

**Academic year 2020 -2021**

**Department of Chemistry**

**1.1.3 Courses focussing on Employability, Entrepreneurship and Skill development**

Sem	Course Code	Course Title	Ins. Hrs / week	Examination			Credits	
				Dur. Hrs	CIA Marks	ESE Marks		Total Marks
I	119TA1/ 119MY1/ 119HD1/ 119FR1	Part I: Language I	6	3	25	75	100	4
	119EN1	Part II: English I	6	3	25	75	100	4
	120C01	Part III: Core I General Chemistry I	7	3	25	75	100	4
		Part III: Core Practical I Inorganic Qualitative Analysis	3	-	-	-	-	-
	117AC1	Part III: Allied I Physics I	4	3	25	50	75	3
		Part III: Allied Physics Practical	2	-	-	-	-	-
	119VEC	Part IV: Value Education	2	2	50	-	50	2
II	219TA2/ 219MY2/ 219HD2/ 219FR2	Part I: Language II	6	3	25	75	100	4
	219EN2	Part II: English II	6	3	25	75	100	4
	220C02	Part III: Core II General Chemistry II	7	3	25	75	100	4
	220CP1	Part III: Core Practical I Inorganic Qualitative Analysis	3	3	25	50	75	3
	217AC2	Part III: Allied II Physics II	4	3	25	50	75	3
	217ACP	Part III: Allied Physics Practical	2	3	20	30	50	2
	219EVS	Part IV: Environmental Studies	2	2	50	-	50	2
III	317TA3/ 317MY3/ 317HD3/ 317FR3	Part I: Language III	6	3	25	75	100	4
	317EN3	Part II: English III	6	3	25	75	100	4
	317C03	Part III: Core III General Chemistry III	4	3	25	75	100	4
		Part III: Core Practical II Volumetric and Organic Analysis	3	-	-	-	-	-
	317AC3	Part III: Allied III Mathematics I	6	3	25	75	100	4
	317NCE	Part IV: Non Major Elective: Chemistry in Everyday Life	2	2	50	-	50	2
	317CS1	Part IV: Skill Enhancement Course I Applications of Computer in Chemistry	3	3	75	-	75	3
IV	417TA4/ 417MY4/ 417HD4/ 417FR4	Part I: Language IV	6	3	25	75	100	4

	417EN4	Part II: English IV	6	3	25	75	100	4
	417C04	Part III: Core IV General Chemistry IV	4	3	25	75	100	4
	417CP2	Part III: Core Practical II Volumetric and Organic Analysis	3	6	40	60	100	4
	417AC4	Part III: Allied IV Mathematics II	6	3	25	75	100	4
	417NGA	Part IV: General Awareness and Information Security	2	2	50	-	50	2
	417CS2	Part IV: Skill Enhancement Course II: Chemistry for Exploration I	3	3	75	-	75	3
	417ALC	Advanced Learner's Course I - Food Science	-	3	-	100	100	4*
V	517C05	Part III: Core V Organic Chemistry I	5	3	25	75	100	4
	517C06	Part III: Core VI Inorganic Chemistry I	4	3	25	75	100	4
	517C07	Part III: Core VII Physical Chemistry I	4	3	25	75	100	4
	517CE1/ 517CE2	Part III: Elective I Polymer and Dye Chemistry / Agro-Industrial Chemistry	4	3	25	75	100	4
	517CE3	Part III: Elective II Project	4	3	25	75	100	4
		Part III: Core Practical III Gravimetric Analysis and Physical Chemistry Experiments	4	-	-	-	-	-
		Part III: Core Practical IV Applied Chemistry Practical	2	-	-	-	-	-
	517CS3	Part IV: Skill Enhancement Course III: Chemistry for Exploration II	3	3	75	-	75	3
VI	617C08	Part III: Core VIII Organic Chemistry II	5	3	25	75	100	5
	617C09	Part III: Core IX Inorganic Chemistry II	4	3	25	75	100	4
	617C10	Part III: Core X Physical Chemistry II	4	3	25	75	100	4
	617C11	Part III: Core XI Spectroscopy	4	3	25	75	100	4
	617CE4/ 617CE5	Part III: Elective III Industrial Chemistry/ Applied Chemistry	4	3	25	75	100	4
	617CP3	Part III: Core Practical III Gravimetric Analysis and Physical Chemistry Experiments	4	6	40	60	100	4
	617CP4	Part III: Core Practical IV Applied Chemistry Practical	2	3	25	50	75	2
	617CS4	Part IV: Skill Enhancement Course IV: Nanoscience	3	3	75	-	75	3
	617EX1/ 617EX2/ 617EX3 617EX4/ 617EX5	Part V: Extension Activity	-	-	50	-	50	2
	617ALC	Advanced Learner's Course II - Dairy Chemistry	-	3	-	100	100	4*
		<b>Total</b>					<b>3500</b>	<b>140</b>

**Employability , Entrepreneurship , Skill development**

### 1.1.3 Courses focussing on Employability

#### B.Sc Chemistry Semesters I and II

(For the students admitted from the academic year 2020– 2021 onwards)

Course: Part III: Core Practical I Inorganic Qualitative Analysis	Course Code: 220CP1
Semesters: I and II	No. of Credits: 3
No. of hours : 90	P: R 78:12
CIA Max. Marks: 25	ESE Max. Marks:50

(P: Practical hours, R: Record and observation work)

#### Course Objectives:

- To impart sound theoretical knowledge in inorganic qualitative analysis.
- To expose the students to laboratory hygiene and safety methods.
- To enhance the skill of handling chemicals, glass wares and apparatus used in inorganic qualitative analysis.
- To apply the chemistry principles in the qualitative analysis.
- To familiarize with filtration, precipitation, decantation, heating, centrifugation and separation techniques.

#### Course Outcomes: On completion of the Course the student will be able to

CO	Statement	Bloom's Taxonomy level
CO1	Gain sound theoretical knowledge in inorganic qualitative analysis.	U
CO2	Handle chemicals, glass wares & apparatus,	A
CO3	Apply qualitative principles i.e. express the physical & chemical processes, use the heating, decantation & centrifugation processes, examine precipitation & filtration processes	A
CO4	Analyze the anions in mixture.	A
CO5	Distinguish the cation groups and examine the given cation	A
CO6	Implement laboratory hygiene and safety methods.	A

#### R-Remembrance U –Understanding A-Apply

#### Syllabus:

- I. Reactions involving anions: Carbonate, sulphate, nitrate, fluoride, chloride, bromide, oxalate, phosphate and borate.
- II. Reactions involving cations: Lead, bismuth, copper, cadmium, iron, manganese, aluminium, cobalt, nickel, zinc, barium, calcium, strontium, ammonium and magnesium

<p>III. Analysis of a mixture containing 2 cations and 2 anions of which one may be an interfering radical requiring elimination during the analysis (Spot tests to be used wherever necessary)</p> <p>IV. <b>Group experiments:</b></p> <p>(i) Demonstration of common ion effect using (a) KCl and HCl (b) liq. NH<sub>3</sub> and NH<sub>4</sub>Cl.</p> <p>(ii) Solvent Extraction.</p> <p>V. <b>Demonstration</b></p> <p>i. Identification of Acetate, Chromate and Iodide ion ii. Use of Hot Plates, Heating Mantles and Magnetic Stirrer</p>
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**Books for Reference:**

S.No	Name of the Book	Authors	Publishers with Edition
1.	Vogel's Text Book of Practical Organic Chemistry	B. S. Furniss, A. J. Hannaford, P. W. G. Smith, and A. R. Tatchell	Pearson Edn., Ltd., 5 <sup>th</sup> ed., 2009.
2.	Basic Principles of Practical Chemistry	V. Venkateswaran, R. Veeraswamy, and A. R. Kulandaivelu,	S. Chand and Sons publications, 2 <sup>nd</sup> ed., 2016.
3.	Advanced Practical Chemistry	RaghupatiMukhopadhyay, and Pratul Chatterjee	Books and Allied publications, 3 <sup>rd</sup> ed., 2007

**E-Resources: (Web resources & E-books)**

<https://chemistry.com.pk/books/vogels-textbook-quantitative-chemical-analysis-5e/>

**Mapping of Course outcome with POs**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	Bloom's Taxonomy level
CO 1	H	H	M	H	H	H	U
CO 2	H	H	M	H	H	H	A
CO 3	H	H	M	H	H	H	A
CO 4	H	H	M	H	H	H	A
CO 5	H	H	M	H	H	H	A
CO 6	H	H	M	H	H	H	A

**Content delivery Methods (Minimum Two):**

1. Demonstration
2. Lecture Method
3. Video Class
4. Virtual Laboratory
5. Problem Solving
6. ICT

**Course Evaluation Methods:**

<b>Direct Methods</b>	<b>Indirect Methods</b>
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Lab Performance Record Model Examination	Course Exit Survey
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**Internal Assessment components:**

Components	Lab Performance	Record	Model Examination	Attendance	Total
Marks	8	8	7	2	25

**Question Paper Pattern**

Section	Experiments	Weightage
A	Qualitative Analysis	90 % (45 Marks)
B	Viva Voce (Questions from CO1- CO6)	10 % (05 Marks)

**Evaluation will be made based on Weightage % given**

Bloom's Category	Lab performance (8)	Record (8)	Model Examination(7)
A	Punctuality : 25% (2 Marks) Safety and Hygiene : 25% (2 Marks) Experimental Skill : 25% (2 Marks) Observation Note : 25% (2 Marks)	Punctuality : 50% (4 Marks) Neatness : 50% (4 Marks)	Marks converted to 7 marks

**ESE Assessment components:**

<b>Qualitative analysis</b>	<b>: 45 marks</b>
<b>Viva</b>	<b>: 05 marks</b>
<b>Total</b>	<b>: 50 marks</b>
<b>Scheme for Qualitative analysis</b>	<b>: 45 marks</b>
a. 4 Ions correct with correct procedure	: 45 Marks
b. 3 Ions correct with correct procedure	: 34 Marks
c. 2 Ions correct with correct procedure	: 23 Marks
d. 1 Ions correct with correct procedure	: 12 Marks
e. Spotting of an Ion	: 5 Marks
f. Precipitating at the correct group	: 5 Marks
g. Correct detection of cations without eliminating the interfering Ion should be treated a spotting	: 5 Marks

**B. Sc Chemistry  
Semester – III and IV**

(For the students admitted from the academic year 2017 – 2018 onwards)

<b>Course: Part III Core Practical II Volumetric and Organic Analysis</b>	<b>Course Code: 417CP2</b>
<b>Semester: III and IV</b>	<b>No. of Credits: 4</b>
<b>No. of hours : 90</b>	<b>P:R 78: 12</b>
<b>CIA Max. Marks: 40</b>	<b>ESE Max. Marks:60</b>

(P: Practical, R: Record and Observation)

**Course Objectives:**

- To impart sound theoretical knowledge in volumetric and organic analysis.
- To expose the students to laboratory hygiene and safety methods.
- To enhance the skill of handling chemicals, glass wares and apparatus used in volumetric and organic analysis.
- To acquire skills of doing quantitative estimations by titrimetry.
- To provide basic knowledge and skills for simple reactions in organic chemistry.
- To determine the functional group of an unknown organic compound.
- To understand the purpose of a synthetic derivative.
- To enable the students to estimate the organic compounds.

**Course Outcomes: On completion of the Course the student will be able to**

CO	Statement	Bloom's Taxonomy level
CO1	Gain sound theoretical knowledge in volumetric and organic analysis and implement laboratory hygiene and safety methods.	U
CO2	Perform accurate quantitative measurements, calculations and draw accurate conclusions and predict the outcome of qualitative organic reactions and prepare suitable derivatives.	A
CO3	Distinguish between qualitative and quantitative chemical analysis	A

**R-Remembrance U –Understanding A-Apply****Syllabus:****I. Volumetric analysis****A. Acidimetry and alkalimetry**

1. Estimation of oxalic acid
2. Estimation of sodium carbonate
3. Estimation of hydrochloric acid

**B. Permanganometry**

1. Estimation of oxalic acid
2. Estimation of ferrous iron in ferrous sulphate
3. Estimation of Mohr's salt

**C. (i) Iodometry**

1. Estimation of potassium dichromate
2. Estimation of copper

**(ii) Iodimetry**

Estimation of arsenious oxide (demo)

**D. Dichrometry (demo)**

1. Estimation of ferrous ion using external indicator
2. Estimation of ferric ion by reduction method

**E. Group experiments**

1. Determination of sodium hydroxide and sodium carbonate in a mixture
2. Estimation of calcium (direct method)
3. Determination of percentage of  $MnO_2$  in pyrolusite

4. Estimation of chloride
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## II. A. Analysis of organic compounds

Systematic analysis of organic compounds:- preliminary tests, detection of elements, nature of functional groups, confirmatory tests and preparation of derivatives of acids, phenols, amides, amines (primary), anilides, carbohydrates, aldehydes, ketones, thiourea, nitro compounds and esters- **Micro scale level except for heating experiments.**

### B. Estimation of organic compounds (Class work)

1. Estimation of Vitamin C.
2. Estimation of Glycine by formal titration.
3. Determination of Acid value of fats
4. Estimation of Ca in milk.
5. Determination of acetic acid in commercial vinegar.
6. Determination of alkali content of antacid tablets

### Books for study:

Unit	Name of the Book	Authors	Publishers with Edition
1.	Basic Principles of Practical Chemistry	V. Venkateswaran, R. Veeraswamy, and A. R. Kulandaivelu	S. Chand and Sons publications, 2016.
2.	Advanced Practical Chemistry	Raghupati Mukhopadhyay, and Pratul Chatterjee	Books and Allied publications, 3 <sup>rd</sup> ed., 2007.
3.	Vogel's Text Book of Practical Organic Chemistry	B. S. Furniss, A. J. Hannaford, P. W. G. Smith, and A. R. Tatchell	Pearson Edn., Ltd., 5 <sup>th</sup> ed., 2009.

