B.Sc., CHEMISTRY

CHOICE BASED CREDIT SYSTEM - LEARNING OUTCOMES BASED CURRICULUM FRAMEWORK (CBCS – LOCF)

(For the candidate admitted in the academic year 2023-2024)

SYLLABUS

PROGRAMME CODE: 3USCHE

SENGAMALA THAYAAR EDUCATIONAL TRUST WOMEN'S COLLEGE

(AUTONOMOUS)

(Affiliated to Bharathidasan University, Tiruchirappalli)

Accredited by NAAC-An ISO 9001:2015 Certified Institution

SUNDARAKKOTTAI- MANNARGUDI –614016,

TAMILNADU, INDIA.

SENGAMALA THAYAAR EDUCATIONAL TRUST WOMEN'S COLLEGE
(AUTONOMOUS)
(Affiliated to Bharathidasan University, Tiruchirappalli)
Accredited by NAAC-An ISO 9001:2015 Certified Institution
SUNDARAKKOTTAI, MANNARGUDI–614016.
TAMILNADU, INDIA.

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(For the candidates admitted in the academic year 2023–2024)

CHOICE BASED CREDIT SYSTEM

The credit-based semester system provides flexibility in designing curriculum and assigning credits based on the course content and hours of teaching. The choice-based credit system provides a 'cafeteria' type approach in which the students can take courses of their choice, learn at their own pace, undergo additional courses and acquire more than the required credits, and adopt an interdisciplinary approach to learning. Our college has moved to CBCS and implemented the grading system.

OUTCOME-BASED EDUCATION (OBE)
LEARNING OUTCOME-BASED CURRICULUM FRAMEWORK (LOCF)

The fundamental premise underlying the learning outcomes-based approach to curriculum planning and development is that higher education qualifications are awarded on the basis of demonstrated achievement of outcomes (expressed in terms of knowledge, understanding, skills, attitudes and values) and academic standards expected of graduates of a programme of study. Learning outcomes specify what graduates completing a particular programme of study are expected to know, understand and be able to do at the end of their programme of study. The expected learning outcomes are used as reference points that would help to formulate graduate attributes, qualification descriptors, programme learning outcomes and course learning outcomes which in turn will help in curriculum planning and development, and in the design, delivery and review of academic programmes. They provide general guidance for articulating the essential learnings associated with programmes of study and courses with in a programme, maintain national standards and international comparability of learning outcomes and academic standards to ensure global competitiveness, and to facilitate student/graduate mobility and provide higher education institutions an important point of reference for designing teaching-learning strategies, assessing student learning levels, and periodic review of programmes and academic standards.

Some important aspects of the Outcome Based Education Course: is defined as a theory, practical or theory cum practical subject studied in a semester.

Course Outcomes (COs): are statements that describe significant and essential learning that learners have achieved, and can reliably demonstrate at the end of a course. Generally, three or more course outcomes may be specified for each course based on its weightage.
Programme: is defined as the specialization or discipline of a degree.
Programme Outcomes (POs): Programme outcomes are narrower statements that describe what students are expected to be able to do by the time of graduation. POs are expected to be aligned closely with Graduate Attributes.
Programme Specific Outcomes (PSOs): PSOs are what the students should be able to do at the time of graduation with reference to a specific discipline.
Some important terminologies repeatedly used in LOCF.
Core Courses (CC) A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course. These are the courses which provide basic understanding of their main discipline. In order to maintain a requisite standard certain core courses must be included in an academic program. This helps in providing a universal recognition to the said academic program.
Discipline Specific Elective Courses (DSE) Elective course may be offered by the main discipline/subject of study is referred to as Discipline Specific Elective (DSE). These courses offer the flexibility of selection of options from a pool of courses. These are considered specialized or advanced to that particular programme and provide extensive exposure in the area chosen; these are also more applied in nature.
Generic Elective Courses An elective course chosen generally from an **unrelated discipline/subject,** with an intention to seek exposure is called a Generic Elective. Generic Elective courses are designed for the students of **other disciplines**. Thus, as per the CBCS policy, the students pursuing particular disciplines would have to opt Generic Elective courses offered by other disciplines, as per the basket of courses offered by the college. The scope of the Generic Elective (GE) Courses is positively related to the diversity of disciplines in which programmes are being offered by the college.
Non Major Elective (NME). A student shall choose at least two Non – major Elective Courses (NME) from outside his /her department. Non –Major Elective I – Those who choose Tamil in Part I can choose a non –major elective course offered by other departments. Those who do not choose Tamil in Part I must choose either a) Basic Tamil if Tamil language was not studies in school level or b) Special Tamil if Tamil language was studies up to 10^{th} & 12^{th} std.
Skill Enhancement Courses (SECs) These courses focus on developing skills or proficiencies in the student, and aim at providing hands-on training. Skill enhancement courses can be opted by the students of any other discipline, but are highly suitable for students pursuing their academic programme. These courses may be chosen from a pool of courses designed to provide value-based and/or skill-based knowledge**.**

Field Study/Industrial Visit/Case Study: It has to be completed during the fifth semester of the degree programme. Credit for this course will be entered in the fifth semester's marks statement.

Internship: Students must complete internship during summer holidays after the fourth semester. They have to submit a report of internship training with the necessary documents and have to appear for a viva-voce examination during fifth semester. Credit for internship will be entered in the fifth semester's mark statement.

Extra Credit Courses: In order to facilitate the students, gaining knowledge/skills by attending online courses MOOC, credits are awarded as extra credits, the extra credit are at three semesters after verifying the course completion certificates. According to the guidelines of UGC, the students are encouraged to avail this option of enriching their knowledge by enrolling themselves in the Massive Open Online Courses (MOOC) provided by various portals such as SWAYAM, NPTEL etc.

Undergraduate Programme:

Programme Pattern: The Under Graduate degree programme consists of **FIVE** vital components. They are as follows:

Part -I: Languages (Tamil / Hindi / French / Sanskrit)

Part-II: General English

Part-III: Core Course (Theory, Practicals, Generic Elective courses, Discipline Specific Elective courses, Compulsory and Optional Allied courses, Project)

Part-IV: Non-Major Elective, Foundation Course, Value Education, Environmental studies, Skill Enhancement Courses/ Soft Skills, Internship / field visit / industrial visit/ Case Study), Professional Competency Course

Part –V

Extension activity, Gender studies

EXAMINATION

Continuous Internal Assessment (CIA):

UG - Distribution of CIA Marks

Passing Minimum: 50 %

Assisgnment-3	=	30%
Test-2	=	50%
Seminar	=	10%
Attendance	=	10%

Question Paper Pattern

Part A:

Part A 1 (10X1=10 marks)

One word question/ Fill in/ /True or False/ Multiple Choice Questions

Two Questions from Each unit

Part A 2 (5X2=10 marks)

Match the following

Short Answers

One question from Each unit

Total Marks – 20

Part B: (5X5=25 marks)

Paragraph Answers
Either/ or type, One Question from each unit
Part C: (10X3=30)
Essay Type Answers
Answer 3 out of 5 Questions
One Question from each unit
Part A: K1 Level
Part B: K2, K3 and K4 Level
Part C: K5 and K6 Level

Knowledge levels for assessment of Outcomes based on Blooms Taxonomy

S. No.	Level	Parameter	Description
1	K1	Knowledge/Remembering	It is the ability to remember the previously learned
2	K2	Comprehension/ Understanding	The learner explains ideas or concepts
3	K3	Application/Applying	The learner uses information in a new way
4	K4	Analysis/Analysing	The learner distinguishes among different parts
5	K5	Evaluation/Evaluating	The learner justifies a stand or decision
6	K6	Synthesis /Creating	The learner creates a new product or point of view

WEIGHTAGE of K – LEVELS IN QUESTION PAPER

(Cognitive Level) K- LEVELS →	Lower Order Thinking			Higher Order Thinking			Total
	K1	K2	K3	K4	K5	K6	
END SEMESTER EXAMINATIONS (ESE)	20	25			30		**75**
Continuous Internal Assessment (CIA)	20	25			30		**75**

QUESTION PATTERN FOR END SEMESTER EXAMINATION/Continuous Internal Assessment		
PART		**MARKS**
PART –A I. (No choice, One Mark) **TWO** questions from each unit **II.** (No choice, Two Mark) **ONE** question from each unit	(10x1 =10) (5x2 =10)	20
PART -B (Either/ or type ,5-Marks) **ONE** questions from each unit	(5x5 =25)	25
PART -C (3 out of 5) (10 Marks) **ONE** question from each unit	(3x10 =30)	30
	Total	**75**

BLUE PRINT OF QUESTION PAPER FOR END SEMESTER EXAMINATION							
DURATION: 3. 00 Hours.							**Max Mark : 75**
K- LEVELS	**K1**	**K2**	**K3**	**K4**	**K5**	**K6**	**Total Marks**
PART							
PART –A (One Mark, No choice) (10x1 =10)	10						10
(2-Marks, No choice) (5x2=10)	10						10

PART –B (5- Marks) (Either/or type) (5x5=25)		5	10	10			25
PART -C (10 Marks) (3 out of 5) (3x10=30) Courses having only **K5, K6** levels, K5 level- 3 Questions, K6 level- 2 Questions **(One K6 level question is compulsory)**					20	10	30
Total	**20**	**05**	**10**	**10**	**20**	**10**	**75**

EVALUATION:

GRADING SYSTEM

Once the marks of the CIA and the end-semester examination for each of the courses are available, they will be added and converted as final mark. The marks thus obtained will then be graded as per the scheme provided in Table-1.

