half marks los. 2 to 5 are to be set from	set from the entire syl 5. all four units one from	labus. It n each. E	will hav	estion wi					
Question newo. Each par wo. Each par Question no answer any	t carries three and half marks	set from the entire syl s. all four units one from ion. Each part carries t	labus. It n each. E hree and	will hav	estion wi		-parts and stud	ents nee		
Question new wo. Each par Question no o answer any	t carries three and half marks los. 2 to 5 are to be set from	set from the entire syl s. all four units one from ion. Each part carries t	labus. It n each. E	will hav	estion wi		-parts and stud			
Question newo. Each par Question newo. Question newo. O answer any <b>Unit No.</b>	t carries three and half marks los. 2 to 5 are to be set from	set from the entire syl s. all four units one from ion. Each part carries t	labus. It n each. E hree and	will hav	estion wi		-parts and stud	ents nee		
Question newo. Each par Question newo. Question newo. answer any Unit No.	t carries three and half marks toos. 2 to 5 are to be set from y two sub-parts of each quest NUCLEAR STRUCTURE Composition of the nucleu	set from the entire syl s. all four units one from ion. Each part carries t Co s, nuclear size, shape	labus. It n each. E hree and ontents	will hav very que d half ma ensity, tl	estion wil arks. heories c	Il have three sub-	-parts and stud	ents nee t <b>act Hrs.</b>		
Question newo. Each par ) Question newo answer any Unit No.	rt carries three and half marks los. 2 to 5 are to be set from y two sub-parts of each quest NUCLEAR STRUCTURE	set from the entire syl s. all four units one from ion. Each part carries t Co s, nuclear size, shape	labus. It n each. E hree and ontents	will hav very que d half ma ensity, tl	estion wil arks. heories c	Il have three sub-	-parts and stud	ents nee t <b>act Hrs.</b>		
Question no wo. Each par ) Question no o answer any <b>Unit No.</b>	t carries three and half marks toos. 2 to 5 are to be set from y two sub-parts of each quest <b>NUCLEAR STRUCTURE</b> Composition of the nucleu magnetic and electric prope <b>NUCLEAR REACTIONS</b>	set from the entire syl s. all four units one from ion. Each part carries t Co s, nuclear size, shape rties of nucleus, nuclea	labus. It n each. E hree and ontents e and de ar spin a	will hav very que d half ma ensity, th nd parity	estion wil arks. heories c y, nuclear	Il have three sub-	-parts and stud Con osition,	ents nee t <b>act Hrs</b> .		
Question newo. Each par ) Question n o answer any <b>Unit No.</b>	t carries three and half marks toos. 2 to 5 are to be set from y two sub-parts of each quest <b>NUCLEAR STRUCTURE</b> Composition of the nucleu magnetic and electric prope <b>NUCLEAR REACTIONS</b> Penetration potential, nuc	set from the entire syl s. all four units one from ion. Each part carries t Co s, nuclear size, shape rties of nucleus, nuclea clear binding energy,	labus. It n each. E hree and ontents a and de ar spin a , nuclea	will hav very que d half ma ensity, th nd parity or emise	estion wil arks. heories c y, nuclear sions, nu	Il have three sub- of nuclear compo- binding forces.	-parts and stud Con osition, ations,	ents nee tact Hrs. 7		
Question newo. Each par ) Question n o answer any <b>Unit No.</b>	t carries three and half marks tos. 2 to 5 are to be set from y two sub-parts of each quest <b>NUCLEAR STRUCTURE</b> Composition of the nucleu magnetic and electric prope <b>NUCLEAR REACTIONS</b> Penetration potential, nuclei bombardment of nuclei, nuclei	set from the entire syls. all four units one from ion. Each part carries t c s, nuclear size, shape rties of nucleus, nuclear clear binding energy, uclear fission, nuclear	labus. It n each. E <u>hree and</u> ontents a and de ar spin a , nuclea fusion,	will hav very que d half ma ensity, th nd parity nr emise nuclear	estion wil arks. heories c γ, nuclear sions, nu	Il have three sub- of nuclear compo- binding forces. uclear transform res, nuclear reac	-parts and stud Con osition, ations,	ents nee tact Hrs. 7		
Question newo. Each par ) Question n o answer any <b>Unit No.</b>	t carries three and half marks toos. 2 to 5 are to be set from y two sub-parts of each quest <b>NUCLEAR STRUCTURE</b> Composition of the nucleu magnetic and electric prope <b>NUCLEAR REACTIONS</b> Penetration potential, nuc	set from the entire syls. all four units one from ion. Each part carries t c s, nuclear size, shape rties of nucleus, nuclear clear binding energy, uclear fission, nuclear	labus. It n each. E <u>hree and</u> ontents a and de ar spin a , nuclea fusion,	will hav very que d half ma ensity, th nd parity nr emise nuclear	estion wil arks. heories c γ, nuclear sions, nu	Il have three sub- of nuclear compo- binding forces. uclear transform res, nuclear reac	-parts and stud Con osition, ations,	ents nee tact Hrs. 7		
) Question no wo. Each par i) Question n o answer any <b>Unit No.</b> I	NUCLEAR STRUCTURE Composition of the nucleu magnetic and electric prope NUCLEAR REACTIONS Penetration potential, nucleu bombardment of nuclei, nucleu India, Szilard–Chalmer's effe	set from the entire syls. all four units one from ion. Each part carries t c s, nuclear size, shape rties of nucleus, nuclear clear binding energy, uclear fission, nuclear	labus. It n each. E <u>hree and</u> ontents a and de ar spin a , nuclea fusion,	will hav very que d half ma ensity, th nd parity nr emise nuclear	estion wil arks. heories c γ, nuclear sions, nu	Il have three sub- of nuclear compo- binding forces. uclear transform res, nuclear reac	-parts and stud Con osition, ations,	ents nee tact Hrs. 7 8		
wo. Each par i) Question n	NUCLEAR STRUCTURE Composition of the nucleu magnetic and electric prope NUCLEAR REACTIONS Penetration potential, nucleu bombardment of nuclei, nucleu India, Szilard–Chalmer's effer RADIOACTIVITY	set from the entire syl s. all four units one from ion. Each part carries t Co s, nuclear size, shape rties of nucleus, nuclear clear binding energy, uclear fission, nuclear ect, fuel cycle and wast	labus. It n each. E hree and ontents a and de ar spin a fusion, e manag	will hav very que d half ma ensity, th nd parity nr emise nuclear gement,	estion wil arks. heories c y, nuclear sions, nu explosiv reactor p	Il have three sub- of nuclear compo- binding forces. uclear transform res, nuclear reac ower control.	-parts and stud Cont osition, nations, tors in	ents nee tact Hrs. 7		
Question no wo. Each par ) Question no o answer any <b>Unit No.</b> I	NUCLEAR STRUCTURE Composition of the nucleu magnetic and electric prope NUCLEAR REACTIONS Penetration potential, nuc bombardment of nuclei, nu India, Szilard–Chalmer's effe RADIOACTIVITY Radioactive decay and grow	set from the entire syl all four units one from ion. Each part carries t <b>C</b> s, nuclear size, shape rties of nucleus, nuclear clear binding energy, uclear fission, nuclear ect, fuel cycle and wast th, naturally occurring	labus. It n each. E hree and ontents a and de a spin a fusion, e manag and art	will hav very que d half ma ensity, the nd parity ir emise nuclear gement, ificially p	estion wil arks. heories c y, nuclear sions, nu explosiv reactor p	Il have three sub- of nuclear compo- binding forces. uclear transform res, nuclear reac ower control. radioactive subst	-parts and stud Cont osition, ations, stors in tances,	ents nee tact Hrs. 7 8		
Question no wo. Each par ) Question no o answer any <b>Unit No.</b>	NUCLEAR STRUCTURE Composition of the nucleu magnetic and electric prope NUCLEAR REACTIONS Penetration potential, nucleu bombardment of nuclei, nu India, Szilard–Chalmer's effe RADIOACTIVITY Radioactive decay and grow Measurement of radioactiv	set from the entire syls. all four units one from ion. Each part carries t <b>C</b> s, nuclear size, shape rties of nucleus, nuclear clear binding energy, uclear fission, nuclear ect, fuel cycle and wast th, naturally occurring ity, group displaceme	labus. It n each. E hree and ontents and de ar spin a fusion, e manag and arti nt law, n	will hav very que d half ma ensity, the nd parity ar emise nuclear gement, ficially p radioact	estion wil arks. heories c y, nuclear sions, nu explosiv reactor p produced ive disint	Il have three sub- of nuclear compo- binding forces. uclear transform res, nuclear reac ower control. radioactive subst egration series,	-parts and stud Con osition, ations, etors in tances, rate of	ents nee tact Hrs. 7 8		
Question no wo. Each par ) Question no o answer any <b>Unit No.</b>	NUCLEAR STRUCTURE Composition of the nucleu magnetic and electric prope NUCLEAR REACTIONS Penetration potential, nuc bombardment of nuclei, nu India, Szilard–Chalmer's effe RADIOACTIVITY Radioactive decay and grow	set from the entire syl s. all four units one from ion. Each part carries t <b>C</b> s, nuclear size, shape rties of nucleus, nuclear clear binding energy, uclear fission, nuclear ect, fuel cycle and wast th, naturally occurring ity, group displacement rage life of radioactive	labus. It n each. E hree and ontents and de ar spin a fusion, e manag and arti nt law, n e eleme	will hav very que d half ma ensity, th nd parity ar emise nuclear gement, ficially p radioact nts, unit	estion wil arks. heories c y, nuclear sions, nu explosiv reactor p produced ive disint c of radic	Il have three sub- of nuclear compo- binding forces. uclear transform res, nuclear reac ower control. radioactive subst egration series,	-parts and stud Con osition, ations, etors in tances, rate of	ents nee tact Hrs. 7 8		

IV	ARTIFICIAL RADIOACTIVITY AND APPLICATIONS OF NUCLEAR CHEMISTRY Discovery of artificial radioactivity, isotopes used in medicines, radiocarbon dating, age determination, effects of radiation on life, applications of tracer element in medical, agriculture and analytical fields, biological effects of radiation, radiation protections, chelation therapy.	8
Sugge	sted Readings:	
1.	G. Friedlander, J. W. Kennedy, E. S. Macias; Nuclear and Radiochemistry, 3 <sup>rd</sup> Edition. <i>Willey</i> , 2013.	
2.	W. D. Loveland, D. Morrissey and G. T. Seaborg, Modern Nuclear Chemistry, John Wiley & Sons, 2006.	
3.	C. E. Housecroft and A. G. Sharpe; Inorganic Chemistry, 2 <sup>nd</sup> Edition.Pearson, 2005.	

4. H. J. Arnikar, Essentials of Nuclear Chemistry, *Wiley Eastern*, 1988.

Course	Course Name:				Course	Code:		
No:	Green Chemistry				SBS CH	010303 DCE 2	2002	
CH-45								
Batch:	Programme:	Semester:	L	Т	Р	Credit	Contact H	rs.
2021							per Week	02
Onwards	M.Sc. Chemistry	III	2	0	0	2	Total Hrs.:	30
Total Evalua	tion Marks:50	Examination Du	iration:		2Hrs.			
CIE: 15 N	larks	Pre-requisite of	course:	Basic kı	nowledge	e of writing bal	anced chemi	cal reaction
		Basic understa	inding o	f natu	re of so	lvents, catalys	sts, chromat	ography an
TEE: 35 №		electromagnet						
Course Objectives	To provide the basic knowledge	of Green Chemist	ry and its	applica	itions in t	he field of chem	ical sciences.	
Course	After completing this course, st	•	to learn	the follo	owing:			
Outcomes:	<b>CO1</b> : Basic understanding of gre		+h a !=	- : + مها				
	<b>CO2</b> : Use of greener and renew <b>CO3</b> : Skills for analyzing and dev	•						
	<b>CO4</b> : Skills for developing indus			lethous				
	<b>CO5</b> : Development of alternate			netic na	thways to	chemicals		
	<b>CO6</b> : Use of advanced and rece		• •	•	•	o enermeans		
			E SYLLA					
NOTE:								
	. 1 is compulsory and to be set	from the entire sv	ıllabus. It	will ha	ve four si	ub-parts and stu	udents need t	o answer ar
	t carries three and half marks.	,		-				
•	os. 2 to 5 are to be set from all	four units one from	n each. I	very qu	uestion w	ill have three su	ub-parts and s	tudents nee
o answer an	y two sub-parts of each question	Each part carries	three an	d half m	narks.		-	
Unit No.		Cor	ntents					Contact Hrs
l	INTRODUCTION TO GREEN CHE	MISTRY						7
	Green chemistry history, need	ls and goals. Lim	itation/O	bstacle	s in purs	uit of the goal	s of green	
	chemistry. Opportunities for a	next generation of	designer	materia	als to cre	eate safer futu	re. Twelve	
	principles of Green Chemistry a	nd their illustratio	ns with e	xample	s.			
II	<b>GREEN CATALYSIS AND RENEW</b>	ABLE RAW MATE	RIALS					8
	Heterogeneous catalysis: Use c	f zeolites, silica, a	lumina, o	clay, po	lymers, c	yclodextrin and	supported	
	catalyst; Phase-transfer catalysi	s; Biocatalysis usir	ng enzym	es; Bior	nass conv	version to fine c	hemicals.	
	GREENER SOLVENTS							7
	Reactions under aqueous medi			•				
	Ionic liquids; Supercritical fluid extraction and chromatography	•	eactions	in solic	d and liq	uid phase; Alte	rnatives in	

IV	GREEN TECHNOLOGY AND FUTURE TRENDS IN GREEN CHEMISTRY Microwave and Ultrasound assisted reactions; photochemical reactions using sunlight; Flow techniques; combinatorial green chemistry. Green synthesis of ibuprofen and adipic acid (traditional vs green ones).	8
11. M. I 12. F. N 13. R. A 14. M. A	Readings: rahmachari, Catalyst-free Organic Synthesis. <i>Royal Society of Chemistry</i> , 2018. ancaster, Green Chemistry: An Introductory Text,3 <sup>rd</sup> Edition. <i>Royal Society of Chemistry</i> , 2016. I. Kerton, Alternative Solvents for Green Chemistry. <i>Royal Society of Chemistry</i> , 2013. . Sheldon, I. Arends and U. Hanefeld, Green Chemistry and Catalysis, 1 <sup>st</sup> Edition. <i>Wiley-VCH</i> , 2007. A. Ryan and M. Tinnes, Introduction to Green Chemistry. <i>American Chemical Society</i> , 2003. . Anastas and J. C. Warner, Green Chemistry: Theory and Practice. <i>Oxford University Press</i> , 1998.	

No:	Course Name:				Cours	e Code:		
INU:	Carbohydrate Chemistry	and its Applications	5		SBS CH	H 010304 [	DCE 2002	
CH-46								
Batch: 2021	Programme:	Semester:	L	Т	Р	Credit	Contact Hrs. per Week:	02
Onwards	M.Sc. Chemistry	111	2	0	0	2	Total Hrs.:	30
Total Evalua	ation Marks: 50	Examination Du	ration:		2 Hrs.			
CIE: 15 N	Лarks							formulae, their . Understanding
TEE: 35 N	/larks	of common rea			•		•	-
Course Objectives	To provide the knowledge							
Course Outcomes:	After completing this cour CO1: Basic understanding CO2: In-depth understand CO3: Important aspects of CO4: Skills to design and c CO5: Understanding the re CO6: Ability to analyse, de	of carbohydrates ling of carbohydrates a f carbohydrates associa reate products and so ole of carbohydrates in	and their re ated with h lutions to r n other allie	eactions numan eal life ed field	s health problem s			
	<b>COO</b> . Ability to allalyse, de				inyurates	)		
		COUR	SE SYLLAE	BUS				
two. Each pa ii) Question to answer an	<ul> <li>D. 1 is compulsory and to be rt carries three and half man nos. 2 to 5 are to be set from y two sub-parts of each que</li> </ul>	rks. m all four units one fro estion. Each part carrie	syllabus. It om each. E s three and	will hav	lestion w			nd students need
two. Each pa ii) Question to answer an Unit No.	rt carries three and half man nos. 2 to 5 are to be set from y two sub-parts of each que	rks. m all four units one fro estion. Each part carrie	syllabus. lt om each. E	will hav	lestion w			nd students need
two. Each pa ii) Question i to answer an	rt carries three and half man nos. 2 to 5 are to be set from	rks. m all four units one fro estion. Each part carrie Cor ical Importance, Class nd non-sugars, Reducir nclature, Structural re	syllabus. It om each. E s three and ntents sification: I ng and non epresentat	will have wery quadright will have the second secon	accharide ng sugars	rill have thr es, oligosac s. Physical a	ee sub-parts ar hharides and and chemical	nd students need
two. Each pa ii) Question to answer an Unit No.	rt carries three and half man nos. 2 to 5 are to be set from y two sub-parts of each que CARBOHYDRATES-I Introduction and biomed polysaccharides, Sugars ar Monosaccharides: Nome properties of some imp	rks. m all four units one fro estion. Each part carrie Cor ical Importance, Class nd non-sugars, Reducir nclature, Structural re portant monosacchari ructose. clature and important	syllabus. It om each. E <u>s three and</u> <b>itents</b> sification: I ng and non epresentat des incluc	will hav very qu I half m Monosa -reduci ion, Iso ling sto	accharide ng sugars omerism. ereochen	es, oligosac s. Physical a nical aspec	ee sub-parts ar hharides and and chemical cts wherever	nd students need

IV	<b>CARBOHYDRATES-IV</b> Applications: Importance of monosaccharides and their derivatives like deoxy sugars, glycosides, myoinositol, amino sugars, <i>N</i> -acetylmuramic acid, sialic acid in different fields. Importance of oligosaccharides and polysaccharides in different sectors. Artificial sweeteners: Synthesis and importance.	8
	ted Readings:	<u> </u>
	P. Y. Bruice, Organic Chemistry, 5 <sup>th</sup> Edition. <i>Pearson Education</i> , 2014.	
2.	M. Sinnott, Carbohydrate Chemistry and Biochemistry: Structure and Mechanism, 2 <sup>nd</sup> Edition. Royal Society	ty of Chemistry,
	2013.	
3.	P. Y. Bruce and K. J. R. Prasad, Essential Organic Chemistry, <i>Pearson Education</i> , New Delhi, 2008.	
	T. K. Lindhorst, Essentials of Carbohydrate Chemistry and Biochemistry, 3 <sup>rd</sup> Edition, <i>Wiley</i> , 2007.	
5.	A. L. Lehninger, D. L. Nelson and M. M. Cox, Lehninger Principles of Biochemistry, 4 <sup>th</sup> Edition. W. H. Freem	an, 2004.
6.	M. Loudon, Organic Chemistry, Oxford University Press, New Delhi, 2002.	