### E-Resources : (Web resources & E-books)

- <http://vlab.amrita.edu/>
- <http://vlab.amrita.edu/?sub=2&brch=193&sim=352&cnt=1>
- <http://vlab.amrita.edu/?sub=2&brch=191>

### Mapping of Course outcome with POs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO6	Bloom's Taxonomy level
CO 1	H	-	M	M	M	M	U
CO 2	H	-	M	M	M	M	A
CO 3	H	-	M	M	M	M	A

### Course delivery Methods (Minimum Two) :

- Lecture Method
- Demonstration Class
- Virtual Laboratory
- Problem Solving

### Course Evaluation Methods:

Direct Methods	Indirect Methods
Lab Performance Record Model Practical Examination	Course Exit Survey

### Internal Assessment components:

Components	Lab Performance	Record	Model Practical Examination	Attendance	Total
Marks	12	16	10	02	40

### Question Paper Pattern

Section	Experiments	Weightage
A	Volumetric Analysis	40 % (24 Marks)
B	Organic Analysis	50 % (30 Marks)
C	Viva Voce (Questions from CO1, CO2 and CO3)	10 % (06 Marks)

Evaluation will be made based on Weightage % given

Bloom's Category	Lab performance (12)	Record (16)	Model Examination
A	Punctuality : 25% (3 Marks) Safety and Hygiene : 25% (3 Marks) Experimental Skill : 25% (3 Marks) Observation Note : 25% (3 Marks)	Punctuality : 25% (4 Marks) Neatness : 25% (4 Marks) Calculations: 25% (4 Marks) Accuracy : 25% (4 Marks)	Model Examination Marks converted to 10 marks

### ESE Assessment components:

<b>Volumetric analysis</b>	<b>: 24 Marks</b>
<b>Organic Analysis</b>	<b>: 30Marks</b>
<b>Viva voce</b>	<b>: 6 Marks</b>
<b>Volumetric analysis : 24 Marks</b>	
Volumetric Error upto 2%	24 Marks
Error upto 2-3%	20 Marks
Error upto 3-4%	15 Marks
Above 5%	10 Marks
<b>Organic Analysis: 30Marks</b>	
Element Present/ absent correctly reported	3 x 2 - 6 Marks
Aliphatic/ Aromatic	2 x 1 - 2 Marks
Saturated/ unsaturated	3 x 1 - 3 Marks
Preliminary test	10 Marks
Functional group	4 Marks
One solid derivative	5 Marks

## B. Sc Chemistry

### Semester – V

(For the students admitted from the academic year 2017 – 2018 onwards)

<b>Course: Part III Elective I Polymer and Dye Chemistry</b>	<b>Course Code: 517CE1</b>
<b>Semester: V</b>	<b>No. of Credits: 4</b>
<b>No. of hours : 60</b>	<b>C:T: 52:8</b>
<b>CIA Max. Marks: 25</b>	<b>ESE Max. Marks:75</b>

(C: Contact hours, T:Tutorial)

### Course Objectives:

- To understand the importance of industrial polymers and their classification
- To acquire the knowledge about the polymerization techniques and polymer processing



- To learn the scientific and chemical principles underlying in dye chemistry
- To understand the importance of dyes and their classification

**Course Outcomes: On completion of the Course the student will be able to**

CO	Statement	Bloom's Taxonomy level
CO1	Account the general structure of polymers, differentiate between natural and man-made polymers, give examples for everyday and industrial application of polymers.	A
CO2	Execute the various polymerization methods, discuss the different polymerization mechanisms and the characterisation methods.	A
CO3	Demonstrate the polymer fractionation methods and Illustrate the methods for the determination of the molecular weight	A
CO4	Analyze the fundamentals involved in the dye chemistry, and to classify the types of dyes on the basis of application	A
CO5	Predict the synthetic methods for some specific dyes and apply the knowledge of dye chemistry in various industry.	A

**R-Remembrance, U –Understanding, A-Apply**

### Syllabus:

#### **Unit I: Classification of Polymers (11 Hours)**

Introduction- polymerization functionality- degree of polymerization- classification of polymers- elastomers, fibres, thermosetting and thermoplastic polymers- methods of polymerization: bulk, solution, suspension and emulsion- polymer processing techniques: calendaring, compression, extrusion and injection moulding, film casting, and foaming.

#### **Unit II: Polymerization Mechanism and Special Polymers (11 Hours)**

Chain polymerization: mechanism of free radical and ionic polymerization- Coordination polymerization: illustration and mechanism using Zeigler-Natta catalyst- tacticity-factors influencing stereo regulation- glass transition temperature- flow temperature- melting temperature- factors affecting  $T_g$ - manufacture, properties and uses of typical polymers: polyethylene, polystyrene, polyesters, PVC, PET, nylon 6, nylon 66, phenolic resins and Teflon.

#### **Unit III: Fractionation and Molecular Weight Determination (10 Hours)**

Characterization of polymers- Polymer fractionation: introduction, fractional precipitation method and gel permeation chromatography- Average molecular weights: introduction and types of average molecular weights- molecular weight- determination by light scattering, viscosity and ultra centrifuge method.

Polymer reactions: addition- substitution- cyclisation- cross linking- vulcanization.

**Unit IV: Dye Chemistry I****(10 Hours)**

Requisites of a dye- colour and constitution – theories of colour and constitution: Witt theory, quinonoid theory- classification of dyes according to application- chemical classification of dyes- Pigments: requirements- classification- difference between dyes and pigments.

Nitro and nitroso dyes: synthesis, properties, uses of naphthol green Y, disperse yellow, picric acid and martius yellow- Azo dyes: mechanism of diazotization and coupling reaction- preparation and uses of butter yellow, para red, bismark brown and congo red- Di and triphenyl methane dyes: auramine-O, malachite green, and crystal violet.

**Unit V: Dye Chemistry II****(10 Hours)**

Acridine dyes: proflavin and acriflavin- cyanine, isocyanine and carbocyanine dyes: Synthesis and uses of quinoline blue, ethyl red and sensitol red- Phthalocyanine dyes: introduction, general methods of preparation and applications of metal phthalocyanine- non-textile uses of dye stuffs: leather, paper, food colours, medicine, photography and cosmetics- pollution due to dyeing industry effluents and its remedial measures- dye effluents treatment using green methodology.

**Books for study:**

Unit	Name of the Book	Authors	Publishers with Edition
I - III	Polymer science	V. R. Gowariker, N. V. Viswanathan, and Jayadev Sreedhar	New Age International Pvt., Ltd. publications, 2 <sup>nd</sup> ed., 2015.
IV - V	Synthetic Dyes	R. Chatwal	Himalayan publications, 4 <sup>th</sup> ed., 2016.
I - V	Industrial Chemistry	B.K. Sharma	Goel publications, 12 <sup>th</sup> ed., 2016.
IV-V	Modern Organic Chemistry	M. K. Jain and S. C. Sharma	Vishal Publications, 4 <sup>th</sup> ed., 2016.

**Books for Reference:**

S.No	Name of the Book	Authors	Publishers with Edition
1.	Text book of Polymer Science	F. W. Billmeyer, and Jr. John	Wiley and Sons publications, 3 <sup>rd</sup> ed., 2015.
2.	Introductory Polymer Science	G. S. Mishra	New Age International Pvt., Ltd. publications, 1 <sup>st</sup> ed., 1993.
3.	A Text book of Synthetic Dyes	O.D. Tyagi and M.Yadav	Anmol publications, 5 <sup>th</sup> ed., 2001

**E-Resources : (Web resources & E-books)**

- [www.youtube.com/watch?v=LBCrSbc0L9g](http://www.youtube.com/watch?v=LBCrSbc0L9g)
- [faculty.kfupm.edu.sa/CHEM/belali/CHEM 456/Chapter 8...](http://faculty.kfupm.edu.sa/CHEM/belali/CHEM%20456/Chapter%208...)
- [www.slideshare.net/amirhamza1234/presentation-on-dye](http://www.slideshare.net/amirhamza1234/presentation-on-dye)
- [www.authorstream.com/Presentation/...polymerization-ppt](http://www.authorstream.com/Presentation/...polymerization-ppt)
- [monographs.iarc.fr/wp-content/uploads/2018/06/...](http://monographs.iarc.fr/wp-content/uploads/2018/06/...)

- [nptel.ac.in/courses/104105039](http://nptel.ac.in/courses/104105039)
- [www.slideshare.net/NehaKumar09/impact-of-the-dye...](http://www.slideshare.net/NehaKumar09/impact-of-the-dye...)
- [web.mit.edu/5.33/www/lec/poly.pdf](http://web.mit.edu/5.33/www/lec/poly.pdf)
- [nptel.ac.in/courses/103103029/pdf/mod7.pdf](http://nptel.ac.in/courses/103103029/pdf/mod7.pdf)

### Mapping of Course outcome with POs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO6	Bloom's Taxonomy level
CO 1	H	L	L	M	M	L	A
CO 2	H	L	L	M	M	L	A
CO 3	H	L	L	M	M	L	A
CO 4	H	L	L	M	M	L	A
CO5	H	L	L	M	M	L	A

### Content Delivery Methods (Minimum Two):

- Lecture Method
- Demonstration Class
- PPT and Video
- ICT Enabled Class
- Guest Lecture

### Course Evaluation Methods:

Direct Methods	Indirect Methods
Continuous Internal Assessment Test I Continuous Internal Assessment Test II Assignment Internship	Course Exit Survey

### Internal Assessment components:

Components	CIA	Assignment	Internship	Attendance	Total
Marks	15	4	4	2	25

### Question Paper Pattern

Section A	MCQ – 10 Questions	(10 X 1= 10 marks)
Section B	Either or Type - 5 Questions	(5 X 4= 20 marks)
Section C	Either or Type - 5 Questions	(5 X 9= 45 marks)

### Questions for CIA will be designed based on Weightage % given

Bloom's Category	CIA I (75)	CIA II (75)	Assignment (4)	Internship (4)

<b>R</b>	30%	30%	Overall Structure: 25% (1 Mark) Content : 50% (2 Marks) Presentation : 25% (1 Mark)	Report - 50 % (2 Marks) Viva Voce - 50% (2 Marks)
<b>U</b>	40%	40%		
<b>A</b>	30%	30%		

### Blue Print for End Semester Examination

U n i t	Section A (10 x 1 = 10)										Section B (5 x 4 = 20)					Section C (5 x 9 = 45)														
	MCQ										11		12		13		14		15		16		17		18		19		20	
	1	2	3	4	5	6	7	8	9	10	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b		
I	✓	✓								T	T							T	T											
II			✓	✓								T	T							T	T									
III					✓	✓								T	T					T	T									
IV							✓	✓								T	T					T	T							
V								✓	✓									T	T							T	T			

### B. Sc Chemistry Semester – V

(For the students admitted from the academic year 2017 – 2018 onwards)

<b>Course: Part III Elective I Agro Industrial Chemistry</b>	<b>Course Code: 517CE2</b>
<b>Semester: V</b>	<b>No. of Credits: 4</b>
<b>No. of hours : 60</b>	<b>C:T 52:8</b>
<b>CIA Max. Marks: 25</b>	<b>ESE Max. Marks:75</b>

(C: Contact hours, T : Tutorial)

#### Course Objectives:

- To learn the scientific and chemical principles underlying in water chemistry
- To acquire knowledge about physical and chemical aspects of soil.
- To understand the chemistry of plant nutrients
- To impart basic knowledge in pesticides, insecticides and herbicides

**Course Outcomes: On completion of the Course the student will be able to**

CO	Statement	Bloom's Taxonomy level
CO1	Demonstrate different water softening and treatment methods	U
CO2	Evaluate different types of physico-chemical properties of water and soil	U
CO3	Describe the components, classification of soil, factors controlling soil reactions and soil colloids	U
CO4	Discuss the manufacture, different types of plant nutrients ,	U

	fertilizers ,pesticides, insecticides and herbicides	
<b>CO5</b>	Investigate the safe handling of fertilizers, pesticides, insecticides and herbicides	<b>A</b>
<b>CO6</b>	Critique the environmental impact of using fertilizers, pesticides, insecticides and herbicides	<b>A</b>

**R-Remembrance U –Understanding A-Apply**

**Syllabus:**

**Unit I – Water Treatment (10 Hours)**

Hardness of water - units of hardness - Equivalence of CaCO<sub>3</sub> - Water softening methods – lime soda process, permutit and ion exchange process - Water quality analysis - Determination of hardness of water, acidity, alkalinity, pH value, chloride content and their estimations - Dissolved oxygen demand (DO), Biological oxygen demand (BOD), chemical oxygen demand (COD) and their determination - Water treatment - Primary, Secondary and Tertiary and dialysis, Desalination and reverse osmosis.

**Unit II – Soil Chemistry I (10 Hours)**

Soil and soil components - definition of soil, major soil components – mineral matter, organic matter, soil water and soil air. Classification of Soil- Modern classification and seventh approximation. Physical properties of soil. Soil texture – definition, classification and characteristics. Soil structure – definition, types and management. Soil porosity – definition and factors affecting porosity. Soil temperature – sources of soil heat, factors affecting soil temperature, regulation of soil temperature. Role of physical properties in soil fertility.

