Koneru Lakshmaiah Education Foundation
(Deemed to be University estd. u/s. 3 of the UGC Act, 1956)
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Campus: Green Fields, Vaddeswaram - 522 502, Guntur District, Andhra Pradesh, INDIA
Phone No. 0863 - 2399999; www.klef.ac.in; www.klef.edu.in; www.kluniversity.in
Admin Off: 29-36-38, Museum Road, Governorpet, Vijayawada - 520 002. Ph: +91 - 866 -2577715, Fax: +91-866-2577717

25-03-2023

DEPARTMENT OF CHEMISTRY
MINUTES OF 6th BOARD OF STUDIES MEETING

The department of chemistry conducted 6th BOS meeting on 25-03-2023 in virtual mode (Webex) Link:
https://kluniversity.webex.com/kluniversity/j.php?MTID=mcfbc668a7d9f4326dbaa9a1f21513a07
from 11:00AM to 1:00 PM.

The following members were present:

1. Dr. A. Venkateswara Rao, Assistant Professor & HOD, BOS-Chairperson
2. Dr. K. Deepti, Asst. Professor, Prof. In-Charge & PG Coordinator, BOS-Secretary
3. Dr. C. Suresh Reddy, Professor, Department of Chemistry, S V University, External Member
4. Dr. K. Mohan Rao, Professor, Department of Chemistry, North-Eastern Hill University (Central University), Meghalaya, External Member
5. Dr. D. Ramachandran, Professor, Department of Chemistry, Acharya Nagarjuna University, Guntur, External Member
6. Dr. V. Sriram, Head of Analytical Development, Bluefish Pharmaceuticals India Pvt Ltd., Bengaluru-Karnataka, Industry Expert
7. Dr. S. Rama Krishna, Senior Scientist-Peptides & Biologics, M/s.Daicel Chiral Technologies-India Pvt. Ltd., Telangana, Industry Expert
8. Dr. J. Subba Rao, Sr. Group leader, Hetero Research and Foundation, Hyderabad, Industry Expert
9. Dr. K Uday Kiran, Assoc Dean (Acad), BOS member from Academics office
10. Dr. A. Vani, Professor, Internal Member
11. Dr. K. R. S. Prasad, Professor, Internal Member
12. Dr. J V Shanmukha Kumar, Professor, Internal Member
13. Dr. Pradeep Kumar Brahman, Associate Professor, Internal Member
14. Dr Niranjan Patra, Associate Professor, Internal Member
15. Dr. Alka D Kamble, Assistant Professor, Internal Member
16. Dr. M. Naresh, Assistant Professor, Internal Member
17. Dr. K. Rambabu, Assistant Professor, Internal Member
18. Dr. Tinku Baidya, Assistant Professor, Internal Member
19. Dr. T. Anusha, Assistant Professor, Internal Member
20. Dr K Swapna, HOD -Physics, KLEF, Subject Expert
21. Prof K. Sreenivasulu, HOD BT, KLEF, Subject Expert,

Members Absent:

1. Prof. N. Venkatram, Dean-Academics & Pro-VC, BOS-Invitee
2. Prof. Hari Kiran Vege, Addl. Dean-Academics, BOS-Invitee

25/3/23
Dr. A. Venkateswara Rao
Head of the Department
Department of Chemistry
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Green Fields, Vaddeswaram-522 302.

Dr. A. Venkateswara Rao, Chairman of BOS opened the meeting by welcoming and introducing the external members to the internal and Special members and thanked them for accepting to become the member of the Board of studies.

After due deliberations, the following resolutions have been adopted.

AGENDA and RESOLUTIONS

AGENDA ITEM 1:

To review and finalize the modified course structure for M. Sc Chemistry 2023 admitted batch	**Recommended for approval in academic council**

Dr. A. Venkateswara Rao, HoD, presented the modified course structure to the BOS members. Followed by the presentation, brief discussion was made on the curriculum.

Recommendation: Based on the stakeholder feedback (Dr Narayana Bhat, Professor, University of Texas Rio Grande Valley, USA., Dr C Suresh Reddy, Professor, S V University, Tirupati, AP, India and Dr. D. Ramachandran, Professor, Acharya Nagarjuna University, Guntur, AP, India.), it is recommended to approve the modified course structure with a revised syllabus and maintain the credits as 80. Various aspects, such as curriculum design, teaching methodologies, student support services, and assessment practices, were thoroughly examined during the discussion. Members considered the importance of a holistic approach that encompasses both academic and non-academic factors impacting student success.

Resolution: It was resolved to finalize the Y23 course structure, which is composed of Professional core courses, Professional elective courses, flexi core courses, audit courses, open elective courses and project, research & internship. It is also resolved to adhere to the maximum 80 credit system as per the National Education Policy and recommended the same for approval in academic council.

It is resolved and recommended for approval in academic council to introduce new courses as elective papers to meet the industrial needs.

Biomolecules
Biosensors and Diagnostic Devices

It is resolved and recommended for approval in academic council to introduce the following new courses to meet the research criteria.

Essentials of Research Design
Term Paper

It is resolved and recommended for approval in academic council to introduce open electives to enhance the focus on industry-relevant skills or sectors, making them more adaptable to diverse career paths and explore areas outside the core chemistry curriculum, such as environmental science, bioinformatics, or materials science.

Open Elective - 1
Open Elective - 2

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The modified structure and detailed syllabus of new courses for M. Sc Chemistry 2023 admitted batch is shown in **Annexure- I**

AGENDA ITEM-2

Improving Industry Collaboration to improve placement opportunities for the students.	**Recommended for approval in academic council**

Recommendation: Based on the stakeholder feedback (Dr K Deepti, Dr Alka Damodhar Kamble, Dr M Naresh, Dr A Venkateswara Rao), it is recommended to have industry collaboration to conduct workshops, facilitate regular faculty engagement with industry professionals, leverage alumni working in the industry to mentor current students and provide insights into career pathways, thereby enhancing student readiness for job placements.

Resolution: Considering the recommendations made, the following points are resolved and recommended for approval in academic council

(i) Arrange corporate guest lectures by industry experts.
(ii) Arrange industry visits & Research Institutions at least once in a semester.
(iii) Skill assessment tests can be conducted by industry experts.
(iv) Connect with the alumni who are in the industry and ask them to arrange on-campus placements.

AGENDA ITEM – 3

Proposed to include Minor degree courses offered by MSc Chemistry to the other departments for the A.Y. 2023-24 admitted batch students.	**Recommended for approval in academic council**

Recommendation: To promote interdisciplinary learning and broaden academic opportunities for students across departments, it is recommended to include Minor degree courses to the other departments for the A.Y. 2023-24 admitted batch students.

Resolution: It is resolved and approved in the BOS meeting to offer Minor degree courses to other department students with 20 credits in a discipline other than his/her major discipline. The proposed syllabus for the course is shown in **Annexure – II.**

AGENDA ITEM – 4

Proposed to include value-added, skill development, employability, entrepreneurship courses for the AY 2023-24.	**Recommended for approval in academic council**

Recommendation: To enhance the technical skills (e.g., laboratory techniques, data analysis) and digital tools widely used in industry, ensuring that students acquire competencies directly applicable to their careers, it is recommended to include value-added, skill development, employability, entrepreneurship courses for the A.Y 2023-24.

25/03/2024

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Resolution: It is resolved and approved in the BOS meeting to enhance employability of the students, value-added, skill development, employability, entrepreneurship, and work-in lieu courses are already included in the existing curriculum. The proposed syllabus for the course is shown in **Annexure – III.**

AGENDA ITEM 5:

To review and finalize the DAC minutes.	**Recommended for approval in academic council**

Recommendation: To approve the DAC minutes.

Resolution: It was resolved that the reviewed DAC minutes are approved in BOS and recommended to present in academic council for approval.

AGENDA ITEM 6:

To review and finalize the PDD for Y23 regulation.	**Recommended for approval in academic council.**

Recommendation: To approve the PDD of M. Sc Chemistry program for Y23 regulation.

Resolution: It was resolved that the PDD for Y23 regulation is approved in BOS and recommended to present in academic council for approval.

AGENDA ITEM 7:

To review and consider the feedback received from various stakeholders.	**Recommended for approval in academic council.**

Recommendation: The feedback collected from various stakeholders (students, academic peers, industry professionals, alumni, parents, and faculty) was reviewed and led to the following resolutions being considered.

Resolution: It is proposed to include 2 industrial visits per year in the curriculum for the Y23 admitted batch students.

28/3/23

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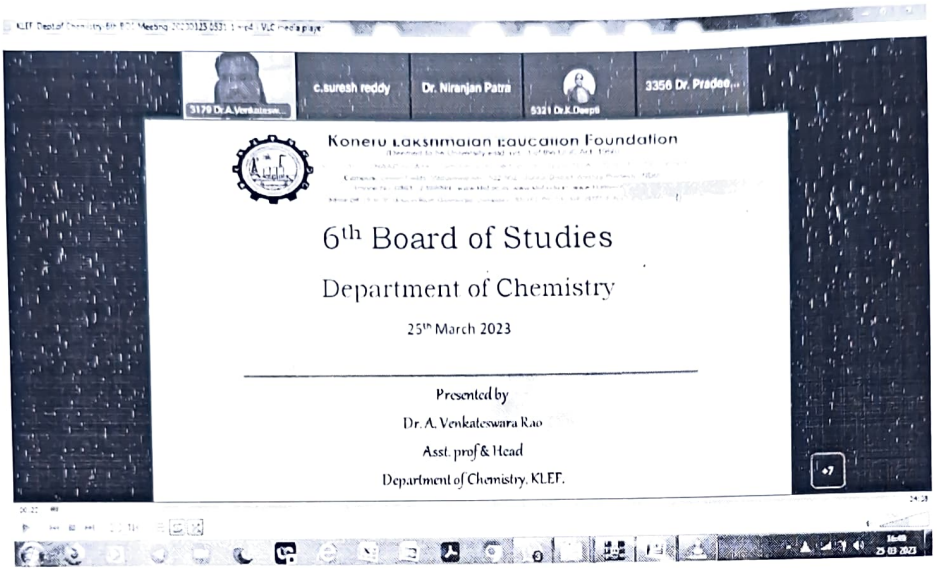

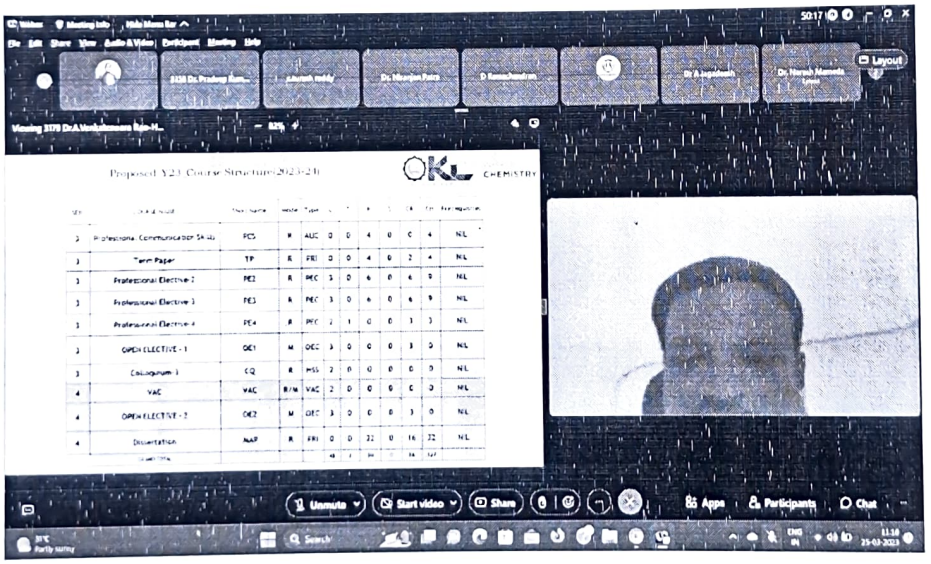

25/3/23

Dr. A. Venkateswara Rao
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Vaddeswaram-522 302.

	Name	Designation	Position	Signature
	Dr. A. Venkateswara Rao	Assistant Professor & HOD	BOS-Chairperson	
1	Prof. N. Venkatram	Dean-Academics & Pro-VC	BOS-Invitee	
2	Prof. Hari Kiran Vege	Addl. Dean-Academics	BOS-Invitee	
3	Dr. K. Deepti	Asst. Professor, Prof. In-Charge & PG Coordinator	BOS-Secretary	
4	C. Suresh Reddy	Professor Department of Chemistry Sri Venkateswara University Tirupati-517502	External Member & Expert	
5	Dr. K. Mohan Rao	Professor Department of Chemistry North-Eastern Hill University (Central University) Meghalaya-793022	External Member & Expert	
6	Dr. D. Ramachandran	Professor Department of Chemistry Acharya Nagarjuna University Nambur, Guntur-522508.	External Member & Expert	
7	Dr. V. Sriram	Head of Analytical Development Bluefish Pharmaceuticals India Pvt Ltd. Bearys Global Research Triangle B - 3, 3rd Floor,Tower B, Einstein Building Sy. no. 63/3B, Gorvigere Village Bidarahalli Hobli,Whitefield Ashram Road Bengaluru-Karnataka 560067.	Industry Expert	
8	Dr. S. Rama Krishna	Senior Scientist-Peptides & Biologics M/s. Daicel Chiral Technologies-India Pvt. Ltd. IKP Knowledge Park, Survey no: 512/2, Kollur-Village, Medchal-Malkajgiri-Dt, Telangana-584314	Industry Expert	
9	Dr. J. Subba Rao	Sr. Group leader Hetero Research and Foundation Plot No B - 80 & 81, Apie, Near Elico Ltd, Shrivani Complex, Anath Nagar, Balanagar, Hyderabad-500018	Industry Expert	
10	Prof K. Giridhar	HOD BT, KLEF	Subject Expert	
11	Dr K Swapna	HOD -Physics, KLEF	Subject Expert	

Dr. A. Venkateswara Rao
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12	Dr. K Uday Kiran	Assoc Dean (Acad)	BOS member from Academics office	
13	A. Vani	Professor	Internal Member	
14	Dr. K. R. S. Prasad	Professor	Internal Member	
15	Dr. J V Shanmukha Kumar	Professor	Internal Member	
16	M. Sujatha	Associate Professor	Internal Member	
17	Dr. Pradeep Kumar Brahman	Associate Professor	Internal Member	
18	Dr Niranjan Patra	Associate Professor	Internal Member	
19	Dr T. Bhaskara Rao	Assistant Professor	Internal Member	
20	Dr. Alka D Kamble	Assistant Professor	Internal Member	
21	Dr. M. Naresh	Assistant Professor	Internal Member	
22	Dr. K. Rambabu	Assistant Professor	Internal Member	

25/3/23

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ANNEXURE I: MODIFIED ACADEMIC STRUCTURE FOR Y23 REGULATION

It is resolved and approved in the BOS meeting that the modified course structure is approved. The same is permitted by the external, internal, and other stakeholders of BOS for inclusion of modified structure.