Grade Point Average (GPA) will be calculated from the first semester onwards for all semester. From the second semester onwards, the total performance within a semester and the continuous performance starting from the first semester are indicated by semester Grade Point Average (GPA) and Cumulative Grade Point Average (CGPA) , respectively. These two are calculated by the following formulae:

$GPA = \frac{\sum_{i=1}^{n} C_i G_i}{\sum_{I=1}^{n} C_i}$	$WAM\,(Weighted\ Average\ Marks) = \frac{\sum_{i=1}^{n} C_i M_i}{\sum_{I=1}^{n} C_i}$
Where, C_i is the Credit earned for the Course i G_i is the Grade Point obtained by the student for the Course i M_i is the marks obtained for the course i and n is the number of Courses **Passed** in that semester.	

CGPA: Average GPA of all the Courses starting from the first semester to the current semester.

CLASSIFICATION OF FINAL RESULTS:

1. For each of the first three parts, there shall be separate classification on the basis of CGPA, as indicated in Table-2.
2. For the purpose of declaring a candidate to have qualified for the Degree of

Bachelor of Arts/Science/Commerce/Management as Outstanding/Excellent/Very Good/Good/Above Average/Average, the marks and the corresponding CGPA earnedby the candidate in Part-III alone will be the criterion, provided the candidate has secured the prescribed passing minimum in the all the Five parts of the Programme.

3. Grade in Part –IV and Part-V shall be shown separately and it shall not be taken into account for classification.

4. A Pass in PART- V will be mandatory although the marks will not count for the calculation of the CGPA.

5. Absence from an examination shall not be taken an attempt.

Table-1: Grading of the Courses - UG

Marks Range	Grade Point	Corresponding Grade
90 and above	10	O
80 and above and below 90	9	A+
70 and above and below 80	8	A
60 and above and below 70	7	B+
50 and above and below 60	6	B
40 and above and below 50	5	C
Below 40	NA	RA

The candidate's performance in every current semester is indicated by **Semester Grade Point Average (SGPA)** and from the second semester onwards, the continuous performance including pervious semester /s is indicated by **Cumulative Grade Point Average (CGPA).**

Table-3: Final Result

CGPA	Corresponding Grade	Classification of Final Result
9.00 and above	O	Outstanding
8.00 to 8.99	A+	Excellent
7.00 to 7.99	A	Very Good
6.00 to 6.99	B+	Good
5.00 to 5.99	B	Above Average
4.00 to 4.99	C	Average
Below 4.00	RA	Re-appearance

The candidates who have passed in the first appearance and within the prescribed duration of the UG programme are eligible. If the candidate's Grade is O/A+ with more than one attempt, the performance is fixed as "Very Good".

VISION

To Empower the women students by providing excellent theoretical, practical and research skills in Chemistry to meet the global needs

MISSION

- Providing quality education in the principles, theory and practice of Chemistry
- Making the students to cope up with the requirements of industry and service sectors
- Excelling in teaching, research, knowledge transfer and to serve the social, cultural and economic needs of the nation.

PROGRAMME OUTCOMES FOR B.Sc.,DEGREE PROGRAMME

PO No.	Programme Outcomes (*Upon completion of the B.Sc. Degree Programme, the Undergraduate will be able to)*
PO-1	**Disciplinary knowledge**: Demonstrate comprehensive knowledge and understanding of one or more disciplines that form a part of an undergraduate program of study in Bachelor of Science.
PO-2	**Critical thinking, Problem Solving and Reflective thinking:** think critically about the issues and identify, critically analyze and solve problems from the disciplines of concern using appropriate tools and techniques and the knowledge, skills and attitudes acquired and extrapolate the same to real life situations; show critical sensibility to life experiences, with self-awareness and reflexivity of both self and society.
PO-3	**Analytical & Scientific Reasoning:** evaluate the reliability and relevance of evidence; identify logical flaws and holes in the arguments of others; analyze and synthesize data from a variety of sources; draw valid conclusions and support them with evidence and examples and addressing opposing viewpoints; critically evaluate ideas, evidence, and experiences from an open minded and reasoned perspective.
PO-4	**Research-related Skills:** develop a sense of capability for relevant/appropriate inquiry and asking questions, synthesize, articulate and report results and to recognize and predict cause and effect relationships, define problems, formulate and establish hypothesis, analyze and interpret and draw conclusions from data, execute and report the results of an experiment or investigation.
PO-5	**Digital literacy and Effective Communication:** use ICT in a variety of learning situations and **s**peak, read, write and listen clearly in person and through electronic media in English and in one or more Indian languages, and make meaning of the world by connecting people, ideas ,books, media and technology; efficiently communicate thoughts and ideas in a clear and concise manner.
PO-6	**Individual and Team Work:** effectively accomplish tasks individually as well as work effectively and respectfully as member or leader with diverse teams, facilitate cooperative or coordinated effort on the part of a group, and act together as a group or a team in the interest so for a common cause and work efficiently as a member of a team.
PO-7	**Multicultural Competence and Social Interaction:** understand the values and beliefs of multiple cultures, global perspectives, engage and interact respectfully with diverse groups and elicit views of others, mediate disagreements and help reach conclusions in group settings.
PO-8	**Awareness of Ethical issues, Human values and Gender Issues:** embrace moral/ethical values in conducting one's life, formulate a position/argument about an ethical issue from multiple perspectives, and use ethical practices in all work and understand the value of relationship between self and the community and aware of the various issues concerning women and society.
PO-9	**Awareness of Environment and Sustainability:** understand the impacts of technology and business practices in societal and environmental contexts, and sustainable development.

PO-10	**Self-directed and Lifelong learning:** acquire knowledge and skills, including learning "how to learn", that are necessary for participating in learning activities throughout life and to engage in independent and life-long learning in the broadest context of socio-technological changes.

PROGRAMME SPECEIFIC OUTCOMES FOR B.Sc. Chemistry

PSO No.	**Programme Specific Outcomes** (***Upon completion of the Course, the Student will be able to)***
PSO-1	Acquire in-depth knowledge of the fundamental concepts in all disciplines of Chemistry.
PSO-2	Disseminate the basics of chemistry and advanced topics and analytical Skills in Organic, Inorganic and Physical Chemistry.
PSO-3	Develop creativity in academics and research.
PSO-4	Apply digital tools to collect, analyze and interpret data and present scientific findings
PSO-5	Gain competence to pursue higher education and career opportunities in chemistry and allied fields
PSO-6	Exhibit leadership qualities to work individually and within a team in organizing curricular, co-curricular and extracurricular activities
PSO-7	Apply the concepts of Chemistry to solve problems in the community, entrepreneurial and research pursuits
PSO-8	Exhibit competence in educational, industrial and research pursuits that contribute towards the holistic development of self and community

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B. Sc CHEMISTRY COURSE STRUCTURE UNDER CHOICE BASED CREDIT SYSTEM-LEARNING OUTCOMES BASED CURRICULUM (CBCS-LOCF)

(For the candidates admitted from the academic year 2023-2024)

ELIGIBILITY: A Pass in 10+2 with Chemistry and Maths /Biology or Botany/Zoology as two of the core subjects.

Sem	Part	Nature of the Course	Course Code	Title of the course	T.In. Hrs/ Week	Ins. Hours/ Week				Credit	Exam Hours	Marks		Total
						L	T	P	S			CIA	ESE	
I	I	Language Course– I	U23LC101	Pothu Tamil-I	6	5	1	-	-	3	3	25	75	100
	II	English Language Course -I	U23ELC101	General English-I	6	5	1	-	-	3	3	25	75	100
	III	Core Course-I	U23CH101	General Chemistry–I	5	4	1	-	-	5	3	25	75	100
		Core Practical-I	U23CH102P	Quantitative Inorganic estimation and inorganic preparations(P)	4	-	-	4	-	4	3	25	75	100
		Allied Course-I	U23AMM101/ U23ABO101	Mathematics – I (Calculus) / Allied Botany – I	3	2	1	-	-	2	3	25	75	100
		Allied Course-II/ Allied Practical-I	U23AMM102/ U23ABO102P	Mathematics – II (Algebra and Analytical Geometry)/ Allied Botany Practical	2	2 -	- -	- 2	- -	- -	- -	- -	- -	- -
	IV	Non-Major Elective-I	U23NMECH11		2	2	-	-	-	2	3	25	75	100
		Foundation Course-I	U23FCCH11	Fundamentals of Chemistry	2	2	-	-	-	2	3	25	75	100
				TOTAL	**30**	**20**	**4**	**6**	**-**	**21**	-	-	-	**700**
II	I	Language Course– II	U23LC202	Pothu Tamil-II	6	5	1	-	-	3	3	25	75	100
	II	English Language Course – II	U23ELC202	General English-II	6	5	1	-	-	3	3	25	75	100
		Core Course-II	U23CH203	General Chemistry–II	5	4	1	-	-	5	3	25	75	100