**Unit III - Soil Chemistry II (10 Hours)**

Soil colloids - Introduction - Properties of colloids- Brownian movement, flocculation, electrical charge, adsorption. Soil reactions - Soil pH, buffer action and its importance in agriculture. Factors controlling soil reactions. Buffer action and its importance in agriculture - Ion exchange reactions – definition, exchange capacity of cations and anions and their importance. Nature of soil - Acid and alkaline soil- classification, cause for formation and methods for reclamation.

**Unit IV– Nutrients for Plants (11 Hours)**

Plant nutrients - macro and micro nutrients - their role in plant growth - sources - forms of plants nutrient absorbed by plants - factors affecting nutrient absorption - deficiency symptoms in plants - corrective measures - chemicals used for correcting nutritional deficiencies. Fertilizer - Introduction - requisites of fertilizers. Nitrogenous fertilizer – manufacture and uses of NH<sub>4</sub>NO<sub>3</sub>, urea and calcium cyanamide. Phosphate fertilizer – preparation and uses of super phosphate of lime and triple super phosphate. Potash fertilizer – preparation and uses of KCl and KNO<sub>3</sub>. Bio fertilizers – definition, precautions and merits - Soil pollution by fertilizer.

**Unit V – Pesticides, Insecticides and Herbicides (11 Hours)**

Pesticides - definition and classification on the basis of types of pests - one example in each case (preparation not necessary) - safe handling of pesticides - impact of pesticides on soil, plants and environment - synthesis and uses of pesticides in the following classes: Organochlorines (DDT, Gammexene,); Organophosphates (Malathion); Carbamates (Carbofuran and carbaryl); Quinones (Chloranil), Anilides (Alachlor and Butachlor). Insecticides - definition and classification - Parathion, Dithion and Aldrin. Herbicides - definition, classification - mechanism of action - arsenic, nitro compounds and chloro compounds. Acaricides - rodenticides - attractants – repellants- green alternatives for pesticides, insecticides and herbicides.

**Books for study:**

Unit	Name of the Book	Authors	Publishers with Edition
I-V	Industrial chemistry	B.K. Sharma	Goel publications, 12 <sup>th</sup> ed., 2016
I-V	Plant ecology and soil science	R. S Shukla, and P. S. Chandel	S. Chand and Sons publications, 1 <sup>st</sup> ed., 1998.
I-V	Soil at glance	U.N. Sahai	Kalyani publications, 1 <sup>st</sup> ed., 2004
I-V	Industrial Chemistry	M. G. Arora and M. Singh	Anmol Publications, Volume I and II, 1 <sup>st</sup> ed., 1994

**Books for Reference:**

S.No	Name of the Book	Authors	Publishers with Edition
1.	Reigel's Hand book of Industrial Chemistry	James A. Kent	CBS publications, 9 <sup>th</sup> ed., 1997
2.	Principles of soil science	M. M. Rai	Macmillan India Limited publications, 1 <sup>st</sup> ed., 1988

**E-Resources : (Web resources & E-books)**

- [https://www.acehsc.net/wpcontent/uploads/Industrial\\_Chemistry\\_by\\_Rohan\\_Barar.pdf](https://www.acehsc.net/wpcontent/uploads/Industrial_Chemistry_by_Rohan_Barar.pdf)
- <https://nptel.ac.in/courses/103107082/7>
- <https://nptel.ac.in/courses/103107086/>

**Mapping of Course outcome with POs**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	Cognitive levels
CO 1	H	-	M	M	M	M	U
CO 2	H	-	M	M	M	M	U
CO 3	H	-	M	M	M	M	U
CO 4	H	-	M	M	M	M	U
CO 5	H	-	M	M	M	M	A
CO 6	H	-	M	M	M	M	A

**Content delivery Methods (Minimum Two):**

- Lecture method
- Power point presentation
- Video
- Hands-on-training
- Demonstration
- Practical session
- Charts and posters
- Industrial visits/Field visits

**Course Evaluation Methods:**

Direct Methods	Indirect Methods
<b>Continuous Internal Assessment Test I</b> <b>Continuous Internal Assessment Test II</b> <b>Group discussion</b> <b>Seminar</b>	<b>Course Exit Survey</b>

**Internal Assessment components:**

Components	CIA	Group discussion	Seminar	Attendance	Total
Marks	15	4	4	2	25

**Question Paper Pattern**

Section A	MCQ – 10 Questions	(10 X 1= 10 marks)
Section B	Either or Type - 5 Questions	(5 X 4= 20 marks)
Section C	Either or Type - 5 Questions	(5 X 9= 45 marks)

**Questions for CIA will be designed based on Weightage % given**

Bloom's Category	CIA I (75)	CIA II (75)	Group discussion (4)	Seminar (4)
<b>R</b>	30%	30%	Presentation: 50% ( 2 Mark) Content : 25% (1 Mark) Interaction/ overall Effort :25%(1 Mark)	Presentation: 50% ( 2 Mark) Content : 25% (1 Mark) Interaction/ overall Effort :25%(1 Mark)
<b>U</b>	40%	40%		
<b>A</b>	30%	30%		

**Blue Print for End Semester Examination**

Unit	Section A (10 x 1 = 10)										Section B (5 x 4 = 20)					Section C (5 x 9 = 45) T-Theory; P-Problems						
	MCQ										11	12	13	14	15	16	17	18	19	20		
	1	2	3	4	5	6	7	8	9	10	a	b	a	b	a	b	a	b	a	b	a	b
I	✓	✓									T	T							T	T		





2. Group size: Maximum 3
3. Review I - Evaluated at the end of I CIA  
Review II - Evaluated at the end of II CIA

**Books for Reference:**

S.No	Name of the Book	Authors	Publishers with Edition
1.	Basic Principles of Practical Chemistry	V. Venkateswaran, R. Veeraswamy, and A. R. Kulandaivelu	S. Chand and Sons publications, 2 <sup>nd</sup> ed., 2016.
2.	Advanced Practical Chemistry	Raghupati Mukhopadhyay and Pratul Chatterjee	Books and Allied publications, 3 <sup>rd</sup> ed., 2007.
3.	Vogel's Text Book of Practical Organic Chemistry	B. S. Furniss, A. J. Hannaford, P. W. G. Smith, and A. R. Tatchell	Pearson Edn., Ltd., 5 <sup>th</sup> ed., 2009.

**E-Resources : (Web resources & E-books)**

- [chem.psu.edu/undergrad/reu/participating-faculty-research-projects](http://chem.psu.edu/undergrad/reu/participating-faculty-research-projects)
- [www.thoughtco.com/chemistry-projects-4133589](http://www.thoughtco.com/chemistry-projects-4133589)
- [www.thoughtco.com/chemistry-projects-4133589](http://www.thoughtco.com/chemistry-projects-4133589)
- <https://www.lib.uoguelph.ca/get-assistance/writing/specific.../writing-literature-review>
- <https://www.ugc.ac.in/journallist/>
- [www.e-journals.in/](http://www.e-journals.in/)
- [www.niscair.res.in/sciencecommunication/researchjournals/rejour/ijcb/ijcb0.asp](http://www.niscair.res.in/sciencecommunication/researchjournals/rejour/ijcb/ijcb0.asp)
- [www.niscair.res.in/sciencecommunication/researchjournals/rejour/ijca/ijca0.asp](http://www.niscair.res.in/sciencecommunication/researchjournals/rejour/ijca/ijca0.asp)
- [ijep.co.in/](http://ijep.co.in/)
- [https://www.annauniv.edu/academic\\_courses/docs/ugthesis.pdf](https://www.annauniv.edu/academic_courses/docs/ugthesis.pdf)

**Mapping of Course outcome with Pos**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO6	Bloom's Taxonomy level
CO 1	M	M	M	M	H	M	A
CO 2	M	M	M	M	H	M	U
CO 3	M	M	M	M	H	M	A
CO 4	M	M	M	M	H	M	U

**Content Delivery Methods (Minimum Two):**

- Workshops
- Hands-on-training
- Demonstration
- Practical session
- Industrial/Instrumentation visits
- Open source
- Problem solving
- Peer teaching
- Scientific thinking

**Course Evaluation Methods:**

Direct Methods	Indirect Methods
<b>Continuous Internal Assessment Test I</b> <b>Continuous Internal Assessment Test II</b> <b>Dissertation</b> <b>Presentation</b> <b>Viva Voce</b>	<b>Course Exit Survey</b>

**Internal Assessment components:**

Bloom's Category	CIA I (review)	CIA II (review)	Total
<b>A</b>	<b>10</b>	<b>15</b>	<b>25</b>

**ESE Assessment components:**

Dissertation	Presentation	Viva Voce	Total
<b>40</b>	<b>10</b>	<b>25 (Questions from CO1, CO2, CO3, &amp; CO4)</b>	<b>75</b>

**Evaluation of the Project**

No	Main component	Total Marks	Sub components	Marks
1.	<b>Dissertation</b>	10	Introduction, Review and Objectives	Excellent : 10 Very Good: 8 Good: 6 Average: 4
2.		10	Materials and methods	Excellent : 10 Very Good: 8 Good: 6 Average: 4
3.		10	Results and Discussion	Excellent : 10 Very Good: 8 Good: 6 Average: 4
4.		10	Conclusion and References	Excellent : 10 Very Good: 8 Good: 6 Average: 4
5.	<b>Project Presentation</b>	10	i) Clarity and understanding ii) Effective presentation iii) Time Management iv) Interaction	All four: 10 Three: 8 Two: 6 One: 4

6.	<b>Viva- Voce</b>	25	Understanding of i) Review ii) Objectives iii) Methodology iv) Results	All four: 25 Three: 20 Two: 15 One: 10
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### Semester VI

(For the students admitted from the academic year 2017 – 2018 onwards)

<b>Course: Part III Core XI Spectroscopy</b>	<b>Course Code: 617C11</b>
<b>Semester: VI</b>	<b>No. of Credits: 4</b>
<b>No. of hours : 60</b>	<b>C:T 52:8</b>
<b>CIA Max. Marks: 25</b>	<b>ESE Max. Marks:75</b>

(C: Contact hours, T: Tutorial)

#### Course Objectives:

- To acquire knowledge on interactions of electromagnetic radiation with matter and their applications in spectroscopy
- To understand the principle and instrumentation of rotational, IR, Raman, NMR, ESR and mass spectrometric techniques
- To learn the factors affecting the position of signals in the spectrum
- To appreciate the applications of rotational, IR, Raman, NMR, ESR and mass spectrometric techniques
- To analyze and interpret spectroscopic data collected by the methods discussed in the course.

#### Course Outcomes: On completion of the Course the student will be able to

CO	Statement	Bloom's Taxonomy level
CO1	Recognize the phenomenon of the interaction of light with matter in terms of the relationship with the molecular structure	U
CO2	Describe the principle and instrumentation of rotational, IR, Raman, UV, NMR, ESR and mass spectrometric techniques	U
CO3	Summarize the applications of rotational, IR, UV, NMR and mass spectrometric techniques	U
CO4	Select suitable molecular spectroscopy methods and solve the given scientific problem	A
CO5	Relate the factors affecting positions of absorption signals, solve and interpret basic spectroscopic data to predict and extract the structures at a preliminary level	A

#### R-Remembrance U –Understanding A-Apply

#### Syllabus:

<b>Unit I: Electromagnetic Spectrum</b>	<b>(9 Hours)</b>
Atomic and molecular Spectroscopy – Absorption and emission spectra- electromagnetic radiation, wavelength, wave number, frequency and energy- regions of electromagnetic spectrum and absorption of radiation- types of molecular energies – Born-oppenheimer approximation.	

Microwave spectroscopy: Principle and theory- diatomic molecule as a rigid rotor- selection rule- instrumentation- applications of rotational spectroscopy- structures of Xenon oxy fluoride, ammonia and Benzonitrile and abundance of isotopes.

**Unit II: IR Spectroscopy and Raman Spectroscopy (11Hours)**

Theory- molecular vibrations- vibrational frequency- force constant- vibrational energy- zeropoint energy- degrees of freedom for linear and non-linear molecules- selection rule- complexity of the spectrum- reasons- factors influencing vibrational frequencies- coupled vibration, fermi resonance and electronic effects- instrumentation- finger print region- overtones, combination and difference bands- applications of IR spectroscopy- qualitative analysis of functional groups- distinction between H-bonding, keto-enol tautomerism and geometrical isomerism-characteristic IR absorption frequencies of important functional groups- vibrational spectra of H<sub>2</sub>O and CO<sub>2</sub>.

Raman spectroscopy- Rayleigh and Raman scattering- stokes and anti-stokes lines- differences between Raman and IR spectroscopy - Mutual exclusion principle -CO<sub>2</sub>

**Unit III: Electronic Spectroscopy (10 Hours)**

Theory of UV spectra- electronic transitions- chromophore concept: chromophore, auxochrome, bathochromic, hyperchromic and hypsochromic effect- - instrumentation -Woodwards Fischer rules- calculation of absorption maxima in dienes only - Franck- Condon principle- applications: detection of functional groups and geometrical isomers.

Atomic absorption spectrometry –Flame photometry – Principle, instrumentation and applications.

**Unit IV: NMR Spectroscopy (11Hours)**

Theory- number of signals- equivalent and non-equivalent protons – instrumentation- chemical shift- TMS-factors influencing chemical shift- shielding and deshielding effects: anisotropy with reference to ethylene, acetylene and benzene- rules for splitting of signals- splitting of signals with reference to 1,1,2- tribromoethane, acetaldehyde, benzaldehyde and ethanol - causes of proton signals- coupling constant(elementary idea only).