S. NO	SEM	Course code	COURSE NAME	Short Name	Mode	Type	L	T	P	S	CR	CH	Prerequisites
1	1	23UC5201	Professional Communication Skills	PCS	R	AUC	0	0	4	0	0	4	NIL
2	1	23CY5101	Symmetry & Molecular Spectroscopy	SMS	R	PCC	2	1	0	0	3	3	NIL
3	1	23CY5102	Chemical bonding & Coordination Chemistry	CBCC	R	PCC	3	0	4	0	5	7	NIL
4	1	23CY5103	Structural Organic & Stereo Chemistry	SOSC	R	PCC	3	0	4	0	5	7	NIL
5	1	23CY5104	Molecular Thermodynamics & Chemical Kinetics	MTCK	R	PCC	3	0	4	0	5	7	NIL
6	2	23CY5205	Reaction Mechanism & Organometallic Chemistry	ROMC	R	PCC	3	0	4	0	5	7	CBCC
7	2	23CY5206	Quantum, Surface & Electrochemistry	QSEC	R	PCC	3	0	4	0	5	7	MTCK
8	2	23CY5207	Biomolecules	BM	R	PCC	3	0	4	0	5	7	SOSC
9	2	23CY5121	Concepts of Organic Synthesis	COS	R	FCC	3	0	0	0	3	3	NIL
10	2	23CY5122	Separation Techniques	ST	R	FCC	3	0	0	0	3	3	NIL
11	3	23CY61E1	Biosensors and Diagnostic Devices	BDD	R	PEC	2	1	0	0	3	3	ST
12	3	23CY61E2	Instrumental Methods of Chemical Analysis	IMCA	R	PEC	3	0	6	0	6	9	NIL
13	3	23CY61E3	Chromatographic Techniques & Method Validation	CTMV	R	PEC	2	1	0	0	3	3	NIL
14	3	23CY61E4	Applied Chemical Analysis	ACA	R	PEC	3	0	6	0	6	9	NIL
15	3	23CY61E5	Nano Chemistry	NC	R	PEC	2	1	0	0	3	3	COS

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05/3/23

16	3	23CY61E6	Organic Synthesis	OS	R	PEC	3	0	6	0	6	9	NIL
17	3	23CY61E7	Organic Spectroscopy	OSP	R	PEC	2	1	0	0	3	3	NIL
18	3	23CY61E8	Natural Products and Heterocyclic Chemistry	NPHC	R	PEC	3	0	6	0	6	9	NIL
19	3		OPEN ELECTIVE - 1	OE1	M	OEC	3	0	0	0	3	0	NIL
20	4		OPEN ELECTIVE - 2	OE2	M	OEC	3	0	0	0	3	0	NIL
21	2	23IE5201	Essentials of Research Design	ERD	R	PRI	1	1	0	0	2	2	NIL
22	3	23IE6103	Term Paper	TP	R	PRI	0	0	4	0	2	4	NIL
23	4	23IE6205	Dissertation	MAP	R	PRI	0	0	32	0	16	32	NIL
24	4	23CC6201	VAC	VAC	R/M	VAC	2	0	0	0	0	0	NIL
			GRAND TOTAL				**46**	**4**	**72**	**0**	**80**	**114**	

Type	Sum of CR	No. of Courses
AUC	0	1
OEC	6	2
PCC	33	7
PEC	18	4
PRI	20	3
FCC	3	1
VAC	0	1
Grand Total	80	19

Semester	Sum of CR	Sum of CH
1	21	27
2	20	26
3	20	29
4	19	32
Grand Total	80	114

Legend: PCC - Professional Core related to Major area, PEC - Professional Elective Courses related to Specialization, PRI - Project, Research or Internship Courses, AUC - Audit Courses, VAC - Value Added Courses, OEC - Open Elective, FCC- Flexi core course which leads to specialization

Graduation requirements: Successful attainment of 80 credits, obtain all PEC credits from courses of specific specialization domain, complete 1 SCI publication and obtain Satisfactory in all 0 credit courses (AUC, VAC and PRI categories)

25/3/23

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ANNEXURE-I

Syllabus Template

BIOMOLECULES

COURSE CODE	23CY5207	MODE	General	LTPS	3-0-6-0	PRE-REQUISITE	NIL

Course Outcomes

CO#	CO Description	BTL	PO Mapping
CO1	Interpret the structure, functions, and chemistry of carbohydrates with respect to their pharmacological activity	3	PO 1, PO 6, PO 7
CO2	Demonstrate the structure, function of amino acids and proteins and explain their metabolic pathways.	3	PO 1, PO 6, PO 7
CO3	Relate the structure of nucleic acids with their functionality and understand the central dogma of molecular biology.	3	PO 1, PO 6, PO 7
CO4	Illustrate the physicochemical properties and characterization of fats and oils.	3	PO 1, PO 6, PO 7
CO5	Apply the principles of chromatography, and qualitative analysis to isolate, separate and identify various biomolecules.	3	PO 3, PO 8

Syllabus

Module 1	**Carbohydrates:** Classification, Physicochemical properties- stereochemistry- Chemistry, Structure and functions of monosaccharides, disaccharides, polysaccharides- Mucopolysaccharides- Deoxy sugars, amino sugars, reactions of carbohydrates- Proteoglycans, Glycoproteins and Glycolipids- separation of carbohydrates.
Module 2	**Amino acids & Proteins:** α- Amino acids: Classification, Structure Physicochemical properties, and biological significance- synthesis and reactivity; Peptides: bond, Peptides of biological importance; Chemical synthesis of peptides – Solid phase peptide synthesis; Proteins – Classification, Isolation, Purification and Characterization of proteins, structure, functions, properties, and significance; Enzymes- Characteristics and functionality.
Module 3	**Nucleic Acids:** Basic Structure, Biological significance, Reactions of Nucleic acid bases, Physicochemical properties of Nucleic Acids, DNA- structure, denaturation, RNA, Functions of Nucleotides, Structure, and properties of nucleotides, nucleosides, purine (Adenine, Guanine) and pyrimidine (Cytosine, Thiamine, Uracil) bases. Structural features of nucleic acids (DNA & RNA) and their biological functions.
Module 4	**Lipids:** Classification, role of lipids, fatty acids and glycerol derived from oils and fats; Physical properties - polymorphism, reactions of fats, rancidity, reversion, polymerization, saponification, addition, hydrogenation, phospholipids, lipid metabolism; intermediary metabolism of fatty acids, synthesis of fatty acids.

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Reference Books:

S. No	Title	Author(s)	Publisher	Year
1	Organic Chemistry, Volume 2	I.L. Finar	Pearson	1975
2	Medicinal Chemistry	Graham L. Patrick	Oxford University Press	2005
3	Chemistry of Natural products	S V Bhat, B.A. Nagasampagi	Narosa	2006
4	Chemistry of Natural Products	V. K. Ahluwalia	Springer & Ane books Pvt. Ltd.	2022
5	The Biosynthesis of Secondary Metabolites	Richard B Herbert	Chapman &Hall	2011

21/03/2023

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BIOSENSORS & DIAGNOSTIC DEVICES

COURSE CODE	23CY52E1	MODE	General	LTPS	2-1-0-0	PRE-REQUISITE	NIL

Course Outcomes

CO#	CO Description	BTL	PO Mapping
CO1	Demonstrate the working mechanism and applications of biosensors towards clinical diagnosis	3	1, 6
CO2	Discuss the principle of various structural and morphological techniques and apply them for clinical quantitative analysis	3	1, 2
CO3	Illustrate the working principles and fabrication of different biosensors	3	1, 2
CO4	Discuss the principle of various diagnostic devices and apply them in clinical samples to understand working principles	3	1, 5

Syllabus

Module 1	**Introduction to Biosensors:** Definition and historical perspective, Various components of biosensors, working mechanism, Probes: antibodies, nucleic acids, enzymes, receptors etc. Methods for probe attachment to surfaces Adsorption; chemisorption, physisorption, polymer trapping, covalent attachment, film deposition techniques; molecularly imprinted polymers and biomimicry. Biosensor construction and modification, Electrodes: carbon (graphene, carbon nanotubes, fullerene, corannulene) metal nanoparticles, polymer, nanocomposites, Thin-Film Electrodes and Screen-Printed electrodes etc. based electrodes. Sensor characteristics: calibration, dynamic range, signal-to-noise ratio, sensitivity, selectivity, interference etc.
Module 2	**Surface characterization and Transducers:** Techniques used to characterize biosensors (UV-Vis, FT-IR, SEM, AFM, XPS, XRD etc.), Various types of transducers and detection methods; principles of Calorimetric, Optical, Electrochemical, Impedimetric, and Chemiluminiscene-based Biosensors.
Module 3	**Design and Applications of Biosensors:** Fabrication and applications of colorimetric, fluorescence, voltammetric, amperometric, and optical biosensors. Working principles of some commercialized biosensors- Glucose biosensor, Urea/Uric Acid biosensor, Pregnancy test biosensor etc. Immunosensors and clinical applications, Biosensors for drug resistance and environmental pollution.
Module 4	**Diagnostic Devices:** Point of care device, necessity and applications, Lab-on-Chip platform, Microfluidic device, Introduction-antigen-antibody binding and assays; Immunoassays –types (RIA, ELISA, Chemiluminescent IA, FIA), working mechanism of few commercial point of care devices.

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Reference Books:

S. No	Title	Author(s)	Publisher	Year
1	Biosensors an Introduction	Brian R Eggins	John Wiley & Sons	1996, 1st Edition
2	Biosensors Principles and Applications	Loic J Blum, Pierre R Coulet	Marcel Dekker,Inc	1991, 1st Edition
3	Biosensors Theory and Applications	Donald G. Buerk	Technomic Publishing	1993, 1st Edition

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ESSENTIALS OF RESEARCH DESIGN (ERD)

Course Code	23IE5201	Mode	R	LTPS	1-1-0-0	Pre-Requisite	Nil

Course Outcomes

CO#	CO Description	BTL	PO Mapping
CO1	Illustrate Research objects, steps involved in research and articulate appropriate Research Questions	3	1, 2, 4, 6
CO2	Perform Literature Review in a Scholarly style and apply appropriate methods for Data collection	3	1, 2, 4, 6
CO3	Represent the data in tabular/Graphical form and prepare data for analysis	3	1, 2, 4, 6
CO4	Perform statistical modelling and analysis to optimize the data, prepare the data for publishing.	4	1, 2, 4, 6

Syllabus

Module 1	Definition and objectives of Research-Types of research, Various Steps in Research process, Applied Mathematical tools for analysis, developing a research question- Choice of a problem, Literature review, Surveying, Synthesizing, critical analysis, reading materials, reviewing, rethinking, critical evaluation, interpretation, Research Purposes, Ethics in research – APA Ethics code.
Module 2	Literature Review (LR)-Meaning and its Types-Narrative and Systematic, LR using Web of Science, Google and Google Scholar, Citations-Types, referencing in academic writing, Citation vs Referencing Vs Bibliography, Citation tools- Zotero, Qualitative Research and its methods, Quantitative Research, and its Methods. Data Collection-Primary data collection using Questionnaire, Google forms, survey monkey, Testing the validity and Reliability of Questionnaire using Factor Analysis and Cronbach's Alpha respectively, Secondary data-sources.
Module 3	Diagrammatic and graphical presentation of data: Diagrams and Graphs of frequency data of one variable- histogram, barcharts-simple, sub-divided and multiple; line charts, Diagrams and Graphs of frequency data of two variables - scatter plot, preparing data for analysis. Concepts of Correlation and Regression, Fundamentals of Time Series Analysis and Error Analysis.
Module 4	Analyzing data using one-dimensional statistics, two-dimensional statistics and multidimensional statistics. Technical Writing and Publishing, Conference presentations, Poster Presentations, Plagiarism-check and tools, Self-Plagiarism. Structure and Components of Research Report, Types of Report, Layout of Research Report, Mechanism of writing a research report, Design Thinking for Contextualized Problem-Solving and Empathetic Research

25/03/

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Reference Books:

S. No	Title	Author(s)	Publisher	Year
1	Research Methods for Engineers	C.R. Kothari	New Age International Publishers	2019
2	Engineering Research Methodology	Y Krishnan Nallaperumal	Wiley	2013
3	Engineering Research Methodology -A Practical Insight for Researchers	Dipankar Deb and Balas	Springer	2019

25/05/2023

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TERM PAPER (TP)

Course Code	23IE6103	Mode	R	LTPS	0-0-4-0	Pre-Requisite	Nil

Course Outcomes

CO#	CO Description	BTL	PO Mapping
CO1	Exploring the Methodology of Retrieving Research Papers from Sci/Scopus Database.	3	6, 7
CO2	Gather information from journals, research database and deliver presentations.	3	6, 7

Syllabus

Module 1	Exploring the Methodology of Retrieving Research Papers from Sci/Scopus Database, Gathering Information, and Delivering Presentations.
Module 2	Gathering Information from journals and Delivering Presentations.
Module 3	Investigate and analyze scholarly articles, books, and reputable sources.
Module 4	Examine and evaluate various data collection methods and sources, including surveys, interviews, archival records, and experimental data.

Reference Books:

S. No	Title	Author(s)	Publisher	Edition
1	Research methodology-methods and techniques	C. R. Kothari	New Age International	4
2	Research Methodology	Panneerselvam R	Prentice Hall India Learning Private Limited	2
3	Fundamentals of Research Methodology & Statistics	Yogesh Kumar Singh	New Age International	4
4	Research Methodology A Step-by-Step Guide for Beginners	Ranjit Kumar	Sage Publications	5

25/03/2024

Annexure II: To propose including Minor degree programs offered by MSc Chemistry in Analytical Chemistry for the A.Y. 2023-24 admitted batch students.

A minor degree is an additional credential a student may earn for 20 credits in a discipline other than his/her major discipline. These additional credits shall be acquired through the list of courses for a Minor Degree prescribed by the respective departments. Students, who are desirous of pursuing their special interest areas other than the chosen discipline of Engineering / Technology / Management / Basic Sciences, may opt for additional courses in minor specialization groups offered by a department other than their parent department.

S. No	Name of the Minor Degree	Course Code	Course Title	L	T	P	S	Cr
1	Analytical Chemistry		Instrumental Methods of Chemical Analysis	3	0	6	0	6
			Applied Chemical Analysis	3	0	6	0	6
			Biosensors & Diagnostic devices	2	1	0	0	3
			Separation Techniques	3	0	0	0	3
			Chromatographic techniques and method validation	2	1	0	0	3
	Total		21 Credits					

Annexure III:

(i) To propose and include value-added courses for upcoming AY 2023-24 batch students.

Value added courses are the types of courses which help a particular individual to develop their own skills in their chosen field of study. These courses are designed to enhance the standard of the students beyond those levels specified in academic curriculum. To enhance employability of the students, value-added courses are included in the curriculum. Hence, it is proposed for the approval of value-added course in BOS meeting. In this regard, the department had received feedback from different stakeholders of our curriculum and recommended the same for its inclusion.

(ii) To propose and include the courses focusing on skill development for AY 2023-24.

Most of the courses comes under practical session in MSc Chemistry program are all focused and motivated the students to develop their skills in all aspect of teaching and research. For eg., the courses such as Instrumental Methods of Chemical Analysis, Applied Chemical Analysis, Organic Synthesis, Natural Products & Heterocyclic Chemistry and Biomolecules are meant to develop and enhance the student's skill where the students have hands-on sessions regularly which makes the student specialized in handling the lab equipment's & instruments widely used in pharmaceutical industries.

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(iii) To propose and include the courses focusing on employability for AY 2023-24.

The courses related with practical and theoretical knowledge concerned to Organic and Analytical chemistry are designed in such a way they are highly benefitted providing a lot of opportunities and employability for the students in both government and private sectors.

(iv)To propose and include courses in Student Activity Centre (SAC) for AY 2023-24.

It is proposed and resolved for approval to include courses offered in Student Activity Centre (SAC) for AY 2023-24 related to the issues on societal, environmental, and public health. However, it is purely in the interest of students in choosing the courses whenever the university offers at the central level to take up courses under SAC.