No:	Course Name:				Course	e Code:			
NU.	Asymmetric Catalysis: F	undamentals to Frontie	rs		SBS CH	1 010305 DCE	2002		
CH-47									
Batch:	Programme:	Semester:	L	т	Р	Credit	Contact H	-	
2021 Onwards	M.Sc. Chemistry		2	0	0	2	per Week Total Hrs.		02 30
	ation Marks: 50		Z	0	0	Ζ		•	50
		Examination Dura	tion:		2 Hrs.				
CIE: 15 N	Marks	Pre-requisite of c	ourse	: Basic	knowled	lge of writing	chemical fo	ormul	ae, thei
		interconversion a	nd ste	ereoche	mistry. I	Basic understa	nding of hor	noger	nous and
	Лarks	heterogeneous ca							
Course Objectives	To provide the advanced k	knowledge of asymmetric	cataly.	sis in or <u>c</u>	ganic syn	thesis.			
Course	After completing this cour	rse, student is expected to	learn	the follo	owing:				
Outcomes:	CO1: Basic and in-depth u								
	<b>CO2</b> : Use of catalysts and			•		hesis			
	<b>CO3</b> : Understanding of ad								
	<b>CO4</b> : Skills for developing					•			
	<b>CO5</b> : Understanding of ne <b>CO6</b> : Ability to analyse, de			•		•	5		
		COURSE							
NOTE:		COORSE		203					
i) Question	rt carries three and half man	e set nom the entire syna	abus. I	t will ha	ve four s	ub-parts and st	udents need	to an	swer an
	nos. 2 to 5 are to be set from two sub-parts of each que	rks. m all four units one from estion. Each part carries th	each. ìree ar	Every qı	uestion w	-		stude	ents need
o answer an Unit No.	nos. 2 to 5 are to be set from by two sub-parts of each que	rks. m all four units one from estion. Each part carries th Conte	each. ìree ar	Every qı	uestion w	-		stude	ents need ntact Hrs.
	nos. 2 to 5 are to be set from	rks. m all four units one from estion. Each part carries th Conte NAND CATALYSIS modes of asymmetric i	each. aree ar ents	Every quind half n	uestion w narks. ymmetric	vill have three s	ub-parts and	stude	ents need
	nos. 2 to 5 are to be set from by two sub-parts of each que ASYMMETRIC INDUCTION Asymmetric induction, in asymmetric catalysis inc	rks. m all four units one from estion. Each part carries th Conte N AND CATALYSIS modes of asymmetric i cluding energetic of rea	each. Iree ar ents induct ctions	Every quind half n	uestion w narks. ymmetric	vill have three s	ub-parts and	stude	ents need
Unit No. I	nos. 2 to 5 are to be set from by two sub-parts of each que ASYMMETRIC INDUCTION Asymmetric induction, n asymmetric catalysis inc catalysis.	rks. m all four units one from estion. Each part carries th <b>Conte</b> <b>N AND CATALYSIS</b> modes of asymmetric i cluding energetic of rea <b>YSIS AND CHIRAL AUXILLI</b> e catalysis including exam rces: selected examples of	each. nree ar ents induct ctions ARIES ples. ( of few	Every qu id half n ion, asy impor Chiral au	vestion w narks. vmmetric tant fact	vill have three s catalysis and tors affecting asic requireme	bub-parts and d basics of asymmetric nts of chiral	stude	ents nee ntact Hrs 7
Unit No. I	ASYMMETRIC INDUCTION Asymmetric induction, in asymmetric catalysis inc catalysis. LEWIS ACID -BASE CATAL Lewis acid and Lewis base auxiliary; Chiral pool sour	rks. m all four units one from estion. Each part carries th <b>Conte</b> <b>N AND CATALYSIS</b> modes of asymmetric i cluding energetic of rea <b>YSIS AND CHIRAL AUXILLI</b> e catalysis including exam rces: selected examples of a amides, 8-phenylmentho <b>SYMMETRIZATION AND N</b> and parallel kinetic reso	each. nree ar ents induct ctions ARIES ples. ( of few ol).	Every qu id half n ion, asy impor Chiral au most co	vestion w narks. vmmetric tant fact uxiliary: B ommon c STUDIES	vill have three s catalysis and tors affecting asic requireme chiral auxiliaries	bub-parts and d basics of asymmetric nts of chiral s (Oppolzer,	stude	ents need ntact Hrs. 7

111 | Page

- 1. E. M. Carreira, L. Kvaerno, Classics in Stereoselective Synthesis, *Wiley-VCH: Weinheim*, Germany, 2009.
- 2. M. Nogrady, Stereoselective Synthesis: A Practical Approach, *Wiley*, 2008.
- 3. P. J. Walsh, M. C. Kozlowski, Fundamentals of Asymmetric Catalysis, University Science Book, 2009.
- 4. A. Berkessel, H. Groger, Asymmetric Organocatalysis: From Biomimetic Concepts to Applications in Asymmetric Synthesis, *Wiley-VCH*, 2005.
- 5. I. Ojima, Catalysis in Asymmetric Synthesis, Wiley-VCH, 2004.
- 6. Recent review and research articles relevant to above topics (reprints to be handed over to students).

Course	e No:	Course Name:				Course (	Code:			
CH-48		Supramolecular C	hemistry			SBS CH (	010306 DC	E 2002		
Batch: 2021		Programme:	Semester:	L	Т	Р	Credit	Contac per We		02
Onwar	ds	M.Sc. Chemistry		2	0	0	2	Total H	Irs.:	30
Total E	Evaluatio	on Marks: 50	Examinatior	Duration:		2 Hrs.				
CIE:	<b>15</b> Mar	ks	Pre-requisit			-	f non-cova	lent inte	eractio	ns, lock
TEE:	<b>35</b> Mar	1	-		-	-				
Course Object		To provide the basi concepts and appli	-	of Supramol	lecular Ch	emistry, the	e terminolo	gies, desi	ign and	
Course Outcor		After completing th CO1: Basic knowled CO2: The concepts CO3: Nature of sup CO4: Understandin CO5: Knowledge of CO6: Develop skills	dge of supram and various te ramolecular ir g of supramol various bindi	olecular che erminologie nteractions ecular conc ng hosts su	emistry es in supra cepts and ch as crov	imolecular o design vn ethers, c	chemistry	pherands	5	
			C	OURSE SYI	LABUS					
i) Ques student	tion nos	wo. Each part carries . 2 to 5 are to be set o answer any two su	from all four	units one fi h question.	Each par				-	
Unit No.				Conten	ts				Conta	act Hrs.
1	Definit Chemi	DUCTION TO SUPRA ion and Developm stry? Host–Guest Cł Compounds.	ent of Supra	amolecular	Chemist	•	•			7
II	TERMI Recept Use; Preorg	NOLOGIES AND CON cors, Coordination ar Measurement of anisation and Com nination.	nd the Lock ar Binding Cons	stants; Coo	operativity	y and the	e Chelate	Effect;		8
III	NATUR Ion-ion Bondir	<b>RE OF SUPRAMOLEC</b> n Interactions; Ion ng; Cation–π Interac and Crystal Close Pa	–Dipole Inte tions; Anion-	ractions; [ π Interaction	Dipole–Dip ons; π–π	oole Intera Interactior	ns; Van dei	r Waals		7
IV	Host E Cation	MOLECULAR CONCE Design; Informed an Coordination Chem nolecular Host; Crow	d Emergent ( iistry; Concep	Complex M ts in Coord	dination C					8

- 1. J. W. Steed, J. L. Atwood, Supramolecular Chemistry, 2<sup>nd</sup> Edition. *Wiley*, 2009.
- 2. J. W. Steed, Supramolecular Chemistry: From Molecules to Nanomaterials, 8 Volume 7<sup>th</sup> Edition. *John Wiley & Sons*, 2012.
- 3. J.-M. Lehn, Supramolecular Chemistry: Concepts and Perspectives. *Wiley*, 2006.

Course N	o: Course Name:				Со	urse Code	:	
CH-49	Introduction to Nanoma	terials			SBS	5 CH 0103	07 DCE 2002	
Batch:	Programme:	Semester:	L	Т	Р	Credit	Contact Hrs.	
2021							per Week:	02
Onwards	M.Sc. Chemistry	I	2	0	0	2	Total Hrs.:	30
Total Eval	uation Marks:50	Examinatio	n Dur	ation	:	2 H	Irs.	
	Marks	-					understanding e area and dime	of materials,
	Marks				-			
Course Objectives		lany importa	nt no	nom	ateri	als such d	as graphene, ca	rbon nanotubes,
	nanorods etc., their classifi to the students.	cation, synth	2515, C	nara	cienz		applications wor	na pe miroaucea
Course	After completing this cours	e students a	re evi	necte	d to	learn the f	ollowing.	
Outcomes					u 10		5.10 Willig.	
outcomes	<b>CO2</b> : Classification of nano		erms	of dii	mens	sionality		
	<b>CO3</b> : Various synthetic pro						n gas phase synt	hesis
	<b>CO4</b> : Characterization met						•	
	CO5: Preliminary knowledg	e of nanotub	es, na	norc	ds ai	nd nanopla	ates	
	CO6: Exposure of wonder r	naterials such	n as gr	raphe	ene a	nd carbon	nanotubes	
	I	COURSE	SYLL	ABU	S			
NOTE:								
	no. 1 is compulsory and to be se	ot from the er	ntire s	vllah	us It	will have	four sub-narts a	nd students need
	any two. Each part carries three			ynab	us. n			la stadents need
	on nos. 2 to 5 are to be set from			from	n eac	h. Everv a	uestion will have	e three sub-parts
	nts need to answer any two sub-							•
Unit No.			nten			•		Contact Hrs.
1	INTRODUCTION							6
	An Introduction to Nanomate	rials with Hi	storic	al Pe	erspe	ctives. Na	nomaterials and	1
	Nanocomposites. Elementary				•			
	Nanoparticles. Classification	of nanomat	erials	; -	zero	dimensi	onal (0D), one	2
	dimensional (1D) and two dime		nanon	nater	ials.			
II	SYNTHESIS OF NANOMATERIAI							8
	Top-Down and Bottom-Up A	••	•					
	Synthesis of Nanoparticles - Ph				•	•		
	and Microwave Plasma Proc	esses. Flame	Aer	osol	Proc	cess. Synt	hesis of Coated	1
	Particles.							
111	CHARACTERIZATION OF NANO		N 1 ~+ 6	ode 4		baracter!-	ation V David	8
	Characterization of Nanomate						•	
	Electron Diffraction, Electron M			впа	115[[]]		. on wherescopy.	
IV	NANOTUBES, NANORODS, AND			1	4.4.1			8
	Introduction of Nanotubes, N							
	Carbon Nanotubes and Grapher Carbon, Synthesis of Nanotubes			INGU	0100	s iroiti ivla	terials other than	
			J2.					

- 1. D. Vollath, Nanomaterials: An Introduction to Synthesis, Properties and Applications, 2<sup>nd</sup> Edition. *Wiley-VCH*, 2013.
- 2. D. C. Agarwal, Introduction to Nanoscience and Nanomaterials. *World Scientific*, 2013.