**Unit V: ESR Spectroscopy and Mass Spectrometry (11 Hours)**

ESR spectroscopy- theory- presentation of ESR spectrum- instrumentation-g factor- hyperfine splitting- ESR spectrum of hydrogen atom and methyl free radical.

Mass Spectrometry - theory and basic principles- double focusing mass spectrometer - types of ions produced in mass spectrometer- molecular ion peak, base peak, dissociation process, rearrangement, multiple charged ions, negative ions and metastable ions -fragmentation: simple cleavage, retro Diel's Alder and Mc-Lafferty Rearrangement- important features of mass spectrum of saturated hydrocarbons and alcohols-mass spectrum and fragmentation pattern of methane and dodecane.

**Books for study:**

Unit	Name of the Book	Authors	Publishers with Edition
I -V	Spectroscopy	Gurdeep R.	Chatwal, Himalaya publications, 5 <sup>th</sup> ed.,

			2015
I-V	Elementary organic absorption spectroscopy	Y. R. Sharma	S.Chand and Sons publications, 5 <sup>th</sup> ed., 2016.
I-V	Instrumental approach to chemical analysis	A. K. Srivastava and P. C. Jain	S.Chand and Sons publications, 4 <sup>th</sup> ed., 2013
I-V	Organic spectroscopy Principles & applications	Jag Mohan	Narosa Publications, 2 <sup>nd</sup> ed., 2014

### Books for Reference:

S.No	Name of the Book	Authors	Publishers with Edition
1.	Spectroscopy of organic compounds	P. S. Kalsi	New age international Pvt. Ltd. publications, 6 <sup>th</sup> ed., 2011
2.	Spectroscopy	B. K. Sharma	Goel Publications, 23 <sup>th</sup> ed., 2013
3.	Molecular structure and spectroscopy	G. Aruldas	Goel publishing house, 2 <sup>nd</sup> ed., 2016

### E-Resources: (Web resources & E-books)

- <https://chemistry.com.pk/books/organic-spectroscopy-by-l-d-s-yadav/>
- <https://chemistry.com.pk/books/pavia-introduction-to-spectroscopy/>
- <https://chemistry.com.pk/books/skoog-principles-of-instrumental-analysis/>
- <http://chemistry.com.pk/books/analytical-chemistry-by-gary-d-christian/>
- <https://www.khanacademy.org/science/organic-chemistry/spectroscopy-jay/infrared-spectroscopy-theory/v/introduction-to-infrared-spectroscopy>
- <https://www.khanacademy.org/science/organic-chemistry/spectroscopy-jay/uv-vis-spectroscopy/v/uv-vis-spectroscopy>
- <https://www.khanacademy.org/science/organic-chemistry/spectroscopy-jay/proton-nmr/v/introduction-to-proton-nmr>

### Mapping of Course outcome with POs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	Cognitive levels
CO 1	H	M	-	-	M	M	U
CO 2	H	M	-	-	M	M	U
CO 3	H	M	-	-	M	M	U
CO 4	H	M	-	-	M	M	A
CO 5	H	M	-	-	M	M	A

### Content delivery Methods (Minimum Two):

- Lecture method
- Power point presentation
- Instrumentation centre visit
- Open source
- Peer teaching
- Problem solving

**Course Evaluation Methods:**

Direct Methods	Indirect Methods
Continuous Internal Assessment Test I Continuous Internal Assessment Test II Gallery walk Online test	Course Exit Survey

**Internal Assessment components:**

Components	CIA	Gallery walk	Online test	Attendance	Total
Marks	15	4	4	2	25

**Question Paper Pattern**

Section A	MCQ – 10 Questions	(10 X 1= 10 marks)
Section B	Either or Type - 5 Questions	(5 X 4= 20 marks)
Section C	Either or Type - 5 Questions	(5 X 9= 45 marks)

**Questions for CIA will be designed based on Weightage % given**

Bloom's Category	CIA I (75)	CIA II (75)	Gallery walk (4)	Online test (4)
R	30%	30%	Content - 25% (1 Mark)	R- 30%
U	40%	40%	Presentation - 50% (2 Marks)	U-40%
A	30%	30%	Interaction/Overall effort-25% (1 Mark)	A-30%

**Blue Print for End Semester Examination**

Unit	Section A (10 x 1 = 10) MCQ										Section B (5 x 4 = 20)					Section C (5 x 9 = 45) T-Theory; P-Problems									
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20					
	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	
I	✓	✓									T	T					T	T							
II			✓	✓								T	T					T	T						
III					✓	✓							T	T					T	T					
IV							✓	✓						T	T								T	T	
V									✓	✓						T	T							T	T

**B. Sc Chemistry**

**Semester –VI**

(For the students admitted from the academic year 2017 – 2018 onwards)

<b>Course: Part III Elective III Industrial Chemistry</b>	<b>Course Code: 617CE4</b>
<b>Semester: VI</b>	<b>No. of Credits: 4</b>
<b>No. of hours : 60</b>	<b>C:T 52:8</b>
<b>CIA Max. Marks: 25</b>	<b>ESE Max. Marks:75</b>

**(C:Contact hours, T:Tutorial)**

**Course Objectives:**

- To acquire knowledge about glass, ceramics, refractories and cement.
- To know the chemistry behind explosives, propellants and toxic chemical weapons.
- To obtain knowledge on Oils, fats and cleansing agents.
- To understand the principles and industrial applications of fermentation.
- To learn and understand about Adhesives and lubricants.

**Course Outcomes: On completion of the Course the student will be able to**

<b>CO</b>	<b>Statement</b>	<b>Bloom's Taxonomy level</b>
<b>CO1</b>	Summarize preparation and uses of Explosives, propellants and toxic chemical weapons.	<b>U</b>
<b>CO2</b>	Generalise adhesive and lubricants.	<b>A</b>
<b>CO3</b>	Implement Rubber and Leather technology.	<b>A</b>
<b>CO4</b>	Design Paper Technology.	<b>A</b>
<b>CO5</b>	Develop Textile Technology.	<b>A</b>

**R-Remembrance U –Understanding A-Apply**

**Syllabus:**

<b>Unit I: Explosives, propellants and toxic chemical weapons</b>	<b>(10 Hours)</b>
Explosives: Introduction and classification- characteristics of explosives- preparation and uses of TNT, nitrocellulose and nitroglycerin- gunpowder and RDX-precautions during storage of explosives-propellants-characteristics and classification-toxic chemicals: definition and requisites- study of mustard gas, phosgene, chloropicrin, teargas and nerve gas- brief study on smoke screens and pyrotechnics.	

<b>Unit II – Adhesives and lubricants</b>	<b>(11 Hours)</b>
Adhesives: Introduction- classification- adhesive action- development of adhesive strength- chemical factors influencing adhesive action- bonding processes by adhesives – advantages and limitations. Lubricants: Introduction-functions- classification- substances used as lubricants- synthetic lubricants- lubricating greases- solid lubricants: Graphite, molybdenum disulphide-properties-viscosity, flash point, fire point, aniline point, neutralization number, carbon residue test-selection of lubricants.	

<b>Unit III- Rubber and Leather technology</b>	<b>(10 Hours)</b>
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Rubber - Introduction - types of rubbers - characteristics of rubbers - latex - processing latex - mastication - compounding of rubber - drawbacks of natural rubber - rubber fabrication- vulcanizations of rubber - types of vulcanization - properties of vulcanized rubber- synthetic rubbers: preparation and applications of SBR, butyl rubber, nitrile rubber, neoprene and silicone rubber.

Leather technology:Introduction- animal skins- manufacture of leather- preparation of hides for tanning- vegetable tanning- chrome tanning- finishing- oil tanning.

#### **Unit IV- Paper Technology**

**(11 Hours)**

Paper Technology:- Introduction- manufacture of pulp- various raw materials used for the preparation of pulp-preparation of sulphite Pulp, soda Pulp, rag pulp- various processes: beating refining, filling sizing and colouring- manufacture of paper, calendaring, uses-paper products: filter paper,card board and plywood - economical problems of Indian pulp and Paper industry- Paints: definition, requisites and constituents of paints-pigments: white lead, titanium dioxide, and red lead-varnishes-characteristics and manufacture.

#### **Unit V- Textile Technology**

**(10 Hours)**

Textile fibres- introduction- plant fibres– structure and composition of cotton and linen – common tests for linen and cotton in cloth– animal fibres– properties, structure and composition of wool and silk- mineral fibre: introduction, properties and uses of asbestos, glass fibres and metallic fibres-yarn formation: blending, opening, cleaning, carding, doubling, combing, drawing, roving and spinning-yarn to fabric: weaving , shedding , picking and beating up textile process: scouring- desizing- singeing- bleaching- dyeing.

#### **Books for study:**

<b>Unit</b>	<b>Name of the Book</b>	<b>Authors</b>	<b>Publishers with Edition</b>
<b>I- III</b>	Industrial chemistry	B.K. Sharma, and Goel publications	Goel publications, 12 <sup>th</sup> ed., 2016.
<b>I- III</b>	Industrial Chemistry	M. G. Arora and M. Singh	Anmol Publications, Volume I and II, 1 <sup>st</sup> ed.,1994.
<b>IV and V</b>	Engineering Chemistry	N.Krishnamurthy, P.Vallinayagam and D.Madhavan	PHI Learning private limited,2 <sup>nd</sup> edition, 2009

#### **Books for Reference:**

<b>S.No</b>	<b>Name of the Book</b>	<b>Authors</b>	<b>Publishers with Edition</b>
<b>1.</b>	Reigel's Hand book of Industrial Chemistry	James A. Kent	CBS publications, 9 <sup>th</sup> ed., 1997.
<b>2.</b>	Engineering Chemistry	Jain and Jain	Dhanpat Rai Publication, Reprint 2010.

#### **E-Resources: (Web resources & E-books)**

- <https://chemistry.com.pk/books/organic-spectroscopy-by-l-d-s-yadav/>
- <https://chemistry.com.pk/books/pavia-introduction-to-spectroscopy/>



- <https://chemistry.com.pk/books/skoog-principles-of-instrumental-analysis/>
- <http://chemistry.com.pk/books/analytical-chemistry-by-gary-d-christian/>
- <https://www.khanacademy.org/science/organic-chemistry/spectroscopy-jay/infrared-spectroscopy-theory/v/introduction-to-infrared-spectroscopy>
- <https://www.khanacademy.org/science/organic-chemistry/spectroscopy-jay/uv-vis-spectroscopy/v/uv-vis-spectroscopy>
- <https://www.khanacademy.org/science/organic-chemistry/spectroscopy-jay/proton-nmr/v/introduction-to-proton-nmr>
- <https://www.youtube.com/watch?v=EnB7aw7IGxg>
- <https://www.youtube.com/watch?v=o8zELwp358A>

### Mapping of Course outcome with POs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	Bloom's Taxonomy level
CO 1	M	L	-	L	M	M	U
CO 2	H	L	-	M	M	M	A
CO 3	H	M	-	M	M	M	A
CO 4	H	M	-	M	M	M	A
CO 5	H	M	-	M	M	M	A

### Content Delivery Methods (Minimum Two):

- Lecture method
- Power point presentation
- Flip class room
- Industrial visits
- Open source
- Gallery walk
- Video
- Charts and posters

### Course Evaluation Methods:

Direct Methods	Indirect Methods
Continuous Internal Assessment Test I Continuous Internal Assessment Test II Assignment Group Discussion	Course Exit Survey

### Internal Assessment components:

Components	CIA	Assignment	Group Discussion	Attendance	Total
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Marks	15	4	4	2	25
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### Question Paper Pattern

Section A	MCQ – 10 Questions	(10 X 1= 10 marks)
Section B	Either or Type - 5 Questions	(5 X 4= 20 marks)
Section C	Either or Type - 5 Questions	(5 X 9= 45 marks)

### Questions for CIA will be designed based on Weightage % given

Bloom's Category	CIA I (75)	CIA II (75)	Assignment (4)	Group Discussion (4)
R	30%	30%	Overall Structure: 25% (1 Mark) Content : 50% (2 Marks) Presentation :25% (1 Mark)	Presentation: 50% (2 Marks) Content : 25% (1 Mark) Interaction/overall Effort :25% (1 Mark)
U	40%	40%		
A	30%	30%		

### Blue Print for End Semester Examination

Unit	Section A (10 x 1 = 10) MCQ										Section B (5 x 4 = 20)					Section C (5 x 9 = 45) T-Theory; P-Problems							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20			
											a	b	a	b	a	b	a	b	a	b	a	b	
I	✓	✓									T	T					T	T					
II			✓	✓								T	T					T	T				
III					✓	✓							T	T					T	T			
IV							✓	✓						T	T						T	T	
V									✓	✓						T	T					T	T

## B. Sc Chemistry

### Semester –VI

(For the students admitted from the academic year 2017 – 2018 onwards)

Course: Part III Elective III Applied Chemistry	Course Code: 617CE5
Semester: VI	No. of Credits: 4
No. of hours : 60	C:T 52:8
CIA Max. Marks: 25	ESE Max. Marks:75

(C:Contact hours, T:Tutorial)

#### Course Objectives:

- To acquire basic knowledge in non-renewable energy
- To learn and understand the utilization of renewable energy.

- To get knowledge in rubber and Leather technology.
- To obtain knowledge in paper technology.
- To attain information in Textile Technology.