ANNEXURE- IV: DAC-2 meeting minutes.

The DAC meeting was conducted on 4th February 2023 at 2.00 PM in F102.

Agenda:

- Welcome Address
- To review DAC-1 meeting minutes.
- To review and finalize the course structure of M. Sc Chemistry 2023 admitted batch.
- Improving Industry Collaboration to improve placement opportunities for the students.
- Minor degree requirements other than M. Sc Chemistry students.
- include value-added, skill development, employability, entrepreneurship courses for the AY 2023-24
- Consideration & Discussion of Feedback from students, Academic peers, parents, industry experts & Alumni.
- Any other item with the permission of the chair Any other item with the permission of the chair

The following members were present:

1	Dr. A. Venkateswara Rao	Head of the Department
2	Dr. K. R. S. Prasad	Professor & Student Affairs (Advisor)
3	Dr. J. V. Shanmukha Kumar	Professor
4	Dr. M. Sujatha	Assoc. Professor
5	Dr. Pradeep Kumar Brahman	Assoc. Professor & Assoc. Dean
6	Dr. Niranjan Patra	Assoc. Professor
7	Dr. T. Bhaskara Rao	Assistant Professor & RPAC
8	Dr. K. Deepti	Assistant Professor & Prof. in charge-Academics, PG coordinator
9	Dr. Alka D Kamble	Assistant Professor
10	Dr. M. Naresh	Assistant Professor
11	Dr. K. Rambabu	Assistant Professor
12	Mr. J. Murali Prakash	Student
13	Miss. Salma Banu	Student
14	Mr. Mohan murali	Student
15	Miss. G Bhavana	Student

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The meeting started with an address by Dr. A Venkateswara Rao (HOD, Chemistry Department) extending a warm welcome to the department academic Committee members present for the meeting.

The following points were discussed and resolved:

ITEM NO 1: **Approval of DAC- 1 minutes**.

Resolution: The minutes of DAC-1 were unanimously approved.

ITEM NO 2: **Update on Course Offerings**

Resolution: The committee discussed the current course offerings and determined that there are enough courses to meet the department's needs for the upcoming academic year.

ITEM NO 3: **To review and finalize the modified course structure M. Sc Chemistry 2023 admitted batch**.

Resolution: Reviewed the courses and finalized the Y23 course structure.

ITEM NO 4: **Discussion of New Course Proposals**

Resolution: The committee discussed two new course proposals. The first proposal was for a course on biosensors. The committee voted to approve the proposal. The second proposal was for a course on biomolecules. The committee voted to approve the proposal. The third proposal was for a course on research methodology. The committee voted to approve the proposal. The fourth proposal was for a seminar series. The committee voted to approve the proposal.

ITEM NO 5: **Improving Industry Collaboration to improve placement opportunities for the students.**

Resolution: The faculty suggested the following statements to:

(v) Arrange corporate guest lectures by industry experts.

(vi) Arrange industry visits at least once in a semester.

(vii) Skill assessment tests can be conducted by industry experts.

(viii) Connect with the alumni who are in the industry and ask them to arrange on-campus placements.

ITEM NO 6: Proposed to include Minor degree certificate courses offered by M. Sc Chemistry to the other departments for the A.Y. 2023-24 admitted batch students.

Resolution: It is resolved that to offer Minor degree certificate courses to other department students with 20 credits in a discipline other than his/her major discipline.

ITEM NO 7: Proposed to include value-added, skill development, employability, and entrepreneurship for the AY 2023-24.

Resolution: It is resolved and to enhance employability of the student's, value-added, skill development, employability and entrepreneurship courses are already included in the existing curriculum.

The meeting ended with a vote of thanks proposed by Dr. A. Venkateswara Rao, Assistant Professor and Head, Department of Chemistry.

25/8/23

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DAC-1 MEETING MINUTES

The DAC meeting was conducted on **10th December 2022** at 2.00 PM in F102.

Agenda:

- Welcome Address
- To review existing syllabus.
- To review and finalize the course structure of M. Sc Chemistry 2023 admitted batch.
- Improving Industry Collaboration to improve placement opportunities for the students.
- Minor degree requirements other than M. Sc Chemistry students.
- include value-added, skill development, employability, entrepreneurship courses for the AY 2023-24
- Consideration & Discussion of Feedback from students, Academic peers, parents, industry experts & Alumni.
- Any other item with the permission of the chair Any other item with the permission of the chair

The following members were present:

1	Dr. A. Venkateswara Rao	Head of the Department
2	Dr. K. R. S. Prasad	Professor & Student Affairs (Advisor)
3	Dr. J. V. Shanmukha Kumar	Professor
4	Dr. M. Sujatha	Assoc. Professor
5	Dr. Pradeep Kumar Brahman	Assoc. Professor & Assoc. Dean
6	Dr. Niranjan Patra	Assoc. Professor
7	Dr. T. Bhaskara Rao	Assistant Professor & RPAC
8	Dr. K. Deepti	Assistant Professor & Prof. in charge-Academics, PG coordinator
9	Dr. Alka D Kamble	Assistant Professor
10	Dr. M. Naresh	Assistant Professor
11	Dr. K. Rambabu	Assistant Professor
12	Mr. J. Murali Prakash	Student
13	Miss. Salma Banu	Student
14	Mr. Mohan Murali	Student
15	Miss. G Bhavana	Student

The meeting started with an address by Dr. A Venkateswara Rao (HOD, Chemistry Department) extending a warm welcome to the department academic Committee members present for the meeting.

The following points were discussed and resolved:

ITEM NO 1: Approval of DAC- 1 minutes.

Resolution: The minutes of DAC-1 were unanimously approved.

ITEM NO 2: To review and finalize the modified course structure M. Sc Chemistry 2023 admitted batch.

Resolution: Reviewed the courses and finalized the Y23 course structure.

25/1/23

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ITEM NO 3: Improving Industry Collaboration to improve placement opportunities for the students.

Resolution: The faculty suggested the following statements to:

(ix) Arrange corporate guest lectures by industry experts.

(x) Arrange industry visits at least once in a semester.

(xi) Skill assessment tests can be conducted by industry experts.

(xii) Connect with the alumni who are in the industry and ask them to arrange on-campus placements.

ITEM NO 4: Proposed to include Minor degree certificate courses offered by M. Sc Chemistry to the other departments for the A.Y. 2023-24 admitted batch students.

Resolution: It is resolved that to offer Minor degree certificate courses to other department students with 20 credits in a discipline other than his/her major discipline.

ITEM NO 5: Proposed to include value-added, skill development, employability, and entrepreneurship for the AY 2023-24.

Resolution: It is resolved and to enhance employability of the students, value-added, skill development, employability and entrepreneurship courses are already included in the existing curriculum.

The meeting ended with a vote of thanks proposed by Dr. A. Venkateswara Rao, Assistant Professor and Head, Department of Chemistry.

25/8/22

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1. **Program structure (with all Courses) containing following categorization.**

Course Name	Course Category	L	T	P	S	CR	Pre-Requisite	New Course/Revised Course/ Retained Course	Changes Proposed by	Focused on Employability/ Entrepreneurship/Skill Development
Symmetry & Molecular Spectroscopy	Prof. Core	2	1	0	0	3	-	Revised	-	Employability
Chemical bonding & Coordination Chemistry	Prof. Core	3	0	4	0	5	-	Revised	-	Skill Development
Structural Organic & Stereo Chemistry	Prof. Core	3	0	4	0	5	-	Revised	-	Skill Development
Molecular Thermodynamics & Chemical Kinetics	Prof. Core	3	0	4	0	5	-	Revised	-	Skill Development
Concepts of Organic Synthesis	Flexi Core	3	0	0	0	3	-	Revised	-	Employability
Separation Techniques	Flexi Core	3	0	0	0	3	-	Revised	--	Employability
Essentials of Research Design	PRI	1	0	2	0	2	-	New course	-	Skill Development
Reaction Mechanism & Organometallic Chemistry	Prof. Core	3	0	4	0	5	CBCC	Revised	-	Skill Development
Quantum, Surface & Electrochemistry	Prof. Core	3	0	4	0	5	MTCK	Revised	-	Skill Development
Biomolecules	Prof. Core	3	0	4	0	5	SOSC	New course	-	Skill Development
Biosensors and Diagnostic Devices	Prof. Elective	3	0	0	0	3	ST	New course	-	Employability
Nano chemistry	Prof. Elective	3	0	0	0	3	COS	Revised		Employability
Professional Communication Skills	Prof. Core	0	0	4	0	0	-	Revised	-	Skill Development
Term Paper	Prof. Core	0	0	4	0	2	-	New course	-	Skill Development
Instrumental Methods of Chemical Analysis	Prof. Elective	3	0	6	0	6	-	Revised	-	Skill Development
Chromatographic Techniques & Method Validation	Prof. Elective	2	1	0	0	3	-	Revised	-	Employability
Applied Chemical Analysis	Prof. Elective	3	0	6	0	6	-	Revised		Skill Development
Organic Synthesis	Prof. Elective	3	0	6	0	6	-	Revised	-	Skill Development
Organic Spectroscopy	Prof. Elective	2	1	0	0	3	-	Revised	-	Employability
Natural Products and Heterocyclic Chemistry	Prof. Elective	3	0	6	0	6	-	Revised	-	Skill Development
Open Elective - 1	Open Elective	3	0	0	0	3	-	New course	-	Skill Development

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25/3/23

VAC	VAC	2	0	0	0	0	-	New course	-	Skill Development
Open Elective - 2	Open Elective	3	0	0	0	3	-	New course	-	Skill Development
Dissertation	PRI	0	0	32	0	16	-	Retained	-	Skill Development

Percentage of Syllabus Revision= 61.5%

Percentage of Courses focusing on Employability= 10/27=37.03%

Percentage of Courses focusing on Entrepreneurship= Nil

Percentage of Courses focusing on Skill Development = 17/27=62.9%

25/3/23

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AAA: Percentage Change in syllabus A.Y.: 2023-24

S.No	Course Title	Existing Syllabus	New Syllabus	Topics added/removed/replaced	Changes in Course Outcome(s)	Justification for no change in percentage of change in syllabus	Revision (%)
1	Symmetry & Molecular Spectroscopy	Symmetry and Group theory in Chemistry: Symmetry elements & operations, group, subgroup, relation between order of a finite group and its subgroup. Point group of symmetry. Schonfiles symbols, representation of groups by Matrices (representation for Cn, Cnv, Cnh, Dn etc. groups to be worked out, explicitly). Character of a representation. The great orthogonality theorem (without proof) and its importance. Character tables and their use, Application of group theory in IR and Raman spectroscopy. Electronic Spectroscopy & Molecular Spectroscopy: Introduction to spectroscopy-Classification based on absorption-Emission-Importance- Characterization of electromagnetic radiation -Beer-Lambert's law-deviations from Beers law-Instrumentation-Applications-Energy levels, molecular orbital's, vibronic transition, vibrational progressions and geometry of the excited sates, Franck-Condon principle. Emission spectra: radioactive and non-radioactive decay, internal conversion, spectra of transition metal complexes, charge-transfer spectra Infrared spectroscopy: Basics of IR spectroscopy-Units of frequency wavelength- wave number-molecular vibrations-factors influencing vibrational frequencies-IR spectrometer, characterization techniques. Harmonic oscillator, vibrational energies of diatomic molecules, zero-point energy, force constant and bond strengths, anhoremonicity Morse potential energy diagram. PQR braches, Born – oppenheimer approximation, selection rules, overtones, hot bands Application Raman spectroscopy: Introduction –Principle-Classical and quantum theories of Raman effects, pure rotational, vibrational and Vibrational – rotational Raman spectra, selection rules, mutual exclusion principle,	Symmetry and Group theory in Chemistry: Symmetry elements & operations, group, subgroup, Understanding Character Tables of Symmetry Groups, relation between order of a finite group and its subgroup. Point group of symmetry. Schon files symbols, representation of groups by Matrices (representation for Cn, Cnv, Cnh, Dn etc. groups to be worked out, explicitly). Chirality and molecular vibrations. The great orthogonality theorem (without proof) and its importance. Character tables and their use, Application of group theory in IR and Raman spectroscopy. Spectroscopic methods: Introduction to spectroscopic methods (UV, IR, NMR, MS) -Electromagnetic spectrum, Quantization of Energy in the Hydrogen Atom, Quantization of Energy in poly-electronic atoms, Electronic states of diatomic and polyatomic molecules, Classification based on absorption-Emission- Importance- Characterization of electromagnetic radiation -Beer-Lambert's law-deviations from Beers Law, Franck-Condon principle. Dispersive spectrometers, Fourier Transform spectrometers, Signal to Noise Ratio, How spectra are obtained. The motion of molecules-Degrees of freedom -Energy associated with the degrees of freedom Type of spectra-Microwave spectroscopy. –Principle-Classification molecules, rigid rotator model, -Microwave spectra of diatomic molecules and polyatomic molecules. Photoelectron Spectroscopy: Basic principles, Koopman's theorem. Photoelectron spectra of simple molecules, Electron spin chemical analysis (ESCA), Auger electron spectroscopy. Electron Spin Resonance (ESR)-Spectroscopy- Theory-ESR lines and intensity-g-values -factors affecting the ESR lines- Zero field splitting and Kramer's	Replaced	CO-2,3,4	BOS members	60%

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		Resonance Raman spectroscopy, coherent antistrokes Raman Spectroscopy (CARS)-Application.Mass spectrometry: Basic Principles: instrumentation: mass spectrometer, isotope abundances; the molecular ion, metastable ions-Fragmentation of small molecules. Mossbauer Spectroscopy: Principle, Experimental Considerations and Presentation of the Spectrum - Isomer Shifts – Quadrupole splitting and Magnetic hyperfine splitting – Selection Rules. Applications-Iron Compounds: Low-spin and High-spin Fe(II) and Fe(III) Complexes - π-bonding Effects in Iron complexes - Diamagnetic and Covalent Compounds-Iodine Compounds: Isomer Shifts of I^{127} and I^{129} – Applications to Alkali metal iodides and Molecular Iodine. Motion of molecules-Degrees of freedom -Energy associates with the degrees of freedom Type of spectra- *Microwave spectroscopy*. –Principle-Classification molecules, rigid rotator model, effect of isotopic substitution on transition frequencies, Intensities non-rigid rotator-Microwave spectra of polyatomic molecules. *Photoelectron Spectroscopy*: Basic principles; photo-electric effect, ionization process, Koopman's theorem. Photoelectron spectra of simple molecules, Electron spin chemical analysis (ESCA), chemical information from ESCA, Auger electron spectroscopy.*Nuclear Magnetic Resonance Spectroscopy:* (Proton and Carbon -13 NMR) Introduction-Principle of NMR-Classical and quantum approach-Nuclear spin, nuclear resonance-Chemically & Magnetically equivalence and Non equivalence protons-The measurement of spectra: Chemical shift: the intensity of NMR signals and integration factors affecting the chemical shifts: shielding-deshielding, spin-spin coupling, (n+1) rule, Pascals triangle, coupling constant, ^{13}C NMR, chemical equivalent and non-equivalent carbons, chemical shift, Applications Electron Spin Resonance (ESR)-Spectroscopy-Theory-Instrumentation-ESR lines and intensity-g-values -factors affecting the ESR lines- Hyperfine interactions. Zero field splitting and Kramer's degeneracy. Applications of ESR for the characterization free radicals and metal compounds. X-ray diffraction-Introduction- Instrumentation-	degeneracy. Applications of ESR. Raman spectroscopy: Principle-Classical and quantum theories of Anharmonic perturbation, Raman effects, selection rules, mutual exclusion principle, Resonance Raman spectroscopy, coherent anti-stokes Raman Spectroscopy (CARS)-Application. Mossbauer Spectroscopy: Principle- Isomer Shifts – Quadrupole splitting and Magnetic hyperfine splitting – Selection Rules. Applications- X-ray Diffraction-Introduction-principle-Braggs law-Scherrer Formula-Applications. Laser spectroscopy- General principles of laser spectroscopy, features of lasers and population inversion. Examples of some common lasers –solid state, gas and dye lasers.				