Sem	Part	Nature of the Course	Course Code	Title of the course	T.In. Hrs/ Week	Ins. Hours/ Week				Credit	Exam Hours	Marks		Total
						L	T	P	S			CIA	ESE	
	III	Core Practical-II	U23CH204P	Qualitative Organic Analysis and Preparation of Organic Compounds(P)	4	-	-	4	-	4	3	25	75	100
		Allied Course-II/ Allied Practical-I	U23AMM102/ U23ABO102P	Mathematics-II (Algebra and Analytical Geometry) / Allied Botany Practical	2 2	2 -	- -	- 2	- -	2 2	3	25	75	100
		Allied Course – III	U23AMM203/ U23ABO203	Mathematics – III (Trigonometry and Fourier Series) /Allied Botany II	3	2	1	-	-	2	3	25	75	100
	IV	Non-Major Elective-II	U23NMECH22		2	2	-	-	-	2	3	25	75	100
		Skill Enhancement Course-I	U23SECH21	Cosmetics and Personal Grooming	2	2	-	-	-	2	3	25	75	100
				TOTAL	**30**	**20**	**4**	**6**	**-**	**23**	-	-	-	**800**
III	I	Language Course– III	U23LC303	Pothu Tamil-III	6	5	1	-	-	3	3	25	75	100
	II	English Language Course – III	U23ELC303	General English-III	6	5	1	-	-	3	3	25	75	100
	III	Core Course-III	U23CH305	General Chemistry–III	5	4	1	-	-	5	3	25	75	100
		Core Practical -III	U23CH306P	Qualitative Inorganic Analysis(P)	4	-	-	4	-	4	3	25	75	100
		Allied Course- III/ IV	U23APY301	Allied Physics- I	3	2	1	-	-	2	3	25	75	100
		Allied Practical -I/ II	U23APY302P	Allied Physics Practical	2	-	-	2	-	--	--	--	--	--
	IV	Skill Enhancement Course-II	U23SECH32	Entrepreneurial Skills in Chemistry	2	-	-	2	-	2	3	25	75	100
		Skill Enhancement Course—III	U23SECH33	Pesticide Chemistry	2	2	-	-	-	2	3	25	75	100
				TOTAL	**30**	**18**	**4**	**8**	**-**	**21**	-	-	-	**700**
	I	Language Course– IV	U23LC404	Pothu Tamil-IV	6	5	1	-	-	3	3	25	75	100
	II	English Language Course	U23ELC404	General English-IV	6	5	1	-	-	3	3	25	75	100

Sem	Part	Nature of the Course	Course Code	Title of the course	T.In. Hrs/ Week	Ins. Hours/ Week				Credit	Exam Hours	Marks		Total
						L	T	P	S			CIA	ESE	
		– IV												
	III	Core Course -IV	U23CH407	General Chemistry–IV	5	4	1	-	-	5	3	25	75	100
		Core Practical- IV	U23CH408P	Gravimetric Analysis (P)	4	-	-	4	-	4	3	25	75	100
		Allied Practical-I/II	U23APY302P	Allied Physics Practical	2	-	-	2	-	2	3	25	75	100
		Allied Course IV/V	U23APY403	Allied Physics -II	3	2	1	-	-	2	3	25	75	100
	IV	Skill Enhancement Course -IV	U23SECH44	Instrumental Methods of Chemical Analysis	2	2	-	-	-	2	3	25	75	100
		Skill Enhancement Course -V	U23SECH45	Forensic Science	2	2	-	-	-	2	3	25	75	100
				TOTAL	**30**	**20**	**4**	**6**	**-**	**23**	-	-	-	**800**
		Core Course –V		Organic Chemistry-I	5	4	1	-	-	5	3	25	75	100
		Core Course –VI		Inorganic Chemistry	5	4	1	-	-	4	3	25	75	100
		Core Course-VII		Physical Chemistry–I	6	5	1	-	-	5	3	25	75	100
		Core Practical- V		Physical Chemistry Practical	4	-	-	4	-	4	3	25	75	100
		Elective Course-I		Nanoscience and Technology /Biochemistry/ Organometallic Chemistry	4	3	1	-	-	3	3	25	75	100
		Elective Course -II		Nuclear, Industrial Chemistry & Metallic State /Solis State Chemistry/Pharmaceutical Chemistry	4	3	1		-	3	3	25	75	100
	IV	Environmental Studies		Environmental Studies	2	2	-		-	2	3	25	75	100
		Internship/ Industrial visit/ Field visit		Internship/ Industrial visit/ Field visit	-	-	-		-	2	-	-	-	-
				TOTAL	**30**	**21**	**5**	**4**	**-**	**28**		-	-	**700**
VI		Core Course-VIII		Organic Chemistry – II	6	5	1	-	-	4	3	25	75	100

Sem	Part	Nature of the Course	Course Code	Title of the course	T.In. Hrs/ Week	Ins. Hours/ Week				Credit	Exam Hours	Marks		Total
						L	T	P	S			CIA	ESE	
	III	Core Course—IX		Physical Chemistry -II	6	5	1	-	-	4	3	25	75	100
		Core Project- X		Group Project with viva voce /Research Topics	**5**	1	**-**	4	**-**	5	3	25	75	100
		Elective Course-III		Fundamentals of Spectroscopy/Industrial Chemistry/ Supramolecular Chemistry	4	3	1		-	3	3	25	75	100
		Elective Course-IV		Polymer Chemistry /Green Chemistry /Textile Chemistry	4	3	1			3	3	25	75	100
	IV	Value Education		Value Education	2	2	-	-	-	2	3	25	75	100
		Professional Competency Course		Chemistry for Competitive Examinations	2	2	-	-	-	2	3	25	75	100
		Gender Studies		Gender Studies	1	1	-	-	-	1	3	25	75	100
	V	Extension activity		Extension activity	-	-	-		-	1	-	-	-	-
				TOTAL	**30**	**22**	**4**	**4**	**-**	**25**	-	-	-	**800**
				Grand Total	**180**	**121**	**25**	**34**	**-**	**141**	-	-	-	**4500**
Extra Credit				MOOC/SWAYAM/NPTEL		**-**	**-**	**-**	**-**	**2**	-	-	-	**-**
				Value added Courses (At least one per year)		**-**	**-**	**-**	**-**	**2**	-	-	-	**-**

L-Lecture **T- Tutorial** **P-Practical** **S-Seminar**

Credit Distribution for UG PROGRAMME: CHEMISTRY

S. No	Part	Subject	No. of Courses	Total Credits
1	I	Language Course	4	12
2	II	English Language Course	4	12
3	III	Core Course	9	42
4		Core Practical	5	20
5		Core Project	1	05
6		Allied Course-Mathematics/ Botany	5/4	10/8
7		Allied Practical -Mathematics/ Botany	1/2	02/04
8		Elective Course	4	12
9	IV	Non-Major Elective	2	04
10		Foundation Course – FC	1	02
12		Skill Enhancement Course	5	10
13		Internship/ Industrial visit/ Field visit	1	02
14		Environmental Studies	1	02
15		Value Education	1	02
16		Professional Competency Course	1	02
17	V	Gender Studies	1	01
18		Extension Activity	1	01
		Total	**47**	**141**

Note:

		CIA	ESE
1	Theory	25	75
2	Practical	25	75

3 Separate passing minimum is prescribed for Internal and External marks

FOR THEORY

The passing minimum for CIA shall be 40% out of 25 marks [i.e. 10 marks]

The passing minimum for University Examinations shall be 40% out of 75 marks [i.e. 30 marks]

FOR PRACTICAL

The passing minimum for CIA shall be 40% out of 25 marks [i.e. 10 marks]

The passing minimum for University Examinations shall be 40% out of 75 marks [i.e. 30 marks]

NONMAJOR ELECTIVE (NME) OFFERED BY THE DEPARTMENT

Semester	Part	Course	Course code	Title of the Course
I	IV	NME– I	U23NMECH11	Food Chemistry
II	IV	NME– II	U23NMECH22	Dairy Chemistry

SEMESTER-III

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(For the Candidates admitted in the academic year 2023 – 2024)
DEPARTMENT OF CHEMISTRY
B.Sc., CHEMISTRY

Semester: III-CC-III: General Chemistry-III

Ins. Hrs. /Week: 5 **Course Credit: 5** **Course Code: U23CH305**

UNIT I : GASEOUS STATE (15 Lectures)

Kinetic molecular model of a gas: postulates and derivation from the kinetic gas equation; The Maxwell –Boltzmann distribution of speed of molecules- average, root mean square and most probable velocity and average kinetic energy, law of equipartition of energy, degrees of freedom and molecular basis of heat capacities. Collision frequency; collision diameter; mean free path and viscosity of gases. Real gases: Deviations from ideal gas behaviour, (Andrew's and Amagat's plots); compressibility factor, Z, and its variation with pressure for different gases. equations of states for real gases-van der Waal's equation; Virial equation; Boyle temperature; Numerical problems based on equations of states for real gases, isotherms of real gases – critical phenomena – isotherms of CO2 - continuity of state–Van der waal's equation and the critical state; law of corresponding states-liquefaction of gases; numerical problems involving the core concepts**.**

UNIT-II: LIQUID AND SOLID STATE (15 Lectures)

Properties of Liquids- Surface tension, viscosity and their applications. Crystalline and amorphous – differences - geometry, isotropy and anisotropy, melting point; isomorphism, polymorphism.

Crystals –size and shape; laws of crystallography; symmetry elements – plane, centre and axis; Miller indices, unit cells and space lattices; classification of crystal systems; Bravais lattices; X – ray diffraction – Bragg's equation Packing in atomic solids – simple cubic, body centered cubic, face centered and hexagonal close packing; Co-ordination number in typical structures - NaCl, CsCl, ZnS, TiO2; comparison of structure and properties of diamond and graphite;.numerical problems involving core concepts Defects in solids - stoichiometric and nonstoichiometric defects. **Liquid crystals** – classification and applications.

UNIT-III: NUCLEAR CHEMISTRY (15 Lectures)

Natural radioactivity - α, β and γ rays; half-life period; Fajans–Soddy group displacement law; Geiger–Nattal rule; isotopes, isobars, isotones, mirror nuclei, iso diaphers; nuclear isomerism; radioactive decay series; magic numbers; units – Curie, Rutherford, Roentgen; nuclear stability - neutron- proton ratio; binding energy; packing fraction; mass defect. Simple calculations involving mass defect and B.E., decay constant and t1/2 and radioactive series.

Isotopes – uses – tracers – determination of age of rocks by radiocarbon dating. (Problems to be worked out) Nuclear energy; nuclear fission and fusion – major nuclear reactors in India; radiation hazards, disposal of radioactive waste and safety measures.