	e No:	Course Name:				Cours	e Code:		
CH-50	)	Molecular Magn	etism			SBS C	H 010308	DCE 2002	
Batch:		Programme:	Semester:	L	Т	Р	Credit	Contact Hrs.	
2021								per Week:	02
Onwar		M.Sc. Chemistry	111	2	0	0	2	Total Hrs.:	30
Total E	Evaluati	ion Marks:50	Examination D	Duratio	n:	2⊦	Irs.		
CIE:	<b>15</b> Ma								
CIE:	T2 INIG	IIKS	Pre-requisite	of co	urse: T	o prov	ide the	basic knowledge	of <i>molecular</i>
TEE:	<b>35</b> Ma	rks	magnetism.						
Course		To provide the bas	sic knowledge of	<sup>r</sup> origin	of magr	etism a	nd molecu	ılar magnetism. At	the end of this
Object	ives	course, students		-				-	-
-		transition and ma	gnetic exchange			-		-	
Course	5	After completing	this course, stud	ent is e	xpected	to learr	n the follow	wing:	
Outcor	mes:	<b>CO1</b> : Origin of ma	gnetism						
		CO2: Scope of mo	-	sm					
		CO3: Effective ma	•						
		CO4: Spin transitio							
		CO5: Quantum tu	-						
		CO6: Single molec	cule magnets						
			C	OURSE	SYLLA	BUS			
				i the en	tire sylla	abus. It	will have f	our sub-parts and	students need
i) Ques	tion no	two. Each part carr s. 2 to 5 are to be s	ies three and hal set from all four	lf marks units o	s. ne from	each. E	very quest		
i) Ques tudent	tion no	two. Each part carr	ies three and hal set from all four	lf marks units oi h quest	s. ne from ion. Eac	each. E	very quest	ion will have three	e sub-parts and
i) Ques tudent <b>Unit</b>	tion no	two. Each part carr s. 2 to 5 are to be s	ies three and hal set from all four	lf marks units oi h quest	s. ne from	each. E	very quest	ion will have three	e sub-parts and
i) Ques itudent Unit No.	tion no	two. Each part carr s. 2 to 5 are to be s	ies three and hal set from all four sub-parts of eac	lf marks units oi h quest	s. ne from ion. Eac	each. E	very quest	ion will have three	e sub-parts and
i) Ques itudent Unit No.	tion no s need BASIC	two. Each part carr s. 2 to 5 are to be s to answer any two	ies three and hal set from all four sub-parts of eac GNETISATION	lf marks units or h quest <b>Cor</b>	s. ne from ion. Eac itents	each. Ev h part c	very quest arries thre	ion will have three e and half marks.	e sub-parts and Contact Hrs. 7
i) Ques tudent Unit No.	tion no s need BASIC Origin	two. Each part carr s. 2 to 5 are to be s to answer any two <b>CONCEPTS OF MA</b> of magnetism, m	ies three and hal set from all four sub-parts of eac GNETISATION nagnetic suscept	If marks units or <u>h quest</u> <b>Cor</b> tibility,	s. ne from ion. Eac itents measur	each. Ev h part c	very quest arries thre of magne	tion will have three the and half marks.	e sub-parts and Contact Hrs. 7
i) Ques itudent Unit No.	BASIC Origin Gouy	two. Each part carr s. 2 to 5 are to be s to answer any two <b>CONCEPTS OF MA</b> of magnetism, m method, inducti	ies three and hal set from all four <u>sub-parts of eac</u> GNETISATION nagnetic suscept on method, s	If marks units or <u>h quest</u> <b>Cor</b> tibility, superco	s. ne from iion. Eac itents measur nductin	each. Ev <u>h part c</u> ement g quar	very quest arries thre of magne ntum inte	tion will have three the and half marks. The susceptibility: the erference device	e sub-parts and Contact Hrs. 7
i) Ques tudent Unit No.	BASIC Origin Gouy magne	two. Each part carri s. 2 to 5 are to be s to answer any two <b>CONCEPTS OF MA</b> of magnetism, m method, inducti etometer, Evans r	ies three and hal set from all four sub-parts of eac GNETISATION nagnetic suscept on method, sero-file	If marks units or <u>h quest</u> <b>Cor</b> tibility, superco eld coo	s. ne from ion. Eac itents measur nductin oled me	each. Ev h part c ement g quar easurem	very quest arries thre of magne ntum inte nents, fiel	tion will have three the and half marks. etic susceptibility: erference device d scan, reduced	e sub-parts and Contact Hrs. 7
i) Ques tudent <b>Unit</b> No.	BASIC Origin Gouy magne	two. Each part carri s. 2 to 5 are to be s to answer any two <b>CONCEPTS OF MA</b> of magnetism, m method, inducti etometer, Evans r etization, hysteres	ies three and hal set from all four <u>sub-parts of eac</u> GNETISATION nagnetic suscept on method, s method, zero-fic sis, AC suscep	If marks units or <u>h quest</u> <b>Cor</b> tibility, superco eld coo otibility,	s. ne from ion. Eac itents measur nductin oled me classif	each. Ev h part c ement g quar easurem	very quest arries thre of magne ntum inte nents, fiel of mag	tion will have three e and half marks. etic susceptibility: erference device d scan, reduced netic behaviour:	e sub-parts and Contact Hrs. 7
i) Ques tudent Unit No. I	BASIC Origin Gouy magne diama	two. Each part carri s. 2 to 5 are to be s to answer any two <b>CONCEPTS OF MA</b> of magnetism, m method, inducti etometer, Evans m etization, hysteres gnetic, paramagne	ies three and hal set from all four sub-parts of eac GNETISATION nagnetic suscept on method, sero-fie sis, AC suscep tic, ferromagnet	If marks units or <u>h quest</u> <b>Cor</b> tibility, superco eld coo otibility,	s. ne from ion. Eac itents measur nductin oled me classif	each. Ev h part c ement g quar easurem	very quest arries thre of magne ntum inte nents, fiel of mag	tion will have three e and half marks. etic susceptibility: erference device d scan, reduced netic behaviour:	e sub-parts and Contact Hrs 7
i) Ques tudent Unit No. I	BASIC Origin Gouy magne diama	two. Each part carris. 2 to 5 are to be s to answer any two <b>CONCEPTS OF MA</b> of magnetism, m method, inducti etometer, Evans m etization, hysteres gnetic, paramagne <b>NETIC INTERACTION</b>	ies three and hal set from all four sub-parts of eac GNETISATION nagnetic suscept on method, sero-fie sis, AC suscep tic, ferromagnet	If marks units on <u>h quest</u> <b>Cor</b> tibility, superco eld coo otibility, ic, ferro	s. ne from ion. Eac itents measur nductin oled me classif omagnet	each. Ev h part c ement g quar easurem ication ic, antif	of magne ntum intenents, fiel of mag	tion will have three the and half marks. etic susceptibility: erference device d scan, reduced netic behaviour: etic compounds.	e sub-parts and Contact Hrs. 7 8
i) Ques tudent Unit No. I	BASIC Origin Gouy magne diama MAGI Classic	two. Each part carris. 2 to 5 are to be s to answer any two <b>CONCEPTS OF MA</b> of magnetism, m method, inducti etometer, Evans m etization, hysteres ignetic, paramagne <b>NETIC INTERACTION</b> cal vs. quantum mo	ies three and hal set from all four <u>sub-parts of eac</u> GNETISATION nagnetic suscept on method, sero-fic sis, AC suscep tic, ferromagnetic Nodel, Curie Law, 1000	If marks units or <u>h quest</u> <b>Cor</b> tibility, superco eld coo otibility, ic, ferro Curie-V	s. ne from ion. Eac itents measur nductin oled me classif omagnet	each. Ev h part c ement g quar easurem ication ic, antif	of magne ntum intents, fiel of magne ntum intents, fiel of mag erromagne	tion will have three e and half marks. etic susceptibility: erference device d scan, reduced netic behaviour: etic compounds.	e sub-parts and Contact Hrs. 7 8
i) Ques tudent Unit No. I	BASIC Origin Gouy magne diama MAGI Classie non-e	two. Each part carris. 2 to 5 are to be s to answer any two <b>CONCEPTS OF MA</b> of magnetism, m method, inducti etometer, Evans m etization, hysteres gnetic, paramagne <b>NETIC INTERACTION</b> cal <i>vs</i> . quantum mo quivalent sites in t	ies three and hal set from all four sub-parts of eac GNETISATION nagnetic suscept on method, sero-fit sis, AC suscep tic, ferromagnet N odel, Curie Law, the unit cell, so	If marks units or <u>h quest</u> <b>Cor</b> tibility, superco eld coo otibility, ic, ferro Curie-V	s. ne from ion. Eac itents measur nductin oled me classif omagnet	each. Ev h part c ement g quar easurem ication ic, antif	of magne ntum intents, fiel of magne ntum intents, fiel of mag erromagne	tion will have three e and half marks. etic susceptibility: erference device d scan, reduced netic behaviour: etic compounds.	e sub-parts and Contact Hrs. 7 8
i) Ques student Unit No. I	BASIC Origin Gouy magne diama MAGI Classie non-e config	two. Each part carris. 2 to 5 are to be s to answer any two <b>CONCEPTS OF MA</b> of magnetism, m method, inducti etometer, Evans m etization, hysteres ignetic, paramagne <b>NETIC INTERACTION</b> cal <i>vs</i> . quantum mo quivalent sites in t gurational equilibriu	ies three and hal set from all four sub-parts of eac GNETISATION nagnetic suscept on method, sero-fit sis, AC suscep tic, ferromagnet N odel, Curie Law, the unit cell, so	If marks units or <u>h quest</u> <b>Cor</b> tibility, superco eld coo otibility, ic, ferro Curie-V	s. ne from ion. Eac itents measur nductin oled me classif omagnet	each. Ev h part c ement g quar easurem ication ic, antif	of magne ntum intents, fiel of magne ntum intents, fiel of mag erromagne	tion will have three e and half marks. etic susceptibility: erference device d scan, reduced netic behaviour: etic compounds.	e sub-parts and Contact Hrs. 7 8
i) Ques student Unit No. I	BASIC Origin Gouy magne diama MAGI Classie non-e config	two. Each part carris. 2 to 5 are to be s to answer any two <b>CONCEPTS OF MA</b> of magnetism, m method, inducti etometer, Evans m etization, hysteres gnetic, paramagner <b>NETIC INTERACTION</b> cal <i>vs</i> . quantum mo quivalent sites in t gurational equilibriu <b>TRANSITION</b>	ies three and hal set from all four <u>sub-parts of eac</u> GNETISATION nagnetic suscept on method, zero-fit sis, AC suscep tic, ferromagneti N odel, Curie Law, the unit cell, so m.	If marks units or <u>h quest</u> <b>Cor</b> tibility, superco eld coo otibility, ic, ferro Curie-V lute-so	s. ne from ion. Eac itents measur nductin oled me classif omagnet veiss Lav	each. Ev h part c ement g quar easurem ication ic, antif	of magne ntum intenents, fiel orbit coup n, solute-s	tion will have three the and half marks. The susceptibility: erference device d scan, reduced netic behaviour: etic compounds. ling, magnetically solute interaction	e sub-parts and Contact Hrs. 7 8 8
i) Ques	BASIC Origin Gouy magne diama MAGI Classic non-e config SPIN T Van V	two. Each part carris. 2 to 5 are to be sto answer any two CONCEPTS OF MAG of magnetism, m method, inducti etometer, Evans m etization, hysteres ignetic, paramagner NETIC INTERACTION cal vs. quantum mo quivalent sites in t gurational equilibriu IRANSITION leck equation, mag	ies three and hal set from all four <u>sub-parts of eac</u> GNETISATION nagnetic suscept on method, se method, zero-fic sis, AC suscep tic, ferromagneti Nodel, Curie Law, the unit cell, so im.	If marks units or h quest Cor tibility, superco eld coo otibility, ic, ferro Curie-V lute-so	s. ne from ion. Eac itents measur nductin classif omagnet Veiss Lav Ivent in pin high	each. Ev h part c ement g quar easurem ication ic, antifi w, spin-v teractio	of magne of magne ntum inte nents, fiel of mag erromagne orbit coup n, solute-s	tion will have three e and half marks. etic susceptibility: erference device d scan, reduced netic behaviour: etic compounds. ling, magnetically solute interaction	e sub-parts and Contact Hrs. 7 8 8
i) Ques student Unit No. I	BASIC Origin Gouy magne diama MAGI Classic non-e config SPIN T Van V	two. Each part carris. 2 to 5 are to be sto answer any two CONCEPTS OF MAR of magnetism, m method, inducti etometer, Evans m etization, hysteres gnetic, paramagner NETIC INTERACTION cal vs. quantum mo quivalent sites in t gurational equilibriu FRANSITION leck equation, mag tion, spin cooperat	ies three and hal set from all four <u>sub-parts of eac</u> GNETISATION nagnetic suscept on method, se method, zero-fic sis, AC suscep tic, ferromagneti Nodel, Curie Law, the unit cell, so im.	If marks units or h quest Cor tibility, superco eld coo otibility, ic, ferro Curie-V lute-so	s. ne from ion. Eac itents measur nductin classif omagnet Veiss Lav Ivent in pin high	each. Ev h part c ement g quar easurem ication ic, antifi w, spin-v teractio	of magne of magne ntum inte nents, fiel of mag erromagne orbit coup n, solute-s	tion will have three e and half marks. etic susceptibility: erference device d scan, reduced netic behaviour: etic compounds. ling, magnetically solute interaction	e sub-parts and Contact Hrs. 7 8 8 7

IV	<b>MAGNETIC EXCHANGE</b> Magnetic exchange, Bleany-Bowers equation, mechanism of exchange coupling, spin hamiltonian, magnetic interaction in oligonuclear complexes, magneto-structural correlations, quantum tunneling of magnetization, single molecule magnets.	8
Sugges	sted Readings:	
1.	J. M. D. Corey, Magnetism and Magnetic Materials. Cambridge University Press, UK, 2010.	
2.	J. E. Huheey, E. A. Keiter, R. L. Keiter, O. K. Medhi, Inorganic Chemistry: Principles of Reactivity, 4 <sup>th</sup> Edition. <i>Pearson Education</i> , 2006.	Structure and
3.	D. Gatteschi, R. Sessoli and J. Villain, Molecular Nanomagnets. Oxford University Press, Oxford	d, 2006.
4.	O. Kahn, Molecular Magnetism, VCH Publishers, Inc., Orsay, France, 1993.	



Course	Course Name:				Course	e Code:			
No:	Computational Che	emistry			SBS CH	I 010201 I	DCS 2002		
CH-51									
Batch: 2021	Programme:	Semester:	L	Т	Р	Credit	Contact Hrs. per Week:	02	
Onwards	M.Sc. Chemistry	1	2	0	0	2	Total Hrs.:	30	
Total Evalua	ation Marks: 50	Examination Dura	tion:	2	Hrs.		1		
	Лarks	Pre-requisite of co understanding of		•		-	•		•
	1arks						•	•.	•
Course Objectives		c knowledge of various understanding the stabil	•		-		•		nistry and its
Course		s course, student is expe			following	:			
Outcomes:		nding of computational o	hemistry						
	CO2: Scope of compu								
	<b>CO3</b> : Computational								
	-	ational software and of p	-			ition states	_		
	COS: Skills for analyz	ing stability of molecule	s and visu	alization	i or trans	ition states	5		
			URSE SY	LLABUS	;				
NOTE:			URSE SY	'LLABUS	;				
						ur sub-part	ts and students	need to	o answer any
i)Question no two. Each par	<ul> <li>D. 1 is compulsory and</li> <li>rt carries three and hall</li> </ul>	CO I to be set from the enti If marks.	re syllabu	us. It wil	have for				·
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i)Question no two. Each pa ii) Question r to answer an <b>Unit No.</b>	<ul> <li>D. 1 is compulsory and rt carries three and hal nos. 2 to 5 are to be set y two sub-parts of eac</li> <li>INTRODUCTION TO COMPUTATIONAL che approximation, idea</li> </ul>	CO I to be set from the enti If marks. et from all four units one h question. Each part ca COMPUTATIONAL CHEM emistry map, scope of self-consistency, Har	re syllabu e from ea <u>rries thre</u> <b>Cont</b> <b>IISTRY</b> of con tree-Fock	us. It will ch. Ever <u>e and ha</u> <b>tents</b> mputations c theory	have for y questio If marks.	n will have emistry, ed HF calco	e three sub-part Born-Oppenhei ulations; open s	s and st	tudents need Contact Hrs.
i)Question no two. Each par ii) Question r to answer an Unit No.	<ul> <li>D. 1 is compulsory and rt carries three and hal nos. 2 to 5 are to be served by two sub-parts of eac</li> <li>INTRODUCTION TO COMPUTATION TO COMPUTATIONAL Che approximation, idea systems, ROHF and L</li> </ul>	CO I to be set from the enti If marks. et from all four units one h question. Each part ca COMPUTATIONAL CHEN emistry map, scope of self-consistency, Har JHF calculations, HF limit	re syllabu e from ea <u>rries thre</u> <b>Cont</b> <b>IISTRY</b> of con tree-Fock	us. It will ch. Ever <u>e and ha</u> <b>tents</b> mputations c theory	have for y questio If marks.	n will have emistry, ed HF calco	e three sub-part Born-Oppenhei ulations; open s	s and st	tudents need Contact Hrs. 7
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i)Question no two. Each par ii) Question r to answer an Unit No.	<ul> <li>D. 1 is compulsory and rt carries three and hal nos. 2 to 5 are to be set y two sub-parts of eac</li> <li>INTRODUCTION TO COMPUTATIONAL Che approximation, idea systems, ROHF and LORSITY FUNCTIONAL Electron density, exception</li> </ul>	CO I to be set from the enti- If marks. et from all four units one h question. Each part ca COMPUTATIONAL CHEN emistry map, scope of self-consistency, Har JHF calculations, HF limit AL THEORY change-correlation funct	re syllabu e from ea <u>rries thre</u> <b>Cont</b> <b>IISTRY</b> of con tree-Fock t and elect ional, loc	us. It will ch. Ever <u>e and ha</u> <b>tents</b> mputation c theory ctron cor	have for y questio If marks. onal ch , restricte relation, ty approv	n will have emistry, ed HF calcu semi empi	e three sub-part Born-Oppenhei ulations; open s rical methods.	s and st mer shell	tudents need Contact Hrs. 7
i)Question no two. Each par ii) Question r to answer an Unit No. I	<ul> <li>D. 1 is compulsory and rt carries three and hal nos. 2 to 5 are to be served by two sub-parts of eac</li> <li>INTRODUCTION TO COMPUTATIONAL COMPUTATIONAL CHE approximation, idea systems, ROHF and LENSITY FUNCTIONAL Electron density, exclapproximation, hybritical computation, h</li></ul>	CO I to be set from the enti If marks. et from all four units one h question. Each part ca COMPUTATIONAL CHEN emistry map, scope of self-consistency, Har JHF calculations, HF limit AL THEORY	re syllabu e from ea <u>rries thre</u> <b>Cont</b> <b>IISTRY</b> of con tree-Fock t and elect ional, loc	us. It will ch. Ever <u>e and ha</u> <b>tents</b> mputation c theory ctron cor	have for y questio If marks. onal ch , restricte relation, ty approv	n will have emistry, ed HF calcu semi empi	e three sub-part Born-Oppenhei ulations; open s rical methods.	s and st mer shell	tudents need Contact Hrs. 7 8
i)Question no two. Each par ii) Question r to answer an Unit No.	<ul> <li>D. 1 is compulsory and rt carries three and hal nos. 2 to 5 are to be set y two sub-parts of eac</li> <li>INTRODUCTION TO C Computational che approximation, idea systems, ROHF and L DENSITY FUNCTION/ Electron density, exc approximation, hybri BASIS SETS</li> </ul>	CO I to be set from the enti- If marks. et from all four units one h question. Each part ca COMPUTATIONAL CHEN emistry map, scope of self-consistency, Har JHF calculations, HF limit AL THEORY change-correlation funct id density functional me	re syllabu e from ea rries thre <b>Cont</b> <b>IISTRY</b> of con tree-Fock t and elect ional, loc thods, sel	us. It will ch. Ever <u>e and ha</u> <b>tents</b> mputatio c theory ctron cor al Densi lf-Interac	have for y questio If marks. onal ch , restricte relation, ty approvision corr	n will have emistry, ed HF calcu semi empi kimation, g rections.	e three sub-part Born-Oppenhei ulations; open s rical methods.	s and st mer shell ient	tudents need Contact Hrs. 7
i)Question no two. Each par ii) Question r to answer an Unit No. I	<ul> <li>D. 1 is compulsory and rt carries three and hal nos. 2 to 5 are to be see y two sub-parts of eac</li> <li>INTRODUCTION TO COMPUTATIONAL COMPUTATIONAL COMPUTATIONAL CHE approximation, idea systems, ROHF and LORSITY FUNCTIONAL Electron density, exc approximation, hybrite BASIS SETS</li> <li>Definition of basis see the second second</li></ul>	CO I to be set from the enti- If marks. et from all four units one h question. Each part ca COMPUTATIONAL CHEN emistry map, scope of self-consistency, Har JHF calculations, HF limit AL THEORY change-correlation funct id density functional me ets, Slater and Gaussian	re syllabu e from ea <u>rries thre</u> <b>Cont</b> <b>IISTRY</b> of con tree-Fock t and elec ional, loc thods, sel	us. It will ch. Ever <u>e and ha</u> <b>tents</b> mputatio < theory ctron cor al Densi if-Interac	have for y questio lf marks. onal ch , restricte relation, ty appro- ction corr nimal, do	n will have emistry, ed HF calcu semi empi kimation, g rections.	e three sub-part Born-Oppenhei ulations; open s rical methods. eneralized grad	s and st mer shell ient	tudents need Contact Hrs. 7 8
i)Question no two. Each par ii) Question r to answer an Unit No. I	<ul> <li>D. 1 is compulsory and rt carries three and hal nos. 2 to 5 are to be see y two sub-parts of eac</li> <li>INTRODUCTION TO COMPUTATION TO COMPUTATIONAL CHE approximation, idea systems, ROHF and LE DENSITY FUNCTIONAL Electron density, exc approximation, hybrite BASIS SETS Definition of basis see valence, Pople style</li> </ul>	CO I to be set from the enti- If marks. et from all four units one h question. Each part ca COMPUTATIONAL CHEN emistry map, scope of self-consistency, Har JHF calculations, HF limit AL THEORY change-correlation funct id density functional me ets, Slater and Gaussian basis Sets, polarization	re syllabu e from ea rries thre <b>Cont</b> <b>IISTRY</b> of con tree-Fock t and elect ional, loc thods, sel type orb n and dif	us. It will ch. Ever <u>e and ha</u> tents mputatio c theory ctron cor al Densi if-Interac itals, min fuse fur	have for y questio <u>If marks.</u> onal ch , restricter relation, ty approvision corr nimal, do actions, control	n will have emistry, ed HF calcu semi empi kimation, g rections.	e three sub-part Born-Oppenhei ulations; open s rical methods. eneralized grad	s and st mer shell ient	tudents need Contact Hrs. 7 8
i)Question no two. Each par ii) Question r to answer an Unit No. I	<ul> <li>D. 1 is compulsory and rt carries three and hal nos. 2 to 5 are to be see y two sub-parts of eac</li> <li>INTRODUCTION TO COMPUTATIONAL COMPUTATIONAL COMPUTATIONAL COMPUTATIONAL COMPUTATIONAL Electron density, exclapproximation, hybrice BASIS SETS</li> <li>Definition of basis see valence, Pople style pseudopotentials or</li> </ul>	CO I to be set from the enti- If marks. et from all four units one h question. Each part ca COMPUTATIONAL CHEM emistry map, scope of self-consistency, Har JHF calculations, HF limit AL THEORY change-correlation funct id density functional me ets, Slater and Gaussian basis Sets, polarization effective core potentials	re syllabu e from ea rries thre <b>Cont</b> <b>IISTRY</b> of con tree-Fock t and elec thods, sel type orb n and dif	us. It will ch. Ever <u>e and ha</u> tents mputatio c theory ctron cor al Densi if-Interac itals, min fuse fur	have for y questio <u>If marks.</u> onal ch , restricter relation, ty approvision corr nimal, do actions, control	n will have emistry, ed HF calcu semi empi kimation, g rections.	e three sub-part Born-Oppenhei ulations; open s rical methods. eneralized grad	s and st mer shell ient	tudents need Contact Hrs. 7 8 7
i)Question no two. Each par ii) Question r to answer an Unit No. I	<ul> <li>D. 1 is compulsory and rt carries three and hal nos. 2 to 5 are to be see y two sub-parts of eac</li> <li>INTRODUCTION TO COMPUTATIONAL COMPUTATIONAL COMPUTATIONAL COMPUTATIONAL Electron density, excluding approximation, hybric BASIS SETS</li> <li>Definition of basis see valence, Pople style pseudopotentials or</li> <li>BASIC CONCEPTS OF</li> </ul>	CO I to be set from the enti- If marks. et from all four units one h question. Each part ca COMPUTATIONAL CHEN emistry map, scope of self-consistency, Har JHF calculations, HF limit AL THEORY change-correlation funct id density functional me ets, Slater and Gaussian basis Sets, polarization effective core potentials POTENTIAL ENERGY SU	re syllabu e from ea rries thre <b>Cont</b> <b>IISTRY</b> of con tree-Fock t and elect ional, loc thods, sel type orb n and dif s, choice c <b>RFACES</b>	us. It will ch. Ever <u>e and ha</u> <b>tents</b> mputation k theory ctron cor cal Densi itals, min fuse fur of basis k	have for y questio If marks. onal ch , restricter relation, ty appro- ction corr nimal, do nctions, co pets.	n will have emistry, ed HF calcu semi empi kimation, g ections. uble-zeta, alculation	e three sub-part Born-Oppenhei ulations; open s rical methods. eneralized grad split-valence, c of basis functi	s and st mer shell ient ore- ons,	tudents need Contact Hrs. 7 8
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i)Question no two. Each par ii) Question r to answer an Unit No. I	<ul> <li>D. 1 is compulsory and rt carries three and hallos. 2 to 5 are to be served by two sub-parts of eact interpretational cheat approximation, ideat systems, ROHF and LENSITY FUNCTION/ Electron density, exclapproximation, hybrite BASIS SETS Definition of basis served by the seudopotentials or BASIC CONCEPTS OF Z-matrix construction transition state theorematical states and the served by the seudopotential states the served by the s</li></ul>	CO I to be set from the enti- If marks. et from all four units one h question. Each part ca COMPUTATIONAL CHEN emistry map, scope of self-consistency, Har JHF calculations, HF limit AL THEORY change-correlation funct id density functional me ets, Slater and Gaussian basis Sets, polarization effective core potentials POTENTIAL ENERGY SU on, Stationary Points, g	re syllabu e from ea rries three <b>Cont</b> <b>IISTRY</b> of cont tree-Fock t and elect ional, loc thods, sel type orb n and dif s, choice c <b>RFACES</b> geometry	us. It will ch. Ever <u>e and ha</u> <b>tents</b> mputatio ( theory ctron cor al Densi lf-Interac itals, min fuse fur of basis k	have for y questio off marks. onal ch , restricter relation, ty approvision corr nimal, do octions, co pets.	n will have emistry, ed HF calcu semi empi kimation, g rections. uble-zeta, alculation	e three sub-part Born-Oppenhei ulations; open s rical methods. generalized grad split-valence, c of basis functi	s and st mer shell ient ore- ons, and	tudents need Contact Hrs. 7 8 7