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		principle-Braggs law-Scherrer formula-Applications Laser spectroscopy- General principles of laser action. features oflasers and population inversion. Examples of some common lasers –solid state, gas and dye lasers. Computer applications in chemistry-Importance of Coding-Developing of small computer codes using any one of the languages FORTRAN/C/BASIC involving simple formulae in Chemistry, such as Van der Waals equation. Rate constant, Radioactive decay (Half Life). Normality, Molarity and Morality of solutions, Nernst Equation, pH-equation					
2	Chemical bonding & Coordination Chemistry	Structure & Bonding: Shapes of molecules (VSEPR Theory, Bent's rule), Valence Bond Theory, Molecular Orbital Theory in explaining the structures of simple molecules [homonuclear diatomics (H_2, H_2^+, He_2, He_2^{2+}, Li_2, Be_2, B_2, C_2, N_2, O_2, F_2), heteronuclear diatomics (HF, CO), and polyatomic molecules (H_3, H_2O)] – role of p and d orbitals in pi bonding. Chemistry of non-transition elements: Preparation, structure, and reactions of boranes, carboranes, metallo carboranes, boron–nitrogen ($H_3B_3N_3H_3$), phosphorus–nitrogen ($N_3P_3Cl_6$), sulphur-nitrogen (S_4N_4, $(SN)_x$) cyclic compounds, interhalogens, pseudo halogens and silicates. Electron counting in boranes – Wades rules (Polyhedral skeletal electron pair theory). Chemistry of transition metal compounds: Bonding in Transition metal complexes: Valence Bond theory, Limitations of VBT, Crystal field theory - crystal field splitting patterns in octahedral, tetrahedral, tetragonal, square planar, square pyramidal and trigonal bipyramidal geometries. Calculation of crystal field stabilization energies. Factors affecting crystal field splitting energies, Spectrochemical series, Jahn – Teller effect, nephelauxetic effect, ligand field theory – Applications. Electronic spectra of transition metal complexes: Term symbols – Russell – Sanders coupling – derivation of term symbols for various configurations. Spectroscopic ground states. Selection rules, break-down of selection rules.	Structure & Bonding: Shapes of molecules (VSEPR Theory, Bent's rule), Valence Bond Theory, Molecular Orbital Theory in explaining the structures of simple molecules [homonuclear diatomic (H_2, H_2^+, He_2, He_2^{2+}, Li_2, Be_2, B_2, C_2, N_2, O_2, F_2), heteronuclear diatomic (HF, CO). Structure and bonding in boron clusters: Preparation, structure and reactions of boranes, carboranes, metallocarboranes, boron–nitrogen ($H_3B_3N_3H_3$), Electron counting in boranes–Wades rules (Polyhedral skeletal electron pair theory). Chemistry of transition metal compounds: Limitations of VBT, Crystal field theory - crystal field splitting patterns in octahedral, tetrahedral, tetragonal, square planar, square pyramidal and trigonal bipyramidal geometries. Calculation of crystal field stabilization energies. Factors affecting crystal field splitting energies, Spectrochemical series, Jahn – Teller effect. Electronic spectra of transition metal complexes: Term symbols – Russell – Sanders coupling – derivation of term symbols for various configurations. Spectroscopic ground states. Selection rules, break-down of selection rules. Orgel and Tanabe-Sugano diagrams for d1 – d9 octahedral and tetrahedral transition metal complexes of 3d series – Calculation of Dq, B and β parameters.	Replaced	CO-2,3,4	BOS members	30%

25/03/2023

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		Orgel and Tanabe-Sugano diagrams for d1 – d9 octahedral and tetrahedral transition metal complexes of 3d series – Calculation of Dq, B and β parameters. Charge transfer spectra. Magnetic properties of transition metal and inner transition metal complexes – spin and orbital moments – quenching of orbital momentum by crystal fields in complexes.					
3	Structural Organic & Stereo Chemistry	Nature of Bonding in Organic Molecules: Localized and delocalized chemical bonding, conjugation, hyper-conjugation, resonance, tautomerism. Huckel's rule- Aromaticity in benzenoid and non-benzenoid compounds, alternant and non-alternant hydrocarbons, annulenes, fullerenes metallocenes, homo-aromaticity, anti-aromaticity. Basic mechanistic concepts-kinetic versus thermodynamic control-Hammond's postulate and Curtin-Hammett principle. Organic reactions-Reactive intermediates-generation, structure, stability and reactivity of carbocations, carbanions, free radicals, carbenes and nitrenes. Effect of structure on reactivity-resonance and field effects, steric effect, quantitative treatment. Hammett equation and linear free energy relationship-substituent and reaction constants-Taft equation. Aliphatic Nucleophilic substitution: SN2, SN1, mixed SN1 and SN2, SET mechanisms. Reactivity- effects of substrates, attacking nucleophiles, leaving groups and reaction medium. Common carbocation rearrangements – primary, secondary and tertiary. The neighbouring group participation (NGP) - anchimeric assistance, NGP by σ and π- bonds, phenonium ions, norbornyl and norbornenyl systems, Classical and nonclassical carbocations, NGP by halogens and heteroatoms (O,N,S). SNi and SN2 mechanisms-Nucleophilic substitution at an allylic, and vinylic carbons. Aromatic Nucleophilic Substitution: The SNAr, SN1, benzyne and SRN1mechanisms. Reactivity - effect of substrate, structure, leaving group and attacking nucleophile. Von Richter, Sommelet - Hauser and Smiles rearrangements. Stereochemistry: Stereoisomerism-Stereoisomers Classification-Configuration and conformation. Molecular three-	Aromaticity and Aromatic electrophilic substitution: Basic definition of aromaticity, Huckel's rule, intermediates and orientation, electrophiles, reactivity and selectivity, kinetic isotopic effects; Nitration, halogenation, sulfonation, Friedel-Crafts reaction, protonation; Nucleophilic aromatic substitution. Reactive Intermediates: Carbenes, Nitrenes, Radicals, Carbo-cations, ylides, benzyne; Substitution and Elimination reactions; Acid and base concept of organic compounds; Ideal synthesis; fundamentals of retrosynthesis; Functional group transformations, umpolung and protecting groups. Reaction mechanisms: Definition of reaction mechanism, transition state theory, Substituent effects, linear free energy relationships, Hammett equation and related modifications. Basic mechanistic concepts like kinetic vs thermodynamic control, Hammond postulate, Curtin-Hammett principle, isotope effects; Oxidation and Reduction reactions, Chemistry of cyclic and acyclic compounds. Stereochemistry: Introduction, optical isomerism and chirality, resolution, conformational analysis, stereo electronic effect, and stereochemical aspects.	Replaced	CO-1,2,3,4	BOS members, Academic Peers	40%

25/03/2023

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		dimensional representations: Wedge, Fischer, Newman and Saw-horse formulae, their description and interconversions. Optical isomerism: Molecular Symmetry and Chirality-Cahn-Ingold-Prelog rules R, S-nomenclature, stereoisomerism resulting from more than one chiral center, meso and pseudo-asymmetric compounds. Axial Chirality-Stereochemistry of allenes spiranes-biphenyl derivatives and atropisomerism. Planar chirality-Ansa compounds and trans-cycloalkenes-Helicity-Helically chiral compounds. Geometrical isomerism- E, Z-nomenclature-physical and chemical methods of determining the configuration of geometrical isomers-Stereoisomerism in 3, 4 and 5-membered cyclic compounds. Free Radical Reactions: Introduction-types of free radical reactions and their detection. Free radical substitution-mechanism at aromatic substrates, free radical addition, free radical rearrangement. Reactivity of the attacking radicals-the effect of solvent on reactivity. Allylic halogenation (NBS)-oxidation of aldehydes to carboxylic acids-auto-oxidation, Radical coupling -arylation of aromatic compounds by diazonium salts-Sand Meyer reaction-Hunsdiecker reaction.					
4	Molecular Thermodynamics & Chemical Kinetics	Thermodynamics: Chemical equilibrium- effect of temperature on equilibrium constant-Van't Hoff equation. Partial molar quantity- different methods of determination of partial molar quantity. Chemical potential- Phase rule and its derivation, Gibbs-Duhem equation, Duhem-Margules equation, Classius-Clapeyron equation. Nernst heat theorem. Third law of thermodynamics-Determination of the absolute entropy- Apparent exceptions to Third law of thermodynamics. Micelles and Macromolecules: Surface active agents, classification of surface active agents, micellization, hydrophobic interaction, critical micelllar concentration (CMC), factors affecting the CMC of surfactants, counter ion binding to micelles, thermodynamics of micellization- phase separation and mass action models, solubilization, micro emulsion, reverse micelles. Polymers-Definition, types of polymers, electrically conducting, fire resistant, liquid crystal polymers,	Thermodynamics: Chemical equilibrium- effect of temperature on equilibrium constant-Van't Hoff equation. Partial molar quantity- different methods of determination of partial molar quantity. Chemical potential- Phase rule and its derivation, Gibbs-Duhem equation, Duhem- Margules equation, Classius-Clapeyron equation. Third law of thermodynamics- Determination of the absolute entropy- Apparent exceptions to Third law of thermodynamics. Micelles and Macromolecules: Surface active agents, classification of surface-active agents, micellization, hydrophobic interaction, critical micellar concentration (CMC), factors affecting the CMC of surfactants, counter ion binding to micelles, thermodynamics of micellization- micro emulsion, reverse micelles. *Polymers*- Definition, types of polymers, electrical conducting, kinetics of polymerization. Molecular	Removed	CO-1,2,3,4	BOS members, Academic Peers	20%

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		kinetics of polymerization. Molecular mass- Number and mass average molecular mass, molecular mass determination- Osmometry, viscometry, diffusion, and light scattering methods. Sedimentation, chain configuration of macromolecules, calculation of average dimensions of various structures. Chemical Kinetics: Theories of reaction rates- Collision theory- Limitations, Transition state theory. Effect of ionic strength- Debye Huckel Theory-Primary and secondary salt effects. Effect of dielectric constant, effect of substituent, Hamett equation -limitations- Taft equation. Consecutive reactions, parallel reactions, opposing reactions (Uni molecular steps only, no derivation). Specific and general acid-base catalysis. Skrabal diagram. Fast reactions- different methods of studying fast reactions- flow methods, relaxation methods- temperature jump and pressure jump methods. Photochemistry: Electronic transitions in molecules, Franck-Condon principle. Electronically excited molecules- singlet and triplet states, spin-orbit interaction. Quantum yield and its determination. Actinometry. Derivation of fluorescence and phosphorescence quantum yields. Quenching effect- Stern Volmer equation. Photochemical equilibrium and delayed fluorescence- E type and P type. Photochemical primary processes, types of photochemical reactions-photo dissociation, addition and isomerization reactions with examples.	mass- Number and mass average molecular mass, molecular mass determination- Osmometry, viscometry, calculation of average dimensions of various structures. Chemical Kinetics: Theories of reaction rates- Collision theory- Limitations, Transition state theory. Effect of ionic strength- Primary and secondary salt effects. Effect of dielectric constant, effect of substituent, Hamett equation -limitations- Taft equation. Consecutive reactions, parallel reactions, opposing reactions (Uni molecular steps only, no derivation). Specific and general acid-base catalysis. Fast reactions- different methods of studying fast reactions- flow methods, relaxation methods- temperature jump and pressure jump methods. Photochemistry: Electronic transitions in molecules, Franck-Condon principle. Electronically, excited molecules- singlet and triplet states, spin-orbit interaction. Quantum yield and its determination. Actinometry. Derivation of fluorescence and phosphorescence quantum yields. Quenching effect- Stern Volmer equation. Photochemical equilibrium and delayed fluorescence- E type and P type. Photochemical primary processes, types of photochemical reactions-photo dissociation, addition, and isomerization reactions with examples.				
5	Concepts of Organic Synthesis	Reaction mechanism: Electrophilic addition to carbon-carbon double bond: Stereoselective addition to carbon-carbon double bond; anti addition-Bromination and epoxidation followed by ring opening-Syn addition of OsO4 and KMnO4. Aliphatic Electrophilic Substitution: Bimolecular mechanism-SE2 and SE1. SE1 mechanism, electrophilic substitution accompanied bydouble bond shifts. Effects of substrate, leaving group and the solvent polarity on the reactivity. Aromatic Electrophilic Substitution:The arenium ion mechanism, orientation and reactivity, energy profile diagrams. The ortho/pararatio, hipso-attack, orientation in other ring systems. Quantitative	Modern methods of synthesis: Modern methods of synthesis and reactions of Carbonyl compounds, addition of N, O, and S nucleophiles, Reduction using hydride reagents, chemo and stereoselectivity, formation of enols and enamines, kinetic and thermodynamic enolates, Reagents: lithium and boron enolates in aldol and Michael reactions, stereoselective aldol condensations, alkylation, and acylation of enolates, condensation reactions, Claisen, Dieckman, Knoevenegal, Stobbe and Darzen glycidic ester, acyloin, emphasis on synthetic utility of these reactions, Rearrangements: earrangement reactions involving electron	Replaced	CO-1,2,3,4	BOS members, Academic Peers	40%

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		treatment of reactivity insubstrates and electrophiles. Diazonium coupling-Vilsmeir reaction, Gattermann-Koch reaction. Elimination reactions: Types of Elimination reactions-E_2. E_1, E_{1cB}-mechanisms. Orientation and stereoselectivity in E_2 eliminations-Bredt's rule, Saytzeff's rule and Hofmann's rule. Pyrolytic syn eliminations-Pericyclic reactions, Factors influencing the elimination reactions-Elimination Vs substitution. Additions involving electrophiles, nucleophiles and free radicals-Markovnikov's rule, Kharash or peroxide effect (anti-Markovnikov's rule). Addition to Carbon-Hetero Multiple Bonds: Grignard reagents, organo-zinc and organo-lithium reagents to carbonyl and unsaturated carbonyl compounds. Mechanisms-metal hydride reduction of saturated and unsaturated carbonyl compounds, acids, esters and nitriles. Carbon-Carbon bond forming reactions (condensation) involving enolates. Named reactions-Aldol, Diels-Alder reaction, Knoevenagel, Mannich, Benzoin, Perkin, Oppenauer oxidation, Clemmensen reduction, Birch reduction, Michael addition, and Stobbe reactions. Hoffmann, Claisen and Favorsky rearrangements, Hydroboration. Green Chemistry: Introduction-Basic principles of Green Chemistry, Green catalysis, Bio catalysis, Examples of Green Reactions-Synthesis of ibuprofen, clean Fischer-Indole synthesis comparison with conventional method. Natural Products: Alkaloids-General methods of extraction and isolation of natural products, classification based on nitrogen heterocyclic ring, structure elucidation and synthesis: Atropine, Papaverine and Quinine. Terpenoids-Classification of terpenoids, isolation of lower terpenoids, Isoprene, special isoprene rule and Biogenetic Isoprene rule. Structure determination and synthesis: Terpineol, Farnesol, Camphor and Abietic acid.Nano Chemistry-Introduction-Carbon Nano tubes: Structure of single and multiwalled carbon nano tubes, synthesis-solid and gaseous carbon based production technique, synthesis with Controlled orientation, Growth mechanism (catalyst free growth & catalyst activated growth) of carbon nano	deficient carbon, nitrogen, oxygen centers and the synthetic utility of these rearrangements. Coupling reactions: Heck, Suzuki, Negishi, Stille, Sonogashira coupling Pericyclic reactions: Classification, electrocyclic, sigmatropic, cycloaddition, chelotropic and ene reactions, Woodward-Hoffmann rules, frontier orbital and orbital symmetry correlation approaches, examples highlighting pericyclic reactions in organic synthesis, stereochemical aspects.				