**Course Outcomes: On completion of the Course the student will be able to**

CO	Statement	Bloom's Taxonomy level
CO1	Execute the utilization of non renewable energy sources .	A
CO2	Design instruments for renewable energy sources	A
CO3	Demonstrate the manufacture of Glass and cement.	U
CO4	Formulate the principle and usage of oils and fats in different products.	A
CO5	Execute Fermentation process in various industries.	A

**R-Remembrance U –Understanding A-Apply**

**Syllabus:**

**Unit I Energy Sources I**

**(11 Hours)**

Introduction- renewable and non renewable energy sources- fuels: introduction, classification and characteristics of a good fuel- comparison between solid, liquid and gaseous fuels- calorific value-determination by bomb calorimeter

Solid fuel:- Coal: introduction and different grades of coal- carbonization of coal- low and high temperature carbonizations- Liquid fuels:- Petroleum: origin and composition- refining and fractionation of petroleum- knocking: definition and its effects- antiknocking: definition and TEL, Fe(CO)<sub>5</sub>- octane number and cetane number: definition and example- cracking: definition, catalytic and thermal cracking- Gaseous fuels:LPG:composition and uses-composition, manufacture and uses of natural gas, coal gas, oil gas, producer gas and water gas.

**Unit II - Energy Sources II**

**(11 Hours)**

Solar energy- thermal applications: solar water heater, solar cooker, solar drier- description of the apparatus and uses- Solar silicon cells-description and uses- Wind energy: description of wind mill its component and uses (elementary idea only)- Biofuels:-Gobar gas- construction of the plant, operation and uses- Geothermal energy: origin and its utilization of geothermal energy- Environmental hazards from the use of geothermal energy- elementary aspects of biomass energy and tidal energy.

**Unit III: Glass, ceramics, refractories and cement**

**(11 Hours)**

Glass: Introduction –chemical properties – manufacture of glass- types of glass:soft glass, hard glass, pyrex glass, safety glass and optical glass- composition and applications. Ceramics:introduction- general properties- raw materials for ceramics- pottery products of ceramics:porous and non-porous wares, earthenware and stoneware. Refractories: Introduction-classification- properties- manufacture –fireclay, High alumina and silica refractories:properties-

manufacture. Cement: introduction and composition of portland cement- manufacture and setting of cement.

#### **Unit IV: Oils, fats and cleansing agents**

**(10 Hours)**

Fats and oils: Introduction, classification and properties- vegetable oil: manufacture of soya bean oil by solvent extraction only-refining of crude oil-hydrogenation of oil-analysis of oils and fats: definition, significance and estimation of acid value, saponification value, RM value and Iodine value. Waxes: classification and properties –synthetic oils, fats and waxes.

Cleansing agents: soap- definition – raw materials- manufacture by continuous hot process- varieties of soap and their uses only (manufacture not necessary)- cleansing action of soap- detergent: introduction –principal groups of synthetic detergents-classification of surface active agents: anionic, cationic, zwitter ionic and non-ionic detergents bio-degradability of surfactants-detergents containing enzymes-distinction between soaps and detergents-manufacture of shampoos.

#### **Unit V: Fermentation**

**(9 Hours)**

Fermentation: Introduction– conditions favourable for fermentations – fermentation processes- enzymes: characteristics of enzymes – manufacture of starch by fermentation process –manufacture of beer, wine and vinegar- importance of power alcohol as a fuel-distillery effluent for agricultural production-manufacture of ethanol from molasses and uses – manufacture of sucrose from cane sugar and beetroot- estimation of sugar: sulphitation and carbonation process.

#### **Books for study:**

<b>Unit</b>	<b>Name of the Book</b>	<b>Authors</b>	<b>Publishers with Edition</b>
<b>I-III</b>	Industrial chemistry	B.K. Sharma	Goel publications, 12 <sup>th</sup> ed., 2016.
<b>I-III</b>	Industrial Chemistry	M. G. Arora and M. Singh	Anmol Publications, Volume I and II, 1 <sup>st</sup> ed.,1994.
<b>IV</b>	Handbook of pulp and paper technology	Kenneth W. Brilt	CBS publications, 1 <sup>st</sup> ed., 1984.
<b>V</b>	Textile fibre to fabric	Bernard P. Corbman	McGraw Hill book publications, 6 <sup>th</sup> ed., 1984,.

#### **Books for Reference:**

<b>S.No</b>	<b>Name of the Book</b>	<b>Authors</b>	<b>Publishers with Edition</b>
<b>1.</b>	Reigel's Hand book of Industrial Chemistry	James A. Kent	CBS publications, 9 <sup>th</sup> ed., 1997.
<b>2.</b>	Engineering Chemistry	Jain and Jain	Dhanpat Rai Publication, Reprint 2010.

#### **E-Resources: (Web resources & E-books)**

- [https://www.acehsc.net/wpcontent/uploads/Industrial\\_Chemistry\\_by\\_Rohan\\_Barar.pdf](https://www.acehsc.net/wpcontent/uploads/Industrial_Chemistry_by_Rohan_Barar.pdf)
- <https://nptel.ac.in/courses/112104225/22>

- [https://nptel.ac.in/courses/113104058/mme\\_pdf/Lecture1.pdf](https://nptel.ac.in/courses/113104058/mme_pdf/Lecture1.pdf)
- <https://nptel.ac.in/courses/103107082/34>
- <https://nptel.ac.in/courses/103107082/7>
- <https://nptel.ac.in/courses/116102005/>
- [https://www.slideshare.net/patelpranav93/e-paper-40017944?qid=d9423103-37d9-48eb-ad90-6a858c25b7f0&v=&b=&from\\_search=1](https://www.slideshare.net/patelpranav93/e-paper-40017944?qid=d9423103-37d9-48eb-ad90-6a858c25b7f0&v=&b=&from_search=1)

### Mapping of Course outcome with POs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	Bloom's Taxonomy level
CO 1	H	L	-	M	M	M	A
CO 2	H	L	-	M	M	M	A
CO 3	H	M	-	M	-	M	U
CO 4	H	M	-	M	-	M	A
CO5	H	M	-	M	-	M	A

### Content Delivery Methods (Minimum Two):

- Lecture method
- Power point presentation
- Flip class room
- Industrial visits
- Open source
- Charts and posters

### Course Evaluation Methods:

Direct Methods	Indirect Methods
Continuous Internal Assessment Test I Continuous Internal Assessment Test II Assignment Group Discussion	Course Exit Survey

### Internal Assessment components:

Components	CIA	Assignment	Group Discussion	Attendance	Total
Marks	15	4	4	2	25

### Question Paper Pattern

Section A	MCQ – 10 Questions	(10 X 1= 10 marks)
Section B	Either or Type - 5 Questions	(5 X 4= 20 marks)
Section C	Either or Type - 5 Questions	(5 X 9= 45 marks)

### Questions for CIA will be designed based on Weightage % given

Bloom's Category	CIA I (75)	CIA II (75)	Assignment (4)	Group Discussion (4)
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R	30%	30%	Overall Structure: 25% (1 Mark) Content : 50% (2 Marks) Presentation :25% (1 Mark)	Presentation: 50% (2 Marks) Content : 25% (1 Mark) Interaction/overall Effort :25% (1 Mark)
U	40%	40%		
A	30%	30%		

### Blue Print for End Semester Examination

Unit	Section A (10 x 1 = 10) MCQ										Section B (5 x 4 = 20)					Section C (5 x 9 = 45) T-Theory								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20				
											a	b	a	b	a	b	a	b	a	b	a	b		
I	✓	✓									T	T					T	T						
II			✓	✓								T	T					T	T					
III					✓	✓							T	T					T	T				
IV							✓	✓							T	T					T	T		
V									✓	✓							T	T					T	T

### B. Sc Chemistry

#### Semesters – V and VI

(For the students admitted from the academic year 2017 – 2018 onwards)

<b>Course: Part III Core Practical III Gravimetric Analysis and Physical Chemistry Experiments</b>	<b>Course Code: 617CP3</b>
<b>Semesters: V and VI</b>	<b>No. of Credits: 4</b>
<b>No. of hours : 120</b>	<b>P:R 104:16</b>
<b>CIA Max. Marks: 40</b>	<b>ESE Max. Marks:60</b>

(C: Contact hours, R: Record and Observation)

#### Course Objectives:

- To acquire the quantitative skills in gravimetric analysis.
- To learn the fundamentals of conductometric and potentiometric titrations.
- To understand the method of determination of molecular weight, CST, TT and rate constant.
- To improve their skills in quantitative analysis by carrying out various physical chemistry experiments using sophisticated instruments.

**Course Outcomes: On completion of the Course the student will be able to**

CO	Statement	Bloom's Taxonomy level
CO1	Develop some understanding of the professional and safety responsibilities residing in working with chemical systems and to organise the glassware and other apparatus to conduct experiments in Gravimetry and Physical Chemistry.	U
CO2	Review and emphasize skills in stoichiometric calculations	U

<b>CO3</b>	Discuss and execute the steps involved in the gravimetric analysis of a given sample and to Interpret data from the physical chemistry experiments, including the construction of appropriate tables, and graphs	<b>A</b>
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**R-Remembrance U –Understanding A-Apply**

**Syllabus:**

**I. Gravimetric analysis**

1. Estimation of barium as barium sulphate
2. Estimation of barium as barium chromate.
3. Estimation of lead as lead chromate.
4. Estimation of calcium as calcium oxalate.
5. Estimation of calcium as calcium carbonate.
6. Estimation of nickel as nickel dimethyl glyoximate.
7. Estimation of magnesium as magnesium oxinate (demonstration).

**II. Physical chemistry**

1. Phase diagram- simple eutectic system.
2. Determination of critical solution temperature of phenol - water system.
3. Determination of concentration of electrolyte – NaCl/ Succinic acid from the miscibility temperatures of phenol-water system .
4. Estimation of  $\text{Fe}^{3+}$  in water spectro photometrically.
5. Determination of transition temperature of a salt hydrate.
6. Determination of  $K_f$  and molecular weight by Rast method.
7. Determination of rate constant of acid catalyzed hydrolysis of an ester.
8. Determination of cell constant, specific conductivity and equivalent conductivity of strong electrolyte
9. Determination of dissociation constant of a weak acid (acetic acid)
10. Conductometry – Acid-Base titration HCl Vs NaOH
11. Estimation of  $\text{Fe}^{2+}$  by potentiometric method using redox titration.
12. Study of Freundlich adsorption isotherm using colorimeter.(demonstration).
13. Potentiometric study Strong acid vs strong base.
14. Estimation of sodium using flame photometer.
15. Determination of Heat of solution of oxalic acid in water.

**Books for Reference:**

<b>S.No</b>	<b>Name of the Book</b>	<b>Authors</b>	<b>Publishers with Edition</b>
1.	Basic Principles of Practical Chemistry	V. Venkateswaran, R. Veeraswamy, A. R. Kulandaivelu	S. Chand and Sons publications, 2 <sup>nd</sup> ed., 2016.
2.	Advanced Practical Chemistry	Raghupati Mukhopadhyay Pratul Chatterjee	Books and Allied publications, 3 <sup>rd</sup> ed., 2007.
3.	Vogel's Text Book of Practical Organic Chemistry	B. S. Furniss, A. J. Hannaford, P. W. G. Smith, and A. R. Tatchell	Pearson Edn., Ltd., 5 <sup>th</sup> ed., 2009.

4.	College Practical Chemistry	V.K. Ahluwalia, Sunita Dhingra, Adarsh Gulati	Universities press
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**E-Resources : (Web resources & E-books)**

- [www.calstatela.edu/.../201/lecture4-gravimetric.pdf](http://www.calstatela.edu/.../201/lecture4-gravimetric.pdf)
- [www.calstatela.edu/.../201-lec/chapt27-lecture-c201.pdf](http://www.calstatela.edu/.../201-lec/chapt27-lecture-c201.pdf)
- [www.khanacademy.org/science/chemistry/chemical...](http://www.khanacademy.org/science/chemistry/chemical...)
- [www.youtube.com/watch?v=gR1ZUIV3n5E](http://www.youtube.com/watch?v=gR1ZUIV3n5E)

**Mapping of Course outcome with POs**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO6	Bloom's Taxonomy level
CO 1	H	M	-	H	M	M	U
CO 2	H	M	-	H	M	M	U
CO 3	H	M	L	H	M	M	A

**Content Delivery Methods (Any two):**

- Hands-on-training
- Demonstration
- Peer teaching
- Practical session
- Industrial/Instrumentation visits

**Course Evaluation Methods:**

Direct Methods	Indirect Methods
Lab Performance Record Model Exam	Course Exit Survey

**Internal Assessment components:**

Components	Lab Performance	Record	Model Exam	Attendance	Total
Marks	16	12	10	2	40

**Evaluation will be made based on Weightage % given**

Bloom's Category	Lab performance	Record	Model Examination
A	Punctuality : 25% (4 Marks) Safety and Hygiene : 25% (4 Marks) Experimental Skill: 25% (4 Marks) Observation Note : 25% (4 Marks)	Punctuality : 25% (3 Marks) Neatness : 25% (3 Marks) Calculations:25% (3 Marks) Accuracy : 25% (3Marks)	Model Examination Marks converted to 10 marks

**Question Paper Pattern**

Section	Experiments	Marks
A	Gravimetry	40 % (24 Marks)
B	Physical Experiments	50 % (30 Marks)
C	Viva Voce (Questions from CO1, CO2 and CO3)	10 % (06 Marks)