- 1. J. B. Foresman and A. Frisch, Exploring Chemistry with Electronic Structure Methods, 2<sup>nd</sup>Edition. *Gaussian Inc.*, 2015.
- 2. F. Jensen, Introduction to Computational Chemistry, John Wiley & Sons, 2007
- 3. C. J. Cramer, Essentials of Computational Chemistry: Theories and Models, 2<sup>nd</sup>Edition. *John Wiley & Sons Ltd*, 2004.
- 4. C. J. Cramer, Essentials of Computational Chemistry: Theories and Models, 2<sup>nd</sup>Edition. *John Wiley & Sons Ltd*, 2002.
- 5. D. A. McQuarrie, Physical Chemistry: A molecular Approach, 1<sup>st</sup>Edition. *University Science Books*, 1997.

Course	Course Name:				Course	Code:			
No:	Analytical Techniques in Chen	mistry			SBS CH (	010202 DC	S 2002		
CH-52									
Batch:	Programme: S	Semester:	L	Т	Р	Credit	Contact Hrs.		
2021							per Week:		12
Onwards	M.Sc. Chemistry	II	2	0	0	2	Total Hrs.:	3	0
Total Evalua	ation Marks: 50	Examination	Duration	:	2 Hrs.				
CIE: 15 N		-			-		• •		ty measure i
TEE: 35 N				-			iowledge up to		
Course	To provide students with a basi			•					•
Objectives	This course will strengthen the	-	tals of an	alytical d	chemistry,	especially	thermogravi	metri	c, imaging and
	impedance spectroscopy techniq								
Course	After completing this course, stu	•		earn the f	ollowing:				
Outcomes:	<b>CO1</b> : Basic understanding of ana	•	•	ion to the		haily lif-			
	<b>CO2</b> : Use of thermogravimetric, <b>CO3</b> : Skills for analyzing and dev					ially life.			
	<b>CO4</b> : Skills for developing indust								
	<b>CO5</b> : Development of alternate				1003.				
	-	•							
	LUB: Use of advanced and recen	ht technique	s in analvi	tical chen	nistrv.				
	<b>CO6</b> : Use of advanced and recer	•			nistry.				
		CC	DURSE SY	'LLABUS		r sub-parts	and students	need	l to answer an
Question no wo. Each pa i) Question no o answer an	c. 1 is compulsory and to be set f rt carries three and half marks. nos. 2 to 5 are to be set from all for y two sub-parts of each question.	CC from the ent our units on	DURSE SY	<b>'LLABUS</b> us. It will uch. Every re and hal	have four	-			l students need
Question no wo. Each pa i) Question no o answer an	<ul> <li>b. 1 is compulsory and to be set f</li> <li>rt carries three and half marks.</li> <li>nos. 2 to 5 are to be set from all fe</li> </ul>	CC from the ent our units on	DURSE SY	<b>'LLABUS</b> us. It will uch. Every	have four	-			
Question newo. Each pa i) Question n o answer an <b>Unit No.</b>	<ul> <li>b. 1 is compulsory and to be set f</li> <li>rt carries three and half marks.</li> <li>nos. 2 to 5 are to be set from all for</li> <li>y two sub-parts of each question.</li> <li>THERMOGRAVIMETRIC ANALYS</li> </ul>	CC rom the ent our units on Each part ca	DURSE SY tire syllable the from ea arries thre Con A/DSC)	<b>'LLABUS</b> us. It will uch. Every te and hal <b>tents</b>	have four question f marks.	will have	three sub-part	ts and	l students need
Question newo. Each pa i) Question n o answer an <b>Unit No.</b>	<ul> <li>b. 1 is compulsory and to be set f</li> <li>rt carries three and half marks.</li> <li>nos. 2 to 5 are to be set from all for y two sub-parts of each question.</li> </ul>	CC rom the ent our units on Each part ca	DURSE SY tire syllable the from ea arries thre Con A/DSC)	<b>'LLABUS</b> us. It will uch. Every te and hal <b>tents</b>	have four question f marks.	will have	three sub-part	ts and	Students need
Question newo. Each pa i) Question i o answer an <b>Unit No.</b>	<ul> <li>b. 1 is compulsory and to be set f</li> <li>rt carries three and half marks.</li> <li>nos. 2 to 5 are to be set from all for</li> <li>y two sub-parts of each question.</li> </ul> THERMOGRAVIMETRIC ANALYS	CC from the ent our units on Each part ca SIS (TGA/DT, TGA, DTA	DURSE SY tire syllabute from ea arries thre Con A/DSC) , and DS	<b>'LLABUS</b> us. It will uch. Every <u>e and hal</u> tents SC. Effec	have four question f marks.	at on Ma	three sub-part	ts and	Students need
Question newo. Each pa i) Question n o answer an Unit No.	<ul> <li>b. 1 is compulsory and to be set f rt carries three and half marks.</li> <li>hos. 2 to 5 are to be set from all for y two sub-parts of each question.</li> <li>THERMOGRAVIMETRIC ANALYS Principle, instrumentation of</li> </ul>	CC rom the ent our units on Each part ca SIS (TGA/DT TGA, DTA 5, Analysis of	DURSE SY tire syllable from ea arries thre Con A/DSC) , and DS T.G. curv	<b>'LLABUS</b> us. It will tch. Every e and hal tents SC. Effect re to show	have four question f marks.	a will have at on Ma decomposi	three sub-part aterials, Cher tion reactions	ts and	Students need
wo. Each pa i) Question i	<ul> <li>b. 1 is compulsory and to be set f rt carries three and half marks.</li> <li>hos. 2 to 5 are to be set from all for y two sub-parts of each question.</li> <li>THERMOGRAVIMETRIC ANALYS Principle, instrumentation of decomposition and T. G. Curves</li> </ul>	CC rom the ent our units on Each part ca SIS (TGA/DT TGA, DTA 5, Analysis of	DURSE SY tire syllable from ea arries thre Con A/DSC) , and DS T.G. curv	<b>'LLABUS</b> us. It will tch. Every e and hal tents SC. Effect re to show	have four question f marks.	a will have at on Ma decomposi	three sub-part aterials, Cher tion reactions	ts and	Contact Hrs
)Question no wo. Each pa i) Question n o answer an Unit No. I	<ul> <li>b. 1 is compulsory and to be set f rt carries three and half marks.</li> <li>hos. 2 to 5 are to be set from all for y two sub-parts of each question.</li> <li>THERMOGRAVIMETRIC ANALYS Principle, instrumentation of decomposition and T. G. Curves product and qualities of compound</li> </ul>	CC From the ent our units on Each part ca SIS (TGA/DTA TGA, DTA TGA, DTA 5, Analysis of unds expelle	DURSE SY arrie syllabute from eat arries thre Con A/DSC) , and DS T.G. curv d, T.G. in o	<b>'LLABUS</b> us. It will tch. Every e and hal tents SC. Effect re to show controlled	have four question f marks. t of hea v nature of d atmosph	at on Ma decomposi nere, applic	three sub-part aterials, Cher tion reactions, cations.	nical , the	Students nee Contact Hrs 8
Question no wo. Each pa ) Question n o answer an <b>Unit No.</b> I	<ul> <li>b. 1 is compulsory and to be set f rt carries three and half marks.</li> <li>hos. 2 to 5 are to be set from all for y two sub-parts of each question.</li> <li>THERMOGRAVIMETRIC ANALYS Principle, instrumentation of decomposition and T. G. Curves product and qualities of compou ELECTROCHEMICAL ANALYSIS</li> </ul>	Co from the ent our units on Each part ca SIS (TGA/DTA TGA, DTA TGA, DTA s, Analysis of unds expelle	DURSE SY ire syllabute from ea arries thre Con A/DSC) , and DS T.G. curv d, T.G. in lizers by	<b>'LLABUS</b> us. It will the Every e and hal tents SC. Effect re to show controlled using el	have four question f marks. t of hea v nature of d atmosph ectrocher	at on Ma decomposi nere, applic mical tech	three sub-part aterials, Cher tion reactions cations. niques like c	nical , the	Students nee Contact Hrs 8
Question no wo. Each pa i) Question n o answer an <b>Unit No.</b> I	<ul> <li>b. 1 is compulsory and to be set f rt carries three and half marks.</li> <li>hos. 2 to 5 are to be set from all for y two sub-parts of each question.</li> <li>THERMOGRAVIMETRIC ANALYS Principle, instrumentation of decomposition and T. G. Curves product and qualities of compounce ELECTROCHEMICAL ANALYSIS Analysis of Metal, Alloys, Soi</li> </ul>	CC From the ent our units on Each part ca SIS (TGA/DTA TGA, DTA TGA, DTA 5, Analysis of unds expelle il and Ferti etry, Pulse vo	DURSE SY ire syllable a from ea arries thre Con A/DSC) , and DS T.G. curv d, T.G. in o lizers by pltammetr	<b>'LLABUS</b> us. It will tch. Every e and hal tents SC. Effect re to show controlled using el	have four question f marks. t of hea v nature of d atmosph ectrocher v, principle	at on Ma decomposi nere, applic mical tech e, working	three sub-part aterials, Cher tion reactions cations. niques like c and applicatio	nical , the	Students nee Contact Hrs 8
Question no wo. Each pa ) Question n o answer an <b>Unit No.</b>	<ul> <li>b. 1 is compulsory and to be set f rt carries three and half marks.</li> <li>carries three and half marks.</li> <li>carries three to be set from all for y two sub-parts of each question.</li> <li>THERMOGRAVIMETRIC ANALYS Principle, instrumentation of decomposition and T. G. Curves product and qualities of compou ELECTROCHEMICAL ANALYSIS Analysis of Metal, Alloys, Soi voltammetry, chronoamperome</li> </ul>	Co from the ent our units on Each part ca SIS (TGA/DT, TGA, DTA 5, Analysis of unds expelle and Ferti etry, Pulse vo perometry,	DURSE SY ire syllable a from ea arries thre Con A/DSC) , and DS T.G. curv d, T.G. in o lizers by pltammetr	<b>'LLABUS</b> us. It will tch. Every e and hal tents SC. Effect re to show controlled using el	have four question f marks. t of hea v nature of d atmosph ectrocher v, principle	at on Ma decomposi nere, applic mical tech e, working	three sub-part aterials, Cher tion reactions cations. niques like c and applicatio	nical , the	Students nee Contact Hrs 8
Question no wo. Each pa i) Question no o answer an <b>Unit No.</b> I	<ul> <li>b. 1 is compulsory and to be set f rt carries three and half marks.</li> <li>hos. 2 to 5 are to be set from all for y two sub-parts of each question.</li> <li>THERMOGRAVIMETRIC ANALYS Principle, instrumentation of decomposition and T. G. Curves product and qualities of compound ELECTROCHEMICAL ANALYSIS Analysis of Metal, Alloys, Soi voltammetry, chronoamperome cyclic voltammetry, chronoamperome</li> </ul>	Co from the ent our units on Each part ca SIS (TGA/DT, TGA, DTA 5, Analysis of unds expelle and Ferti etry, Pulse vo perometry,	DURSE SY ire syllable a from ea arries thre Con A/DSC) , and DS T.G. curv d, T.G. in o lizers by pltammetr	<b>'LLABUS</b> us. It will tch. Every e and hal tents SC. Effect re to show controlled using el	have four question f marks. t of hea v nature of d atmosph ectrocher v, principle	at on Ma decomposi nere, applic mical tech e, working	three sub-part aterials, Cher tion reactions cations. niques like c and applicatio	nical , the	Contact Hrs.
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)Question no wo. Each pa i) Question no o answer an <b>Unit No.</b> I	<ul> <li>b. 1 is compulsory and to be set f rt carries three and half marks.</li> <li>nos. 2 to 5 are to be set from all for y two sub-parts of each question.</li> <li>THERMOGRAVIMETRIC ANALYS Principle, instrumentation of decomposition and T. G. Curves product and qualities of compou ELECTROCHEMICAL ANALYSIS Analysis of Metal, Alloys, Soi voltammetry, chronoamperome cyclic voltammetry, chronoamp environmental pollutant detecti IMAGING TECHNIQUES</li> </ul>	CC from the ent our units on Each part ca SIS (TGA/DTA TGA, DTA TGA, DTA S, Analysis of unds expelle il and Ferti etry, Pulse vo perometry, ion.	DURSE SY cire syllabo arries thre Con A/DSC) , and DS T.G. curv d, T.G. in o lizers by oltammetr Pulse volt	<b>'LLABUS</b> us. It will uch. Every e and hal <b>tents</b> SC. Effect using el ry. Theory cammetry scanning	have four question f marks. t of hea v nature of d atmosph ectrocher v, principle v. Use of electron	at on Ma decomposi nere, applic mical tech e, working chemical microscop	three sub-part aterials, Cher tion reactions cations. niques like c and applicatic and biosenso	nical , the yclic on of rs in otics,	Contact Hrs. 8 7
)Question no wo. Each pa i) Question no o answer an <b>Unit No.</b> I	<ul> <li>b. 1 is compulsory and to be set f rt carries three and half marks.</li> <li>nos. 2 to 5 are to be set from all for y two sub-parts of each question.</li> <li>THERMOGRAVIMETRIC ANALYS Principle, instrumentation of decomposition and T. G. Curves product and qualities of compound ELECTROCHEMICAL ANALYSIS Analysis of Metal, Alloys, Soi voltammetry, chronoamperome cyclic voltammetry, chronoamperome</li> </ul>	CC From the ent our units on Each part ca SIS (TGA/DTA TGA, DTA TGA, DTA 5, Analysis of unds expelle il and Ferti etry, Pulse vo perometry, ion. the transmi imaging sys	DURSE SY The syllabu- te from ea arries three Con A/DSC) , and DS T.G. curv d, T.G. in o lizers by pltammetr Pulse volt ssion and tem, dyna	<b>'LLABUS</b> us. It will tch. Every e and hal tents SC. Effect to show controlled using el ry. Theory cammetry scanning amics of s	have four question f marks. t of hea v nature of d atmosph ectrocher v, principle t. Use of electron scattering	at on Ma decomposi nere, applic mical tech e, working chemical microscop , operating	three sub-part aterials, Cher tion reactions, cations. niques like c and applicatic and biosenso e, electron op g principle of S	nical nical , the cyclic on of rs in otics, SEM,	Contact Hrs.
)Question no wo. Each pa i) Question no o answer an <b>Unit No.</b> I	<ul> <li>b. 1 is compulsory and to be set f rt carries three and half marks.</li> <li>nos. 2 to 5 are to be set from all for y two sub-parts of each question.</li> <li>THERMOGRAVIMETRIC ANALYS</li> <li>Principle, instrumentation of decomposition and T. G. Curves product and qualities of compou</li> <li>ELECTROCHEMICAL ANALYSIS</li> <li>Analysis of Metal, Alloys, Soi voltammetry, chronoamperome cyclic voltammetry, chronoamperome</li> </ul>	CC from the ent our units on Each part ca SIS (TGA/DTA TGA, DTA TGA, DTA S, Analysis of unds expelle il and Ferti etry, Pulse vo perometry, ion. the transmi imaging sys ds, SEM op	DURSE SY cire syllabu- te from ea arries thre Con A/DSC) , and DS T.G. curv d, T.G. in o lizers by oltammetr Pulse volt ssion and tem, dyna erating co	<b>'LLABUS</b> us. It will uch. Every e and hal <b>tents</b> SC. Effector using el cy. Theory cammetry scanning amics of so onditions	have four question f marks. t of heaving atmosph ectrocher y, principle t. Use of electron scattering and spec	at on Ma decomposi nere, applic mical tech e, working chemical microscop , operating	three sub-part aterials, Cher tion reactions, cations. niques like c and applicatic and biosenso e, electron op g principle of S	nical nical , the cyclic on of rs in otics, SEM,	Contact Hrs. 8 7 8 8
)Question no wo. Each pa i) Question no o answer an <b>Unit No.</b> I	<ul> <li>b. 1 is compulsory and to be set f rt carries three and half marks.</li> <li>nos. 2 to 5 are to be set from all for y two sub-parts of each question.</li> <li>THERMOGRAVIMETRIC ANALYS Principle, instrumentation of decomposition and T. G. Curves product and qualities of compou ELECTROCHEMICAL ANALYSIS Analysis of Metal, Alloys, Soi voltammetry, chronoamperome cyclic voltammetry, chronoamperome environmental pollutant detecti</li> <li>IMAGING TECHNIQUES An introduction to microscopy, TEM specimen preparation and penetration of electron in soli</li> </ul>	CC From the ent our units on Each part ca SIS (TGA/DTA TGA, DTA TGA, DTA 5, Analysis of unds expelle il and Ferti etry, Pulse vo perometry, ion. the transmi imaging sys ds, SEM op	DURSE SY The syllabu- the from each arries three Con A/DSC) , and DS T.G. curv d, T.G. in o lizers by pltammetr Pulse volt ssion and tem, dyna erating co IPEDANCE	<b>'LLABUS</b> us. It will tch. Every e and hal tents SC. Effect to show controlled using el ry. Theory cammetry scanning amics of s onditions	have four question f marks. t of heaving t of heaving d atmosph ectrocher , principle t Use of electron scattering and spec	at on Ma decomposi here, applic mical tech e, working chemical microscop , operating cimen pre	three sub-part aterials, Cher tion reactions cations. niques like c and applicatic and biosenso e, electron op g principle of S paration, elec	nical nical , the cyclic on of rs in otics, SEM, ctron	Contact Hrs.

corrosion current density, Open circuit potential, Impedance spectroscopy, Nyquesi plots, Bode
plots.