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		tubes-applications.					
6	Separation Techniques	Chromatography: classification of different chromatographic methods, methods of development-Elution development, Gradient elution development, displacement development, and frontal analysis. Principles of chromatography, different migration, adsorption phenomena, partition, adsorption coefficient, retardation factor, retention time and volume, column capacity, temperature effects, partition isotherm. Dynamics of chromatography-efficiency of chromatographic column, zone spreading, High Equivalent Theoretical Plate (HETP), Van Deempter equation, resolution, choice of column, length and flow velocity, qualitative and quantitative analysis. Column chromatography (adsorption chromatography): principles, general aspects, adsorption isotherms, chromatographic media, nature of forces between adsorbent and solutes, eluents (mobile phase), column chromatography without detectors and liquid chromatography with detectors and applications. Paper chromatography: principle, papers as a chromatographic medium, modified papers, solvent systems, mechanism of paper chromatography, experimental technique, different development methods-ascending, descending, horizontal, circular spreading, multiple development, two dimensional development, reverse phase paper chromatographic technique-visualization and evaluation of chromatograms, applications. Thin layer chromatography: principle, chromatographic media-coating materials, applications, activation of adsorbent, sample development, solvent systems, development of chromatoplate, types of development, visualization methods, documentation, applications in the separation, HPTLC-principle, technique, applications. Capillary Electrophoresis: Principle, Details of the Instrument, Applications to Inorganic and Organic compounds. Ion Exchange: principles of ion-exchange systems,	Introduction to Separation Techniques: Types of extraction - Solid Liquid extraction and liquid liquid separation, Theory of LLE , Selection of Solvents, partition coefficient, solvent extraction, factors affecting LLE (Distillation: Fractional distillation, Molecular distillation), Problems with the LLE Process. Chromatography theory and principle: Classification of different chromatographic methods, methods of development-Elution development, Gradient elution development, displacement development, and frontal analysis. Principles of chromatography, different migration, adsorption phenomena, partition, adsorption coefficient, retardation factor, retention time and volume, column capacity, temperature effects, partition isotherm. Dynamics of chromatography-efficiency of chromatographic column, zone spreading, High Equivalent Theoretical Plate (HETP), Van Deempter equation, resolution, choice of column, length and flow velocity, qualitative and quantitative analysis. Planar and Column Chromatography: Thin layer Chromatography:- principle, chromatographic media-coating materials, applications, activation of adsorbent, sample development, solvent systems, development of chromate plate, types of development, visualization methods, documentation, applications in the separation, HPTLC-principle, technique, applications. Paper Chromatography: - Principle, papers as a chromatographic medium, modified papers, solvent systems, mechanism of paper chromatography, experimental technique, different development methods-ascending, descending, horizontal, circular spreading, multiple development, two-dimensional development, reverse phase paper chromatographic technique-visualization and evaluation of chromatograms, applications. Column Chromatography: principles, general	Replaced	CO-1,2,3,4	BOS members, Academic Peers	40%

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		synthetic ion-exchange resins, properties of anion and cation exchange resins, ion-exchange mechanism, ion-exchange equilibria, selectivity, ion-exchange capacity, applications of ion-exchangers in different fields. Ion exchange chromatography: Principle, Equipment, Application Specifically Separations of Lanthanides, Actinides, amino acids. Ion chromatography: principles of separation, instrumentation, detectors, separation of cations and anions, applications in the analysis of water and air pollutants. Solvent Extraction: principles and processes of solvent extraction, Distribution Law and Partition coefficient, nature of partition forces, different types of solvent extraction systems Batch extraction, Continuous extraction, Counter current extraction, solvent extraction systems, applications in metallurgy, general applications in analysis and pre-concentration, special extraction systems like crown ethers, super fluid and surfactant extractions-examples. Gel Exclusion chromatography or Gel filtration chromatography: principles, properties of xerogels, apparatus and detectors, resolution of gel type, applications to organic compounds.	aspects, adsorption isotherms, chromatographic media, nature of forces between adsorbent and solutes, eluents (mobile phase), column chromatography without detectors and liquid chromatography with detectors and applications. Solvent Extraction: principles and processes of solvent extraction, Distribution Law and Partition coefficient, nature of partition forces, different types of solvent extraction systems Batch extraction, Continuous extraction, Counter current extraction, solvent extraction systems, applications in metallurgy, general applications in analysis and pre-concentration, special extraction systems like crown ethers, super fluid, and surfactant extractions-examples. Capillary Electrophoresis: Principle, Details of the Instrument, Applications to Inorganic and Organic compounds.				
7	Essentials of Research Design	NEW	INTRODUCTION TO METHODOLOGY: Format of thesis and dissertation, Research article, Reviews, Monographs, Bibliography, Literature search, Significance of research, Research methods versus methodology, Research and Scientific methods, Defining the research Problem and Research design. Quantitative Methods for Problem Solving:Introduction to Statistical Modeling and Analysis, Concepts of Correlation and Regression, Fundamentals of Time Series Analysis and Spectral Analysis, Error Analysis, Applications of Spectral Analysis. Physical Statistical Methods:Definition and Scope; Types of data; Collection and presentation of Data (Tables, Graphs, Diagrams); Measure of Central Tendency; Dispersion; Goodness of fit (X2 Test).Sampling Fundamentals:Census and sample Survey, Steps in sample design, Different types sample design, Selection of a random sample, Estimation, Estimating the population mean and population	Added	CO-1,2,3,4	BOS members, Academic Peers, Student members	100%

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			proportion.Interpretation and Report Writing:Meaning of interpretation; Techniques of interpretation; Precautions in Interpretation; Significanceof Report writing; Different steps in Report writing; Layout of Research Project; Types of Reports;Patent writing and filing and Oral presentation.				
8	Reaction Mechanism & Organometallic Chemistry	Reactivity of coordination complexes: Kinetics of reactions – inert and labile complexes, associative, dissociative and interchange mechanisms – ligand substitution reactions in octahedral and square planar complexes, acid and base hydrolysis reactions, electron transfer reactions – inner and outer sphere electron transfer mechanisms. Metal Ligand equilibria in solution: Thermodynamics of complex formation in aqueous medium – stepwise and overall formation constants – factors affecting formation constant – determination of formation constant – chelate and macrocyclic effects; isomerism and chirality of coordination complexes – concepts of acids and bases in gas phase and effect of solvation – hard and soft acid base principle. Organometallic complexes of d-block element :16 and 18 electron rules – synthesis, structure and bonding of complexes with sigma and pi donor ligands (H^-, H_2, alkane, phosphine, N_2, CO, NO, allyl, alkene, alkyne, cyclopentadiene, benzene, cyclooctatraene etc.) – carbenes, carbynes and metallocenes. Organometallic reactions and catalysis: ligand substitution, addition and elimination reactions, migratory insertion reaction in organometallic complexes, metal-metal bonds, carbonyl and non-carbonyl clusters,isolobal analogy, application of Wade's rule, metal cluster compounds, Zintle ions, Chevrel phases. Catalysis: Homogeneous (Hydrogenation, hydroformylation, acetic acid synthesis, metathesis and olefin oxidation) and heterogenous (Fischer-Tropsch reaction, Ziegler-Natta polymerization, Haber process).	Reactivity of coordination complexes – inert and labile complexes –ligand substitution reactions in octahedral and square planar complexes – Trans effect– electron transfer reactions – inner and outer sphere electron transfer mechanisms. Thermodynamics of complex formation in aqueous medium – stepwise and overall formation constants –factors affecting formation constant – determination of formation constant- HSAB principle to explain the stability of coordination compounds. Organometallic complexes of d-block element – 16 and 18 electron rules – Synthesis, structure and spectral properties of metal carbonyl and metal nitrosyl complexes-Fischer and Schrock carbene complexes. Metal clusters – metal-metal bonds – carbonyl and non-carbonyl clusters – isolobal analogy and application of Wade's rule – Zintle ions – Chevrel phases. Catalysis: Homogeneous (Hydrogenation, hydroformylation, acetic acid synthesis, metathesis and olefin oxidation) and hrterogenous (Fischer-Tropsch reaction, Ziegler Natta Polymerization, Haber process).	Replaced	CO-1,2,3,4	BOS members, Academic Peers	40%

9	Quantum, Surface & Electrochemistry	Quantum Mechanics: Introduction to quantum mechanics. Schrödinger wave equation. Time-independent and timedependent Schrödinger wave equations and the relation between their solutions. Eigenfunctions and Eigenvalues. Physical Interpretation of wave function. Concepts of Operators:Laplacian, Hamiltonian, Linear and Hermition operators. Angular Momentum operators and their properties. Commutation of operators. Normalization, orthogonality and orthonormality of wave functions. Average (expectation) values. Postulates of quantum mechanics. Solutions of Schrödinger wave equation for a free particle, particle in a ring, particle in a three dimensional box. Quantum mechanical degeneracy, tunneling (no derivation). Application of Schrödinger equation to harmonic oscillator, rigid rotator. Eigenfunctions and eigenvalues of angular momentum. Ladder operator method for angular momentum. Surface phenomena : Types of adsorption isotherms, Effect of temperature on adsorption,Mechanical adsorption, Estimation of surface area using BET equation, Gibbs adsorption isotherm and its significance, Surface tension and surface energy, Pressure difference across curved surface (Laplace equation), Vapour pressure of droplets (Kelvin equation), Surface film on liquids (electro-kinetic phenomena), Catalytic activity of surfaces Electrochemistry: Activity coefficients and ion-ion interactions. Physical significance of activity coefficients, mean activity coefficient of an electrolyte and its determination. Derivation of the Debye-Hückel theory of activity coefficients The electrode-electrolyte interface. The electrical double layer. The Helmholtz-Perrin parallel-plate model, the Gouy-Chapman diffuse-charge model and the Stern model.Electrodics: Charge transfer reactions at the electrode-electrolyte interface. Exchange current density and overpotential. Derivation of Butler-Volmer equation. High field approximation, Tafel equation, Low field equilibrium, Nernest equation. Voltametry-Concentration polarization, experimental techniques. *Statistical Thermodynamics:* Fundamentals: Idea of microstates and macrostates.	**Quantum Mechanics:** Introduction to quantum mechanics. Schrödinger wave equation. Time-independent and time dependent Schrödinger wave equations and the relation between their solutions. Eigenfunctions and Eigenvalues. Physical Interpretation of wave function. Concepts of Operators: Laplacian, Hamiltonian, Linear and Hermition operators. Angular Momentum operators and their properties. Commutation of operators. Normalization, orthogonality and orthonormality of wave functions. Average (expectation) values. Postulates of quantum mechanics. Solutions of Schrödinger wave equation for a free particle, particle in a ring, particle in a three-dimensional box. Quantum mechanical degeneracy, tunneling (no derivation). Application of Schrödinger equation to harmonic oscillator, rigid rotator. **Surface phenomena:** Types of adsorption isotherms, Effect of temperature on adsorption, Mechanical adsorption, Estimation of surface area using BET equation, Gibbs adsorption isotherm and its significance, Surface tension and surface energy, Pressure difference across curved surface (Laplace equation), Vapour pressure of droplets (Kelvin equation), Surface film on liquids (electro-kinetic phenomena), **Electrochemistry**: Activity coefficients and ion-ion interactions. Physical significance of activity coefficients, mean activity coefficient of an electrolyte and its determination. Derivation of the Debye-Hückel theory of activity coefficients the electrode-electrolyte interface. The electrical double layer. The Helmholtz-Perrin parallel-plate model, the Gouy-Chapman diffuse-charge model and the Stern model. Electrodics: Charge transfer reactions at the electrode-electrolyte interface. Derivation of Butler-Volmer equation.Tafel equation, Low field equilibrium, Nernest equation. ***Statistical Thermodynamics:*** Fundamentals: Idea of microstates and macro states. Concept of distributions- Binomial & multi-nomial distributions for non-degenerate and degenerate systems, Thermodynamic probability, and most probable distribution. Canonical and other ensembles. Statistical mechanics for systems of independent particles and its importance in chemistry. Types of statistics: Boltzmann, Bose-	Removed	CO-1,2,3,4	BOS members, Academic Peers	20%

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		Concept of distributions- Binomial & multi-nomial distributions for non-degenerate and degenerate systems. Thermodynamic probability and most probable distribution. Canonical and other ensembles. Statistical mechanics for systems of independent particles and its importance in chemistry. Types of statistics: Boltzmann, Bose-Einstein and Fermi-Dirac statistics. Thermodynamic probability (W) for the three types of statistics. Derivation of distribution laws (most probable distribution) for the three types of statistics. Lagrange's undetermined multipliers. Stirling's approximation, Molecular partition function and its importance. Assembly partition function.	Einstein. and Fermi-Dirac statistics. Thermodynamic probability (W) for the three types of statistics. Derivation of distribution laws (most probable distribution) for the three types of statistics. Lagrange's undetermined multipliers.				
10	Biomolecules	NEW	**Carbohydrates:** Classification, Physicochemical properties- stereochemistry- Chemistry, Structure and functions of monosaccharides, disaccharides, polysaccharides- Mucopolysaccharides- Deoxy sugars, amino sugars, reactions of carbohydrates- Proteoglycans, Glycoproteins and Glycolipids- separation of carbohydrates. **Amino acids & Proteins:** α- Amino acids: Classification, Structure Physicochemical properties, and biological significance- synthesis and reactivity; Peptides: bond, Peptides of biological importance; Chemical synthesis of peptides – Solid phase peptide synthesis; Proteins – Classification, Isolation, Purification and Characterization of proteins, structure, functions, properties, and significance; Enzymes- Characteristics and functionality. **Nucleic Acids:** Basic Structure, Biological significance, Reactions of Nucleic acid bases, Physicochemical properties of Nucleic Acids, DNA-structure, denaturation, RNA, Functions of Nucleotides, Structure, and properties of nucleotides, nucleosides, purine (Adenine, Guanine) and pyrimidine (Cytosine, Thiamine, Uracil) bases. Structural features of nucleic acids (DNA & RNA) and their biological functions. **Lipids:** Classification, role of lipids, fatty acids and glycerol derived from oils and fats; Physical properties - polymorphism, reactions of fats, rancidity, reversion, polymerization, saponification, addition, hydrogenation, phospholipids, lipid metabolism; intermediary metabolism of fatty acids, synthesis of fatty acids.	Added	CO-1,2,3,4	By the recommendations of academic peers, industry persons and Parents	100%
11	Biosensors and Diagnostic Devices	NEW	Introduction to Biosensors: Definition and historical perspective, Various components of biosensors, working mechanism, Probes: antibodies, nucleic acids, enzymes, receptors etc. Methods for probe attachment to surfaces	Added	CO-1,2,3,4	By the recommendations of Faculty &Industry Peers	100%