UNIT-IV: HALOGEN DERIVATIVES AND ALIPHATIC HALOGEN DERIVATIVES

(18 Lectures)

Nomenclature and classes of alkyl halides – isomerism, physical properties, Chemical reactions. Nucleophilic substitution reactions – SN1, SN2 and SNi mechanisms with stereochemical aspects and effect of solvent.

Di, Tri & Tetra Halogen derivatives: Nomenclature, classification, preparation, properties and applications.

Aromatic halogen compounds Nomenclature, preparation, properties and uses Mechanism of nucleophilic aromatic substitution – benzyne intermediate

Aryl alkyl halides Nomenclature, benzyl chloride – preparation – preparation properties and uses

Alcohols: Nomenclature, classification, preparation, properties, use; conversions – ascent and descent of series; test for hydroxyl groups. Oxidation of diols by periodic acid and lead tetraacetate

UNIT-V: PHENOLS AND AROMATIC ALCOHOLS (15 Lectures)

Nomenclature; classification, Preparation from diazonium salts, cumene, Dow's process, Raching process; properties – acidic character and effect of substitution on acidity. Reactions – Fries, claisen rearrangement, Electrophilic substitution reactions, Reimer - Teimen, Kolbe, Schmidt, Gatermann synthesis, Libermann, nitro reaction, phthalein reaction. Resorcinol, quinol, picric acid – preparation, properties and uses.

Nomenclature, benzyl alcohol – methods of preparation – hydrolysis, reduction of benzaldehyde, Cannizzaro reaction, Grignard synthesis, physical properties, reactions – reaction with sodium, phosphorus pentachloride, thionyl chloride, acetic anhydride, hydrogen iodide, oxidation – substitution on the benzene nucleus, uses. Thiols: Nomenclature, structure, preparation and properties.

Total Lecture Hours: 75

COURSE OUTCOME

The students are able to

1. Explain the kinetic properties of gases by using mathematical concepts.

2. Describe the physical properties of liquid and solids; identify various types of crystals with respect to its packing and apply the XRD method for crystal structure determinations.

3. Investigate the radioactivity, nuclear energy and it's production, also the nuclear waste management.

4. Write the nomenclature, physical & chemical properties and basic mechanisms of halo organic compounds and alcohols.

5. Investigate the named organic reactions related to phenol; explain the preparation and properties of aromatic alcohol including thiol.

TEXT BOOKS

1. Anil J Elias. 2019. The Chemistry of p block elements, Synthesis, Reactions and Applications, First Edition, The orient Black swan.
2. Arun Bahl and BS Bahl. 2018. A Text book of Organic Chemistry, 5th edition, New Delhi,Sultan Chand & Co.
3. Buri BR, Sharma LR and Pathania MS, 2020. Principles of Physical Chemistry, 47th edition, Vishal publishing Co, Punjab.
4. Kalsi PS. 2017. Stereochemistry conformation and mechanism, 9th edition, New Age International publishers.
5. Satake M. 2003. The Chemistry of p block elements, First Edition, Discovery publishing Pvt, Ltd.

6. B.R. Puri, L.R. Sharma, M.S. Pathania; *Principles of Physical Chemistry*, 46th edition, Vishal Publishing, 2020.

7. S.M. Mukherji, and S.P. Singh, Reaction Mechanism in Organic Chemistry, Macmillan India Ltd., third edition, 1994.

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1. T. W. Graham Solomons, *Organic Chemistry*, John Wiley & Sons, fifth edition, 1992.
2. A. Carey Francis, *Organic Chemistry*, Tata McGraw-Hill Education Pvt., Ltd.,New Delhi, seventh edition, 2009.
3. I. L. Finar, *Organic Chemistry*, Wesley Longman Ltd, England, sixth edition, 1996.
4. P. L. Soni, and H. M.Chawla - *Text Book of Organic Chemistry*, New Delhi, Sultan Chand & Sons, twenty ninth edition, 2007.
5. J.D. Lee, *Concise Inorganic Chemistry*, Blackwell Science, fifth edition, 2005.

E-RESOURCES

1. http://jpsw.shikshamandal.org chemistry of p block elements
2. https:// www. britannica.com. Organohalogen compounds
3. https://wiki.ubc.ca. chemistry of p block elements
4. https;//www.khanacademy.org.stereochemistry
5. https://www.topper.comchemistry The gaseous state

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DEPARTMENT OF CHEMISTRY
B.Sc., CHEMISTRY

Semester: III-CP-III: Qualitative Inorganic Analysis (P)

Ins. Hrs. /Week: 4 **Course Credit: 4** **Course Code: U23CH306P**

Semi - Micro Qualitative Analysis

1. Analysis of simple acid radicals: Carbonate, Sulphide, Sulphate, Thiosulphite, Chloride, Bromide, Iodide, Nitrate
2. Analysis of interfering acid radicals: Fluoride, oxalate, borate, phosphate, arsenate, arsenite.
3. Elimination of interfering acid radicals and identifying the group of basic radicals
4. Analysis of basic radicals (group wise): Lead, copper, bismuth, cadmium, tin, antimony, iron, aluminum, arsenic, zinc, manganese, nickel, cobalt, calcium, strontium, barium, magnesium, ammonium
5. Analysis of a mixture - I to VIII containing two cations and two anions (of which one is interfering type)

COURSE OUTCOME

The students are able to,

1. Acquire knowledge on the systematic analysis of Mixture of salts.
2. Identify the cations and anions in the unknown substance.
3. Identify the cations and anions in the soil and water and to test the quality of water.
4. Assess the role of common ion effect and solubility product

TEXT BOOKS

1. Amarnath Mishra. 2018. Qualitative Inorganic Analysis, Bharati Bhawan (P& D).
2. Rakesh Sharma L, Dr. 2021. Practical Inorganic Chemistry. Evince Publishing.
3. Svehla G, Sivasankar B. 2012. Qualitative Inorganic Analysis. 7th Ed, Pearson Education, India.
4. Vogel, 2000. Text Book of Quantitative Inorganic Analysis. 6th Ed, Longman, New Delhi.
5. V. Venkateswaran, R. Veeraswamy and A. R. Kulandivelu, Basic Principles of Practical Chemistry, Sultan Chand & Sons, New Delhi, second edition, 1997

REFERENCES

1. George Marr BW, Rachetl. 1972. Practical Inorganic Chemistry. Van Nostrand Reinhold Company.
2. Gurdeep Raj. 2013. Advanced Practical Inorganic Chemistry. Krishna Prakashan Media (P) Ltd.
3. Ramanujam VV. 1988. Inorganic Semimicro Qualitative Analysis. 3rd Ed, National Pubs, London.

4. Sonia Ratnani, Swati Agarwal, Sujeet Mishra, 2020. Practical Chemistry, Ist Ed, McGraw Hill Education Private Ltd.
5. Svehla G. 1987. Text Book of Macro and Semimicro Qualitative Inorganic Analysis. 5th Ed, Longman group Ltd, London.

E-RESOURCES

1. https://www.researchgate.net/publication/283476036_inorganic_qualitative_analysis_a greener_approach
2. https://www.readallbooks.org/book/vogels-qualitative-inorganic-analysis-7th-edition/
3. https://www.academia.edu/14685017/vogels_textbook_of_qualitative_inorganic_ analysis
4. https://kresnadipayana.files.wordpress.com/2018/10/macro-and-semimicro-qualitative-inorganic-analysis-5ed-vogel.pdf
5. https://bookflow.in/books/vogels-qualitative-inorganic-analysis/
6. https://www.vlab.co.in/broad-area-chemical-sciences

ALLIED PHYSICS

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DEPARTMENT OF PHYSICS
For the students of II B.Sc. CHEMISTRY

Semester: III – AC – III/ IV: Allied Physics – I

Ins. Hrs. / Week:3 **Course Credit: 2** **Course Code: U23APY301**

UNIT – I Waves, Oscillations and Ultrasonics (10 Hours)

Simple harmonic motion (SHM) – Composition of two SHMs at right angles (periods in the ratio 1:1) – Lissajous figures – uses – Laws of transverse vibrations of strings – Determination of AC frequency using Sonometer (steel and brass wires) – Ultrasound – production – piezoelectric method – application of ultrasonics: Medical field – Lithotripsy.

UNIT – II: Properties of Matter (10 Hours)

***Elasticity*:** Elastic constants – bending of beam – theory of non- uniform bending – determination of Young's modulus by non-uniform bending – energy stored in a stretched wire – torsion of a wire – determination of rigidity modulus by torsional pendulum.

***Viscosity*:** Streamline and Turbulent motion – Critical Velocity – Coefficient of viscosity – Poiseuille's formula – Comparison of viscosities – Burette method.

***Surface tension*:** Definition – Molecular theory – Droplets formation – shape, size and lifetime – COVID transmission through droplets, saliva – Drop weight method – Interfacial surface tension.

UNIT – III: Heat and Thermodynamics (8 Hours)

Joule - Kelvin effect – Joule - Thomson Porous Plug experiment – Theory – Temperature of inversion – Liquefaction of Oxygen – Linde's process of liquefaction of air – Liquid Oxygen for medical purpose – Thermodynamic System – Thermodynamic Equilibrium – Laws of thermodynamics – Heat engine – Carnot'scycle – Efficiency – Entropy – Change of entropy in reversible and irreversible process.

UNIT – IV: Electricity and Magnetism (8 Hours)

Potentiometer – Principle – Measurement of Thermoemf using potentiometer –Magnetic field due to a current carrying conductor – Biot-Savart's law – Field along the axis of the coil carrying current – Peak, Average and RMS values of ac Current and Voltage – Power factor and Current values in an AC circuit – Types of switchesin household and factories – Smart Wi-Fi switches -Fuses and Circuit breakers in houses.