**End Semester Practical Examination Assessment components:**

Components	Gravimetry	Physical Experiment		Viva-voce	Total
		Manipulation	Execution		
Marks	24	10	20	6 (Questions	60



				from CO1, CO2 & CO3)	
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<b><u>Scheme of evaluation for Gravimetric analysis : Experiment (Result) : 24 marks</u></b>	
<b><u>Distribution of marks for the result:</u></b>	
Error up to 2%	: 24marks
Error between 1-2%	: 20 marks
Error between 2-3%	: 15 marks
Error between 3-4%	: 12 marks
Error above 4%	: 10 marks
<b><u>Scheme of valuation for Physical experiments: Experiment: 30 marks</u></b>	
<b><u>Distribution of marks for the Experiment:</u></b>	
For carrying out the experiment (manipulation)	: 10 marks
Value	: 20 marks
Total	: 30 marks

## B. Sc Chemistry

### Semesters – V and VI

(For the students admitted from the academic year 2017 – 2018 onwards)

<b>Course: Part III Core Practical IV Applied Chemistry Practical</b>	<b>Course Code: 617CP4</b>
<b>Semesters – V and VI</b>	<b>No. of Credits: 2</b>
<b>No. of hours : 60</b>	<b>C:P:R 4:56:10</b>
<b>CIA Max. Marks: 25</b>	<b>ESE Max. Marks:50</b>

(C: Contact Hours, P: Practical, R:Record and Observation Work)

#### Course Objectives:

- To enable the students to prepare organic compounds
- To learn the colorimetric techniques for estimation of cations
- To know the method of determining the melting and boiling point of organic chemicals

**Course Outcomes: On completion of the Course the student will be able to**

CO	Statement	Bloom's Taxonomy level
CO1	Explain the apparatus handling such as melting point, boiling point and Soxhlet extraction.	U
CO2	Develop basic skills for the determination of physical parameters, estimations, multi-step synthesis of organic compounds and water analysis.	A
CO3	Apply basic techniques used in chemistry laboratory for preparation, purification and identification.	A

**R-Remembrance U –Understanding A-Apply**

**Syllabus:**

1. Determination of melting and boiling point of organic substances
2. Colorimetric experiments using Nessler's tubes:
  - a. Estimation of  $\text{Fe}^{3+}$  with ammonium thiocyanate
  - b. Estimation of nickel as nickel dimethyl glyoximate
  - c. Estimation of  $\text{Mn}^{2+}$  in  $\text{KMnO}_4$  using potassium iodate
3. Preparation of organic compounds
  - a. Acetanilide from aniline (acetylation)
  - b. p- Bromo acetanilide from Acetanilide(Bromination)
  - c. Phenylbenzoate from phenol (Benzylation)
  - d. Salicylic acid from ethylsalicylate (Hydrolysis)
  - e. Nitrosalicylic acid from Salicylic acid (Nitration)
  - f. Benzoic acid from benzaldehyde (Oxidation)
  - g. Preparation of dyes – Methyl orange and Phenyl azo – 2 - naphthal.
5. Water Quality Parameter Analysis  
Alkalinity, Hardness, Chloride, Dissolved Oxygen, Estimation of TDS, TSS, TS and pH of the given water samples
6. Determination of water of crystallization of barium chloride dihydrate.
7. Group experiments:
  - a. Soxhlet extraction
  - b. Determination of saponification value of oil

#### Books for Reference:

Unit	Name of the Book	Authors	Publishers with Edition
1.	Basic Principles of Practical Chemistry	V. Venkateswaran, R. Veeraswamy, and A. R. Kulandaivelu	S. Chand and Sons publications, 2016.
2.	Advanced Practical Chemistry	Raghupati Mukhopadhyay, and Pratul Chatterjee	Books and Allied publications, 3 <sup>rd</sup> ed., 2007.
3.	Vogel's Text Book of Practical Organic Chemistry	B. S. Furniss, A. J. Hannaford, P. W. G. Smith, and A. R. Tatchell	Pearson Edn., Ltd., 5 <sup>th</sup> ed., 2009.

#### E-Resources : (Web resources & E-books)

- <http://vlab.amrita.edu/>
- <http://vlab.amrita.edu/?sub=2&brch=193&sim=1548&cnt=2>

#### Mapping of Course outcome with POs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO6	Bloom's Taxonomy level
CO 1	H	H	M	M	M	M	U
CO 2	H	H	M	M	M	M	A

CO 3	H	H	M	M	M	M	A
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**Content delivery Methods (Minimum Two):**

- Lecture Method
- Demonstration Class
- Problem Solving
- Virtual Laboratory

**Course Evaluation Methods:**

Direct Methods	Indirect Methods
Lab Performance Record Model Practical Examination	Course Exit Survey

**Internal Assessment components:**

Components	Lab Performance	Record	Model Practical Examination	Attendance	Total
Marks	8	8	7	2	25

**Question Paper Pattern**

Section	Experiments	Marks
A	Estimation	30 % (15 Marks)
B	Preparation	40 % (20 Marks)
C	Melting point / Boiling point	20 % (10 Marks)
D	Viva Voce (Questions from CO1, CO2 and CO3)	10 % (05 Marks)

**Evaluation will be made based on Weightage % given**

Bloom's Category	Lab performance (8)	Record (8)	Model Examination
A	Punctuality : 25% (2 Marks) Safety and Hygiene : 25% (2 Marks) Experimental Skill : 25% (2 Marks) Observation Note : 25% (2 Marks)	Punctuality : 25% (2 Marks) Neatness : 25% (2 Marks) Calculations: 25% (2 Marks) Accuracy : 25% (2 Marks)	Model Examination Marks converted to 7 marks

**ESE Assessment components:**

<b>M.pt/ B.pt (10 Marks)</b>	
Within $\pm 2^0$	= 10 marks
Between $2^0$ to $3^0$	= 08 marks
Above $3^0$	= 05 marks
<b>Preparation (20 marks)</b>	
Recrystallisation & Quality	= 05 marks
Quantity	= 15 marks
<b>Estimation (15 marks)</b>	
Error up to 10%	= 15 marks
Error between 10 to 15%	= 12 marks
Error between 15 to 20%	= 09 marks
Above 20%	= 05 marks

## B. Sc Chemistry Semester – VI

(For the students admitted from the academic year 2017 – 2018 onwards)

<b>Course: Part IV Skill Enhancement Course IV Nanoscience</b>	<b>Course Code: 617CS4</b>
<b>Semester: VI</b>	<b>No. of Credits: 3</b>
<b>No. of hours : 45</b>	<b>C:P:T 33:6:6</b>
<b>CIA Max. Marks: 75</b>	<b>ESE Max. Marks: -</b>

(C:Contact hours, T:Tutorial, P:Practical)

### Course Objectives:

- To know the basics of nanoscience and nanotechnology.
- To learn characterization techniques of nanomaterials.
- To understand the applications of nanomaterials.
- To acquire skill in synthesizing nanoparticles.

**Course Outcomes: On completion of the Course the student will be able to**

CO	Statement	Bloom's Taxonomy level
CO1	Know the history and future aspects of Nanoscience and nanotechnology.	R
CO2	Classify nanostructured materials.	A
CO3	Apply various methods for synthesis of nanomaterials.	A
CO4	Recognize some common characterization techniques of nanomaterials and apply them in various interdisciplinary fields.	A

**R-Remembrance U –Understanding A-Apply**

### Syllabus:

<b>Unit I: Fundamentals and overview of Nanoscience:</b>	<b>(6 Hours)</b>
Nano revolution of the XX century- Properties of nanoscale materials. Definitions, scaling and importance of nano materials-Current status and future of nanomaterials.	

<b>Unit II: Different classes of nanomaterials:</b>	<b>(7 hours)</b>
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Metal and Semiconductor Nanomaterials, Types of nanoparticles – preparation, properties and uses of gold, silicon, silver, zinc oxide, iron oxide and titania nanoparticles (common growth methods). Quantum Dots, Wells and Wires, Graphene, Molecule to bulk transitions Bucky balls and Carbon Nanotubes.

**Unit III: Synthesis of nanomaterials: (7 hours)**

Physical methods: Bottom up-Ball Milling, Melt mixing, Physical vapour deposition, Laser pyrolysis, Sputter deposition. (Preliminary ideas only)

Chemical methods: Hydrothermal combustion, bath deposition with capping techniques and top down, Chemical vapour deposition, Synthesis of metal & semiconductor nanoparticles by colloidal route, Microemulsions, Sol-gel method, Wet chemical method. (Preliminary ideas only)

**Unit IV: Nano Materials and their Characterization: (7 hours)**

Electron microscopes – scanning electron microscopes (SEM) – transmission electron microscopes (TEM) – scanning probe microscopy – atomic force microscopy (AFM) – scanning tunneling electron microscope (STEM) – TEM and EDAX analysis, X-ray Diffraction. (Basic principles only)

**Unit V: Nanoapplications: (6 hours)**

Solar energy conversion- Chemical semiconductor solar cells – Dye sensitized solar cells – Nano quantum dot solar cells – and catalysis, Nanosensor, Nanomedicine, Nanomaterials in water purification and food science.

**Practicals : Synthesis of Nanomaterials: (6 hours)**

1. Chemical Synthesis of Copper nanoparticles
2. Chemical Synthesis of iron oxide nanoparticles
3. Chemical Synthesis of CdS Nanoparticles
4. Eco friendly synthesis of metal oxide nanoparticles.
5. Bandgap calculation of nanoparticles using UV-Visible spectroscopy.
6. Chemical Synthesis of Silver nanoparticles (demonstration)
7. Synthesis of ZnO Nanoparticles using Sol-gel methods (demonstration)
8. Synthesis of nanoparticles using Ball milling technique (demonstration)

**Books for study:**

Unit	Name of the Book	Authors	Publishers with Edition
I/II	Nanotechnology principles and Practices	Sulabha K Kulkarni	Second Edition Capital publishing company New Delhi Reprint 2011.
III/ IV/V	Nano: The Essentials	T. Pradeep	Tata Mc-Graw Hill New Delhi Edition 2007.

**Books for Reference:**

S.No	Name of the Book	Authors	Publishers with Edition
1.	Nanoscience and Nanotechnology	T. Pradeep	Tata Mc-Graw Hill New Delhi Edition 2012
2.	Bio-Nanotechnology Concept & Application	Madhuri Sharon, Maheshwar Sharon, Sunil Pandey, Goldie Oza	Ane Books Pvt Ltd, Edition 2012

**E-Resources : (Web resources & E-books)**

1. <http://www.hailienene.com/resources/nano-technology.pdf>
2. [http://elibrary.bsu.az/books\\_250/N\\_229.pdf](http://elibrary.bsu.az/books_250/N_229.pdf)
3. <https://www.aiha.org/aihce07/handouts/rt201krause.pdf>
4. [http://elibrary.bsu.az/books\\_250/N\\_229.pdf](http://elibrary.bsu.az/books_250/N_229.pdf)
5. <https://bookboon.com/en/nano-technology-ebook>
6. [https://www.youtube.com/watch?v=ebO38bbq0\\_4](https://www.youtube.com/watch?v=ebO38bbq0_4)
7. <https://nptel.ac.in/courses/118104008/>
8. <https://nptel.ac.in/courses/118102003/3>

**Mapping of Course outcome with POs**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO6	Bloom's Taxonomy level
CO 1	H	M	-	M	M	M	R
CO 2	H	M	L	M	H	M	A
CO 3	H	H	-	M	H	M	A
CO 4	H	H	L	M	H	M	A

**Content delivery Methods (Minimum Two):**

- PPT and Video
- Demonstration
- Lecture Method
- Guest Lecture
- Group Assignments
- Hands-on-training
- Instrumentation visits
- Practical session

**Course Evaluation Methods:**

Direct Methods	Indirect Methods
Continuous Internal Assessment Test I Continuous Internal Assessment Test II Activity (Practicals)	Course Exit Survey

**Internal Assessment components:**

Components	CIA I	CIA II	(Activity: Practical)		Total
			Lab performance	Record	
Marks	30	30	7	8	75

**Question Paper Pattern**

Section A	Either or Type - 5 Questions (5 × 4 = 20)
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<b>Section B</b>	<b>Either or Type - 5 Questions (5 × 8 = 40)</b>
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**Questions for CIA will be designed based on Weightage % given**

Bloom's Category	CIA I (60)	CIA II (60)	Activity (Practicals)	
			Lab performance (7)	Record (8)
<b>R</b>	30%	20%	Punctuality, Safety and Hygiene : 50% (3.5 Marks) Experimental skill and observation note: 50% (3.5 Marks)	Punctuality : 25% (2 Marks) Neatness : 25% (2 Marks) Calculations: 25% (2 Marks) Accuracy : 25% (2 Marks)

### Courses focussing on Entrepreneurship

#### B. Sc Chemistry Semester –IV

(For the students admitted from the academic year 2017 – 2018 onwards)

<b>Course: Part IV Skill Enhancement Course II Chemistry for Exploration I</b>	<b>Course Code: 417CS2</b>
<b>Semester: IV</b>	<b>No. of Credits: 3</b>
<b>No. of hours : 45</b>	<b>P:I:T 24:15:6</b>
<b>CIA Max. Marks: 75</b>	<b>ESE Max. Marks: -</b>

(P:Practical , I:Internship, T: Tutorial)

#### Course Objectives:

- To upgrade the technical skills and knowledge in the preparation of household products.
- To develop entrepreneurship skills
- To carry out general chemical work in academic laboratories.
- To obtain skill in handling burner, Kipp's apparatus and adopting separating techniques
- To separate and purify mixture of chemicals using different methods.
- Enhance knowledge and skill in the particular area of internship
- Assist development of employer-valued skills such as teamwork, communications and attention to detail.
- Assume responsibility for varied duties and job function