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			Adsorption; chemisorption, physisorption, polymer trapping, covalent attachment, film deposition techniques; molecularly imprinted polymers and biomimicry. Biosensor construction and modification, Electrodes: carbon (graphene, carbon nanotubes, fullerene, corannulene) metal nanoparticles, polymer, nanocomposites, Thin-Film Electrodes and Screen-Printed electrodes etc. based electrodes. Sensor characteristics: calibration, dynamic range, signal-to-noise ratio, sensitivity, selectivity, interference etc. Surface characterization and Transducers: Techniques used to characterize biosensors (UV-Vis, FT-IR, SEM, AFM, XPS, XRD etc.), Various types of transducers and detection methods; principles of Calorimetric, Optical, Electrochemical, Impedimetric, and Chemiluminescence-based Biosensors. Design and Applications of Biosensors: Fabrication and applications of colorimetric, fluorescence, voltametric, amperometric, and optical biosensors. Working principles of some commercialized biosensors-Glucose biosensor, Urea/Uric Acid biosensor, Pregnancy test biosensor etc. Immunosensors and clinical applications, Biosensors for drug resistance and environmental pollution. Diagnostic Devices: Point of care device, necessity and applications, Lab-on-Chip platform, Microfluidic device, Introduction-antigen-antibody binding and assays; Immunoassays –types (RIA, ELISA, Chemiluminescent IA, FIA), working mechanism of few commercial point of care devices.				
12	Nano chemistry	Scope and importance of nanoscience and nanotechnology. Synthetic Methods: Chemical Routes: Physical methods, Techniques for characterization. BET method for surface area analysis. Dynamic light scattering for particle size determination. Synthesis, properties and applications of fullerenes, carbon nanotubes, core-shell nanoparticles, self-assembled monolayers, nanocrystalline materials, magnetic nanoparticles thermoelectric materials. Non-linear optical materials, liquid crystals.	Introduction: Scope and importance of nano chemistry. Types of nanostructures, Properties of nanomaterials: Chemical, and Physical. Role of particle size, Concept of confinement, strong and weak confinement with suitable examples, Size and shape dependent optical, electronic, photonic, magnetic, properties. Synthesis: Bottom-up synthesis of nanomaterials: Chemical precipitation; Sol-gel synthesis; Microemulsions or reverse micelles; Hydrothermal routes, Microwave heating synthesis; Top-down synthesis of nanomaterials:	Added	CO-1,2,3,4	By the recommendations of Faculty &Industry Peers	60%

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			ball milling, photolithography, laser ablation, CVD. Green pathways to synthesize nanomaterials. Characterization methods: X-ray absorption spectroscopy, BET method for surface area analysis. Dynamic light scattering for particle size determination. Metal nanoparticles in catalysis: Catalysis by nanoparticles in Gas-Phase Reactions: CO Oxidation, Propylene Epoxidation, Catalysis by nanoparticles in Liquid-Phase Reactions: Hydrogenations, Coupling Reactions (Sonogashira, Hiyama–Denmark, Heck-Mizoroki, Suzuki-Miyaura Cross-Coupling), Oxidation of Alcohols (Alcohols to Aldehydes, Aldehydes to Carboxylic Acids, Esterification of Alcohols and Aldehydes). Applications of nano chemistry in energy, environment, and health. Hydrogen energy and development. Hydrogen storage. Carbon capture, Transformation of CO_2 to fine chemicals. Environmental remediation by chemical degradation/removal of contaminants. Nanomaterials as sorbents.				
13	Professional Communication Skills	NEW	Basic Grammar - Countable and uncountable nouns, present simple and continuous, past simple and continuous – classroom practice – Understand and interpret Texts and workplace situations B) Structural Pattern - Present continuous for future arrangements State verbs, Regular and irregular verbs, Voice, Modal verbs – Reporting on going tasks in the corporate world. C)Descriptive and Qualitative Patterns: Adjectives and Adverbs classroom practice) Time Expressions, Comparatives and superlatives, Pronouns, Conditionals, Phrases and clauses (Including Relative). COMPETENCY: 2: a) Formal contexts: Being a PA, describing changes in a company Taking orders over the phone. b) Listening & Speaking: Participate in conversation with proper contextual language markers, turn taking. Classroom practice- Presenting context, reason, problem – Case analysis (short). Body Language: Dos and Don'ts of one-to-one interaction, Telephone interaction Video/ web conferencing. Culture	Added	CO-1,2,3,4	By the recommendations of Faculty &Academic peers.	100%

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			specific practices. Work Etiquette- situation, ambience, team skills, time management and leadership ability. COMPETENCY: 3: Understand and assimilate main ideas and specific details. (250-300 words text of moderate difficulty). A) Read for general understanding, interpreting, factual or specific information, for grammatical accuracy and information transfer. B) Understand the general meaning of corporate context and office correspondence. d)Understand short reports of predictable nature. COMPETENCY:4: a) Internal Correspondence. Making notes on routine matters, such as, taking/ placing orders. B) Emails: Types of emails, salutations, vocabulary used in formal and informal (Including beginnings and endings). C)Writing straight-forward, routine letters of factual nature.				
14	Term Paper	NEW	NEW	Added	NEW	Recommendations of faculty and academic peers.	100
15	Instrumental Methods of Chemical Analysis	UV-Visible Spectroscopy: laws of absorption, deviation from Beer's law, single and double beam spectrophotometers- instrumentation, sources of radiation, detectors, qualitative analysis by absorption measurements, general precautions in colorimetric determinations, determination of certain metal ions by using ligands – Fe^{2+}, Fe^{3+}, Al^{3+}, NH^{4+}, Cr^{3+}, Cr^{6+}, Co^{3+}, Cu^{2+}, Ni^{2+} and anions – NO^{2-}, PO_4^{3-} using suitable reagents, simultaneous determinations of dichromate and permanganate in a mixture, spectrophotometric titrations, principle of diode array spectrophotometers. Spectrofluorimetry: Theory of fluorescence, phosphorescence, factors affecting the above, quenching, relation between intensity of fluorescence and concentration, instrumentation, application with reference to Al^{3+}, chromium salts, fluorescence, thiamin (B1) and riboflavin (B2) in drug samples. Chemiluminescences: Introduction, principle, types Measurement of chemiluminescence, Instrumentation quantitative	Electro analytical Methods of Analysis: Polarographic principles, polarogram and polarographic currents, charging or capacitive current, role of supporting electrolyte, factors affecting on polarographic wave, Ilkovic Equation, advantages and disadvantages of DME, polarographic maxima and maxima suppresors, interference due to dissolved oxygen, Applications, numerical problems. Differential pulse polarography, square wave polarography, Anode stripping voltametry: principle, instrumentation, Hanging mercury drop electrode, application in the analysis of Pb and Cd in environmental samples, principle of cathode stripping voltammetry. Principle of cyclic Voltammetry, cyclic voltamogram of K3[Fe(CN)6], and parathion, criteria of reversibility of electrochemical reactions, quasireversible and irreversible processes. Coulometric analysis: principles of coulometric analysis with constant current, coulometric	Removed	CO-1,2,3,4	By the recommendations of BOS members &Faculty	30%

		chemiluminescences Gas phase chemiluminescence's analysis Chemiluminescences titrations, Electro-chemiluminescence. Infrared spectroscopy: Units of frequency, wavelength and wave number molecular vibrations, factors influencing vibrational frequencies, instrumentation, sampling techniques, detectors, characteristic frequencies of organic molecules, qualitative and quantitative analysis with reference to (petroleum refinery and polymer industry), selected molecules like CO, CO_2, non-destructive IR method for the analysis of CO and other organic compounds, principles of Fourier transform IR. Mass Spectroscopy: Principle, basic instrumentation, energetics of ion formation, types of peaks observed, resolution, qualitative analysis, molecular weight determination, quantitative analysis, advantages. X-ray Spectroscopy: chemical analysis by X-ray spectrometers, energy dispersive and wavelength dispersive techniques, evaluation methods, instrumentation, matrix effects, applications. An Introduction to Microscopy (surface characterization techniques) Limitations of the Human Eye, the X-ray Microscope, The Transmission Electron Microscope, The Scanning Electron Microscope, Scanning Transmission Electron Microscope, Analytical Electron Microscopy, Scanning-Probe Microscopes, the transmission electron microscope. Electro analytical Methods of Analysis: Polarographic principles, Instrumentation (different types of microelectrode such as dropping mercury electrode, the static drop mercury electrode, rotating disc and ring disc electrode, cell for polarography, reference and counter electrode and circuit diagram), polarogram and polarographic currents, charging or capacitive current, role of supporting electrolyte, factors affecting on polarographic wave, Ilkovic Equation, advantages and disadvantages of DME, polarographic maxima and maxima suppresors, interference due to dissolved oxygen, Applications (qualitative analysis, quantitative analysis by calibration curve and standard addition methods), specific examples of analysis–analysis of Cu, Cd, Zn, Pb, etc. from tap water and alloys., problems. Pulse Polarography: different types of excitation	analysis with controlled potential, applications of coulometric methods for the analysis of cations-As (III), Fe (II) and I- and S2- by using I2 liberations and Ce4+ liberation in solutions. UV-Visible Spectroscopy: Single and double beam spectrophotometers-instrumentation, sources of radiation, detectors, determination of certain metal ions by using ligands, simultaneous determinations of dichromate and permanganate in a mixture, spectrophotometric titrations. Spectrofluorimetry: Theory of fluorescence, phosphorescence, factors affecting the above, quenching, the relation between the intensity of fluorescence and concentration,Chemiluminescence, Electroluminescence and Bioluminescence (Principle and Applications). Infrared spectroscopy: Principle, instrumentation, molecular vibrations, factors influencing vibrational frequencies, sampling techniques, characteristic frequencies of organic molecules, principle of Fourier transform IR. Mass Spectroscopy: Principle, basic instrumentation, ionization techniques, fragmentation rules, interpretation of mass spectra. Spectro-Analytical Methods of Analysis: Flame photometry: theory, instrumentation, applications Atomic Absorption Spectrometer: theory, instrumentation, radiation source, applications. Inductively coupled plasma, principle of ICP-OES and ICP-MS. Thermal methods of Analysis: Thermo gravimetry-theory, instrumentation, applications with examples, Differential thermal analysis-principle, instrumentation, Differential scanning calorimetry-principle, instrumentation, applications. Radio chemical methods of analysis: detection and measurement of radioactivity, introduction to radioactive tracers, applications of tracer technique, isotope dilution analysis-applications, activation analysis-application, advantages and disadvantages, radiocarbon dating technique and applications, Radiochemical Immunoassay and clinical applications.				

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		signals in pulse polarography. Differential pulse polarography, square wave polarography, Stripping method. Voltametry with ultra microelectrode, Applications of these techniques Cu and Zn from tap water by differential pulse polarography and by square wave polarography, Vitamin-C by differential pulse polarography Anode stripping voltametry: principle, instrumentation, Hanging mercury drop electrode, application in the analysis of Pb and Cd in environmental samples, principle of cathode stripping voltammetry. Principle of cyclic Voltammetry, cyclic voltamogram of $K_3[Fe(CN)_6]$, and parathion, criteria of reversibility of electrochemical reactions, quasireversible and irreversible processes. Coulometric analysis: principles of coulometric analysis with constant current, coulometric analysis with controlled potential, applications of coulometric methods for the analysis of cations-As (III), Fe (II) and I^- and S^{2-} by using I_2 liberations and Ce^{4+} liberation in solutions Spectro-Analytical Methods Of Analysis: Flame photometry: theory, instrumentation, combustion flames, detectors, and analysis of Na, K, Ca, Mg etc. Atomic Absorption Spectrometer: theory, instrumentation, flame and non-flame techniques, resonance line sources, hollow cathode lamp, instrumentation, chemical and spectral interferences, applications with special reference to analysis of trace metals in oils, alloys and toxic metals in drinking water and effluents. Inductively coupled plasma spectrometer (ICP-AES, ICP-MS): principles, instrumentation, plasma, AES detectors, quadrupole mass spectrometers, difference between the two detectors, analysis methods for liquids and solids, applications in the analysis of trace and toxic metals in water, geological and industrial samples Thermal methods of Analysis: Thermo gravimetry-theory, instrumentation, applications with special reference to $CuSO_4.5H_2O$, $CaC_2O_4.2H_2O$, $CaCO_3$, $(COOH)_2.2H_2O$ Differential thermal analysis-principle, instrumentation, difference between TG and DTA-applications with special reference to the clays and minerals, coals (fuels). Differential scanning calorimetry-principle, instrumentation, applications to inorganic materials like chlorates and per chlorates,					

25/03/2023

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		ammonium nitrate, organic compounds and Drugs Radio chemical methods of analysis: detection and measurement of radioactivity, introduction to radioactive tracers, applications of tracer technique, isotope dilution analysis-applications, activation analysis – application, advantages and disadvantages, radio carbon dating technique.					
16	Chromatographic Techniques & Method Validation	Gas chromatography: Theory, Instrument description of equipment and different parts, columns (packed and capillary columns), detector specifications-thermal conductivity detector, flame ionization detector, electron capture detector, nitrogen-phosphorus detector, photo ionization detector, programmed temperature gas chromatography; applications in the analysis of gases, petroleum products etc., other detectors used their Principles and Applications. GC-MS-Introduction: Instrumentation – GC – MS interface – Mass spectrometer (MS) Instrument operation, processing GC – MS data – ion chromatogram Library searching – Quantitative measurement-sample preparation Selected ion monitoring – Application of GC-MS for Trace constituents, Drugs analysis, Environmental analysis and others. Liquid-liquid partition chromatography: Principle supports, partitioning liquids, eluents, reverse phase chromatography, apparatus and applications. High performance liquid chromatography: Theory, Instrument description of the different parts of the equipment, columns, detectors-UV detector, refractometric detector, Fluorescence detector, Diode Array detector, applications in the separation of organic compounds, names of other detectors used their Principles and Applications. LC-MS: Introduction-Instrumentation-liquid chromatograph-Mass spectrometer Interface Instrumental details-Processing LC-MS data-ion chromatograms-Library searching-Quantitative measurements. Sample preparation – selected ion monitoring. Application of LC-MS for Drug analysis, Environmental samples and others. Inorganic molecular sieves: structure of zeolites, crystals, types of sieves, application in the separation of gases including hydrocarbons, ion	Gas chromatography: Theory, Instrument description of equipment and different parts, columns (packed and capillary columns), detector specifications-thermal conductivity detector, flame ionization detector, electron capture detector, nitrogen-phosphorus detector, photo ionization detector, programmed temperature gas chromatography; applications in the analysis of gases, petroleum products etc., other detectors used their Principles and Applications. GC-MS-Introduction: Instrumentation – GC – MS interface – Mass spectrometer (MS) Instrument operation, processing GC – MS data – ion chromatogram Library searching – Quantitative measurement-sample preparation Selected ion monitoring – Application of GC-MS for Trace constituents, Drugs analysis, Environmental analysis, and others. Liquid-liquid partition chromatography: Principle supports, partitioning liquids, eluents, reverse phase chromatography, apparatus, and applications. High performance liquid chromatography: Theory, Instrument description of the different parts of the equipment, columns, detectors-UV detector, refractometric detector, Fluorescence detector, Diode Array detector, applications in the separation of organic compounds, names of other detectors used their Principles and Applications. LC-MS: Introduction-Instrumentation-liquid chromatograph-Mass spectrometer Interface Instrumental Details-Processing LC-MS data-ion chromatograms-Library Searching-Quantitative measurements. Sample preparation – selected ion monitoring. Application of LC-MS for Drug analysis, Environmental samples, and others. Inorganic molecular sieves: structure of zeolites, crystals,	Replaced	CO-1,2,3,4	By the recommendations of BOS members &Faculty	30%

