

**AUXILIUM COLLEGE (AUTONOMOUS)**  
**VELLORE**  
**M.Sc. CHEMISTRY**  
**Curriculum Development – Skill Development Needs**

**SEMESTER II**

**PCCHG20 - PRACTICAL I: ORGANIC CHEMISTRY - I**

Year: I SEM: II	Course Code	Title of the Course	Course Type	Course Category	H/W	Credits	Marks
	PCCHG20	Practical I: Organic Chemistry – I	Practical	Core	3	3	100

**Course Outcomes:**

The Learners will be able to

1. Identify the components in two component mixture and detect the functional groups.
2. Prepare the organic compounds and purify them.
3. Perform common laboratory techniques like separation, refluxing, recrystallization, vacuum filtration, and sublimation.

CO	PSO					
	1	2	3	4	5	6
CO1	H	H	L	H	H	H
CO2	H	H	M	H	H	H
CO3	H	H	H	H	H	H

CO	PO					
	1	2	3	4	5	6
CO1	H	H	H	H	H	H
CO2	H	H	H	H	H	H
CO3	H	H	H	H	H	H

**H-High (3), M-Moderate (2), L-Low (1)**

1. Identification of components in a two-component mixture and preparation of their derivatives.
2. Preparations:
  - (i) p-nitrobenzoic acid from p-nitrotoluene (Oxidation)
  - (ii) Anthroquinone from Anthracene (Oxidation)
  - (iii) 1,2,3,4 - tetrahydrocarbazole from Cyclohexanone (Reduction)

- (iv) Methyl orange from Sulphanilic acid
- (v) Acetyl Salicylic acid (Aspirin) from Salicylic acid (Acetylation)
- (vi) m-nitro aniline from m-dinitrobenzene (Reduction)

### Reference Books:

1. S. Furniss Brain, Vogel's Textbook of Practical Organic Chemistry, Pearson Publication, 5<sup>th</sup> Edition, Reprint 2004.
2. N. S. Gnanaprasadam & G. Ramamurthy, Organic Lab Manual (Semi-Micro Qualitative Analysis and Separation), S. Viswanathan Printers & Publishers Pvt., Ltd, Reprint 2002.

### OER:

1. <http://vlab.amrita.edu/?sub=2&brch=191&sim=345&cnt=1>
2. [https://www.brainkart.com/article/Organic-Qualitative-Analysis\\_38680/](https://www.brainkart.com/article/Organic-Qualitative-Analysis_38680/)
3. <http://amrita.olabs.edu.in/?sub=73&brch=8&sim=141&cnt=715>

### Continuous Assessment - 40 Marks

I C.A. - 50 Marks

II C.A. - 50 Marks

Average - 25 Marks

Performance during regular practicals - 10 Marks

Regularity in submission of observation notebook and Record - 5 Marks

### CA Practical Examination - 50 Marks

Record - 5 Marks

Viva - 5 Marks

Experiment - 30 Marks

Preparation - 10 Marks

(Quality - 4 Marks, Quantity - 4 Marks, Recrystallization - 2 Marks)

### Semester Practical Examination - 60 marks

Record - 10 Marks

Viva - 5 Marks

Qualitative Organic Analysis - 35 Marks

Preparation - 10 Marks

(Quality - 4 Marks, Quantity - 4 Marks, Recrystallization - 2 Marks)

## SEMESTER II

### PCCHH20 - PRACTICAL II: INORGANIC CHEMISTRY - I

<b>Year:</b> I <b>SEM:</b> II	<b>Course Code</b> PCCHH20	<b>Title of the Course</b> Practical II: Inorganic Chemistry – I	<b>Course Type</b> Practical	<b>Course Category</b> Core	<b>H/W</b> 3	<b>Credits</b> 3	<b>Marks</b> 100
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#### Course Outcomes:

The Learners will be able to

1. Demonstrate group separation and analysis of inorganic mixtures.
2. Identify rare and common ions present in the inorganic mixtures.
3. Prepare selected inorganic complexes.
4. Estimate the metal ions present in the sample by colorimetric method.