#### Course Outcomes: On completion of the Course the student will be able to

CO	Statement	Bloom's Taxonomy level
<b>CO1</b>	Design and develop a small business marketing plan using household products.	<b>A</b>
<b>CO2</b>	Utilize the appropriate laboratory equipment and instrumentation.	<b>A</b>
<b>CO3</b>	Assess real-world experience through off-campus, laboratory-based work in a chemistry related field.	<b>A</b>

<b>CO4</b>	Generate scientific communication skills by writing a technical report and delivering an oral.	<b>A</b>
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**Syllabus:**

<b>a) Industrial Visit (2 No.) Report Making on the visit</b>	<b>- 12 hours</b>
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<b>b) Preparation of following house hold products</b>			
<b>(Formulation and procedures)</b>			
			<b>- 14 lab hours</b>
Soap	Talcum powder	Bed bug repellent	Cake
Detergent	Shampoo	Mosquito repellent	Bread
Laundry blue	Perfumes	Cockroach repellent	Biscuits
Bleaching powder	Tooth powder	Chalk	Homemade chocolates
Phenoyl	Tooth paste	Candle	Ink
Incandescent sticks	Kumkum	Laundry starch	Cutflower Preservative

<b>c) Basic experiments in Chemistry</b>		<b>- 13Hours</b>
<b>TITLE</b>	<b>Time in hours</b>	
Experiment :1 Servicing bunsen burners	1	
Experiment :2 To bore a hole in a cork	1	
Experiment :3 Preparation of H <sub>2</sub> S gas using Kipp's apparatus	1	
Experiment :4 Calibration of volumetric apparatus	2	
Experiment :5 Preparation of laboratory reagents	1	
Experiment :6 Column chromatography-Separation of methylene blue and malachite green	1	
Experiment :7 Paper chromatography- Separation of metal ions of group I	1	
Experiment :8 TLC – Separation of different types of inks and aminoacids	1	
Experiment :9 Distillation and sublimation	2	
Experiment :10 Solvent purification-Ethanol and acetone	2	

**Books for study:**

<b>Unit</b>	<b>Name of the Book</b>	<b>Authors</b>	<b>Publishers with Edition</b>
<b>a, b and c</b>	Text book of applied chemistry	Thangamma Jacob	Macmillan publications, Home science and allied science 1 <sup>st</sup> ed., 1987.
<b>a, b and c</b>	Industrial chemistry	B.K. Sharma	Goel publications, 12 <sup>th</sup> ed., 2016.

**E-Resources: (Web resources & E-books)**

- <https://nptel.ac.in/courses/103108100/40>
- <https://nptel.ac.in/courses/103103034/21>



- <https://nptel.ac.in/courses/103105110/38>

### Mapping of Course outcome with POs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	Bloom's Taxonomy level
CO 1	H	H	M	H	H	H	A
CO 2	H	H	M	H	H	H	A
CO 3	H	H	M	H	H	H	A
CO 4	H	H	H	H	H	H	A

### Content Delivery Methods (Minimum Two):

- Video
- Hands-on-training
- Demonstration
- Practical session
- Industrial visit.
- Experiential learning
- Problem solving

### Course Evaluation Methods:

Direct Methods	Indirect Methods
Continuous Internal Assessment Test I Continuous Internal Assessment Test II Industrial visit Record	Course Exit Survey

### Internal Assessment components:

Components	I CIA (Practical)	II CIA (Practical)	Industrial visit	Record	Total
Marks	30	30	10	5	75

### Question Paper Pattern - Practical

Section A	Preparation of house-hold products (2 × 15 = 30 Marks)
Section B	Experiment (2 × 15 = 30 Marks)

### Questions for CIA will be designed based on Weightage % given

Bloom's Category	I CIA (Practical)	II CIA (Practical)	Industrial visit (10)	Record (5)
A	<b>Practical - 20 marks</b> (Converted from 60 marks of I CIA) <b>Lab Performance- 10</b> Punctuality : 20% (2 Marks) Safety and Hygiene : 20% (2 Marks)	<b>Practical - 20</b> (Converted from 60 marks of II CIA) <b>Lab Performance- 10</b> Punctuality : 20% (2 Marks) Safety and Hygiene : 20% (2 Marks)	<b>Report - 5</b> Overall Structure: 20% (1 Mark) Content : 60% (3 Marks) Presentation : 20% (1 Mark)	Punctuality and Neatness: 60% (3 Marks) Calculations and Accuracy: 40% (2 Marks)

	Experimental Skill : 60% (6 Marks) <b>Total: 30 marks</b>	Experimental Skill : 60% (6 Marks) <b>Total: 30 marks</b>	<b>Total: 10 marks</b>	
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**B.Sc. Chemistry**  
**Semester IV**

(For the students admitted from the academic year 2017 – 2018 onwards)

<b>Advanced Learner's Course I: Food Science</b>	<b>Course Code: 417ALC</b>
<b>Semester: IV</b>	<b>No. of Credits: 4*</b>
<b>No. of hours : -</b>	<b>C:T -</b>
<b>CIA Max. Marks: -</b>	<b>ESE Max. Marks:100</b>

(C: Contact hours, T: Tutorial)

**Course Objectives:**

- To familiarize the students with the topics like nutrients, additives and quality of the food and also the methods to preserve food.
- To recognize the chemistry underlying the properties and reactions of various food components.
- To comprehend the principles involving food preservation.

**Course Outcomes: On completion of the Course the student will be able to**

<b>CO</b>	<b>Statement</b>	<b>Bloom's Taxonomy level</b>
<b>CO1</b>	Explain the food groups & major nutrients and constituents of food	<b>U</b>
<b>CO2</b>	Acquire fundamental information about food additives.	<b>U</b>
<b>CO3</b>	Discuss the food adulterants and standards the theory of food adulteration and food safety & standards	<b>U</b>
<b>CO4</b>	Enumerate the principles involved in food preservation and the importance of food preservation and processing.	<b>A</b>
<b>CO5</b>	Make use of testing food quality and explicit its importance	<b>A</b>

**R-Remembrance U –Understanding A-Apply**

**Syllabus:**

**Unit I: Constituents of Food**

Introduction to food science- Food groups and their major nutrients- Constituents of food carbohydrates, proteins, fats and oils, emulsifiers, enzymes, pigments and colors, flavors, vitamins and minerals, natural toxicants and water(elementary treatment only)

**Unit II: Food Additives**

Food additives- definition- need, classification- Antioxidants, chelating agents, coloring agents, curing agents, humectants, anticaking agents- Preservatives: definition, action of sodium chloride, sorbic acid and acetic acid as preservative.

**Unit III: Adulteration**

Adulteration- definition, types- intentional and incidental, metallic and other contaminations- Simple test to detect food adulterants- Food safety and standards- national (BIS) and international standards(CODEX)- FSSAI.

**Unit IV: Food Preservation and Processing**

Food spoilage- Causes, Types- Food preservation- Preservation and processing by heating- sterilization, pasteurization and blanching Preservation and processing by low temperature- slow freezing, quick freezing and dehydro freezing.

**Unit V: Food Quality**

Reason for testing food quality- Sensory evaluation- appearance, colour, flavour (odour, taste and mouth feel) - types of tests- difference test (paired comparison test, triangle test)- Rating test- single sample and two sample difference test- objective evaluation: advantages and disadvantages- physico- chemical test methods of objective evaluation.

**Books for study:**

Unit	Name of the Book	Authors	Publishers with Edition
I to V	Food science	B. Sri Lakshmi	New age international (P) Ltd publications, 6 <sup>th</sup> ed., 2015
III-V	Food science	N. N. Potter, and J. H. Hotchkiss	CBS publications, 5 <sup>th</sup> ed.,2007.
I to V	Food Chemistry	H. K. Chopra, and P. S. Panesar	Narosa Publishing house, 1 <sup>st</sup> ed., 2013

**E-Resources: (Web resources & E-books)**

- <http://www.fao.org/docrep/w0073e/w0073e04.htm>
- <https://nptel.ac.in/courses/103107088/module4/lecture1/lecture1.pdf>
- <http://bis.gov.in/>
- <https://www.fssai.gov.in>
- <https://nptel.ac.in/courses/103103029/pdf/mod6.pdf>
- <https://nptel.ac.in/courses/103107088/17>

**Blue Print for End Semester Examination**

Bloom's Category	Section	Marks	Description	Total Marks
R	2 Questions	5 x 20 = 100	Questions covering all Units (Open choice 5 out of 8)	100
U	3 Questions			
A	3 Questions			

**Question Paper Pattern (100 Marks) -Theory Paper for Advanced Learner's Course**

Unit	Section A (5 x 20 = 100)							
	Open Choice							
	1	2	3	4	5	6	7	8
I	✓							
II		✓	✓					

III				✓				
IV					✓	✓		
V							✓	✓

## B. Sc Chemistry

### Semester – VI

(For the students admitted from the academic year 2017 – 2018 onwards)

<b>Advanced Learner's Course II: Dairy Chemistry</b>	<b>Course Code: 617ALC</b>
<b>Semester: VI</b>	<b>No. of Credits: 4</b>
<b>No. of hours : -</b>	<b>C:T -</b>
<b>CIA Max. Marks: -</b>	<b>ESE Max. Marks: 100</b>

#### Course Objectives:

- To impart knowledge in physico-chemical aspects of milk and milk products with special reference to their processing.
- To impart knowledge on different aspects of major milk products.
- To impart knowledge on fermented and other milk products.

#### Course Outcomes: On completion of the Course the student will be able to

CO	Statement	Bloom's Taxonomy level
CO1	Recognize the composition and factors affecting the composition of milk	R
CO2	Describe the processing of milk	U
CO3	Explain the major milk products and standardization of milk.	A
CO4	Summarize the methods of preparation of various milk products.	U
CO5	Implement the methods for production of fermented milk products	A

#### R-Remembrance U –Understanding A-Apply

#### Syllabus:

##### Unit I – Composition of Milk

Milk- Definition, general composition of milk- Constituents of milk- lipids, proteins, carbohydrates, vitamins and minerals- Physical properties of milk- colour, odour, acidity, specific gravity, viscosity and conductivity- Factors affecting the composition of milk- adulterants, preservatives and neutralizer- examples and their detection- Estimation of fat, acidity and total solids in milk.

**Unit II – Processing of Milk**

Micro biology of milk- destruction of micro organisms in milk- Physico- chemical changes taking place in milk due to processing- Boiling, pasteurization- types of pasteurization- bottle, batch and HTST(high temperature short time),Vacuum pasteurization- ultra high temperature pasteurization.

**Unit III –Major Milk Products**

Cream- definition- composition- Chemistry of creaming process- gravitational and centrifugal methods of separation of cream- estimation of fat in cream - Butter- definition, composition- theory of churning- desibutter- salted butter- estimation of acidity and moisture content in butter- Ghee- major constituents- common adulterants added to ghee and their detection- rancidity- definition- prevention- antioxidants and synergists- natural and synthetic.

**Unit IV– Special Milk**

Standardised milk- definition- merits- Reconstituted milk- definition- Flow diagram of manufacture- homogenized milk- flavoured milk- vitaminised- milk- toned milk- incitation milk- vegetable toned milk- humanized milk- condensed milk- definition, composition and nutritive value.

**Unit V– Fermented and other Milk Products**

Fermented milk products- fermentation of milk- definition, conditions- Cultured milk- definition of culture- examples, conditions- cultured cream- cultured butter milk- Bulgaxious milk- acidophilous milk- yoheer indigeneous products- Khoa - preparation of khoa , gulabjamun, and rassogalla- Ice-cream- definition- percentage composition- types ingredients- manufacture of ice-cream - Stabilizers- emulsifiers and their role - Milk powder- definition- need for making milk powder- drying process- types of drying- Dairy detergents- characteristics- classification- washing procedure- sterilization- hypochlorite solution.

**Books for Study:**

Unit	Name of the Book	Authors	Publishers with Edition
I/II	A text book of dairy Chemistry	Edgar. R. Ling	JV Publishing house 2 <sup>nd</sup> ed 2008.
I-III	Dairy Science	V.Rangarajan	Mangaldeep publications 1 <sup>st</sup> ed.2007.
II/III	Chemistry and testing of Dairy Products	Henry.V.Atherton JA. Newlander	CBS publishers, 4 <sup>th</sup> ed. 2000.
IV/V	Dairy microbiology	H.A.Modi	Aavishkar Publishers 1 <sup>st</sup> ed. 2009.

**Books for Reference:**

S.No	Name of the Book	Authors	Publishers with Edition
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## Courses focussing on Skill development

### B.Sc. Chemistry Semester III

(For the students admitted from the academic year 2017 – 2018 onwards)

<b>Course: Part IV Skill Enhancement Course I Applications of Computer in Chemistry</b>	<b>Course Code: 317CS1</b>
<b>Semester: III</b>	<b>No. of Credits: 3</b>
<b>No. of hours : 45</b>	<b>C:T:P 24:6:15</b>
<b>CIA Max. Marks: 75</b>	<b>ESE Max. Marks: -</b>

**(C: Contact hours, T: Tutorial, P: Practical)**

#### Course Objectives:

- To promote the core competency skills and augment citizenship values.
- To enable students to communicate chemical structures and perform data analysis.
- To familiarize with working of Chemdraw and Origin software.
- To know the fundamental concepts of cheminformatics.