25/05/2020

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		exclusion-principles and applications. Counter current chromatography-principles and application. Affinity chromatography-principles and applications. Analytical Method Developments and validation: Importance of Qualitative and Quantitative analysis in research and development, industries and other branches of science. Development and validation of an analytical method, units, concentrations, calculations, standards, chemical reactions, expressions of concentrations. Introduction, Dissolution test. Apparatus –USP type –I and II, Sampling and analytical instrumentation, Single point test Vs. Dissolution profile, Calibration, regulatory guidelines, analytical validation, linearity, accuracy, precision, specificity. Limit of quantification, sensitivity, ruggedness and robustness, analyte stability in the sample matrix, how to reduce systematic errors, mean and standard deviation, reliability of results, confidence interval, comparison of results, comparison of two means of two samples, experimental design. Sampling of solids, liquids and gases.	types of sieves, application in the separation of gases including hydrocarbons, ion exclusion-principles and applications, Counter current chromatography-principles and application, Affinity chromatography-principles and applications. Analytical Method Developments and validation: Importance of Qualitative and Quantitative analysis in research and development, industries, and other branches of science. Development and validation of an analytical method, units, concentrations, calculations, standards, chemical reactions, expressions of concentrations. Introduction, Dissolution test, Apparatus –USP type –I and II, Sampling and analytical instrumentation, Single point test Vs. Dissolution profile, Calibration, regulatory guidelines, analytical validation, linearity, accuracy, precision, specificity. Limit of quantification, sensitivity, ruggedness and robustness, analyte stability in the sample matrix, how to reduce systematic errors, mean and standard deviation, reliability of results, confidence interval, comparison of results, comparison of two means of two samples, experimental design. Sampling of solids, liquids and gases.				
17	Applied Chemical Analysis	Analysis of Ores: General techniques of analysis applied to complex materials - Scope of metallurgical analysis-General methods of dissolution of complex materials - Various chemical methods for the effective separation of the constituents in the complex materials. Analysis of ores: Iron ore- Analysis of the Constituents – Moisture, loss of ignition, Total Iron, ferrous Iron, Ferric Iron, alumina, silica, Titania, Lime, Magnesia, Sulphur, phosphrous, manganese, alkalies, combined water, Carbon in blast furnace, flue dust and sinter. Manganese Ore-Analysis of the Constituents– Total Manganese, MnO_2, SiO_2, BaO, Fe_2O_3, Al_2O_3, CaO, P and S Chromite Ore - Analysis of the Constituents-Chromium, SiO_2, FeO, Al_2O_3 CaO, & MgO. Phosphate rock Ore - Analysis of the Constituents-CaO, P_2O_5, F, SiO_2, CO_2, S, Na_2O, Al_2O_3, Fe_2O_3, Mgo, K_2O, Cl, MnO. Organic carbon, Moisture, Loss of ignition.	Analysis of raw materials: Analysis of non-ferrous alloys: Brass – Analysis of the constituents – Cu, Zn, Sn, Pb and Fe. Bronze - Analysis of the constituents -Cu, Sn, Zn, Pb and Fe. Solder - Analysis of the constituents – Sn, Pb and Sb. Analysis of Ferro alloys : Ferro silicon - Analysis of the constituents – Si, C, P,S Ferro vanadium- Analysis of the constituents – V, C, P, S. Si, Al. Ferro manganese - Analysis of the constituents – Mn, S, C, P, Si Silico manganese - Analysis of the constituents –Mn, S, C, P, Si Ferro chromium - Analysis of the constituents – Cr, C, Si. Analysis of Soil, Fertilizer and Fuel: Analysis of soils: sampling, determination of moisture, total N, P, Si, lime, humus nitrogen, alkali salts, soil absorption ratio. Analysis of fertilizers: ammonical fertilizers, Phosphate fertilizers, Nitrate fertilizers. Analysis of fuels: solid fuels-coal, proximate analysis, ultimate analysis,	Replaced	CO-1,2,3,4	By the recommendations of BOS members &Faculty	40%

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		Aluminium Ore (Bauxite)-Analysis of the Constituents-Silica, Alumina, Fe_2O_3, Titania, MnO, P_2O_5, CaO, MgO, vanadium, zirconium, and alkalies. Analysis of Finished Products: Analysis of steel for C, Si, S, P, Mn, Ni, Cr, Mg and analysis of blast furnace slag. Analysis of refractory materials: fire clay, flour spar, and magnesite Analysis of fluxes - limestone and dolomite. Chemical Analysis of cement-silica, NH_4OH group, ferric oxide, alumina, lime, magnesia, Sulphide Sulphur , K_2O,Na_2O, free CaO in Cement and Clinker, SO_3 and loss on ignition. Analysis of oils-saponification number, iodine number, and acid number. Analysis of soaps - moisture, volatile matter, total alkali, total fatty matter, free caustic alkali or free fatty acids, sodium silicate, chloride. Analysis of paints-vehicle and pigment, $BaSO_4$, total lead and lead chromate. Assessment of water Quality: Sources of water, classification of water for different uses, types of water pollutants and their effects, Analytical methods for the determination of the following ions in water: Anions: CO_3^{2-}, HCO^{3-}, F^-, Cl^-, SO_4^{2-}, PO_4^{3-}, NO^{3-}, NO^{2-}, CN^-, S^{2-} Cations: Fe^{2+}, Fe^{3+}, Ca^{2+}, Mg^{2+}, Cr^{3+}, As^{5+}, Pb^{2+}, Hg^{2+}, Cu^{2+}, Zn^{2+}, Cd^{2+}, Co^{2+} Determination of Dissolved oxygen (D.O), Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD), standards for drinking water. Analysis of raw materials: Analysis of non-ferrous alloys: Brass – Analysis of the constituents – Cu, Zn, Sn, Pb and Fe. Bronze - Analysis of the constituents -Cu, Sn, Zn, Pb and Fe. Solder - Analysis of the constituents – Sn, Pb and Sb. Analysis of Ferro alloys : Ferro silicon - Analysis of the constituents – Si, C, P,S Ferro vanadium - Analysis of the constituents – V, C, P, S. Si, Al. Ferro manganese - Analysis of the constituents – Mn, S, C, P, Si Silico manganese -Analysis of the constituents –Mn, S, C, P, Si Ferro chromium - Analysis of the constituents – Cr, C, Si. Analysis of Soil, Fertilizer and Fuel: Analysis of soils: sampling, determination of moisture, total N, P, Si, lime, humus nitrogen, alkali salts, soil absorption ratio. Analysis of fertilizers: ammonical fertilizers, Phosphate fertilizers, Nitrate fertilizers. Analysis of fuels: solid fuels-coal, proximate	heating value, grading of coal based on Ultimate Heat Value (UHV). ASSESSMENT OF AIR QUALITY: Composition of Pure Air, Classification of Air Pollutants, Toxic Elements Present in Dust, and their Sources – Collection of Air Samples. Sources, Effects, Control of Pollution and Chemical Analysis for the following. Primary Pollutants: Carbon compounds - Carbon monoxide (CO) and Carbon dioxide (CO2). Sulphur compounds- sulphur dioxide (SO2), Sulphur trioxide (SO3) and Hydrogen Sulphide (H2S). Nitrogen compounds - nitric oxide (NO), and nitrogen dioxide (NO2), Hydrocarbons - Aliphatic hydrocarbons and polycyclic aromatic hydrocarbons (PAH). Particulate matter - Repairable and Suspended particulate matter, Inorganic and Organic particulates. Secondary pollutants - ozone (O3), peroxy acetyl nitrate (PAN), peroxy benzyl nitrate (PBN), Standards for ambient air quality. Kinetic Methods of Analysis & Non aqueous Titrimetry: Kinetic methods of analysis: introduction, slow reactions, catalyzed reactions, methods of determination of catalyst concentration, extrapolation method for the determination of catalyst, variable time method, fixed time method, examples for the determination of toxic metals and anions using some typical kinetic reactions. Non aqueous titrimetry: Classification of solvents and titrations for non-aqueous titrimetry- Types of reactions – Indicators. Determination of acids Determination of bases Karl-Fisher reagent for the determination of moisture content in drugs and other samples.				

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		analysis. ultimate analysis. heating value, grading of coal based on Ultimate Heat Value (UHV). ASSESSMENT OF AIR QUALITY: Composition of Pure Air, Classification of Air Pollutants, Toxic Elements Present in Dust and their Sources – Collection of Air Samples. Sources, Effects, Control of Pollution and Chemical Analysis for the following. Primary Pollutants: Carbon compounds - Carbon monoxide(CO) and Carbon dioxide(CO_2). Sulphur compounds-sulphur dioxide (SO_2), Sulphur trioxide (SO_3) and Hydrogen Sulphide (H_2S). Nitrogen compounds - nitric oxide (NO), and nitrogen dioxide (NO_2),Hydrocarbons - Aliphatic hydrocarbons and polycyclic aromatic hydrocarbons (PAH). Particulate matter - Repairable and Suspended particulate matter, Inorganic and Organic particulates. Secondary pollutants - ozone (O_3), peroxy acetyl nitrate (PAN), peroxy benzyl nitrate (PBN), Standards for ambient air quality. Kinetic Methods of Analysis & Non aqueous Titrimetry: Kinetic methods of analysis: introduction, slow reactions, catalyzed reactions, methods of determination of catalyst concentration, extrapolation method for the determination of catalyst, variable time method, fixed time method, examples for the determination of toxic metals and anions using some typical kinetic reactions. Non aqueous titrimetry: Classification of solvents and titrations for non-aqueous titrimetry- Types of reactions – Indicators. Determination of acids Determination of bases Karl-Fisher reagent for the determination of moisture content in drugs and other samples.						
18	Organic Synthesis	Formation of Carbon-Carbon single bounds: alkylations via enolate the enamine and related reactions, umplong (dipole inversion) reactions – the aldol reaction – applications of organo palladium, organo nickel and organo copper reagents, applications of α-thiocarbonions, selenocarbonions and sulphur ylides, synthetic applications of carbenes and carbenoids. Formation of carbon-carbon double bonds: Elimination reactions Pyrolytic, syneliminations, sulphoxide-	Formation of Carbon-Carbon bonds: alkylation via enolate the enamine and related reactions, umplong (dipole inversion) reactions – the aldol reaction – applications of organo palladium, organo nickel and organo copper reagents, applications of α-thio carbanions, seleno carbonions and sulphur ylides, synthetic applications of carbenes and carbenoids. Elimination reactions Pyrolytic, syn-eliminations, sulphoxide-sulphonate	Replaced	CO-1,2,3,4	By the recommendations of BOS members &Faculty	20%

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		sulphonate rearrangement the witting reaction-alkenes from arylsulphonyl hydrazones. claisen rearrangement of allyl vinylethers. Organoboranes: Preparation of Organobornaes viz hydroboration with BH_3-THF, dicyclohexyl borane, disiamyl borane, thexyl borane, 9-BBN and diisopino camphenyl borane, functional group transformations of Organo boranes-Oxidation, protonolysis and rearrangements. Formation of carbon – carbon bonds viz organo boranes carbonylation, the cyanoborate process and reaction of alkenyl boranes and trialkenyl borates. Methods of polymerization (a) addition polymerization (b) Condensation polymerization (c) Radical polymerizations (two examples of each method) Reactions of unactivated carbon-hydrogen bonds: The HoffmannLieffier- Freytag reaction-the Barton reaction-Photolysis of organic hypothalites. Organo silanes, Synthetic applications of trimethylsilyl chloride dimethyl-t-butylsilyl chloride, trimetthylsilyl cyanide, trimethylsilyl iodide and trimethylsilyl triflate, synthetic applications of silyl carbanion and B-silyl carbonium ions. Oxidations of hydrocarbons, alkenes, alcohols, aldehydes and ketones. Oxidative coupling reactions by the use of Pb $(OAC)_4$, NBs, CRO_3, SeO_2, $NinO_2$ Dc-alkoxyluphonium yields, $KMnO_4$, OsO_4, peracids and Ti (III) nitrate. Catalytic hydrogenation (homogeneous and heterogeneous), reduction by dissolving metals. Reduction by hydride transfer -reagents, reduction with hydrazine and diamide, selectivity in reduction of nitroso and nitro compounds, reductive cleavage. Design of Organic Synthesis: Retrosynthesis the disconnection approach-basic principles convergent and linear synthesis. Phase transfer catalysis-Principle and applications.	rearrangement the witting reaction-alkenes from aryl sulphonyl hydrazones, claisen rearrangement of allyl vinyl ethers. Organoboranes & Silanes: Preparation of Organobornaes viz hydroboration with BH_3-THF, di cyclohexyl borane, disiamyl borane, thexyl borane, 9-BBN and diisopino camphenyl borane, functional group transformations of Organo Boranes-Oxidation, protonolysis and rearrangements. Formation of carbon – carbon bonds viz organo boranes carbonylation, the cyanoborate process and reaction of alkenyl boranes and trialkenyl borates. Organo silanes: Synthetic applications of trimethylsilyl chloride dimethyl-t-butyl silyl chloride, trimethyl silyl cyanide, trimethylsilyl iodide and trimethylsilyl triflate, synthetic applications of silyl carbanion and B-silyl carbonium ions. Oxidation and Reduction: Oxidations of hydrocarbons, alkenes, alcohols, aldehydes, and ketones. Oxidative coupling reactions using Pb $(OAC)_4$, NBs, CRO_3, SeO_2, $NinO_2$ Dc- alkoxyl uphonium yields, $KMnO_4$, OsO_4, peracids and Ti (III) nitrate. Catalytic hydrogenation (homogeneous and heterogeneous), reduction by dissolving metals. Reduction by hydride transfer -reagents, reduction with hydrazine and diamide, selectivity in reduction of nitroso and nitro compounds, reductive cleavage. Design of Organic Synthesis: Retrosynthesis the disconnection approach-basic principles convergent and linear synthesis. Phase transfer catalysis-Principle and applications. Methods of polymerization (a) addition polymerization (b) Condensation polymerization (c) Radical polymerizations (two examples of each method) Reactions of un activated carbon-hydrogen bonds: The Hoffmann Lieffier- Freytag reaction-the Barton Reaction-Photolysis of organic hypo thalites.				
19	Organic Spectroscopy	uv-visible spectroscopy: various electronic transitions - effect of solvent on electronic transitions - ultraviolet bands for carbonyl compounds, unsaturated carbonyl compounds, dienes and conjugated polyenes. fieser-woodward	UV-VISIBLE SPECTROSCOPY: Various electronic transitions - Effect of solvent on electronic transitions - Chromophores, Auxochromes, Bathochromic and hypsochromic shifts, Solvent effects Ultraviolet bands for	Replaced	CO-1,2,3,4	By the recommendations of BOS members &Faculty	40%