UNIT – V: Digital Electronics and Digital India (9 Hours)

Logic gates, OR, AND, NOT, NAND, NOR, EXOR logic gates – Universal building blocks – Boolean algebra– De Morgan's theorem – verification – overview of Government initiatives: software technological parks under MeitY, NIELIT- Semiconductor laboratories under Dept. of Space – an introduction to Digital India.

Total Lecture Hours – 45

COURSE OUTCOME:

1. Explain types of motion and extend their knowledge in the study of various dynamic motions analyzeand demonstrate mathematically. Relate theory with practical applications in medical field.

2. Explain their knowledge of understanding about materials and their behaviors and apply it to varioussituations in laboratory and real life. Connect droplet theory with Corona transmission.

3. Comprehend basic concept of thermodynamics concept of entropy and associated theorems able tointerpret the process of flow temperature physics in the background of growth of this technology.
4. Articulate the knowledge about electric current resistance, capacitance in terms of potential electric
   fieldand electric correlate the connection between electric field and magnetic field and analyze them mathematically verify circuits and apply the concepts to construct circuits and study them.

5. Interpret the real life solutions using AND, OR, NOT basic logic gates and intend their ideas to universal building blocks. Infer operations using Boolean algebra and acquire elementary ideas of IC circuits.Acquire information about various Govt. programs/ institutions in this field.

TEXT BOOKS

1. R. Murugesan (2001), *Allied Physics*, S. Chand & Co, New Delhi.
2. Brijlal and N.Subramanyam (1994), *Waves and Oscillations*, Vikas Publishing House, New Delhi.
3. Brijlal and N.Subramaniam (1994), *Properties of Matter*, S.Chand & Co., New Delhi.
4. J. B. Rajam and C.L.Arora (1976), *Heat and Thermodynamics,* (8^{th} edition), S.Chand & Co., New Delhi.
5. R. Murugesan (2005), *Optics and Spectroscopy*, S.Chand & Co,New Delhi.
6. A. Subramaniyam, *Applied Electronics, 2^{nd}Edn.,* National Publishing Co.,Chennai.

REFERENCES

1. Resnick Halliday and Walker (2018), *Fundamentals of Physics* (11^{th}edition),John Willey and Sons,Asia Pvt. Ltd., Singapore.

2. V. R. Khanna and R.S.Bedi (1998), *Textbook of Sound*, 1^{st}Edn. Kedharnaath Publish & Co, Meerut.

3. N. S. Khare and S.S.Srivastava (1983), *Electricity and Magnetism*, 10^{th}Edn., Atma Ram & Sons, NewDelhi.

4. D. R. Khanna and H.R. Gulati (1979), *Optics*, S. Chand & Co. Ltd., New Delhi.

5. V. K. Metha (2004), *Principles of Electronics*, 6th Edn., S.Chand and Company.

E- RESOURCES

1. https://youtu.be/M_5KYncYNyc
2. https://youtu.be/ljJLJgIvaHY
3. https://youtu.be/7mGqd9HQ_AU
4. https://youtu.be/h5jOAw57OXM
5. https://learningtechnologyofficial.com/category/fluid-mechanics-lab/

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DEPARTMENT OF PHYSICS

Semester: III- AP- I/II: Allied Physics Practical (Any Eight Experiments)

Ins. Hrs. /Week: 2 **Course Credit: 2** **Course Code:U23APY302P**

1. Young's modulus by non-uniform bending using pin and microscope.
2. Young's modulus by non-uniform bending using optic lever, scale and telescope.
3. Rigidity modulus by static torsion method.
4. Rigidity modulus by torsional oscillations without mass.
5. Surface tension and interfacial Surface tension – drop weight method.
6. Comparison of viscosities of two liquids – burette method.
7. Specific heat capacity of a liquid – half time correction.
8. Verification of laws of transverse vibrations using sonometer
9. Calibration of low range voltmeter using potentiometer
10. Determination of thermo emf using potentiometer
11. Verification of truth tables of basic logic gates using ICs
12. Verification of De Morgan's theorems using logic gate ICs.
13. Use of NAND as universal building block.
14. Radius of curvature of lens by forming Newton's rings.
15. Thickness of a wire using air wedge.
16. Wavelength of mercury lines using spectrometer and grating.
17. Refractive index of material of the lens by minimum deviation.
18. Refractive index of liquid using liquid prism.
19. Determination of AC frequency using sonometer.
20. Specific resistance of a wire using PO Box.
21. Thermal conductivity of poor conductor using Lee's disc.
22. Determination of figure of merit table galvanometer.
23. Determination of Earth's magnetic field using field along the axis of a coil.
24. Characterisation of Zener diode.
25. Construction of Zener/IC regulated power supply.
26. Construction of AND, OR, NOT gates using diodes and transistor.
27. NOR gate as a universal building block.

Total Lecture Hours – 30

COURSE OUTCOME

1. Understand the laboratory technique and to educate and motivate the students in the field of Physics.

TEXT BOOKS

1. Dr. S. Somasundaram, *Practical Physics*, Apsara Publications, Tiruchirappalli, 2012.
2. R. Sasikumar, *Practical Physics*, PHI Learning Pvt. Ltd, New Delhi 2011.

REFERENCES

1. S. Srinivasan, *A Text Book of Practical Physics*, Sultan Chand Publications.

E – RESOURCES

1. https://youtu.be/Q8Otf6k3uGk
2. https://youtu.be/8DhfUz0idwM

SEC-IV & V

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DEPARTMENT OF CHEMISTRY
B.Sc., CHEMISTRY

Semester: III-: SEC-II Entrepreneurial Skills in Chemistry

Ins. Hrs. /Week: 2 **Course Credit: 2** **Course Code**: **U23SECH32**

UNIT –I FOOD CHEMISTRY **(6 Hours)**

Food adulteration-contamination of food items with clay stones, water and toxic chemicals -Common adulterants. Food additives, Natural and synthetic anti-oxidants, glazing agents (hazardous effect), food colorants, Preservatives, leavening agents, baking powder and baking soda, yeast, MSG, vinegar.

UNIT II: HANDS ON EXPERIENCE (Students can choose any four) **(4 Hours)**

Detection of adulterants in food items like coffee, tea, pepper, chilly powder, turmeric powder, butter, ghee, milk, honey etc., by simple techniques. Preparation of Jam, squash and Jelly, Gulkand, cottage cheese. Preparation of products like candles,

UNIT III: CHEMISTRY IN HOUSEKEEPING **(6 Hours)**

Deodorants, acid cleaners, laundry aids, alkaline cleaners, metal polishes, Preparation of products like candles, pain balm, tooth paste/powder rand disinfectants in small scale. Extraction of oils from spices and flowers. Testing of water samples using testing kit

UNIT IV: SHAMPOOS AND DYES **(9 Hours)**

Shampoos- Requisites, formulation and ingredients. Dandruff curing shampoos- preparation,

Dyes Classification – Natural, synthetic dyes and their characteristics – basic methods and principles of dyeing

UNIT V: SOAPS AND DETERGENTS **(5 Hours)**

Soaps - Definition, different raw materials in soap manufacture-hot and cold process. Varieties of soap and their uses (brief study- manufacture not necessary)

Detergents- Introduction. Cleansing action of soap. Distinction between soaps and detergents.

Total Lecture Hours-30

COURSE OUTCOME

The students are able to

1. The students are able to understand the requirements and ingredients of cosmetics.
2. Learn the basic requirements and classifications of flavorings agent.
3. Describe the preparation of shampoos and Hair dyes.
4. Know how to prepare the powder tooth paste.
5. Understand the manufacturing process of soaps and detergents

TEXTBOOKS

1. Text book of Applied Chemistry, Thangamma Jacob, Macmillan, 1987 home science and allied science Edition.
2. Modern Technology of Perfumes, NIIR Board of Technologies. Flavors and essential oils
3. Modern Technology of cosmetics, NIIR Board of technologies.
4. Industrial Chemistry, B.K. Sharma, Goel publishing house.
5. Shyam Jha, Rapid detection of food adulterants and contaminants (Theory and Practice),

REFERENCES

1. Dr. Kashmiri, M. khamkar, vaishali, M. Gokhale, Applied science 2018 Technical Publications.
2. Cosmetic Science Dr. AIJAZ shellah, Dr.subnash, V.Deshmane, Do.Kallash, R.Biyani, Dr.Md. Rageeb md Usman 2019 S.Vikas and Company (PV).
3. Natural hair dye oct.2017 Dinalanier.
4. Making your own shampod july 2021 Emily D Monter.
5. Analysis of one.Minute potentially available fluoride from dentifrice.
6. George S &Muralidharan V, (2007) Fibre to Finished Fabric – A Simple Approach, Publication Division, University of Madras, Chennai.

E-RESOURCES

1,https://doi.org/10.3108/beej.14.1

2.https://doi.org/10.1152/advan.00007.2017

3.https://www.jstor.org/stable/40555946

4.https://www.vlab.co.in/broad-area-chemical-sciences.

5.https://faculty.kfupm.edu.sa/chem/belali/CHEM%20456/Chapter%205/CHAPTER%205_SOAPS%20AND%20DETERGENTS.pdf

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DEPARTMENT OF CHEMISTRY
B.Sc., CHEMISTRY

Semester: III-: SEC-III Pesticide Chemistry

Ins. Hrs. /Week: 2 **Course Credit: 2** **Course Code: U23SECH33**

UNIT I: INTRODUCTION AND TOXICITY OF PESTICIDES (9 Hours)

History of pesticides. Chemistry of Pesticides: Brief introduction to classes of pesticides (Chemical class, targets), structures, chemical names, physical and chemical properties. **Toxicity of pesticides**: Acute and chronic toxicity in mammals, birds, aquatic species etc. Methods of analysis of pesticides.