- 1. S. L. Chopra and J. S. Kanwar, Analytical Agriculture Chemistry, *Kalyani publishers*, 2008.
- 2. S. M. Khopkar, Concepts in Analytical Chemistry, 2<sup>nd</sup> Edition. New Age International Pub.2004.
- 3. H. H. Willard, L. L. Merritt, J. A. Dean and F. A. Settle, Instrumental methods of analysis, 7<sup>th</sup> Edition. *United States*, 1988.
- 4. D. A. Skoog and D. M. West, Principles of instrumental analysis, 2<sup>nd</sup> Edition. *Saunders College*, Philadelphia, 1980.
- 5. F. D. Snell and F. M. Biffen, Commercial Methods of Analysis, Tata McGraw Hill Book Company, New York, 1944.

	Course Name:				Cours	e Code:			
No:	Process Development of	Active Pharmaceut	ical Ingre	dients	SBS CH	H 010403 DCS	5 2002		
CH-53									
Batch: 2021	Programme:	Semester:	L	Т	Р	Credit	Contact H per Week	-	02
Onwards	M.Sc. Chemistry	IV	2	0	0	2	Total Hrs.	:	30
Total Evalua	ation Marks:50	Examination D	uration:		2 Hrs.		·		
	Aarks Aarks	Pre-requisite of spectroscopic			tanding	of general p	principles of	chen	nistry and
Course	To provide the knowledge of	of Process Developme	nt of Activ	o Dharn	acoutic	al Ingradiants	to the student	-	
<i>Objectives</i>	To provide the knowledge (	oj Process Developine	ant of Activ	e Phum	πιεαιτι	in myreulents t	to the students	>	
Course	After completing this cours	se, student is expecte	d to learn	the follo	wing:				
Outcomes:	<b>CO1</b> : Basic understanding of		-						
	CO2: Understand the proce	•	•	•		S			
	<b>CO3:</b> Important features as	•	•						
	<b>CO4</b> : Skills to develop tech				lab scale	e to commerci	al batch		
	<b>CO5</b> : understanding of GLP <b>CO6</b> : Ability to understand				airc				
	COU. Ability to understand		-	-	ali 5				
NOTE:	a 1 is compulsory and to be		SE SYLLA		ve four s	ub-parts and s	students need	to a	nswer anv
i)Question no two. Each par ii) Question r to answer an	<ul> <li>D. 1 is compulsory and to be</li> <li>rt carries three and half marl</li> <li>nos. 2 to 5 are to be set from</li> <li>y two sub-parts of each quest</li> </ul>	set from the entire ks. n all four units one fr stion. Each part carrie	syllabus. I om each. es three ar	t will hav Every qu	lestion w			stud	lents need
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i)Question no two. Each par ii) Question r to answer an <b>Unit No.</b> I	rt carries three and half mark nos. 2 to 5 are to be set from y two sub-parts of each ques PHARMACEUTICAL INDUS Pharmaceutical industries: ingredients, bulk drugs and Scale-up approach of AP percentage yield of the pro CHEMICAL TECHNOLOGY (	set from the entire ks. n all four units one fr stion. Each part carrie <b>C</b> <b>TRY AND ACTIVE PHA</b> Past and present; Ir d their intermediates, Is: process research oduct, in-process cont <b>DF SELECTED APIS</b> emphasis on variou	syllabus. It om each. es three ar ontents ARMACEU atroductio Import ar and dev crol techni s factors	t will hav Every qu id half m TICAL IN n and In id Expor velopme ques. for selee	GREDIEN Nportance t of APIs nt, optin	vill have three <b>NTS(APIS)</b> e of active ph mization, max routes: availa	sub-parts and armaceutical kimization of bility of raw	stud	lents need ntact Hrs. 8
i)Question no two. Each par ii) Question r to answer an Unit No.	rt carries three and half mark nos. 2 to 5 are to be set from y two sub-parts of each ques PHARMACEUTICAL INDUS Pharmaceutical industries: ingredients, bulk drugs and Scale-up approach of AP percentage yield of the pro CHEMICAL TECHNOLOGY ( Case studies with special materials and intermediate safety issues, productivity of	e set from the entire ks. n all four units one fr stion. Each part carrie <b>C</b> <b>TRY AND ACTIVE PHA</b> Past and present; Ir their intermediates, is: process research oduct, in-process cont <b>DF SELECTED APIS</b> emphasis on variou es, process control pa etc.	syllabus. I om each. es three ar ontents ARMACEU atroductio Import ar and dev crol techni s factors arameters	t will hav Every qu id half m TICAL IN n and In id Expor velopme ques. for selee	GREDIEN Nportance t of APIs nt, optin	vill have three <b>NTS(APIS)</b> e of active ph mization, max routes: availa	sub-parts and armaceutical kimization of bility of raw	stud	lents need ntact Hrs. 8 7
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i)Question no two. Each par ii) Question r to answer an <b>Unit No.</b> I	rt carries three and half mark nos. 2 to 5 are to be set from y two sub-parts of each ques PHARMACEUTICAL INDUS Pharmaceutical industries: ingredients, bulk drugs and Scale-up approach of AP percentage yield of the pro CHEMICAL TECHNOLOGY C Case studies with special materials and intermediate safety issues, productivity of PROCESS TECHNOLOGY an Overview of plant layout, p and costing, Overview of of	set from the entire ks. h all four units one fr stion. Each part carrie <b>C</b> <b>TRY AND ACTIVE PHA</b> Past and present; Ir their intermediates, Is: process research oduct, in-process cont <b>DF SELECTED APIS</b> emphasis on variou es, process control pa etc. <b>Id REGULATORY PRO</b> plant design, utilities	syllabus. It om each. es three ar ontents ARMACEU atroductio Import ar and dev crol techni s factors arameters FILE and proce	t will hav Every qu id half m TICAL IN n and In id Expor velopme ques. for selec , pollutio	GREDIEN nportanc t of APIs nt, optim ction of on contro sheets,	vill have three NTS(APIS) e of active ph mization, max routes: availa ol procedures, Raw material	sub-parts and armaceutical kimization of bility of raw polymorphs, consumption	stud	lents need ntact Hrs. 8 7

- 1. N. G. Anderson, Practical Process Research and Development, 2<sup>nd</sup> Edition. *Academic Press, Elsevier*, 2012.
- 2. P. J. Harrington, Pharmaceutical Process Chemistry for Synthesis: Rethinking the Routes to Scale-Up, *Wiley*, 2011.
- 3. D. Lednicer, Strategies for Organic Drug Synthesis and Design, 2<sup>nd</sup> Edition, *Wiley*, 2008.
- 4. D. J. Pisano, D. S. Mantus, FDA Regulatory Affairs: A Guide for Prescription Drugs, Medical Devices, and Biologics 2<sup>nd</sup> Edition. *CRC Press*, 2008
- 5. K. Gadamasetti, Process Chemistry in Pharmaceutical Industry, Volume-I & II, *Taylor and Francis*, 1999.