**Course Outcomes: On completion of the Course the student will be able to**

CO	Statement	Bloom's Taxonomy level
CO1	Emerge as skilled one in chemdraw and origin software.	A
CO2	Apply chemdraw to draw accurate chemical structures scheme, reactions and its mechanisms	A
CO3	Exploit origin to draw simple and advanced 2D and 3D plot charts, the absorption, emission and IR spectrum using Origin from the given data.	A
CO4	Gain basic knowledge in cheminformatics	R

#### **R-Remembrance U –Understanding A-Apply**

#### **Syllabus:**

#### **Unit I: Chemdraw**

**(10 Hours)**

Introduction- salient features in Chemdraw- Main tools- optional tools- Significance of Chemdraw- Chemdraw Shortcuts- Drawing Chemical Structures and pasting them in the text- Working with Structures - drawing schemes - Chemdraw analysis - Advantages.

#### **Unit II: Origin**

**(11 Hours)**

Origin – Introduction – significance – toolbars– Workbook and Worksheet Operations - Multi-sheet Workbooks – file types (opj and ascii) - Importing Data from different sources - Basic Data Manipulation - Creating and Customizing Graphs - Publishing Graphs (export) - Basic Data Analysis - Creating and Customizing Multilayer Graphs - graph types - origin in chemistry - Working with Excel and Origin.

#### **Unit III: Cheminformatics**

**(3 Hours)**

Introduction to cheminformatics, History and Evolution of cheminformatics - Uses of cheminformatics.

**Practicals**

**(15 Hours)**

1. Draw the structure of molecule using Chemdraw.
2. Draw the structure of macromolecule using Chemdraw.
3. Sketch the distillation process using Chemdraw template.
4. Sketch the titration process using Chemdraw template.
5. Sketch the given scheme using Chemdraw.
6. Draw the given organic reaction mechanism.
7. Draw and analyze the given structure by  $^1\text{H-NMR}$  spectra.
8. Bring out analytical data of the given structure using Origin
9. Create of line graph and symbol graph using Origin.
10. Create line and symbol graph using Origin.
11. Create bar graph and pie chart using Origin.
12. Create stacked bar and column graph using Origin.
13. Create grouped columns – indexed graph using Origin.
14. Create 3D bar graph using Origin.
15. Import the given ascii data to draw the absorption, emission and IR spectrum using Origin.
16. Import the given multiple ascii data to draw the absorption, emission and IR spectra using Origin.
17. Export the graph to pdf format using Origin.
18. Compare the excel bar diagram with origin bar diagram using Origin.

**E-Resources: (Web resources & E-books)**

- Database usage in Chemdraw and ChemOffice, Cambridge Soft (2010).
- [https://library.columbia.edu/content/dam/libraryweb/locations/dsc/Software%20Subpages/ChemDraw\\_17\\_manual.pdf](https://library.columbia.edu/content/dam/libraryweb/locations/dsc/Software%20Subpages/ChemDraw_17_manual.pdf)
- [http://www.cambridgesoft.com/support/DesktopSupport/Documentation/Manuals/files/chemdraw\\_9\\_english.pdf](http://www.cambridgesoft.com/support/DesktopSupport/Documentation/Manuals/files/chemdraw_9_english.pdf)
- <https://www.youtube.com/watch?v=olqqwovFfU>
- <https://www.youtube.com/watch?v=-sjhlpQID6Q>
- <https://www.youtube.com/watch?v=Kt4UzYVF6E>
- [https://www.originlab.com/pdfs/Origin2017\\_Documentation/English/Origin\\_Tutorial\\_2017\\_E.pdf](https://www.originlab.com/pdfs/Origin2017_Documentation/English/Origin_Tutorial_2017_E.pdf)
- Database usage in Origin (Microcal Software, Inc., One Roundhouse Plaza, Northhampton, MA -01060).
- <https://www.internetchemistry.com/chemistry/cheminformatics.htm>

**Mapping of Course outcome with POs**

	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>Bloom's Taxonomy level</b>
<b>CO 1</b>	H	H	L	-	M	M	<b>A</b>
<b>CO 2</b>	H	H	L	-	M	M	<b>A</b>



<b>CO 3</b>	H	H	L	-	M	M	<b>A</b>
<b>CO 4</b>	L	-	-	-	-	-	<b>R</b>

**Content Delivery Methods (Minimum Two) :**

- Lecture method
- Power point presentation
- Seminar
- Practical session
- Computational thinking
- ICT-open source
- Peer teaching
- Scientific thinking

**Course Evaluation Methods:**

<b>Direct Methods</b>	<b>Indirect Methods</b>
<b>Continuous Internal Assessment Test I</b> <b>Continuous Internal Assessment Test II</b> <b>Lab performance</b> <b>Record</b>	<b>Course Exit Survey</b>

**Internal Assessment components:**

<b>Components</b>	<b>CIA I (Theory)</b>	<b>CIA II (Practical)</b>	<b>Lab performance</b>	<b>Record</b>	<b>Total</b>
<b>Marks</b>	<b>30</b>	<b>30</b>	<b>07</b>	<b>08</b>	<b>75</b>

**Question Paper Pattern**

<b>Theory</b>	Section A	Either Or type - 5 Questions (5 X 4= 20)
	Section B	Either Or type - 5 Questions (5 X 8= 40)
<b>Practical</b>	Three out of five (3 X 20= 60)	

**Questions for CIA will be designed based on Weightage % given**

<b>Bloom's Category</b>	<b>CIA I (60)</b>	<b>CIA II (60)</b>	<b>Lab performance (7)</b>	<b>Record (8)</b>
<b>R</b>	20 %	-	Punctuality : 43% (3 Marks) Experimental Skill: 28.5% (2 Marks) Observation Note : 28.5% (2 Marks)	Punctuality : 25% (2 Marks) Neatness : 25% (2 Marks) Calculations: 25% (2 Marks) Accuracy : 25% (2 Marks)

**B.Sc. Chemistry**

**Semester V**

**(For the students admitted from the academic year 2017 – 2018 onwards)**

<b>Course: Part IV Skill Enhancement Course III Chemistry for Exploration II</b>	<b>Course Code: 517CS3</b>
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<b>Semester: V</b>	<b>No. of Credits: 3</b>
<b>No. of hours : 45</b>	<b>C:T 39:6</b>
<b>CIA Max. Marks: 75</b>	<b>ESE Max. Marks: -</b>

**(C: Contact hours, T: Tutorial)**

### Course objectives

- To cultivate statistical thinking among students
- To develop skills in handling complex problems in data analysis and research design
- To distinguish between qualitative and quantitative measurements, assess the sources of error in chemical and instrumental analysis and account for errors in data analysis.
- To interpret analytical results and to develop scientific and practical skills in data analysis and to comprehend the concepts of hypothesis, sampling and calibration.
- To use Excel to conduct statistical analysis
- To provide an awareness on Intellectual Property Rights to the graduates.
- To develop understanding of the basic framework of research process.
- To identify various sources of information for literature review and data collection.

### Course Outcomes: On completion of the Course the student will be able to

<b>CO</b>	<b>Statement</b>	<b>Bloom's Taxonomy level</b>
<b>CO1</b>	Collect, organize, apply, assess, analyze complex experimental data using statistical methods and account for different types of errors and rejection of data	<b>A</b>
<b>CO2</b>	Execute and evaluate calibration curves and linear regressions	<b>A</b>
<b>CO3</b>	Compute statistical inference in the form of confidence intervals, t-test, f-test, one-way analysis of variance and Chi-square test in chemical problems	<b>A</b>
<b>CO4</b>	Develop professional mannered data in an informative graphical representation	<b>A</b>
<b>CO5</b>	Review of literature data from print, web resources and summarize different types of intellectual property rights	<b>A</b>

**R-Remembrance U –Understanding A-Apply**

### Syllabus:

<b>Unit I:Data Analysis I</b>	<b>(7 Hours)</b>
Measurement- nature of quantitative measurements - need for data analysis - errors- types of errors- minimization of errors - uncertainty in experimental techniques - absolute and relative	

uncertainty- The Gaussian distribution -accuracy and precision - significant numbers.

**Unit II: Data Analysis II**

**(7 Hours)**

Mean, median, mean deviation, standard deviation and variance - confidence intervals and confidence limits - Linear calibration curves-regression and correlation.

**Unit III: Data Analysis III**

**(7 hours)**

Test of hypothesis - t-test and f-test - rejection of data Analysis of variance- one way ANOVA– sampling techniques.

**Unit IV: Handling of numeric and graphical data in spread sheet software (9 hours)**

Handling numeric data: Spreadsheet software - creating a spreadsheet - entering and formatting information - basic functions and formulae - creating charts, tables and graphs-incorporating tables and graphs into word processing documents - simple calculations for statistical analysis using a spreadsheet - plotting calibration graphs using a spreadsheet -graphical solution of equations (calculation of entropy/enthalpy change from Arrhenius plot).

Numerical curve fitting - linear regression (molar extinction coefficients from absorbance data), numerical differentiation (pH metric titrations) and integration (entropy/enthalpy change from heat capacity data).

**Unit V: Literature survey in chemistry research and introduction to IPR (9 Hours)**

**Literature Survey:** Print sources of information: Primary - secondary and tertiary sources - Journals: abstracts – reviews - monographs - dictionaries - text-books. Digital sources of information: Web resources - E-journals - Hot articles - Citation index - Impact factor - H-index. E-books, Internet discussion groups and communities, Blogs, Search engines- Scirus, Google Scholar, ChemSpider, Science Direct, SciFinder, Scopus, ACS and RSC. Internet resources for chemistry. Finding and citing published information.

**Intellectual Property Rights:** Introduction and the need for intellectual property rights- patents - copyrights - trademarks - geographical indications- industrial designs - IP Administration in India.

**Books for study:**

Unit	Name of the Book	Authors	Publishers with Edition
I-III	Instrumental methods of chemical analysis,	H. Kaur	PragathiPrakasan publications, 6 <sup>th</sup> ed., 2006.
I-V	Research Methodology- Methods & technology	C.R. Kothari	New Age International Publishers, 2 <sup>nd</sup> ed., 2004.
V	Research Methodology for biological sciences	N. Gurumani	MJP publisher, 1 <sup>st</sup> ed., 2014
I-V	Research Methodology	R. Paneerselvam	Prentice Hall of India private Ltd., 1 <sup>st</sup> ed., 2007.

V	Intellectual property rights	R. Radhakrishnan, and S. Balasubramanian	Excel books, 1 <sup>st</sup> ed., 2008.
V	Practical approach to Intellectual property rights	R. Karuppasamy, and H. C. Bindhusa.	Himalaya publishing house, 1 <sup>st</sup> ed., 2008.

### Books for Reference:

S.No	Name of the Book	Authors	Publishers with Edition
1.	Elements of analytical chemistry	R. Gopalan, P.S. Subramanian, and K. Rengarajan	Sultan chand and sons publishers, 2016
2.	Fundamental of analytical chemistry	Skoog, West, Hollerr, Crouch	Cengage learning publisher, 8 <sup>th</sup> Edition, 2012
3.	Principles of analytical chemistry	M. Valcarcel	Springer edition, 2011
4.	Analytical chemistry	U.N. Dash	Sultan chand and sons publisher, 3 <sup>rd</sup> edition, 2013.

### E-Resources: (Web resources & E-books)

- <http://chemistry.com.pk/books/analytical-chemistry-by-gary-d-christian/>
- <https://chemistry.com.pk/books/skoog-principles-of-instrumental-analysis/>
- <https://www.icsi.edu/media/webmodules/publications/9.4%20Intellectual%20Property%20Rights.pdf>
- [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachm ent\\_data/file/627956/IP-Rights-in-India.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachm ent_data/file/627956/IP-Rights-in-India.pdf)
- [https://edisciplinas.usp.br/pluginfile.php/2317618/mod\\_resource/content/1/BLOCO%202\\_Research%20Methods%20The%20Basics.pdf](https://edisciplinas.usp.br/pluginfile.php/2317618/mod_resource/content/1/BLOCO%202_Research%20Methods%20The%20Basics.pdf)

### Mapping of Course outcome with POs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	Bloom's taxonomy
CO 1	H	M	L	-	M	M	A
CO 2	H	M	L	-	M	M	A
CO 3	H	M	L	-	M	M	A
CO 4	H	M	M	-	M	M	A
CO 5	H	M	M	-	M	M	A

### Content Delivery Methods (Minimum Two):

- Lecture method
- Power point presentation
- Video
- Practical session
- ICT-open source

- Peer teaching
- Hands-on training
- Problem solving
- Computational thinking

**Course Evaluation Methods:**

Direct Methods	Indirect Methods
Continuous Internal Assessment Test I Continuous Internal Assessment Test II Assignment Review	Course Exit Survey

**Internal Assessment components:**

Components	CIA I	CIA II	Assignment	Review	Total
Marks	30	30	8	7	75

**Question Paper Pattern**

Section A	Either or Type - 5 Questions (5 x4 = 20 Marks)
Section B	Either or Type - 5 Questions (5 x 8 =40 Marks)

**Questions for CIA will be designed based on Weightage % given**

Bloom's Category	CIA I (60)	CIA II (60)	Assignment (8)	Review (7)
<b>R</b>	30%	30%	Overall Structure: 25% (2 Marks)	Report - 50% (3.5 Marks)
<b>U</b>	40%	40%	Content : 50% (4 Marks)	Presentation and Viva Voce -
<b>A</b>	30%	30%	Presentation : 25% (2 Marks)	50% (3.5 Marks)