UNIT II : INSECTICIDES (9 Hours)

Classification and study of following insecticides with respect to structure, chemical name, physical properties, chemical properties, synthesis, degradation, metabolism, formulations, Mode of action, uses, toxicity. Organophosphates and Phosphothionates: Acephate, Chlorpyriphos, Monocrotophos, and parathion-methyl. Organochlorine – Endosulfan, heptachlor; Carbamate: Cartap hydrochloride, Methomyl, Propoxur

UNIT III: PESTICIDES RESIDUES (9 Hour)

Introduction- application of agrochemicals, dissemination pathways of pesticides, causes of pesticide residues, remedies. Pesticides residues in atmosphere- entry into atmosphere, action of pesticides, effects on environments. Pesticides residues in water - entry into water systems, action and effect in aquatic environment. Pesticides residues in soil. entry into soil, absorption, retention and transport in soil, effects on microorganism, soil condition and fertility, decomposition and degradation by climatic factors and microorganism

UNIT IV: PESTICIDE RESIDUES EFFECT AND ANALYSIS (9 Hours)

Effects of pesticides residue on human life, birds and animals- routes for exposure to pesticides, action of pesticides on living system. Analysis of pesticides residues- sample preparation, extraction of pesticides residues (soil, water and vegetables/fruits) simple methods and schemes of analysis, multi-residue analysis.

UNIT V: BIO PESTICIDES (9 Hours)

Pheromones, attractants, repellents – Introduction, types and application (8- Dodecen-1-ol, 10-cis-12-hexadecadienoic, Trimedlure, Cue-lure, methyl eugenol, N,N- Diethyl-m-toluamide, Dimethyl phthalate, Icaridin). Baits- Metaldehyde, Iron (II) phosphate, Indoxacarb, Zinc Phosphide, Bromadiolone.

Total Lecture Hours-45

COURSE OUTCOME

The students are able to

1. Teach about the pesticides and their toxicity with respect to structure and category.

2. Explain the preparation and property of pesticides

3. Investigate the pesticide residues, prevention and care

4. Demonstrate the extraction and analytical methods of pesticide residues

5.Make awareness to the public on bio-pesticides

TEXTBOOKS

1. Handa SK. Principles of pesticide Chemistry. Agrobios (India); 2012.
2. Matolcsy G, Nádasy M, Andriska V. Pesticide Chemistry. Elsevier; 1989.
3. J. Miyamoto and P. C. Kearney Pesticide Chemistry Human Welfare and the Environment vol.
4. IV Pesticide Residue and Formulation Chemistry, Pergamon press,1985. R. Cremlyn: Pesticides, John Wiley.

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1. Roy N. K., Chemistry of Pesticides. CBS Publisher & Distributors P Ltd; 1st Ed. (2010).
2. Nollet L.M., Rathore H.S., Handbook of pesticides: methods of pesticide residues analysis. CRC press; 2016.
3. Ellerbrock R.H., Pesticide Residues: Significance, Management and Analysis, 2005

E-RESOURCES

1. https://www.amazon.in›Healthy-Chemistry-Optimal-H.
2. https://www.amazon.in›Fundamentals-Biochemistry-A...
3. https://www.amazon.in›Handbook-Common-Diseases-...
4. https://www.flipkart.com›fundamentals-biochemistry-.
5. *https://www.amazon.in›Textbook-Pharmaceutical-Che*

SEMESTER-IV

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DEPARTMENT OF CHEMISTRY
B.Sc., CHEMISTRY

Semester: IV-: CC IV General Chemistry–IV

Ins. Hrs. /Week: 5 **Course Credit: 5** **Course Code**: **U23CH407**

UNIT I: THERMODYNAMICS I (15 Hours)

Terminology – Intensive, extensive variables, state, path functions; isolated, closed and open systems; isothermal, adiabatic, isobaric, isochoric, cyclic, reversible and irreversible processes; First law of thermodynamics – Concept and significance of heat (q), work (w), internal energy (E),

enthalpy (H); calculations of q, w, E and H for reversible, irreversible expansion of ideal and real gases under isothermal and adiabatic conditions; relation between heat capacities (Cp & Cv); Joule Thomson effect- inversion temperature

Thermochemistry - heats of reactions, standard states; types of heats of reactions and their applications; effect of temperature (Kirchhoff's equations) and pressure on enthalpy of reactions; Hess's law and its applications; determination of bond energy; Measurement of heat of reaction – determination of calorific value of food and fuels . Zeroth law of thermodynamics-Absolute Temperature scale.

UNIT II: THERMODYNAMICS II (15 Hours)

Second Law of thermodynamics - Limitations of first law, spontaneity and randomness; Carnot's cycle; Concept of entropy, entropy change for reversible and irreversible processes, entropy of mixing, calculation of entropy changes of an ideal gas and a van der Waals gas with changes in temperature, volume and pressure, entropy and disorder.

Free energy and work functions - Need for free energy functions, Gibbs free energy, Helmholtz free energy - their variation with temperature, pressure and volume, criteria for spontaneity; Gibbs-Helmholtz equation – derivations and applications; Maxwell relationships, thermodynamic equations of state; Thermodynamics of mixing of ideal gases, Ellingham Diagram-application

Third law of thermodynamics - Nernst heat theorem; Applications of third law - evaluation of absolute entropies from heat capacity measurements, exceptions to third law.

UNIT III: GENERAL CHARACTERISTICS OF d-BLOCK ELEMENTS (15 Hours)

Transition Elements- Electronic configuration - General periodic trend variable valency, oxidation states, stability of oxidation states, colour, magnetic properties, catalytic properties and tendency to form complexes. Comparative study of transition elements and non transition elements – comparison of II and III transition series with I transition series. Group study of Titanium, Vanadium, Chromium, Manganese, Iron, Cobalt, Nickel and Zinc groups

UNIT IV : ETHERS, THIO ETHERS , EPOXIDES, ALDEHYDES AND KETONES

(15 Hours)

Nomenclature, isomerism, general methods of preparations, reactions involving cleavage of C-O linkages, alkyl group and ethereal oxygen. Zeisel's method of estimation of methoxy group. Reactions of epoxides with alcohols, ammonia derivatives and LiAH4 Thioethers - nomenclature, structure, preparation, properties and uses

Aldehydes and Ketones

Nomenclatue, structure and reactivity of aliphatic and aromatic aldehydes and ketones; general methods of preparation and physical properties. Nucleophilic addition reactions, base catalysed reactions with mechanism- Aldol, Cannizzaro's reaction, Perkin reaction, Benzoin condensation, Haloform reaction, Knoevenagel reaction. Oxidation of aldehydes. Baeyer - Villiger oxidation of ketones. Reduction: Clemmensen reduction, Wolf - Kishner reduction, Meerwein – Pondorf Verley reduction, reduction with LiAlH4 and NaBH4.

Addition reactions of unsaturated carbonyl compounds: Michael addition

UNIT V : CARBOXYLIC ACIDS **(15 Hours)**

Nomenclature, structure, preparation and reactions of aliphatic and aromatic monocarboxylic acids. Physical properties, acidic nature, effect of substituent on acidic strength. HVZ reaction, Claisen ester condensation, Bouveault Blanc reduction, decarboxylation, Hunsdieckerreaction.Formic acid-reducing property. Reactions of dicarboxylic acids, hydroxy acids and unsaturated acids

Carboxylic acid Derivatives: Preparations of aliphatic and aromatic acid chlorides, esters, amides and anhydrides. Nucleophilic substitution reaction at the acyl carbon of acyl halide, anhydride, ester, amide. Schottan- Baumann reaction. Claisen condensation, Dieckmann and Reformatsky reactions, Hofmann bromamide degradation and Curtius rearrangement

Active methylene compounds: Keto – enol tautomerism. Preparation and synthetic applications of diethyl malonate and ethyl acetoacetate

Halogen substituted acids – nomenclature; preparation by direct halogenation, iodination from unsaturated acids, alkyl malonic acids

Hydroxy acids – nomenclature; preparation from halo, amino, aldehydic and ketonic acids, ethylene glycol, aldol acetaldehyde; reactions – action of heat on α, β and γhydroxy acids.

Total Lecture Hours- 75

COURSE OUTCOME

1. Explain the terms and processes in thermodynamics; discuss the various laws of thermodynamics and thermo chemical calculations.
2. Discuss the second law of thermodynamics and its application to heat engine; discuss third law and its application on heat capacity measurement.
3. Investigate the chemistry of transition elements with respect to various periodic properties and group wise discussions.
4. Discuss the fundamental organic chemistry of ethers, epoxides and carbonyl compounds including named organic reactions.
5. Discuss the chemistry and named reactions related to carboxylic acids and their derivatives; discuss chemistry of active methylene compounds, halogen substituted acidsand hydroxyl acid

TEXT BOOKS

1. B.R. Puri and L.R. Sharma, *Principles of Physical Chemistry*, Shoban Lal Nagin Chand and Co., thirty three edition, 1992.
2. K. L. Kapoor, *A Textbook of Physical chemistry*, (volume-2 and 3), Macmillan, India Ltd, third edition, 2009.
3. P.L. Soni and Mohan Katyal, *Textbook of Inorganic Chemistry*, Sultan Chand & Sons, twentieth edition, 2006.
4. M. K. Jain, S. C. Sharma, *Modern Organic Chemistry*, Vishal Publishing, fourth reprint, 2003.
5. S.M. Mukherji, and S.P. Singh, *Reaction Mechanism in Organic Chemistry*, Macmillan India Ltd., third edition, 1994.