No: CH-54       Chemistry of Industrially Important Products       SBS CH 010404 DCS 2002         CH-54       Programme:       Semester:       L       T       P       Credit       Contact Hrs. per Week: 02         2021       M.Sc. Chemistry       IV       2       0       0       2       Total Hrs.: 30         Total Evaluation Marks: 50       Examination Duration:       2 Hrs.       2 Hrs.       2       Integration Processing Procesprena Processing Processing Processing Procespre		Course Name:				Course	Code:		
Batch: 2021         Programme: M.Sc. Chemistry         Semester: IV         I         T         P         Credit Credit Pre-Week: 30         Contact Hrs. per Week: 30           Total Evaluation Marks: 50         IV         2         0         0         2         Total Hrs.: 30           CIE: 35 Marks         15 Marks         Fre-requisite of course: bipectroscopic techniques in addition to synthetic aspects.         Pre-requisite of course: 0 appects         Understanding of general principles of chemistry spectroscopic techniques in addition to synthetic aspects.           Course Objectives         To provide the knowledge of Chemistry of industrially important Products to the students Objectives         Outcomes: CO1: Overview of industrially important products           CO2: Various process parameters associated with dyes, pigments, petrochemicals, blends, additives and polymer CO3: Important features associated with process development of industrially important compounds CO4: Skills to develop technology for of industrially important compounds CO4: Skills to develop technology for of industrially important compounds CO5: Understanding of agrochemicals and polymers used in textile industries CO6: Ability to understand various issues related to petrochemicals and dyes           NOTE: Question nos. 1 is compulsory and to be set from the entire syllabus. It will have four sub-parts and students need to answer wo. Each part carries three and half marks.         Contact H S           IN NO.         Contents         Contact H Contact H I         PERCOFEMICALS Course of different dyes and challenges associated with them. Chemistry and a	No:	Chemistry of Industria	lly Important Produc	ts		SBS CH	010404 DCS 200	2	
University       IV	CH-54								
Total Evaluation Marks: 50         Examination Duration:         2 Hrs.           CIE:         15 Marks         Pre-requisite of course: Understanding of general principles of chemistry spectroscopic techniques in addition to synthetic aspects.           Course         To provide the knowledge of Chemistry of Industrially Important Products to the students           Objectives         After completing this course, student is expected to learn the following:           COL: Overview of industrially important products         CO2: Various process parameters associated with dyes, pigments, petrochemicals, blends, additives and polymer           CO3: Important features associated with process development of industrially important compounds         CO3: Important features associated with process development of industrials           CO4: Skills to develop technology for of industrially important compounds         CO5: Understanding of agrochemicals and polymers used in textile industries           CO5: Understanding of agrochemicals and polymers used in textile industries         CO2: Various process parameters           NOTE:         Question no. 1 is compulsory and to be set from the entire syllabus. It will have four sub-parts and students need to answer works.           Question nos. 2 to 5 are to be set from all four units one from each. Every question will have three sub-parts of each question. Each part carries three and half marks.           Question nos didifferent dyes and challenges associated with them. Chemistry and applications of optical brightening agents and pigments.         7           III		Programme:	Semester:	L	Т	Р			02
Examination Duration:         2 Hrs.           CIE:         15 Marks         Pre-requisite of course: Understanding of general principles of chemistry spectroscopic techniques in addition to synthetic aspects.           Course         To provide the knowledge of Chemistry of Industrially Important Products to the students           Objectives         CO1: Overview of industrially important products           CO2: Various process parameters associated with dyes, pigments, petrochemicals, blends, additives and polymer CO3: Important features associated with process development of industrially important compounds           CO4: Skills to develop technology for of industrially important compounds         CO5: Understanding of agrochemicals and polymers used in textile industries           CO5: Understanding of agrochemicals and polymers used in textile industries         CO6: Ability to understand various issues related to petrochemicals and dyes           NOTE:         Question no. 1 is compulsory and to be set from the entire syllabus. It will have four sub-parts and students need to answer wo. Each part carries three and half marks.         Question nos. 2 to 5 are to be set from all four units one from each. Every question will have three sub-parts and students o answer any two sub-parts of each question. Each part carries three and half marks.         Applications of different dyes and challenges associated with them. Chemistry and applications of optical brightening agents and pigments.         8           Introduction and classification of dyes, color & constitution, different types of chromophores. Fluorescence and phosphorescence, dye intermediates, Developments of acid and basic dy	Onwards	M.Sc. Chemistry	IV	2	0	0	2	Total Hrs.:	30
Pre-requisite of course:         Understanding of general principles of chemistry spectroscopic techniques in addition to synthetic aspects.           Course         To provide the knowledge of Chemistry of Industrially Important Products to the students           Dijectrives         After completing this course, student is expected to learn the following:           Course         CO1: Overview of industrially important products           CO2: Various process parameters associated with dyes, pigments, petrochemicals, blends, additives and polymer           CO3: Important features associated with process development of industrially important compounds           CO4: Skills to develop technology for of industrially important compounds           CO5: Understanding of agrochemicals and polymers used in textile industries           CO6: Ability to understand various issues related to petrochemicals and dyes           VOTE:           Question no. 1 is compulsory and to be set from the entire syllabus. It will have four sub-parts and students need to answer wo. Each part carries three and half marks.           I Question nos. 2 to 5 are to be set from all four units one from each. Every question will have three sub-parts and students is answer any two sub-parts of each question. Each part carries three and half marks.           J DYES AND PIGMENTS         8           Introduction and classification of dyes, color & constitution, different types of chromophores.         8           Fluorescence and phosphorescence, dye intermediates, Developments of acid and basic dyes. <td< td=""><td>Fotal Evalua</td><td>ation Marks: 50</td><td>Examination D</td><td>uration:</td><td></td><td>2 Hrs.</td><td></td><td></td><td></td></td<>	Fotal Evalua	ation Marks: 50	Examination D	uration:		2 Hrs.			
Interview       Interview       Interview         Objectives       To provide the knowledge of Chemistry of Industrially Important Products to the students         Objectives       After completing this course, student is expected to learn the following:         Outcomes:       CO1: Overview of industrially important products         CO2: Various process parameters associated with dyes, pigments, petrochemicals, blends, additives and polymer         CO3: Important features associated with process development of industrially important compounds         CO4: Skills to develop technology for of industrially important compounds         CO5: Understanding of agrochemicals and polymers used in textile industries         CO6: Ability to understand various issues related to petrochemicals and dyes         COURSE SYLLABUS         NOTE:         Question no. 1 is compulsory and to be set from the entire syllabus. It will have four sub-parts and students need to answer wo. Each part carries three and half marks.         ) Question nos. 2 to 5 are to be set from all four units one from each. Every question will have three sub-parts and students is a newer any two sub-parts of each question. Each part carries three and half marks.         ) Question nos. 2 to 5 are to be set from all four units one from each. Every question will have three sub-parts and students is a answer any two sub-parts of each question. Each part carries three and half marks.       Contact H         Init No.       Contents       Contact H       PYES AND PIGMENTS       8	CIE: 15 N	<b>/</b> larks	•			•	• •	ples of chem	nistry an
Objectives         After completing this course, student is expected to learn the following:           Courses:         CO1: Overview of industrially important products           CO2: Various process parameters associated with dyes, pigments, petrochemicals, blends, additives and polymer           CO3: Important features associated with process development of industrially important compounds           CO3: Understanding of agrochemicals and polymers used in textile industries           CO6: Ability to understand various issues related to petrochemicals and dyes           COURSE SYLLABUS           NOTE:           Question no. 1 is compulsory and to be set from the entire syllabus. It will have four sub-parts and students need to answer wo. Each part carries three and half marks.           ) Question nos. 2 to 5 are to be set from all four units one from each. Every question will have three sub-parts and students need to answer any two sub-parts of each question. Each part carries three and half marks.           Unit No.         Contents         Contact H           DYES AND PIGMENTS         8           Introduction and classification of dyes, color & constitution, different types of chromophores.         8           Fluorescence and phosphorescence, dye intermediates, Developments of acid and basic dyes.         7           Crude oil and natural gas, refinery operations, energy consumption, lower olefins and acetylenes, cracking processes, synthesis gas, ammonia and methanol production, acetic acid and acetic anhydride production, C_1 products: Formic acid, hydrogen cyani	TEE: 35 N						•		
Dutcomes:         CO1: Overview of industrially important products CO2: Various process parameters associated with dyes, pigments, petrochemicals, blends, additives and polymer CO3: Important features associated with process development of industrially important compounds CO4: Skills to develop technology for of industrially important compounds CO5: Understanding of agrochemicals and polymers used in textile industries CO6: Ability to understand various issues related to petrochemicals and dyes           NOTE:         COURSE SYLLABUS           Question no. 1 is compulsory and to be set from the entire syllabus. It will have four sub-parts and students need to answer wo. Each part carries three and half marks.         Ouestion nos. 2 to 5 are to be set from all four units one from each. Every question will have three sub-parts and students i o answer any two sub-parts of each question. Each part carries three and half marks.           Unit No.         Contents         Contact H           I         DYES AND PIGMENTS Introduction and classification of dyes, color & constitution, different types of chromophores. Fluorescence and phosphorescence, dye intermediates, Developments of acid and basic dyes. Applications of different dyes and challenges associated with them. Chemistry and applications of optical brightening agents and pigments.         7           II         PETROCHEMICALS Crude oil and natural gas, refinery operations, energy consumption, lower olefins and acetylenes, cracking processes, synthesis gas, ammonia and methanol production, acetic acid and acetic anhydride production, C <sub>1</sub> products: Formic acid, hydrogen cyanide, chloromethanes, C <sub>2</sub> products: ethanol, acetaldehyde, ethylene oxide         8           III         PROCESS TECHNOLOGO		To provide the knowledg	e of Chemistry of Indu	strially Imp	oortant l	Products to	the students		
C02: Various process parameters associated with dyes, pigments, petrochemicals, blends, additives and polymer         C03: Important features associated with process development of industrially important compounds         C04: Skills to develop technology for of industrially important compounds         C05: Understanding of agrochemicals and polymers used in textile industries         C06: Ability to understand various issues related to petrochemicals and dyes         COURSE SYLLABUS         NOTE:         Question no. 1 is compulsory and to be set from the entire syllabus. It will have four sub-parts and students need to answer wo. Each part carries three and half marks.         Question nos. 2 to 5 are to be set from all four units one from each. Every question will have three sub-parts and students is an answer any two sub-parts of each question. Each part carries three and half marks.         Unit No.       Contents       Contact H         DYES AND PIGMENTS       8       Introduction and classification of dyes, color & constitution, different types of chromophores.       8         Fluorescence and phosphorescence, dye intermediates, Developments of acid and basic dyes.       7         Crude oil and natural gas, refinery operations, energy consumption, lower olefins and acetylenes, cracking processes, synthesis gas, ammonia and methanol production, acetic acid and acetic anhydride production, C <sub>1</sub> products: Formic acid, hydrogen cyanide, chloromethanes, C <sub>2</sub> products: ethanol, acetaldehyde, ethylene oxide       8         I       PETROCHEMICALS       7	Course	After completing this co	urse, student is expect	ed to learn	n the foll	owing:			
CO3: Important features associated with process development of industrially important compounds         CO4: Skills to develop technology for of industrially important compounds         CO5: Understanding of agrochemicals and polymers used in textile industries         CO6: Ability to understand various issues related to petrochemicals and dyes         COURSE SYLLABUS         NOTE:         Question no. 1 is compulsory and to be set from the entire syllabus. It will have four sub-parts and students need to answer wo. Each part carries three and half marks.         ) Question nos. 2 to 5 are to be set from all four units one from each. Every question will have three sub-parts and students is an any two sub-parts of each question. Each part carries three and half marks.         ) Question nos. 2 to 5 are to be set from all four units one from each. Every question will have three sub-parts and students is an any two sub-parts of each question. Each part carries three and half marks.         Unit No.       Contact M         DYES AND PIGMENTS       8         Introduction and classification of dyes, color & constitution, different types of chromophores.       8         Fluorescence and phosphorescence, dye intermediates, Developments of acid and basic dyes.       7         Applications of different dyes and challenges associated with them. Chemistry and applications of optical brightening agents and pigments.       7         I       PETROCHEMICALS       7         Crude oil and natural gas, refinery operations, energy co	Outcomes:								
C04: Skills to develop technology for of industrially important compounds         C05: Understanding of agrochemicals and polymers used in textile industries         C06: Ability to understand various issues related to petrochemicals and dyes         COURSE SYLLABUS         NOTE:         Question no. 1 is compulsory and to be set from the entire syllabus. It will have four sub-parts and students need to answer wo. Each part carries three and half marks.         ) Question nos. 2 to 5 are to be set from all four units one from each. Every question will have three sub-parts and students is an aswer any two sub-parts of each question. Each part carries three and half marks.         ) Question nos. 2 to 5 are to be set from all four units one from each. Every question will have three sub-parts and students is an aswer any two sub-parts of each question. Each part carries three and half marks.         Unit No.       Contents       Contact H         I DYES AND PIGMENTS       8         Introduction and classification of dyes, color & constitution, different types of chromophores.       8         Fluorescence and phosphorescence, dye intermediates, Developments of acid and basic dyes.       7         Crude oil and natural gas, refinery operations, energy consumption, lower olefins and acetylenes, cracking processes, synthesis gas, ammonia and methanol production, acetic acid and acetic anhydride production, C <sub>1</sub> products: Formic acid, hydrogen cyanide, chloromethanes, C <sub>2</sub> products: ethanol, acetaldehyde, ethylene oxide       8         II       PROCESS TECHNOLOGY OF POLYMERS/FABRICS<				• •	-	•		•	lymers
COS: Understanding of agrochemicals and polymers used in textile industries         COURSE SYLLABUS         NOTE:         Question no. 1 is compulsory and to be set from the entire syllabus. It will have four sub-parts and students need to answer wo. Each part carries three and half marks.         ) Question nos. 2 to 5 are to be set from all four units one from each. Every question will have three sub-parts and students need to answer any two sub-parts of each question. Each part carries three and half marks.         Unit No.       Contents       Contact H         I       DYES AND PIGMENTS       8         Introduction and classification of dyes, color & constitution, different types of chromophores.       Fluorescence and phosphorescence, dye intermediates, Developments of acid and basic dyes.       8         Applications of different dyes and challenges associated with them. Chemistry and applications of optical brightening agents and pigments.       7         II       PETROCHEMICALS cracking processes, synthesis gas, ammonia and methanol production, acetic acid and acetylenes, cracking processes, synthesis gas, ammonia and methanol production, acetic acid and acetylenes, cracking processes, synthesis gas, ammonia and methanol production, acetic acid and acetylenes, cracking processes, synthesis gas, ammonia and methanol production, acetic acid and acetylenes, cracking processes, synthesis gas, ammonia and methanol production, acetic acid and acetylenes, cracking processes, synthesis gas, ammonia and methanol production, acetic acid and acetylenes, cracking processes, synthesis gas, ammonia gas, chinery oplates, colare did, hydrogen cyanide, c			•				ly important comp	ounds	
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Chemistry and Technology of chemical processing of polyester, nylon and acrylics. Dyeing		Introduction and classifi Fluorescence and phosp Applications of different of optical brightening ag <b>PETROCHEMICALS</b> Crude oil and natural ga cracking processes, syn	Co cation of dyes, color & horescence, dye interr t dyes and challenges gents and pigments. s, refinery operations, thesis gas, ammonia	ies three a ontents constitutionediates, l associated energy co and meth	nd half r on, diffe Developr d with th nsumption	narks. rent types ments of a nem. Chem on, lower o oduction, a	of chromophores cid and basic dyes histry and applicat plefins and acetyle acetic acid and a	Cont tions enes, cetic	act Hrs. 8
		Introduction and classifi Fluorescence and phosp Applications of different of optical brightening ag <b>PETROCHEMICALS</b> Crude oil and natural ga cracking processes, syn anhydride production, C	Co cation of dyes, color & horescence, dye interr t dyes and challenges gents and pigments. s, refinery operations, thesis gas, ammonia f1 products: Formic aci	ies three a ontents constitutionediates, l associated energy co and meth	nd half r on, diffe Developr d with th nsumption	narks. rent types ments of a nem. Chem on, lower o oduction, a	of chromophores cid and basic dyes histry and applicat plefins and acetyle acetic acid and a	Cont tions enes, cetic	act Hrs. 8
machines for duoing fiber warp and fabric Mass selecation. Coloration of polymorphylone	11	Introduction and classifi Fluorescence and phosp Applications of different of optical brightening ag <b>PETROCHEMICALS</b> Crude oil and natural ga cracking processes, syn anhydride production, C ethanol, acetaldehyde, e	Co cation of dyes, color & horescence, dye interr t dyes and challenges ents and pigments. s, refinery operations, thesis gas, ammonia f1 products: Formic aci ethylene oxide	ies three a ontents constitution nediates, l associated energy co and meth d, hydroge	nd half r on, diffe Developr d with th nsumption	narks. rent types ments of a nem. Chem on, lower o oduction, a	of chromophores cid and basic dyes histry and applicat plefins and acetyle acetic acid and a	Cont tions enes, cetic	8 7
machines for uyeing mer, yarn and rabits, wass coloration. Coloration of polypropylene	11	Introduction and classifi Fluorescence and phosp Applications of different of optical brightening ag <b>PETROCHEMICALS</b> Crude oil and natural ga cracking processes, syn anhydride production, C ethanol, acetaldehyde, e	Co cation of dyes, color & horescence, dye interr t dyes and challenges gents and pigments. s, refinery operations, thesis gas, ammonia f1 products: Formic acid ethylene oxide OF POLYMERS/FABRIC	ies three a ontents constitutionediates, I associated energy co and meth d, hydroge	nd half r on, diffe Developr d with th nsumption anol pro- n cyanic	narks. rent types ments of a nem. Chem on, lower o oduction, a le, chloron	of chromophores. cid and basic dyes histry and applicat plefins and acetyle acetic acid and a nethanes, C <sub>2</sub> prod	Cont Cont Cions enes, cetic ucts:	8 7
	11	Introduction and classifi Fluorescence and phosp Applications of different of optical brightening ag <b>PETROCHEMICALS</b> Crude oil and natural ga cracking processes, syn anhydride production, C ethanol, acetaldehyde, e <b>PROCESS TECHNOLOGY</b> Chemistry and Technol	Co cation of dyes, color & horescence, dye interr t dyes and challenges gents and pigments. s, refinery operations, thesis gas, ammonia f1 products: Formic acid ethylene oxide OF POLYMERS/FABRIC logy of chemical pro	ies three a ontents constitution nediates, I associated energy co and meth d, hydroge CS cessing of	nd half r on, diffe Developr d with th nsumption anol pro- r cyanic	narks. rent types ments of a nem. Chem on, lower o oduction, a le, chloron ter, nylon	of chromophores. cid and basic dyes histry and applicat plefins and acetyle acetic acid and a hethanes, C <sub>2</sub> prod and acrylics. Dy	Cont Cont Cions enes, cetic ucts:	act Hi 8 7

IV	BLENDS, ADDITIVES AND AGROCHEMICALS	7
	Blends, antioxidants, UV stabilizers, antistatic agents, peroxides, lubricants, fire retardants, heat	
	stabilizers, plasticizers. Agricultural Chemicals: Fertilizers, insecticides, herbicides, fungicides.	
Suggest	ed Readings:	I
1.	A. Heaton, An introduction to Industrial Chemistry, 3 <sup>rd</sup> Edition, <i>Springer Science</i> , 2013.	
2.K.	Venkataraman, The Chemistry of Synthetic Dyes, CBS, 2010.	
3.J.	A. Tyrell, Fundamental of Industrial Chemistry, <i>Wiley</i> , 2005.	
4. K	. Hunger, Industrial Dyes: Chemistry, Properties, Applications, Wiley, 2002.	
	. V. Datye and A. A. Vaidya, Chemical Processing of Synthetic Fibers and Blends, Wiley, 1984.	

## DISSERTATION (Research Project)

Course No:		Course Name:				Course	Code:
CH-55A		Dissertation-I		SBS CH 010327 DCS 001408			
Batch: 2021 Onwards	Programme:	Semester:	L	Т	Р	Credit	Contact Hrs. per Week: 14
	M.Sc. Chemistr	ry III	0	0	14	8	Total Hrs.: 220
Total Evaluation	Marks: 200	Examination Duration	n:	Externa	l Viva-V	oce	
CIE: 66 Mark	-	Pre-requisite of cours	e: None				
Course Objectives	The aim of the	dissertation project work is to f	amiliarize	the stude	nts with	advanced	research.
Course Outcomes:	CO1: Overview CO2: Develop s CO3: Handling CO4: Research CO5: Ability to	ng this course, student is expect of handling research projects skills in planning and setting-up of various instruments presentation skills understand various issues relat priting research reports	experimer	nts	wing:		
		COURSE	SYLLABU	S			
Unit No.		Contents	;				Contact Hrs.
I-IV	Central University Supervisor/guid constituted by	oplies to students who opt to sity of Haryana. The topic for th de concerned. The project repo the Head, Department of Chen ternal member.	e project v ort is to be	vork is to evaluate	be decid d by a c	led by the ommittee	220

Course No:	Course Name: Course Code:																							
CH-55B		Dissertat	ion-II				SBS CH 010428 DCS 001408																	
Batch:	Programme:		Semester:	L	Т	Р	Р	Р	Р	Р	Р	Р	Р	Р	Р	Р	Р	Р	Р	Р	Р	Credit	Contact Hrs.	
2021 Onwards								per Week:	14															
	M.Sc. Chemis	try	IV	0	0	14	8	Total Hrs.:	220															
Total Evaluation Ma	<b>rks:</b> 200		Examination	Duration	:	Exteri	nal Viva-Voo	ce																
CIE: 66 Marks			Pre-requisite	of course	None																			
TEE: 134 Marks			Fielequisite	or course	. None																			
Course Objectives	The aim of th	e dissertati	on project work	is to fam	iliarize t	he studei	nts with adv	anced research	۱.															
Course Outcomes:	After complet	ting this co	urse, student is e	expected	to learn	the follo	wing:																	
	CO1: Overvie	w of handli	ndling research projects																					
	CO2: Develop	skills in pla	n planning and setting-up experiments																					
	CO3: Handlin	g of various	ous instruments																					
	CO4: Researc	h presenta	intation skills																					
	CO5: Ability t	o understa	stand various issues related to research																					
	CO6: Skills in	writing res	g research reports																					
			COURS	E SYLLAE	BUS																			
Unit No.			Conte	nts				Conta	act Hrs.															
I-IV	This course a	pplies to st	udents who op	t to carry	out the	ir dissert	ation work	2	220															
	in Central University of Haryana. The topic for the project work is to be																							
	decided by the supervisor/guide concerned. The project report is to be																							
	evaluated by	y a comn	nittee constitut	ed by t	the Hea	id, Depa	artment of																	
	Chemistry, Sc	hool of Bas	ic Sciences havi	ng at leas	t one ex	ternal me	ember.																	

# **GENERIC ELECTIVE COURSES**

ELECTIVE COURSE OFFERED BY THE DEPARTMENT TO STUDENTS OF OTHER DEPARTMENTS

Course	Course Name:					Course Code:				
No:	Chemistry for Biologists				SBS CH	010101 GE 4	4004			
CH-58										
Batch:	Programme:	Semester:	L	т	Р	Credit	Contact Hrs.			
2021							per Week:	04		
Onwards	P.G. (Generic Elective Course)	I	4	0	0	4	Total Hrs.:	60		
Total Evalua	ation Marks:100	Examination D	uration:		3 Hrs.					
CIE: 30 N	Лarks									
		Pre-requisite c	of course:	None						
TEE: 70 N	<u>Marks</u>									
Course	To provide an opportunity to lear	n some basic con	cepts of cl	nemistry	/ importa	nt for biologis	ts.			
Objectives	To provide the knowledge of UV	'-vis., IR and <sup>1</sup> H	-NMR spe	ectrosco	ору					
Course	After completing this course, stud	lent is expected	to learn th	e follow	ving:					
Outcomes:	CO1: Basic understanding of som	e important cond	epts of ch	emistry	-					
	<b>CO2</b> : Understanding of formulae	writing and stere	ochemistr	y of org	anic com	pounds				
	CO3: Important aspects associate	d with other bra	nches of s	cience						
	CO4: Skills to interpret data of or	ganic compound	s using adv	anced s	spectral te	echniques				
	CO5: Ability to communicate abo	ut chemical scier	nces across	the fie	lds					
	CO6: Ability to analyse, design an	d solve problems	5							
	1	COLIDCI		10						

**COURSE SYLLABUS** 

NOTE:

i)Question no. 1 is compulsory and to be set from the entire syllabus. It will have seven sub-parts and students need to answer any four. Each part carries three and half marks.

ii) Question nos. 2 to 5 are to be set from all four units one from each. Every question will have three sub-parts and students need to answer any two sub-parts of each question. Each part carries seven marks.

iii) P.G. Students from other departments may opt this course.