CO	PSO					
	1	2	3	4	5	6
CO1	H	M	H	H	H	H
CO2	H	M	H	H	H	H
CO3	H	H	H	H	H	H
CO4	H	H	H	H	H	H

CO	PO					
	1	2	3	4	5	6
CO1	H	H	H	H	H	H
CO2	H	H	H	H	H	H
CO3	H	H	H	H	H	H
CO4	H	H	H	H	H	H

**H-High (3), M-Moderate (2), L-Low (1)**

1. Semi micro qualitative analysis of mixture containing two common and two rare cations. (The following are the rare cations to be included - W, Te, Se, Ce, Zr, Be, V, Mo, Li)
2. Colorimetric Analysis using photoelectric method: Estimation of Iron, Nickel, Copper and Manganese.
3. Preparations:
  - i. Potassium tris(oxalato)aluminate(III) trihydrate
  - ii. Tris(thiourea)copper(I) chloride
  - iii. Sodium hexanitrocobaltate(III)
  - iv. Tetramminecopper(II) sulphate
  - v. Sodium cuproustiosulphate

### Reference Books:

1. V. V. Ramanujam, Inorganic Semi Micro Qualitative Analysis, The National Publication, 3<sup>rd</sup> Edition, Reprint 2004.
2. G. Svehila, Vogel's Qualitative Inorganic Analysis, Pearson Publication, 7<sup>th</sup> Edition, Reprint 2012.

### OER:

1. <http://www.public.asu.edu/~jpbirk/index.html>
2. <http://amrita.olabs.edu.in/?sub=73&brch=7&sim=180&cnt=515>
3. [http://wwwchem.uwimona.edu.jm/lab\\_manuals/c21jexpt.html](http://wwwchem.uwimona.edu.jm/lab_manuals/c21jexpt.html)

### Continuous Assessment - 40 Marks

I C.A.	- 50 Marks
II C.A.	- 50 Marks
Average	- 25 Marks

Performance during regular practicals - 10 Marks

Regularity in submission of observation note-book and Record - 5 Marks

### CA Practical Examination - 50 Marks

Record	- 5 Marks
Viva	- 5 Marks
Short Procedure	- 5 Marks
Semi micro qualitative analysis (2 rare + 2 common cations)	- 15 Marks
Preparation	- 10 Marks
Colorimetric analysis	- 10 Marks

### Error Percentage for Colorimetric Estimation:

Upto 5%	- 10 Marks
5 – 7%	- 9 Marks
7 – 9%	- 8 Marks
9 – 12%	- 7 Marks
Above 12%	- 5 Marks

### Semester Practical Examination - 60 marks

Record	- 10 Marks
Viva – Voce	- 5 Marks
Short Procedure	- 5 Marks
Semi micro qualitative analysis (2 rare + 2 common cations)	- 20 Marks
Preparation	- 10 Marks
Colorimetric analysis	- 10 Marks

### Error Percentage for Colorimetric Estimation:

Upto 5%	- 10 Marks
5 – 7%	- 9 Marks
7 – 9%	- 8 Marks
9 – 12%	- 7 Marks
Above 12%	- 5 Marks

**SEMESTER - II****PCCHI20 - PRACTICAL III: PHYSICAL CHEMISTRY - I**

<b>Year:</b> I <b>SEM:</b> II	<b>Course Code</b> PCCHI20	<b>Title of the Course</b> Practical III: Physical Chemistry - I	<b>Course Type</b> Practical	<b>Course Category</b> Core	<b>H/W</b> 3	<b>Credits</b> 3	<b>Marks</b> 100
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**Course Outcomes:**

The Learners will be able to

1. Prepare the solutions of different concentrations.
2. Experiment and calculate the rate constant of ester hydrolysis and primary salt effect.
3. Determine the order and energy of activation using kinetics.
4. Construct and analyze phase diagrams, and examine the validity of Freundlich and Langmuir adsorption isotherms.
5. Determine the rate constant using polarimeter and stability constant using photo colorimeter, and develop skills in handling colorimeter and polarimeter.