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1. Maron, S. H. and Prutton C. P. *Principles of Physical Chemistry,* 4^{th}ed.; The Macmillan Company: Newyork,1972.
2. Lee, J. D. *Concise Inorganic Chemistry,* 4th ed.; ELBS William Heinemann: London,1991.
3. Gurudeep Raj, *Advanced Inorganic Chemistry,* 26^{th}ed.; Goel Publishing House: Meerut, 2001.
4. Atkins, P.W. & Paula, J. *Physical Chemistry*, 10th ed.; Oxford University Press:New York, 2014.
5. Huheey, J. E. *Inorganic Chemistry: Principles of Structure and Reactivity,* 4^{th} ed; Addison Wesley Publishing Company: India,1993

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2. https://pubs.acs.org/doi/10.1021/ja02254a006solidstate
3. https://learn.careers360.com/chemistry/chemical-kinetics-chapter/
4. https://nptel.ac.in/courses/112102255 Thermodynamics
5. https://nptel.ac.in/courses/104101136 Advanced transition metal chemis

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DEPARTMENT OF CHEMISTRY
B.Sc., CHEMISTRY

Semester: IV CP-IV Gravimetric Analysis (P)

Ins. Hrs. /Week: 4 **Course Credit: 4** **Course Code**: **U23CH408P**

GRAVIMETRIC ANALYSIS:

1.Estimation of Lead as lead chromate.
2. Estimation of Barium as barium chromate.
3. Estimation of Nickel as Nickel - DMG complex.
4. Estimation Calcium as calcium oxalate monohydrate
5.Estimation of Barium as barium sulphate.

ONLY FOR DEMONSTRATION:
1. Estimation of Copper as copper (I) thiocyanate.
2. Estimation of Magnesium as magnesium oxalate.
3. Estimation of Iron as Iron (III) oxide

Scheme of Valuation:		**Max.Marks**
Internal		25 Marks
External		75 Marks
Record		10 Marks
Procedure Writing		10 Marks
Results		
< 2%	-	55 Marks
2-3%	-	45 Marks
3-4%	-	35 Marks
>4%	-	25 Marks

COURSE OUTCOME

The students are able to,

1. To recognize the principles of gravimetric analysis.
2. To understand the basics of gravimetric analysis of selected cations involving methods, selection of precipitants, nucleation, aggregation of precipitate, removal of contamination and weighing a precipitate.
3. To conduct experiments to determine physical constantof unknown compounds.
4. To use proper apparatus to minimize the errors.

TEXT BOOKS

1. John Charles Olsen. 2015. Text Book of Quantitative Chemical Analysis. Arkose Press, New Delhi.

2. Nicholas Knight. 2016. A Course in Quantitative Chemical Analysis Gravimetric and Volumetric. Leopold Classic Library. Austrlia.

3. Pandey OP, Bajpai DN, Giri S Dr. 2010. Practical Chemistry. Revised Edition, S. Chand , New Delhi.

4. Venkateswaran. V, Veeraswamy.R, Kulanthaivelu.A.R. 2015. Basic Principles of Practical Chemistry. Sultan Chand & Sons, New Delhi.

5. Vogel, A. I. 2000. Text Book of Quantitative Inorganic Analysis; 6th Ed., Longman,

REFERENCES

1. John Charles Olsen. 2010. Text Book of Qunatitative Chemical Analysis. Nabu Press,

2. Shikha Gulati, Sharma . JL. Shagun Manocha. 2017. Practical Inorganic Chemistry. CBS Publisher, Chennai.

3. Henry Morton, Alfert . R. 2015.The Students Practical Chemistry. Palala Press.
4. Erdey. L. 2013. Gravimetric Analysis Part 2. Vol 7. Pergamon, Oxford.

5. John G Watson, Richard J Tropp, Steven D Kohl, Xiaoliang Wang, Judith C Chow. 2017. Filter Processing and Gravimetric Analysis for Suspended Particulate Matter samples. Aerosol Science and Engineering, 1 (2), 93-105.

E-RESOURCES

1. https://www.elsevier.com/books/gravimetric-analysis/erdey/978-1-4831-9756-2

2. https://www.sciencedirect.com/book/9781483197647/gravimetric-analysis
3. https://books.google.com/books/about/Gravimetric_Analysis.html?id=MxkSBQAAQBAJ
4. https://books.google.com/books/about/Gravimetric_Analysis.html?id=7RoSBQAAQB

5. https://www.amazon.in/Gravimetric-Analysis-International-Monographs-Analytical-ebook/dp/B01DT29BUU
6. https://doi.org/10.1007/s41810-017-0010-4.

ALLIED PHYSICS

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DEPARTMENT OF PHYSICS
For the students of II B.Sc. CHEMISTRY

Semester: IV – AC - II: Allied Physics – II

Ins.Hrs. / Week: 3 **Course Credit: 2** **Course Code: U23APY403**

UNIT – I Optics **(10 Hours)**

Interference – Interference in thin films – Colors of thin films – Air wedge – determination of diameter of a thin wire by air wedge – Diffraction – Diffraction of light vs sound – Normal incidence – experimental determination of wavelength using diffraction grating (no theory) – Polarization – Polarization by Double reflection – Brewster's law.

UNIT – II Atomic Physics **(10 Hours)**

Atom models – Bohr atom model – Mass number – Atomic number – Nucleons – Vector atom model – various quantum numbers – Pauli's exclusion principle – Electronic configuration – Periodic classification ofelements – Bohr Magneton – Stark effect –Zeeman effect (elementary ideas only) – Photo electric effect – Einstein's photoelectric equation – Applications of photoelectric effect: Solar cells, Solar panels, Optoelectric devices.

UNIT – III Nuclear Physics **(8 Hours)**

Nuclear models – Liquid drop model – Magic numbers – Shell model – Nuclear energy – Mass defect – Binding energy – Radioactivity – uses – Half- life – Mean life - Radio isotopes and uses – Controlled and Uncontrolled chain reaction – Nuclear fission – Energy released in fission – Chain reaction – Critical reaction – Critical size - Atom bomb – Nuclear reactor – Breeder reactor – Importance of commissioning PFBR in our country – Heavy water disposal, Safety of reactors: Seismic and floods – Introduction to DAE, IAEA – Nuclear fusion – Thermonuclear reactions – Differences between fission and fusion.

UNIT – IV Introduction to Relativity and Gravitational Waves **(8 Hours)**

Frame of reference – Postulates of Special theory of relativity – Galilean transformation equations – Lorentztransformation equations – Derivation – Length contraction – Time Dilation – Twin Paradox – Mass-Energyequivalence – Introduction on Gravitational waves, LIGO, ICTS opportunities at International Centre forTheoretical Sciences.

UNIT – V Semiconductor Physics **(9 Hours)**

P- n Junction diode – Forward and reverse biasing – Characteristic of diode – Zener diode – characteristic ofZener diode – Voltage regulator – Full wave bridge rectifier – construction and working – Advantages (no mathematical treatment) – USB cell phone charger – Introduction to e-vehicles and EV charging stations.

Total Lecture Hours - 45

COURSE OUTCOME

1. Explain the concepts of interference diffraction using principles of superposition of waves and rephrasethe concept of polarization based on wave patterns.
2. Outline the foundation of different atom models and various experiments establishing quantumconcepts. Relate the importance of interpreting improving theoretical models based on observation.Appreciate interdisciplinary nature of science and in solar energy related applications.
3. Summarize the properties of nuclei, nuclear forces structure of atomic nucleus and nuclear models. Solve problems on delay rate half-life and mean-life. Interpret nuclear processes like fission and fusion. Understand the importance of nuclear energy, safety measures carried and get our Govt. agencies likeDAE guiding the country in the nuclear field.
4. To describe the basic concepts of relativity like equivalence principle, inertial frames and Lorentz transformation. Extend their knowledge on concepts of relativity and vice versa. Relate this with currentresearch in this field and get an overview of research projects of National and International importance, like LIGO, ICTS, and opportunities available.
5. Summarize the working of semiconductor devices like junction diode, Zener diode, transistors andpractical devices we daily use like USB chargers and EV charging stations.

TEXT BOOKS

1. R. Murugesan (2005), *Allied Physics*, S.Chand & Co, New Delhi.
2. K. Thangaraj and D.Jayaraman (2004), *Allied Physics*, Popular Book Depot, Chennai.
3. Brijlal and N.Subramanyam (2002), *Text book of Optics*, S.Chand & Co, New Delhi.
4. R. Murugesan (2005), *Modern Physics*, S.Chand & Co, New Delhi.
5. A. Subramaniyam, *Applied Electronics*, 2nd Edn.,National Publishing Co., Chennai.

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1. Resnick Halliday and Walker (2018), *Fundamentals of Physics*, 11th Edn., John Willey and Sons, Asia Pvt.Ltd., Singapore.
2. D.R.Khanna and H.R. Gulati (1979), *Optics*, S.Chand & Co. Ltd., New Delhi.
3. A.Beiser (1997), *Concepts of Modern Physics*, Tata McGraw Hill Publication, New Delhi.
4. Thomas L. Floyd (2017), *Digital Fundamentals*, 11thEdn., Universal Book Stall, New Delhi.
5. V.K.Metha (2004), *Principles of electronics,* 6thEdn., S.Chand and Company, New Delhi.