Unit No.	Contents	Contact Hrs.
1	SOME BASIC TERMS AND CONCEPTS Mole concept and Stoichiometry. Solution and different methods of expressing the concentration of a solution. Chemical bonds: Ionic, covalent, coordinate and metallic bonds. Shapes of the molecules, Polarized chemical bonds and polarity in the molecules. Intermolecular forces: Dispersion, dipole-dipole, hydrogen bonds, ion-dipole forces and their effect on the properties of the compounds. Biological implications of hydrogen bonding. Problems based on given topics.	15
II	<b>STEREOCHEMISTRY</b> Isomerism: Introduction, Formula writing, Structural and stereo isomerism, Conformations: analysis of ethane, <i>n</i> -butane, cyclohexane and its derivatives, Configurational isomerism, Geometrical and optical isomerism. Symmetry and chirality in the molecules having one or more than one chiral center, R & S, D & L, threo and erythro nomenclature, enantiotopic and diastereotopic atoms, groups and faces, stereospecific and stereoselective reactions. Problems based on given topics.	15

	CONCEPTS OF PHYSICAL CHEMISTRY	15
	Thermodynamics: Change in Internal energy, enthalpy, free energy and entropy; Endothermic and	
	exothermic processes, Exergonic and endergonic processes, Coupled biological processes,	
	Chemical Kinetics: Reaction rate and rate constant, Catalysts and catalysis, Enzymes as catalysts,	
	Enzyme inhibition.	
	Chemical equilibrium: Equilibrium, equilibrium constant, Le Châtelier's principle and factors	
	affecting the principle, Aqueous Equilibria: Introduction, importance in biology, pH and pH control,	
	Buffers and their importance.	
IV	SPECTROSCOPIC TECHNIQUES	15
	Ultraviolet and visible (UV-vis) spectroscopy: Introduction, Principle and selection rules of UV	
	phenomenon, Various electronic transitions, Beer-Lambert law, presentation of spectrum, effect of	
	solvents on electronic transitions, ultraviolet bands for carbonyl compounds and unsaturated	
	carbonyl compounds. Fieser-Woodward rules for conjugated dienes.	
	Infrared Spectroscopy: Introduction, Principle and selection rules of IR spectroscopy, Hookes law,	
	Characteristic vibrational frequencies of organic compounds. Overtones, combination bands and	
	Fermi resonance. Factors affecting the vibrational frequencies.	
	<sup>1</sup> H NMR: Principle, nuclear spin states, nuclear magnetic moments, mechanism of resonance,	
	chemical shifts, diamagnetic shielding, magnetic anisotropy, spin-spin splitting, coupling constant,	
	<sup>1</sup> H NMR spectra of various simple organic compounds.	
Suggested	•	
	R. Puri, L. R. Sharma and M. S. Pathania, Principles of Physical Chemistry,47 <sup>th</sup> Edition. <i>Vishal Publishing C</i>	
	R. Puri, L. R. Sharma, K. C. Kalia, Principles of Inorganic Chemistry, 33 <sup>rd</sup> Edition. <i>Vishal Publishing Co.,</i> 201	
	L. Pavia, G. M. Lampman, G. S. Kriz and J. R. Vyvyan, Spectroscopy, 5 <sup>th</sup> Edition. <i>Cengage Learning India</i> 15.	Private Limitea,
	S. Kalsi, Stereochemistry: Conformation and Mechanism, <i>New Age International Private Limited</i> , 2015.	
	M. Mukherji and S. P. Singh, Reaction Mechanism in Organic Chemistry, Revised Edition. (Revised by S. I	P Singh and Om
	akash). TRINITY Press, An Imprint of Laxmi Publications Pvt. Ltd., 2015.	. Singi and On
	Atkins and J. Paula, Atkins' Physical Chemistry, 10 <sup>th</sup> Edition. <i>Oxford University Press</i> , 2014.	
	Clayden, N. Geeves and S. Warren, Organic Chemistry, <i>Oxford University Press</i> , 2012.	
	prrison, Boyd and Bhattcharjee, Organic Chemistry, 7 <sup>th</sup> Edition, <i>Pearson</i> , 2010.	
	A. Carey and R. J. Sundburg, Advanced Organic Chemistry PART A., Springer, 2007.	
	Nasipuri, Stereochemistry of Organic Compounds, 2 <sup>nd</sup> Edition, <i>New Age International</i> , 2005.	
	J. Laidler, Chemical Kinetics, 3 <sup>rd</sup> Edition. <i>Pearson Education</i> , 1997.	

	Course Name: Course						Course Code:				
No:	Chemistry of Materials	ry of Materials SBS CH 010102 GE 4004									
CH-59											
Batch:	Programme:	Semester:	L	Т	Р	Credit	Contact				
2021							per Wee		04		
Onwards	P.G. (Generic Elective Course)	l	3	1	0	4	Total Hr	rs.:	60		
Total Evalua	ation Marks:100	Examination Dur	ation:		3 Hrs.						
	/larks	Pre-requisite of phenomena	course:	То р	rovide b	asic nanomat	erials and	photo	ophysical		
	Narks				viala non	auguna atoriala	and come				
Course Objectives	To give a very basic understa phenomena with focus on energ			iomatei	riais, por	ous materiais	ana some	pnote	opnysicai		
Course	After completing this course, stu	ident is expected to	learn th	e follow	/ing:						
Outcomes:	<b>CO1</b> : Basic understanding of nan										
	<b>CO2</b> : To understand the dramati	<b>e</b>	rties that	occurs	by reduc	ing the size					
	<b>CO3</b> : Characterization of nanom		wathacia	ofcush	cmall cia	as and shanas	ofmotorial	_			
	<b>CO4</b> : To impart knowledge on how to perform the synthesis of such small sizes and shapes of materials <b>CO5</b> : Knowledge of fundamental of photophysical phenomena										
	<b>CO6</b> : Application of nanomateria										
		COURSE	•								
NOTE											
NOTE:	a 1 is compulsory and to be set fr	om the entire sylla	hus Itwi	ll have	seven sul	n-narts and stu	idents need	to an	swer anv		
i)Question n	D. 1 is compulsory and to be set from the set of the se	om the entire sylla	bus. It wi	ll have	seven sul	o-parts and stu	idents need	to an:	swer any		
i)Question n four. Each pa	rt carries three and half marks.					·					
i)Question n four. Each pa ii) Question		our units one from	each. Eve	ery que		·					
i)Question n four. Each pa ii) Question	art carries three and half marks. nos. 2 to 5 are to be set from all fo	our units one from Each part carries se	each. Eve	ery que		·		stude			
i)Question n four. Each pa ii) Question to answer ar	art carries three and half marks. nos. 2 to 5 are to be set from all fo	our units one from Each part carries se	each. Eve even marl	ery que		·		stude Cont	nts need		
i)Question n four. Each pa ii) Question to answer ar Unit No.	art carries three and half marks. nos. 2 to 5 are to be set from all for y two sub-parts of each question.	our units one from Each part carries so Co	each. Eve even marl ontents	ery que ks.	stion will	have three su	b-parts and	stude Cont	nts need act Hrs.		
i)Question n four. Each pa ii) Question to answer ar Unit No.	art carries three and half marks. nos. 2 to 5 are to be set from all for y two sub-parts of each question. NANOMATERIALS	our units one from Each part carries so Consequences of S	each. Eve even marl ontents	ery que ks. ticle Si	stion will	have three su	b-parts and	stude Cont	nts need act Hrs.		
i)Question n four. Each pa ii) Question to answer ar Unit No.	nt carries three and half marks. nos. 2 to 5 are to be set from all for y two sub-parts of each question. NANOMATERIALS An Introduction, Elementary C Classification of nanomaterials- nanomaterials. Gas-Phase Synt	our units one from Each part carries so Consequences of S zero dimensional ( hesis of Nanopart	each. Even even marl ontents Small Par DD)-one o icles - P	ery que ks. ticle Si dimensi hysical	stion will ze - Sur onal (1D and Che	have three su face of Nano )-two dimension mical Vapor	b-parts and particles. onal (2D) Synthesis	stude Cont	nts need act Hrs.		
i)Question n four. Each pa ii) Question to answer ar Unit No.	not carries three and half marks. nos. 2 to 5 are to be set from all for y two sub-parts of each question. NANOMATERIALS An Introduction, Elementary C Classification of nanomaterials- nanomaterials. Gas-Phase Synt Processes. Radio- and Microwa	our units one from Each part carries so Consequences of S zero dimensional ( hesis of Nanopart	each. Even even marl ontents Small Par DD)-one o icles - P	ery que ks. ticle Si dimensi hysical	stion will ze - Sur onal (1D and Che	have three su face of Nano )-two dimension mical Vapor	b-parts and particles. onal (2D) Synthesis	stude Cont	nts need act Hrs.		
i)Question n four. Each pa ii) Question to answer ar Unit No.	An Introduction, Elementary C Classification of nanomaterials. Nanomaterials. Gas-Phase Synt Processes. Radio- and Microwa Particles.	Consequences of S zero dimensional ( hesis of Nanopart ve Plasma Process	each. Even even marl ontents Small Par DD)-one o icles - P	ery que ks. ticle Si dimensi hysical	stion will ze - Sur onal (1D and Che	have three su face of Nano )-two dimension mical Vapor	b-parts and particles. onal (2D) Synthesis	stude Cont	nts need act Hrs. 15		
i)Question n four. Each pa ii) Question to answer ar <b>Unit No.</b>	An Introduction, Elementary C Classification of nanomaterials. Nanomaterials. Gas-Phase Synt Processes. Radio- and Microwa Particles. CHARACTERIZATION OF NANOM	our units one from Each part carries so Consequences of S zero dimensional ( hesis of Nanopart ve Plasma Process	each. Eve even marl ontents mall Par DD)-one o icles - P es. Flamo	ery que ks. ticle Si dimensi hysical e Aeros	stion will ze - Sur onal (1D and Che ol Proces	have three su face of Nano )-two dimension mical Vapor ss. Synthesis c	b-parts and particles. onal (2D) Synthesis if Coated	stude Cont	nts need act Hrs.		
i)Question n four. Each pa ii) Question to answer ar Unit No.	An Introduction, Elementary C Classification of nanomaterials. An Introduction, Elementary C Classification of nanomaterials- nanomaterials. Gas-Phase Synt Processes. Radio- and Microwa Particles. CHARACTERIZATION OF NANON Global Methods for Characteriza	Consequences of S Consequences of S Zero dimensional ( hesis of Nanopart ve Plasma Process MATERIALS ation, X-Ray and Ele	each. Even even marl ontents mall Par DD)-one o icles - P es. Flamo	ery que ks. ticle Si dimensi hysical e Aeros	stion will ze - Sur onal (1D and Che ol Proces	have three su face of Nano )-two dimension mical Vapor ss. Synthesis c	b-parts and particles. onal (2D) Synthesis if Coated	stude Cont	nts need act Hrs. 15		
i)Question n four. Each pa ii) Question to answer ar Unit No.	An Introduction, Elementary C Classification of nanomaterials. Nanomaterials. Gas-Phase Synt Processes. Radio- and Microwa Particles. CHARACTERIZATION OF NANOM Global Methods for Characteriza Transmission Electron Microscop	Consequences of S Zero dimensional ( hesis of Nanopart ve Plasma Process MATERIALS ation, X-Ray and Ele	each. Even even marl ontents amall Par DD)-one o icles - P es. Flame	ery que ks. ticle Si dimensi hysical e Aeros	ze - Sur onal (1D and Che ol Proces	have three su face of Nano )-two dimensio mical Vapor ss. Synthesis c n Microscopy,	b-parts and particles. onal (2D) Synthesis of Coated Scanning	stude Cont	nts need act Hrs. 15		
i)Question n four. Each pa ii) Question to answer ar Unit No.	An Introduction, Elementary C Classification of nanomaterials- nanomaterials. Gas-Phase Synt Processes. Radio- and Microwa Particles. CHARACTERIZATION OF NANOM Global Methods for Characteriza Transmission Electron Microscop Nanotubes, Nanorods, and M	Consequences of S Zero dimensional ( hesis of Nanopart ve Plasma Process <b>MATERIALS</b> ation, X-Ray and Ele Dy. Nanoplates, One-I	each. Eve even marl ontents imall Par DD)-one o icles - P es. Flame octron Dif	ery que ks. ticle Si dimensi hysical e Aeros fractior	stion will ze - Sur onal (1D and Che ol Proces n, Electro ystals, G	have three su face of Nano )-two dimension mical Vapor ss. Synthesis con n Microscopy, iraphene and	b-parts and particles. onal (2D) Synthesis of Coated Scanning Carbon	stude Cont	nts need act Hrs. 15		
i)Question n four. Each pa ii) Question to answer ar Unit No.	An Introduction, Elementary C Classification of nanomaterials. Nanomaterials. Gas-Phase Synt Processes. Radio- and Microwa Particles. CHARACTERIZATION OF NANOM Global Methods for Characteriza Transmission Electron Microscop	Consequences of S Zero dimensional ( hesis of Nanopart ve Plasma Process <b>MATERIALS</b> ation, X-Ray and Ele Dy. Nanoplates, One-I	each. Eve even marl ontents imall Par DD)-one o icles - P es. Flame octron Dif	ery que ks. ticle Si dimensi hysical e Aeros fractior	stion will ze - Sur onal (1D and Che ol Proces n, Electro ystals, G	have three su face of Nano )-two dimension mical Vapor ss. Synthesis con n Microscopy, iraphene and	b-parts and particles. onal (2D) Synthesis of Coated Scanning Carbon	stude Cont	nts need act Hrs. 15		
i)Question n four. Each pa ii) Question to answer ar Unit No.	An Introduction, Elementary C Classification of nanomaterials- nanomaterials. Gas-Phase Synt Processes. Radio- and Microwa Particles. CHARACTERIZATION OF NANOM Global Methods for Characteriza Transmission Electron Microscop Nanotubes, Nanorods, and Manotubes. Nanotubes and Nar	Consequences of S Zero dimensional ( hesis of Nanopart ve Plasma Process <b>MATERIALS</b> ation, X-Ray and Ele Dy. Nanoplates, One-I	each. Eve even marl ontents imall Par DD)-one o icles - P es. Flame octron Dif	ery que ks. ticle Si dimensi hysical e Aeros fractior	stion will ze - Sur onal (1D and Che ol Proces n, Electro ystals, G	have three su face of Nano )-two dimension mical Vapor ss. Synthesis con n Microscopy, iraphene and	b-parts and particles. onal (2D) Synthesis of Coated Scanning Carbon	stude Cont	nts need act Hrs. 15		
i)Question n four. Each pa ii) Question to answer ar Unit No.	An Introduction, Elementary C Classification of nanomaterials- nanomaterials. Gas-Phase Synt Processes. Radio- and Microwa Particles. CHARACTERIZATION OF NANOM Global Methods for Characteriza Transmission Electron Microscop Nanotubes, Nanorods, and M Nanotubes. Nanotubes and Nar and Nanorods.	Consequences of S Zero dimensional ( hesis of Nanopart ve Plasma Process MATERIALS ation, X-Ray and Ele by. Nanoplates, One-I norods from Mater	each. Even even marl ontents imall Par DD)-one o icles - P es. Flame ectron Dif Dimension ials othe	ery que ks. ticle Si dimensi hysical e Aeros fraction nal Cry r than	ze - Sur onal (1D and Che ol Proces n, Electro ystals, G Carbon, S	have three su face of Nano )-two dimension mical Vapor ss. Synthesis of n Microscopy, iraphene and Synthesis of N	b-parts and particles. onal (2D) Synthesis of Coated Scanning Carbon anotubes	stude Cont	nts need act Hrs. 15		
i)Question n four. Each pa ii) Question to answer ar Unit No.	An Introduction, Elementary C Classification of nanomaterials- nanomaterials. Gas-Phase Synt Processes. Radio- and Microwa Particles. CHARACTERIZATION OF NANOM Global Methods for Characteriza Transmission Electron Microscop Nanotubes, Nanorods, and N Nanotubes. Nanotubes and Nar and Nanorods. HYBRID MATERIALS	Consequences of S Consequences of S Zero dimensional ( hesis of Nanopart ve Plasma Process <b>MATERIALS</b> ation, X-Ray and Ele by. Nanoplates, One-I norods from Mater ction, Classificatior	each. Even even marl ontents imall Par DD)-one o icles - P es. Flame octron Dif Dimension ials othe	ery que ks. ticle Si dimensi hysical e Aeros fractior nal Cry r than dinatior	stion will ze - Sur onal (1D and Che ol Proces n, Electro ystals, G Carbon, S n Polyme	have three su face of Nano )-two dimension mical Vapor ss. Synthesis of n Microscopy, araphene and Synthesis of Nano Synthesis of Nano	b-parts and particles. onal (2D) Synthesis of Coated Scanning Carbon anotubes	stude Cont	nts need act Hrs. 15 15		
i)Question n four. Each pa ii) Question to answer ar Unit No. I	An Introduction, Elementary C Classification of nanomaterials nanomaterials. Gas-Phase Synt Processes. Radio- and Microwa Particles. CHARACTERIZATION OF NANOM Global Methods for Characteriza Transmission Electron Microscop Nanotubes, Nanorods, and M Nanotubes. Nanotubes and Nar and Nanorods. HYBRID MATERIALS Coordination Polymers, Introdu	Consequences of S Consequences of S Zero dimensional ( hesis of Nanopart ve Plasma Process MATERIALS ation, X-Ray and Ele by. Nanoplates, One-I norods from Mater cotion, Classification odes and Linkers, Coordination Polyn	each. Eve even marl ontents imall Par DD)-one o icles - P es. Flame octron Dif Dimension ials othe of Coord Secondar ners-Solve	ery que ks. ticle Si dimensi hysical e Aeros fraction nal Cry r than dination y Build otherm	stion will ze - Sur onal (1D and Che ol Proces n, Electro ystals, G Carbon, S Carbon, S n Polyme ing Unit al/Hydrot	have three su face of Nano )-two dimension mical Vapor ss. Synthesis of n Microscopy, iraphene and Synthesis of Nano rs, Design Stra Concept, Topo chermal, Sono	b-parts and particles. onal (2D) Synthesis of Coated Scanning Carbon anotubes tegies of plogy and chemical,	stude Cont	nts need act Hrs. 15		

	Applications of Coordination Polymers in Gas Storage, Gas Separation, Catalysis and Drug Delivery.	
IV	PHOTOPHYSICAL PHENOMENA Interaction of electromagnetic radiation with matter, Grotthus-Draper law, Stark-Einstein law of photochemical equivalence, quantum yield, electronically excited singlet states, life time of electronically excited state, construction of Jablonski diagram, electronic transitions and intensity of absorption bands, types of photophysical pathways, radiationless transitions, fluorescence emission, phosphorescence emission, Fluorescence quenching, chemiluminescence, photochemical reactions.	
Suggested	Readings:	
2. D. 3. S. 4. M	Vollath, Nanomaterials: An Introduction to Synthesis, Properties and Applications, 2 <sup>nd</sup> Edition. <i>Wiley-VCF</i> C. Agarwal, Introduction to Nanoscience and Nanomaterials. <i>World Scientific</i> , 2013. R. Batten, S. M. Neville and D. R. Turner, Coordination Polymers: Design, Analysis and Application. <i>RSC Pu</i> C. Hong and L. Chen, design and Construction of Coordination Polymers. <i>Wiley</i> , 2009.	

- 5. S. Kaskel, The Chemistry of Metal-Organic Frameworks, Vol. 1, *Wiley-VCH*, 2016.
- 6. L. R. Macgillivray, Metal-Organic Frameworks: Design and Applications, *Wiley*, 2010.
- 7. W. D. Jr. Callister and D. G. Rethwisch, Fundamentals of Materials Science and Engineering: An Integrated Approach, *John Wiley and Sons*, 2012.
- 8. K. K. Rohatgi and K. K. Mukherjee; Fundamentals of Photochemistry, 3<sup>rd</sup>Edition. *New Age International (P) Ltd.*, 2014.