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		rules for conjugated dienes and carbonyl compounds - ultraviolet spectra of aromatic and heterocyclic compounds - steric effect in biphenyls. applications towards deduction of structure of molecule. ir spectroscopy: characteristic vibrational frequencies of alkanes, alkenes, alkynes, aromatic compounds, alcohols, ethers, phenols , nitrogen compounds and sulphur compounds-detailed study of bending vibrations and stretching vibrations-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 steric effect on vibrational frequencies, overtones, combination bands and fermi resonance, applications towards deduction of structure of molecule nmr spectroscopy:hnmr: nuclear spin - nuclear resonance - saturation, shielding of magnetic nuclei - chemical shifts and its measurements - factors influencing chemical shift - deshielding - spin-spin interactions - factors influencing coupling constant 'j' – classification on (abx, amx, abc, a2b2etc.) - spin decoupling - basic ideas about instrument - ft-nmr - advantages of ft-nmr. shielding mechanism - mechanism of measurement - chemical shift values and correlation for protons bonded to carbon (aliphatic, olefinic, aldehydic and aromatic) and other nuclei (alcohols, phenols, en ols, carboxylic acids, amines and amides) - chemical exchange - effect of deuteration - complex spin-spin interaction between two, three, four and five nuclei (first order spectra) - virtual coupling. stereochemistry - hindered rotation - karplus curve variation of coupling constant with dihedral angle. simplification of complex spectra: nuclear magnetic double resonance - contact shift reagents - nuclear overhauser effect (noe). 2d-nmr spectroscopy:the separation of chemical shift and coupling on to two different axes (2d-nmr, cosy), spin decoupling, the nuclear over hauser effect associating the signal from directly bonded ^{1}h. ^{13}c-nmr spectroscopy: general considerations - chemical shift (aliphatic, olefinic, alkyne, aromatic, heteroaromatic and carbonyl carbon) - coupling constants. applications towards deduction of structure of molecule. mass	carbonyl compounds, unsaturated carbonyl compounds, dienes, and conjugated polyenes. Woodward -Fieser rules for conjugated dienes and carbonyl compounds - Ultraviolet spectra of aromatic and heterocyclic compounds - Steric effect in biphenyls. Applications towards deduction of the structure of Molecule and instrumentation of recording of spectra. IR SPECTROSCOPY: Characteristic vibrational frequencies of alkanes, alkenes, alkynes, aromatic compounds, alcohols, ethers, phenols, Nitrogen compounds and sulphur compounds-Detailed study of Bending vibrations and stretching vibrations- 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 steric effect on vibrational frequencies, overtones, combination bands and Fermi resonance, Factors affecting I.R. group frequency, Applications towards deduction of structure of Molecule. NMR SPECTROSCOPY: HNMR: Nuclear spin - nuclear resonance - Saturation, shielding of magnetic nuclei - Chemical shifts and its measurements - Factors influencing chemical shift FT-NMR - Advantages of FT-NMR. Shielding mechanism - Mechanism of measurement - Chemical shift values and correlation for protons bonded to carbon (aliphatic, olefinic, aldehydic and aromatic) and other nuclei (alcohols, phenols, enols, carboxylic acids, amines, and amides) Contact shift reagents - Nuclear overhauser effect (NOE). 2D-NMR SPECTROSCOPY: The Coupling constants. Applications towards deduction of the structure of Molecule. MASS SPECTROMETRY -Mass Spectrometry Introduction - Ion production - Types of ionization; EI, CI, FD, and FAB - Factors affecting fragmentation - Ion analysis - Ion abundance. Mass spectral fragmentation of organic compounds - Common functional groups - Molecular-ion peak - Metastable peak - Mc. Lafferty rearrangement. Nitrogen rule - Isotope labelling – High-resolution mass spectrometry. Examples of mass spectral fragmentation of organic compounds with respect to their structure determination. NUMERICAL				

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		spectrometry -mass spectrometry introduction - ion production - types of ionization: ei, ci, fd, and fab - factors affecting fragmentation - ion analysis - ion abundance. mass spectral fragmentation of organic compounds - common functional groups - molecular-ion peak - metastable peak - mc. lafferty rearrangement. nitrogen rule - isotope labeling - high resolution mass spectrometry. examples of mass spectral fragmentation of organic compounds with respect to their structure determination.	PROBLEMS- Spectroscopic Interpretation of different Compounds for structure elucidation problems using multiple spectroscopic data (NMR, MS, IR and UV-Vis).				
20	Natural Products and Heterocyclic Chemistry	Occurrence, nomenclature, basic skeleton, stereochemistry, Isolation, Structure determination and synthesis of the following class of natural products from plant, animal, and microbial sources and biopolymers. Alkaloids: Morphine, reserpine, and vincristine; Microbial metabolites: Penicillin G, Cephalosporin-O and streptomycin. Terpenes: Forskolin, Taxol, Azadirachtin, Biosynthesis of terpenes; Steroids: Diel's hydrocarbon, Cholesterol, Androsterone, Testosterone, Estrone, Progesterone, Aldosterone, and Biosynthesis of Steroids. Carbohydrates: Naturally occurring sugars: Deoxy sugars, amino sugars, branched sugars. Structure elucidation of lactose, D-glucosamine and meso inositol. Structural features and applications of inositol, starch, cellulose, chitin, and heparin. Biomolecules: Amino acids, peptides, and proteins: Chemical and enzymatic hydrolysis of proteins to peptides, Secondary, tertiary and quaternary structure of proteins, amino acid sequencing, α-Amino acids-general properties & synthesis. Synthesis of peptides by Merrifield solid phase synthesis. Nucleic acids: Structure and function of physiologically important nucleotides (c-AMP, ADP, ATP) and nucleic acids (DNA and RNA), replication, genetic code, protein biosynthesis, mutation. Nomenclature (Hantzsch Widman System), spectral characteristics, reactivity, and aromaticity of monocyclic, fused, and bridged heterocycles. Nonaromatic heterocycles. Different types of strains, interactions, and conformational aspects on nonaromatic heterocycles. Synthesis, reactivity, and importance of the following ring systems. Azirines,	Chemistry of Alkaloids & Steroids: Introduction-classification- General methods of extraction and isolation of natural products, importance of natural products, biosynthesis- acetate pathway, shikimate pathway, mevalonate pathway- Structure elucidation, synthesis, and biological significance of Alkaloids- Quinine, cinchonine, morphine, reserpine; Steroids- Cholesterol, Oesterone, Progesterone. Chemistry of Terpenoids & Vitamins: Terpenoids-Classification of terpenoids, isolation and biosynthesis, Isoprene rule, Structure determination and synthesis of Farnesol, Camphor and Abietic acid, biological significance, and mode of action of forskolin and Taxol; Vitamins: Introduction, chemical properties and structure elucidation of vitamin A, Vitamin B, Ascorbic Acid and Vitamin D. Aromatic Heterocycles: General introduction to heterocyclics and their importance, classification, Nomenclature of ring systems (Hantzsch-Widman System). Synthesis and reactions of indoles, Quinoline, iso quinoline, pyrazole, pyridine, furan, oxazole, thiophene- Role of heterocyclic compounds in biological systems. Aliphatic Heterocycles and Betaines: Synthesis and reactions of oxetanes, piperidines, epoxides, aziridines, diazirines, thiiranes; Azirines, Oxiranes, Azetidines. Betaines: Formation, aromaticity, and reactivity of pyridine-N-oxides and pyridinium imides. Meso-ionic heterocycles: Synthesis and aromaticity of Sydnones and 1,3- dipolar addition reaction of meso-ionic heterocycles.	Added	CO-1,2,3,4	By the recommendations of Industry persons and Parents	50%

24/03/2023

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		Oxiranes, Thiiranes, Diazirenes, Diaziridines, Azetidines. Five and six-membered heterocycles with two hetero atoms: Synthesis, reactivity, aromatic character, and importance of the following heterocycles: Pyrazole, Imidazole, Oxazole, Thiazole, Pyrimidine, Pyrazine, Oxazine, and Thiazine. Heterocycles with more than two hetero atoms: Synthesis, reactivity, aromatic character, and importance of the following heterocycles: Triazoles, Oxadiazoles, Thiadiazols, Triazines. Larger ring and other heterocycles: Synthesis and reactivity of Azepines, Oxepines and Thiepines. Synthesis and rearrangement of Diazepines. Synthesis of Benzoazepines, Benzodiazepines, Benzooxepines, Benzothiepines, Azocines, and Azonines. Benzannulated azoles and dipolar structures: Benzannulated azoles: Synthesis and reactivity of Benzimidazoles, Benzoxazoles and Benzothiazoles. Heterocycles with Ring-Junction nitrogen: Synthesis and reactivity of Quinolizines, Indolizines and Imidazopyridines. Heterocycles with dipolar structures. Betaines: Formation, aromaticity, and reactivity of pyridine-N-oxides and pyridinium imides. Meso ionic heterocycles: Synthesis and aromaticity of Sydnones and 1,3-dipolar addition reaction of meso ionic heterocycles.					
21	Open Elective - I	NEW	NEW	Added	-	By the recommendations of stakeholders	100
22	VAC	NEW	NEW	Added	-	By the recommendations of stakeholders	100
23	Open Elective - 2	NEW	NEW	Added	-	By the recommendations of stakeholders	100
24	Dissertation	-	-	Retained	--	-	0

25/03/2023

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Phone No. 0863 - 2399999; www.klef.ac.in; www.klef.edu.in; www.kluniversity.in
Admin Off: 29-36-38, Museum Road, Governorpet, Vijayawada - 520 002. Ph: +91 - 866 -2577715, Fax: +91-866-2577717

DEPARTMENT OF CHEMISTRY

Department Academic Committee (DAC)-2

Minutes of Meeting, A.Y. 2022-23

The DAC meeting was conducted on 4th February 2023 at 2.00 PM in F102.

Agenda:

- Welcome Address
- To review DAC-1 meeting minutes.
- To review and finalize the course structure of M. Sc Chemistry 2023 admitted batch.
- Improving Industry Collaboration to improve placement opportunities for the students.
- Minor degree requirements other than M. Sc Chemistry students.
- include value-added, skill development, employability, entrepreneurship courses for the AY 2023-24
- Consideration & Discussion of Feedback from students, Academic peers, parents, industry experts & Alumni.
- Any other item with the permission of the chair Any other item with the permission of the chair

The following members were present:

1	Dr. A. Venkateswara Rao	Head of the Department
2	Dr. K. R. S. Prasad	Professor & Student Affairs (Advisor)
3	Dr. J. V. Shanmukha Kumar	Professor
4	Dr. M. Sujatha	Assoc. Professor
5	Dr. Pradeep Kumar Brahman	Assoc. Professor & Assoc. Dean
6	Dr. Niranjan Patra	Assoc. Professor
7	Dr. T. Bhaskara Rao	Assistant Professor & RPAC
8	Dr. K. Deepti	Assistant Professor & Prof. in charge-Academics, PG coordinator
9	Dr. Alka D Kamble	Assistant Professor
10	Dr. M. Naresh	Assistant Professor
11	Dr. K. Rambabu	Assistant Professor
12	Mr. J. Murali Prakash	Student
13	Miss. Salma Banu	Student
14	Mr. Mohan Murali	Student
15	Miss. G Bhavana	Student

The meeting started with an address by Dr. A Venkateswara Rao (HOD, Chemistry Department) extending a warm welcome to the department academic Committee members present for the meeting.

The following points were discussed and resolved:

ITEM NO 1: Approval of DAC- 1 minutes.
Resolution: The minutes of DAC-1 were unanimously approved.

ITEM NO 2: Update on Course Offerings
Resolution: The committee discussed the current course offerings and determined that there are enough courses to meet the department's needs for the upcoming academic year.

ITEM NO 3: To review and finalize the modified course structure M. Sc Chemistry 2023 admitted batch.
Resolution: Reviewed the courses and finalized the Y23 course structure.

ITEM NO 4: Discussion of New Course Proposals
Resolution: The committee discussed two new course proposals. The first proposal was for a course on biosensors. The committee voted to approve the proposal. The second proposal was for a course on biomolecules. The committee voted to approve the proposal. The third proposal was for a course on research methodology. The committee voted to approve the proposal. The fourth proposal was for a seminar series. The committee voted to approve the proposal.

ITEM NO 5: Improving Industry Collaboration to improve placement opportunities for the students.

Resolution: The faculty suggested the following statements to:

(xiii) Arrange corporate guest lectures by industry experts.
(xiv) Arrange industry visits at least once in a semester.
(xv) Skill assessment tests can be conducted by industry experts.
(xvi) Connect with the alumni who are in the industry and ask them to arrange on-campus placements.

ITEM NO 6: Proposed to include Minor degree certificate courses offered by M. Sc Chemistry to the other departments for the A.Y. 2023-24 admitted batch students.

Resolution: It is resolved that to offer Minor degree certificate courses to other department students with 20 credits in a discipline other than his/her major discipline.

ITEM NO 7: Proposed to include value-added, skill development, employability, and entrepreneurship for the AY 2023-24.

Resolution: It is resolved and to enhance employability of the students, value-added, skill development, employability and entrepreneurship courses are already included in the existing curriculum.

The meeting ended with a vote of thanks proposed by Dr. A. Venkateswara Rao, Assistant Professor and Head, Department of Chemistry.

4/2/23

Head of the Department

Dr. A. Venkateswara Rao
Head of the Department
Department of Chemistry
Koneru Lakshmaiah Education Foundation
(Deemed to be University)
Green Fields, Vaddeswaram-522 302,
Guntur Dist., A.P., India.

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DEPARTMENT OF CHEMISTRY

Department Academic Committee (DAC)-1

Minutes of Meeting, A.Y. 2022-23

The DAC meeting was conducted in on **10th December 2022** at 2.00 PM in F102.

Agenda:

- Welcome Address
- To review existing syllabus.
- To review and finalize the course structure of M. Sc Chemistry 2023 admitted batch.
- Improving Industry Collaboration to improve placement opportunities for the students.
- Minor degree requirements other than M. Sc Chemistry students.
- include value-added, skill development, employability, entrepreneurship courses for the AY 2023-24
- Consideration & Discussion of Feedback from students, Academic peers, parents, industry experts & Alumni.
- Any other item with the permission of the chair Any other item with the permission of the chair

The following members were present:

1	Dr. A. Venkateswara Rao	Head of the Department
2	Dr. K. R. S. Prasad	Professor & Student Affairs (Advisor)
3	Dr. J. V. Shanmukha Kumar	Professor
4	Dr. M. Sujatha	Assoc. Professor
5	Dr. Pradeep Kumar Brahman	Assoc. Professor & Assoc. Dean
6	Dr. Niranjan Patra	Assoc. Professor
7	Dr. T. Bhaskara Rao	Assistant Professor & RPAC
8	Dr. K. Deepti	Assistant Professor & Prof. in charge-Academics, PG coordinator
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14	Mr. Mohan murali	Student
15	Miss. G Bhavana	Student

The meeting started with an address by Dr. A Venkateswara Rao (HOD, Chemistry Department) extending a warm welcome to the department academic Committee members present for the meeting. The following points were discussed and resolved:

ITEM NO 1: Approval of DAC- 1 minutes.
Resolution: The minutes of DAC-1 were unanimously approved.

ITEM NO 2: To review and finalize the modified course structure M. Sc Chemistry 2023 admitted batch.
Resolution: Reviewed the courses and finalized the Y23 course structure.

ITEM NO 3: Improving Industry Collaboration to improve placement opportunities for the students.

Resolution: The faculty suggested the following statements to:

(xvii) Arrange corporate guest lectures by industry experts.
(xviii) Arrange industry visits at least once in a semester.
(xix) Skill assessment tests can be conducted by industry experts.
(xx) Connect with the alumni who are in the industry and ask them to arrange on-campus placements.

ITEM NO 4: Proposed to include Minor degree certificate courses offered by M. Sc Chemistry to the other departments for the A.Y. 2023-24 admitted batch students.

Resolution: It is resolved that to offer Minor degree certificate courses to other department students with 20 credits in a discipline other than his/her major discipline.

ITEM NO 5: Proposed to include value-added, skill development, employability, and entrepreneurship for the AY 2023-24.

Resolution: It is resolved and to enhance employability of the students, value-added, skill development, employability and entrepreneurship courses are already included in the existing curriculum.

The meeting ended with a vote of thanks proposed by Dr. A. Venkateswara Rao, Assistant Professor and Head, Department of Chemistry.

10/12/2022

Head of the Department
Dr. A. Venkateswara Rao
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