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1. https://www.berkshire.com/learning-center/delta-p-facemask/https://www.youtube.com/watch?v=QrhxU47gtj4https://www.youtube.com/watch?time_continue=3 18&v=D38BjgUdL5U&feature=emb_logo
2. https://www.youtube.com/watch?v=JrRrp5F-Qu4
3. https://www.validyne.com/blog/leak-test-using-pressure-transducers/
4. https://www.atoptics.co.uk/atoptics/blsky.htm -
5. https://www.metoffice.gov.uk/weather/learn-about/weather/optical-effects

SEC-IV & V

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DEPARTMENT OF CHEMISTRY
B.Sc., CHEMISTRY

Semester: IV SEC-IV Instrumental Methods of Chemical Analysis

Ins. Hrs. /Week: 2 **Course Credit: 2** **Course Code**: **U23SECH44**

UNIT-I : QUALITATIVE AND QUANTITATIVE ASPECTS OF ANALYSIS

(9hours)

S.I Units, Distinction between Mass and Weight. Moles, Millimoles, Milli equivalence, Molality, Molarity, Normality, Percentage by Weight and Volume, ppm, ppb. Density and Specific Gravity of Liquids. Stoichiometry Calculations Sampling, evaluation of analytical data, Errors – Types of Errors, Accuracy, Precision, Minimization of Errors. Significant Figures. Methods of Expressing Precision: Mean, Median, Average Deviation, Standard Deviation, Coefficient of Variation, Confidence Limits, Q- test, F-test, T-test. The Least Square Method for Deriving Calibration plots.

UNIT II : ATOMIC ABSORPTION SPECTROSCOPY (9 hours)

Basic principles of instrumentation (choice of source, monochromator, detector, choice of flame and Burner designs. Techniques of atomization and sample introduction; Method of background correction, sources of chemical interferences and their method of removal. Techniques for the quantitative estimation of trace level of metal ions from water samples

UNIT III: UV-VISIBLE AND IR SPECTROSCOPY (9 hours)

Origin of spectra, interaction of radiation with matter, fundamental laws of spetroscopy and selection rules, validity of Beer-Lambert's law. **UV-Visible Spectrometry:** Basic principles, instrumentation (choice of source, monochromator and detector) for single and double beam instrument; Basic principles of quantitative analysis: estimation of metal ions from aqueous solution, geometrical isomers, keto-enol tautomers. **Infrared Spectroscopy:** Basic principles of instrumentation (choice of source, monochromator& detector) for single and double beam instrument; sampling techniques.

UNIT IV: THERMAL AND ELECTRO-ANALYTICAL METHODS OF ANALYSIS

(9 hours)

TGA and DTA- Principle, Instrumentation, methods of obtaining Thermograms, factors affecting TGA/DTA, Thermal analysis of silver nitrate, calcium oxalate and calcium acetate DSC- Principle, Instrumentation and applications. Electroanalytical methods: polarography - principle, instrumentation and applications. Derivative polarography- Cyclic Voltammetry – principle

UNIT V: SEPARATION AND PURIFICATION TECHNIQUES . (9 hours)

Classification, principle, Factors affecting - Solvent Extraction – Liquid - Liquid Extraction, Chromatography: Column, TLC, Paper, Gas, HPLC and Electrophoresis, Principle, Classification, Choice of Adsorbents, Solvents, Preparation of Column, Elution Mechanism of separation: adsorption, partition & ion exchange. Development of chromatograms and Rf value.

Total Lecture Hours-45

COURSE OUTCOME

The students are able to,

1. Apply error analysis in the calibration and use of analytical instruments, explain theory, instrumentation and application of flame photometry and Atomic Absorption spectrometry

2. Explain theory, instrumentation and application of UV visible and Infrared spectroscopy.

3. Able to discuss instrumentation, theory and applications of thermal and electrochemical techniques

4. Explain the use of chromatographic techniques in the separation and identification of mixtures

5. Explain preparation of solutions, stoichiometric calculations

TEXT BOOKS

1. Vogel, Arthur I: A Test book of Quantitative Inorganic Analysis (Rev. by G.H. Jeffery and others) 5th Ed., The English Language Book Society of Longman.
2. R. Gopalan, P. S. Subramanian and K. Rengarajan, Elements of Analytical Chemistry, Sultan Chand, New Delhi, 2007
3. Skoog, Holler and Crouch, Principles of Instrumental Analysis, Cengage Learning, 6th Indian Reprint (2017).
4. R. Speyer, Thermal Analysis of Materials, CRC Press, 1993.R.A. Day and A.L. Underwood, Quantitative Analysis, 6thedn., Prentice Hall of India Private Ltd., New Delhi, 1993

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1. D. A. Skoog, D. M. West and F. J. Holler, Analytical Chemistry: An Introduction, 5thedn., Saunders college publishing, Philadelphia, 1998.
2. Dash U N, Analytical Chemistry; Theory and Practice, Sultan Chand and sons Educational Publishers, New Delhi, 2011.
3. Christian, Gary D; Analytical Chemistry, 6th Ed., John Wiley & Sons, New York, 2004.
4. Mikes, O. &Chalmes, R.A. Laboratory Handbook of Chromatographic & Allied Methods, Elles Harwood Ltd. London
5. G.H. Jeffery, J. Bassett, J. Mendham and R.C. Denney, Vogel's Textbook of Quantitative Chemical Analysis, sixth edition Pearson Education, 2000

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2. http://eric.ed.gov/?id=EJ386287
3. http://www.sjsu.edu/faculty/watkins/diamag.htm
4. http://www.britannica.com/EBchecked/topic/108875/separation- and-purification

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B.Sc., CHEMISTRY

Semester: IV SEC-V Forensic Science

Ins. Hrs. /Week: 2 **Course Credit: 2** **Course Code: U23SECH45**

UNIT I: POISONS (9 hours)

Poisons - types and classification - diagnosis of poisons in the living and the dead -clinical symptoms - postmortem appearances. Heavy metal contamination (Hg, Pb, Cd) of seafoods - use of neutron activation analysis in detecting arsenic in human hair. Treatment in cases of poisoning – use of antidotes for common poisons

UNIT-II: CRIME DETECTION (9 hours)

Accidental explosion during manufacture of matches and fireworks (as in Sivakasi). Human bombs - possible explosives (gelatin sticks and RDX) - metal detector devices andother security measures for VVIP-composition of bullets and detecting powder burns

UNIT-III: FORGERY AND COUNTERFEITING (9 hours)

Documents - different types of forged signatures - simulated and traced forgeries -inherent signs of forgery methods - writing deliberately modified - uses of ultraviolet rays -comparison of type written letters – checking silver line water mark in currency notes – alloy analysis using AAS to detect counterfeit coins – detection of gold purity in 22 carat ornaments – detecting gold plated jewels -authenticity of diamond.

UNIT-IV: TRACKS AND TRACES (9 hours)

Tracks and traces - small tracks and police dogs - foot prints - costing of foot prints -residue prints, walking pattern or tyre marks – miscellaneous traces and tracks – glass fracture - tool marks - paints - fibres - Analysis of biological substances - blood, semen, saliva, urine and hair - Cranial analysis (head and teeth) DNA Finger printing for tissue identification in dismembered bodies - detecting steroid consumption in athletes and racehorses.

UNIT-V: MEDICAL ASPECTS (9 hours)

Aids - causes and prevention - misuse of scheduled drugs - burns and their treatment by plastic surgery. Metabolite analysis using mass spectrum - Gas chromatography-Arson -natural fires and

arson - burning characteristics and chemistry of combustible materials -nature of combustion. Ballistics - classification - internal and terminal ballistics - small arms -laboratory examination of barrel washing and detection of powder residue by chemical tests.

Total Lecture Hours-45

COURSE OUTCOME

The students are able to,

1. Learn about the Poisons - types and classification of poisons in the living and the dead organisms and also get information about Postmortem.
2. Get awareness on Human bombs, possible explosives (gelatin sticks and RDX) and metal defector devices and other security measures for VVIP - composition of bullets and detecting powder burns
3. Detect the forgery documents, different types of forged signatures
4. Have an idea about how to tracks and trace using police dogs, foot prints identification and gain the knowledge in analyzing biological substances - blood, semen, saliva, urine and hair - DNA Finger printing for tissue identification in dismembered bodies
5. Get the awareness on Aids - causes and prevention and also have an exposure on handling fire explodes.

TEXT BOOKS

1. SA Iqbal, M Liviu, Textbook of forensic chemistry, Discovery publishing house private limited, 2011.
2. Kelly M. Elkins, Introduction to Forensic Chemistry, CRC Press, Taylor & Francis Group, 2019.
3. Javed I. Khan, Thomas J. Kennedy, Donnell R. Christian, Jr., Basic principles of Forensic chemistry, Humana Press, first edition, 2012.
4. Bapuly AK, (2006) Forensic Science – Its application in crime investigation, Paras Medical Publisher, Hyderabad.
5. Sharma B.R., (2006) Scientific Criminal Investigation, Universal Law Publishing Co. Pvt. Ltd, New Delhi.

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1. Richard Saferst in and Criminalistics-An Introduction to Forensic Science (College Version), Sopfestein, Printice hall, eighth edition,2003
2. Suzanne Bell, Forensic Chemistry, Pearson, second international edition, 2014.
3. Jay Siegel, Forensic chemistry: Fundamentals and applications, Wiley- Blackwell, first edition, 2015.
4. Max M. Houck & Jay A. Segal, (2006) Fundamentals of Forensic Science, Elsevier Academic press.
5. Henry C. Lee, Timothy Palmbach, Marilyn T. Miller, (2006) Henry Lee's Crime Scene Book Elsevier Academic press

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2. http://www.wonder howto.com/topic/forensic-science
3. https://www.routledge.com/rsc/downloads/ATQ50_K22324_Sample.pdf
4. https://virtuallearningacademy.net/vla/lessondisplay/lesson9011/SCIFSU01Forensic_Introduction.pdf
5. https://catalogimages.wiley.com/images/db/pdf/9781119608967.excerpt.pdf