Course	Course Name:				Cours	e Code:		
No:	Medicinal Chemistry SBS CH 010203 GE 4004						GE 4004	
CH-60	_							
Batch: 2021	Programme:	Semester:	L	Т	Р	Credit	Contact Hrs. per Week:	04
Onwards	P.G. (Generic Elective Course)	II	4	0	0	4	Total Hrs.:	60
Total Evalua	ntion Marks:100	Examination [	Ouration:		3Hrs.			
<b>CIE:</b> 30 M	larks		-f		uida haai	aa af maadi		
<b>TEE:</b> 70 M	1arks	Pre-requisite o	of course	: 10 pro	vide basi	cs of medic	cinal chemistry	
Course	This course will provide a basic u	⊥ Inderstandina ar	nd fundar	nentals	of Medic	inal Chemi	strv. drua-tarae	t actions. process
Objective	of development of new drugs a misuse.	-	-		•			•
Course Outcomes:	After completing this course, stu CO1: General overview about dr CO2: Idea of the various steps in CO3: Fundamental understandin CO4: Basic understanding of che CO5: Classification and uses of va CO6: A broad idea of drug manu	ugs and their fur drug discovery a g of how drug-ta mical principles arious drugs	nction and deve arget inte involved	lopmen <sup>:</sup> raction: in pharr	t s happen nacodyn			
		COURS	SE SYLL	ABUS				
four. Each pa ii) Question to answer a	io. 1 is compulsory and to be set fi art carries three and half marks. nos. 2 to 5 are to be set from all f ny two sub-parts of each question lents from other departments may	our units one fro . Each part carrie	om each. es seven	Every q				
Unit No.		•	tents					Contact Hrs.
I	FUNDAMENTALS       15         Historical development of systems of medicine, Basic chemical and biochemical principles, Key definitions, drug, target, receptors, enzymes, common drugs and their classification, anti-inflammatory drugs, antihistamines, antacids, antibiotics, narcotics, antivirals, and antineoplastics.							
11	DRUG ACTION Chemistry of drug-target interac excretion (ADME), pharmacokin and hydrophilicity, blood-brain b	etics and pharn	nacodyna	mics, to	oxicity, si	de effects,	lipophilicity	15

III	DRUG DESIGN AND SYNTHESIS Development of new drugs, concept of lead compounds and lead modifications, structure-activity relationship (SAR), isosterism, bio-isosterism, important chemical principles behind design of drugs, natural products and their uses, chemical synthesis of drugs, drug formulation, drug delivery, photodynamic therapy.	15
IV	<b>DRUGS AND SOCIETY</b> Regulatory processes for drug approval, regulatory agencies, intellectual property, patents, drug misuse, drug abuse, abuse of antibiotics, fraud practices in treatment, historically important drugs and vaccines.	15
2. G. L 3. D. S 4. Ed. 5. Ed.	Readings: Solverman, The Organic Chemistry of Drug Design and Drug Action, 3 <sup>rd</sup> Edition. <i>Academic Press</i> , 2014. Patrick, An Introduction to Medicinal Chemistry, 5 <sup>th</sup> Edition. <i>Oxford University Press</i> , 2013. Iriram and P. Yogeshwari, Medicinal Chemistry, 2 <sup>nd</sup> Edition. <i>Pearson</i> , 2012. Robert F. Dorge, Wilson and Gisvold'sTextBook of Organic Medicinal and Pharmaceutical Chemistry, 1 M. E. Wolff, Burger's Medicinal Chemistry and Drug Discovery, Vol. 1, 7 <sup>th</sup> Edition. <i>John Wiley</i> , 2010. Pandeya and J. R. Dmmock, An Introduction to Drug Design, 1 <sup>st</sup> Edition. <i>New Age International</i> , 1999	12 <sup>th</sup> Edition, 2010.

Course	Course Name:				Course	Code:				
No:	Drug, Design and Discovery	, Design and Discovery SBS CH 010304 GE 4004					004			
CH-61										
Batch:	Programme:	Semester:	L	Т	Р	Credit	Contact H	rs.		
2021							per Week	: 04		
Onwards	P.G. (Generic Elective Course)	111	4	0	0	4	Total Hrs.	: 60		
Total Evalu	tal Evaluation Marks: 100Examination Duration:3 Hrs.									
CIE: 30 N	1arks									
		Pre-requisite of	course:	None						
	Marks		16 1							
Course Objective	This course will provide a basic t	inderstanding an	d fundamei	ntals to	wards dru	g discovery an	d developme	nt process.		
Course	After completing this course, stu	dent is expected	to learn th	e follow	/ing:					
Outcomes:	<b>CO1</b> : General idea about moder			emistry	,					
	<b>CO2</b> : The process of drug discov									
	CO3: Fundamental understandin		-							
	<b>CO4</b> : Basic understanding of che		nvolved in	pharma	codynami	CS				
	<b>CO5</b> : Classification and uses of v	•								
	<b>CO6</b> : A broad idea of drug manu	facture, administ	ration and	drug ab	use					
		COURS	E SYLLAB	US						
NOTE:										
i)Question	no. 1 is compulsory and to be set f	rom the entire sy	llabus. It wi	II have s	seven sub·	parts and stud	dents need to	answer any		
four. Each p	part carries three and half marks.									
ii) Question	nos. 2 to 5 are to be set from all f	our units one froi	n each. Eve	ery ques	stion will h	ave three sub	parts and stu	idents need		
	ny two sub-parts of each question	•	s seven ma	rks.						
	lents from other departments ma									
Unit No.		Cont	ents				Co	ontact Hrs.		
I	INTRODUCTION							15		
	History of drug discovery and targets: Introduction, Stages of drug discovery, lead discovery,									
	Recent trends in drug discovery. Validation and diversity of drug targets									
	Biological drug targets: Drug target identification, Receptors, types, binding and activation,									
	theories of drug receptor intera				•	antagonists, ar	tificial			
	enzymes, Biopharmaceutical therapies, , Hit to lead, Clinical biomarkers.									
II	DRUG DESIGN			•				15		
	Prodrug design: Basic concept			•		-				
	group, prodrugs to improve	•	•	-	•					
	distribution, site specific drug de	•	ned drug ad	Ction. Ra	ationale of	prodrug desig	gn and			
	practical consideration of prodr Combating drug resistance: Ca		istanco ctr	atorior	to comb	t drug rocieta	nce in			
	antibiotics and anticancer thera	-		-		it ulug lesista				
	and biolics and anticalicer thera	py, genetic princi			nice.					
	Analog Design: Introduction of	assical & non de	-		ranlacom	ont stratogias	rigid			
	Analog Design: Introduction, c		ssical, bioi	sosteric						
	<b>Analog Design</b> : Introduction, c analogs, alteration of chain bran isomers and geometric isomers,	iching, changes ir	ssical, bioi ring size, r	sosteric ing pos	ition isom	ers, design of	stereo			

III	ANTIBIOTICS AND CARDIOVASCULAR DRUGS	15
	Cell wall biosynthesis, inhibitors, $\beta$ -lactam rings, antibiotics inhibiting protein synthesis, Synthesis	
	of penicillin G, amoxycillin, cephalosporin, ciprofloxacin. Introductory idea of tetracycline and	
	streptomycin. Introduction and general mode of action. Synthesis of ditiazem, verapamil, methyldopa and atenolol.	
IV	LOCAL ANTIINFECTIVE DRUGS AND PSYCHOACTIVE DRUGS	15
	Introduction and general mode of action. Synthesis of furazolidone, naldixic acid, dapsone,	
	isoniazid, ethambutol, gluconazole, chloroquin and primaquin. Introduction, neurotransmitters,	
	CNS depressants, general anaesthgetics, mode of action of hypnotics, sedatives, anti-anxiety	
	drugs, benzodiazopines, buspirone. Antipsychotic drugs-theneuroleptics, antidepressants,	
	butyrophenones. Synthesis of diazepam, alprazolam, phenyltoin and glutethimide.	
Suggeste	d Readings:	
1. R	. B. Silverman, The Organic Chemistry of Drug Design and Drug Action, 3 <sup>rd</sup> Edition. Academic Press, 2014	4.
2. C	. M. Brahmankar and S. B. Jaiswal, Biopharmaceutics and Pharmacokinetics, 2 <sup>nd</sup> Edition. Vallabh Prak	<i>ashan,</i> New Delhi,
2	014.	
3. G	i. L. Patrick, An Introduction to Medicinal Chemistry, 5 <sup>th</sup> Edition. <i>Oxford University Press</i> , 2013.	
4. C	9. Sriram and P. Yogeshwari, Medicinal Chemistry, 2 <sup>nd</sup> Edition. <i>Pearson</i> , 2012.	
	d. Robert F. Dorge, Wilson and Gisvold's Text Book of Organic Medicinal and Pharmaceutical Chem 010.	istry, 12 <sup>th</sup> Edition,

6. Ed. M. E. Wolff, Burger's Medicinal Chemistry and Drug Discovery, Volume 1, 7<sup>th</sup> Edition. *John Wiley*, 2010.

7. S. S. Pandeya and J. R. Dmmock, An Introduction to Drug Design, 1<sup>st</sup> Edition. *New Age International*, 1999.

Course	Course Name:					Course Code:					
No:	Magneto Nuclear Chemistry				SBS CH	010405 GE 40	04				
CH-62											
Batch: 2021	Programme:	Semester:	L	Т	Р	Credit	Contact Hrs. per Week:	02			
Onwards	P.G. (Generic Elective Course)	IV	2	0	0	2	Total Hrs.:	30			
Total Evalua	ation Marks:50	Examination Dur	ation:	2	2 Hrs.						
CIE: 15 N	<ul> <li>Magneto Nuclear Chemistres</li> <li>Magneto Nuclear Chemistres</li> <li>Programme:</li> <li>Provide the basic knowledge of exchange cost conceptory of magnetic cost core of magnetism and cost cost cost cost cost cost cost cost</li></ul>	<b>Pre-requisite of course:</b> To provide the basic knowledge of magnetism and nuclear chemistry.									
TEE: 35 N	/larks	chemistry.									
Course Objectives	To provide the basic knowledge learn about the basic concept of							lents will			
Course Outcomes:	<b>CO1</b> : Basic theory of magnetism <b>CO2</b> : Knowledge of exchange in <b>CO3</b> : To understand orbital con <b>CO4</b> : Basic understanding of nu	Achange interaction Orbital contribution ding of nuclear structure Intificial radioactivity and chelation therapy									
		COURS	E SYLLABI	JS							
two. Each pa ii) Question r	rt carries three and half marks. nos. 2 to 5 are to be set from all	four units one fror	n each. Evo	ery que	stion will ł						
Unit No.		C	ontents				Conta	ct Hrs.			
I	paramagnetic, ferromagnetic	magnetism, classification of magnetic behaviour; diamagnetic,									
11	MAGNETIC INTERACTION Mechanism of exchange intera	C INTERACTION n of exchange interaction, reduced magnetization, magnetic hysteresis, calculation of noment, orbital contribution to the magnetic moment, anomalous magnetic moments,									
111	<b>RADIOACTIVITY</b> Radioactive decay and grow substances, Measurement of series, rate of disintegration, h	radioactivity, grou nalf-life, average lif	ally occurring and artificially produced radioactive ty, group displacement law, radioactive disintegration erage life of radioactive elements, unit of radioactivity, nstants, decay rates, types of nuclear decay.								

IV	ARTIFICIAL RADIOACTIVITY AND APPLICATIONS OF NUCLEAR CHEMISTRY Discovery of artificial radioactivity, isotopes used in medicines, radiocarbon dating, age determination, effects of radiation on life, applications of tracer element in medical, agriculture and analytical fields, biological effects of radiation, radiation protections, chelation therapy.	8					
Suggested	Readings:						
1. G.	Friedlander, J. W. Kennedy, E. S. Macias; Nuclear and Radiochemistry, 3 <sup>rd</sup> Edition. <i>Willey</i> , 2013.						
2. J. I	M. D. Coey, Magnetism and Magnetic Materials, Cambridge University Press, UK, 2010.						
3. J.	E. Huheey, E. A. Keiter, R. L. Keiter, O. K. Medhi, Inorganic Chemistry: Principles of Structure and Reactivity,						
4 <sup>th</sup>	Edition. Pearson Education, 2006.						
4. W.	D. Loveland, D. Morrissey and G. T. Seaborg, Modern Nuclear Chemistry, John Wiley & Sons, 2006.						
5. D.	Gatteschi, R. Sessoli and J. Villain, Molecular Nanomagnets, Oxford University Press, Oxford, 2006.						

- 6. C. E. Housecroft and A. G. Sharpe; *Inorganic Chemistry*, 2<sup>nd</sup>Edition.*Pearson*, 2005.
- 7. O. Kahn, Molecular Magnetism, VCH Publishers, Inc., Orsay, France, 1993.
- 8. H. J. Arnikar, Essentials of Nuclear Chemistry, Wiley Eastern, 1988.



			Course Na	Name:				Course Code:			
			Activities a	es at Department and University Level					SBS CH 010105 DCS 0042		
Batch:     Programme:       2021 Onwards     M.Sc. Chemistry       Total Evaluation Marks:		9	Semester:		Т	Α	Credit		-		
		M.S. Chamist			0				per Week:	6	
		.ry 1	to IV	0	0	6	2	Total Hrs.:	100		
		E	Examination Duration: NA								
			F	Pre-requisite of course: None							
Course		The main objective of this course is to make the students aware about the importance of cleanlines								ess for social	
<b>Dbjectives</b> development.											
Course After completing this course, student is expected to learn the fol							ving:				
Outcomes:		<b>CO1</b> : Learn about the importance of cleanliness									
		<b>CO2</b> : Develop skills in finding and solving sanitation related problems									
	CO3: Motivating others not to litter CO4: Motivating others not to use plastic bags										
	<b>CO5</b> : To manage and implement campaigns and demonstrate sanitation advice in nearby villages										
	<b>CO6</b> : Skill to train others										
	I			COURSE S	YLLABUS						
Unit No.				Conten	its					Contact Hrs.	
I-IV	This course is applicable to all students to carry out various activities associated with cleanliness and								100		
	recycling of the waste materials at departmental and university level in line with Swachh Bharat										
	Abhiyan that may include:										
	• To conduct outreach programs for creating awareness on Swachh Bharat in association										
	with NCC or NSS or women cell etc.										
	<ul> <li>To produce energy and manure using bio-wastes.</li> <li>Plantation drives to increase the green cover and conservation of old trees.</li> </ul>										
	<ul> <li>Self-sustainable units through energy production using solar panels.</li> </ul>										
	<ul> <li>Plastic free environment.</li> </ul>										
	<ul> <li>Development of Green Buildings concept in the society.</li> </ul>										
	Effective Waste management and recycling.										
	Rain water harvesting.										
	Proper disposal of chemical waste.										
	Creating awareness in the community through short films.										
	Use of social media for broader community outreach.										
	Note: Students will submit a brief report on the activities carried out to the department for the										
	Note: Stu	uents will subili	it a brief repo	ort on the activ	ities carried	out to	the de	partment	for the		

### A = Activity

### **9. TEACHING-LEARNING PROCESS**

- Lectures
- Discussions
- Simulations
- Role Playing
- Participative Learning
- Interactive Sessions
- Seminars
- Research-based Learning/Dissertation or Project Work
- Technology-embedded Learning
- Hands on training
- Self study analysis
- Report writing

### **10. IMPLEMENTATION OF BLENDED LEARNING**

Blended Learning is a pedagogical approach that combines face to-face classroom methods with computermediated activities in the process of teaching and learning. It implies nice blend of face-to-face and online activities to make the learning processes more interesting and engaging. It focuses on integration of traditional classroom activities and innovative ICT-enabled strategies. It emphasizes student-centric learning environment where the teacher is the facilitator for productive and measurable learning outcomes. It optimizes and compliments the face to face learning, giving ample freedom and flexibility to the students and teachers to access and explore the wide range of open-access sources such as video lectures, podcasts, recordings and articles through digital platforms. It gives freedom and autonomy to the teachers in selection of appropriate digital platforms, resources and time-slots to complement and supplement face to face learning. The Blended Learning doesn't undermine the role of the teacher, rather it gives him/her an opportunity to explore the unexplored in accordance with the requirements of the curriculum.

#### **Key features of Blended Learning**

- **Student-Centric Pedagogical Approach** focusing on flexibility in timing, quality content, needs and interests of students and freedom to study through the mode of his/her choice;
- Freedom to Select variety of mediums and techniques;
- Increased student engagement in learning;
- Enhanced teacher and student interaction;

- Improved student learning outcomes;
- More flexible teaching and learning environment;
- More responsive for self and continuous learning;
- Better opportunities for experiential learning;
- Increased learning skills;
- Greater access to information, improved satisfaction and learning outcomes.

**Note:** It was resolved that Blended Learning with 40% component of online teaching and 60% face to face classes for each programme, may be adopted

### **11. ASSESSMENT AND EVALUATION**

### Overall assessment will be made as per CUH PG ordinances

- Continuous Comprehensive Evaluation at regular after achievement of each Course-level learning outcome
- Formative Assessment on the basis of activities of a learner throughout the programme instead of one-time assessment
- Oral Examinations to test presentation and communication skills
- Open Book Examination for better understanding and application of the knowledge acquired if required
- Group Examinations on Problem solving exercises
- Seminar Presentations
- Review of Literature
- Collaborative Assignments

### **12. KEYWORDS**

- LOCF
- NEP-2020
- Blended Learning
- Face to face (F to F) Learning
- Programme Outcomes
- Programme Specific Outcomes
- Course-level Learning Outcomes

- Postgraduate Attributes
- Learning Outcome Index
- Formative Assessment and Evaluation
- Comprehensive and Continuous Evaluation

### **13. REFERENCES**

- National Education Policy-2020. <u>https://www.education.gov.in/sites/upload\_files/mhrd/files/NEP\_Final\_English\_0.pdf</u>
- The draft subject specific LOCF templates available on UGC website. <u>https://www.ugc.ac.in/ugc\_notices.aspx?id=MjY50Q</u>==
- Draft Blended Mode of Teaching and Learning: Concept Note available on UGC website. <u>https://www.ugc.ac.in/pdfnews/6100340 Concept-Note-Blended-Mode-of-Teaching-and-Learning.pdf</u>

### **14. APPENDICES**

Curricular Reforms — Extracts from National Education Policy-2020

8118809\_UGC-Letter-reg-Swachcha-Bharat-Abhiyan-.pdf

3258851\_swach-bharat-swashth-bharat--guidelines-2014.pdf