CO	PSO					
	1	2	3	4	5	6
CO1	H	H	H	H	H	H
CO2	H	H	H	H	H	H
CO3	H	H	H	H	H	H
CO4	H	H	H	H	H	H
CO5	H	H	H	H	H	H

CO	PO					
	1	2	3	4	5	6
CO1	H	H	H	H	H	H
CO2	H	H	H	H	H	H
CO3	H	H	H	H	H	H
CO4	H	H	H	H	H	H
CO5	H	H	H	H	H	H

**H-High (3), M-Moderate (2), L-Low (1)**

1. Determination of rate constant and order of the reaction of iodination of acetone in the presence of acid catalyst.
2. Determination of order of the reaction of potassium iodide and potassium persulphate.
3. Determination of the strengths of the given unknown acids and their relative strength.
4. Determination of activation energy and Arrhenius parameter for the acid catalyzed hydrolysis of methyl acetate at two different temperatures.

5. Determination of rate constant of the reaction between potassium iodide and potassium persulphate and study the effect of added neutral salt on the rate constant of the reaction.
6. Determination of adsorption of oxalic acid from aqueous solutions by activated charcoal and examines the validity of Freundlich adsorption isotherm.
7. Verification of the Freundlich and Langmuir isotherms for adsorption of acetic acid on activated charcoal.
8. Construction of the phase diagram for a binary mixture to determine the eutectic temperature and composition and determination of the composition of the given mixture A and B by making use of the phase diagram - simple eutectic system.
9. \*Determination of the saponification of ethyl acetate with sodium hydroxide at equal concentrations of ester and alkali.
10. Kinetics of inversion of sucrose - polarimetry.
11. \*Determination of composition of ferric ions-salicylic acid by Job's method.
12. \*Determination of partial molar volume of acetic acid in aqueous solution by apparent molar volume method.

\*Not to be given for examination

#### Reference Books:

1. V. Venkateswaran, R. Veeraswamy, A. R. Kulandaivelu, Basic Principles of Practical Physical Chemistry, Sultan Chand and Sons Educational Publishers, Reprint 1995.
2. V. K. Ahluwalia, Sunita Dhingra Adarsh Gulati, College Practical Chemistry, University Press (India) Private Limited, Reprint 2008.
3. David Shoemaker, Joseph Nibler, Carl Garland, Experiments in Physical Chemistry, 7<sup>th</sup> Edition, 2003.
4. B. D. Khosla, V. C. Garg, Adarsh Gulati, Senior Practical Physical Chemistry, R. Chand and Co., Edition 2007.

#### OER:

1. <http://vlab.amrita.edu/?sub=3&brch=208&sim=563&cnt=958>

#### Continuous Assessment - 40 Marks

I C.A.	- 50 Marks
II C.A.	- 50 Marks
Average	- 25Marks
Performance during regular practicals	- 10 Marks
Regularity in submission of observation notebook and Record	- 5 Marks

#### CA Practical Examination - 50 Marks

Record	- 5 Marks
Viva	- 5 Marks
Principle and model graph	- 5 Marks
Manipulation	- 15 Marks
Result	- 20 Marks

#### Semester Practical Examination - 60 Marks

Record	- 10 Marks
Viva-Voce	- 5 Marks
Principle and model graph	- 5 Marks

Manipulation - 20 Marks  
Result - 20 Marks

1. KINETICS: (Iodination of acetone, Second order kinetics)

Error:

Upto + 0.2 - 20 Marks

>+ 0.2 to + 0.4 - 13 Marks

> + 0.4 - 7 Marks

2. PHASE DIAGRAM FOR SIMPLE EUTECTIC SYSTEM:

Eutectic temperature and composition - 20 Marks

Eutectic temperature - 10 Marks

Error:

Upto + 2°C - 10 Marks

>+ 2°C to + 4°C - 7 Marks

>+4°C - 5 Marks

Unknown composition - 10 Marks

Upto 5% - 10 Marks

>5-6% - 7 Marks

>6% - 5 Marks

3. ARRHENIUS:

Arrhenius parameter - 10 Marks

Error:

< 1% - 10 Marks

>1-2% - 7 Marks

> 2% - 5 Marks

Activation Energy - 10 Marks

Below a factor of 10 - 10 Marks

By a factor of 10 - 7 Marks

Above a factor of 10 - 5 Marks

4. PRIMARY SALT EFFECT: (Absence of electrolyte = 10 Marks; Presence =10 Marks)

Error:

Below a factor of 10 - 10 Marks

By a factor of 10 - 7 Marks

Above a factor of 10 - 5 Marks

5. ACID STRENGTH:

Error:

< 2% - 20 Marks

>2-3% - 13 Marks

> 3% - 7 Marks

6. ADSORPTION OF ACETIC ACID/OXALIC ACID ON CHARCOAL:

Error:

< 2% - 20 Marks

>2-3% - 13 Marks

> 3% - 7 Marks

**SEMESTER III****PICHG20 - IEP - RESEARCH METHODOLOGY**

<b>Year:</b> II <b>SEM:</b> III	<b>Course Code</b> PICHG20	<b>Title of the Course</b> Research Methodology	<b>Course Type</b> Theory	<b>Course Category</b> Independent Elective	<b>H/W Own Pace</b>	<b>Credits</b> 2	<b>Marks</b> 100
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**Learning Objectives:**

- To introduce the purpose and importance of research.
- To gain information about the various sources of literature.
- To learn the scientific method of collecting data and to compute statistical parameters to arrive at meaningful conclusions.
- To emphasize the importance of ethics in research and chemical safety.

**Course Outcomes:**

The Learners will be able to

1. Define research and its objectives, illustrate hypothesis testing, and draw the research plan.
2. Carry out literature search offline and online to fix the research problem and illustrate the importance of IF, SCI, h index and i-index.
3. Apply statistical analysis in research methodology.
4. Describe the general format of thesis writing and the research ethics to be followed.
5. Illustrate the safety measures to be taken in handling toxic, inflammable and explosive chemicals.

CO	PSO					
	1	2	3	4	5	6
CO1	H	H	H	H	H	H
CO2	H	H	H	H	H	H
CO3	H	H	H	H	H	H
CO4	H	H	H	H	H	H
CO5	H	H	H	H	H	H

CO	PO					
	1	2	3	4	5	6
CO1	H	H	H	H	H	H
CO2	H	H	H	H	H	H
CO3	H	H	H	H	H	H
CO4	H	H	H	H	H	H
CO5	H	H	H	H	H	H

**H-High (3), M-Moderate (2), L-Low (1)**



## **Unit I**

- 1.1 Scope of research - research methodology - definition of research, purpose of research. (K1, K2 & K3)
- 1.2 Types of research - descriptive vs analytical, applied vs fundamental, quantitative vs qualitative, conceptual vs empirical and other types of research. (K1, K2 & K3)
- 1.3 Research design - planning of research, selection of a problem for research. (K1, K2, K3 & K4)
- 1.4 Research process - steps involved. (K1, K2 & K3)
- 1.5 Problems and hypothesis in research - identification of problems, sources, factors influencing selection of problems. (K1, K2, K3 & K4)
- 1.6 Development and testing of hypothesis. (K1, K2, K3 & K4)

## **Unit II**

- 2.1 Literature search techniques - sources of information, need for reviewing literature. (K1, K2 & K3)
- 2.2 Primary, secondary and tertiary sources - journals, E-journals, journal access, journal abbreviations, chemical abstracts, Beilstein, reviews, monographs, dictionaries, text books. (K1, K2 & K3)
- 2.3 UGC infonet, E-resources. (K1, K2, K3 & K4)
- 2.4 Search engines - Google scholar, chemical industry, Wiki-databases, chemSpider, Science Direct, SciFinder, Scopus, SPN, Reaxys, orbit.com, Thompson innovations. (K1, K2, K3 & K4)
- 2.5 Indices - subject index, substance index, author index, formula index and other indices with examples, searches through structure, knowledge of national and international journals. (K1, K2, K3 & K4)
- 2.6 Impact Factor, Citation-Index, h Index, I-index, SCI Journals. (K1, K2, K3 & K4)

## **Unit III**

- 3.1 Data Analysis - errors in chemical analysis, types of errors, precision and accuracy. (K1, K2, K3 & K4)
- 3.2 Significant figures, measures of central tendency - arithmetic mean, median, mode. (K1, K2, K3 & K4)
- 3.3 Methods of dispersion - standard deviation, co-efficient of variation (discrete series and continuous series). (K1, K2, K3 & K4)
- 3.4 Comparison of results - t- test, F- test and chi square test. (K1, K2, K3 & K4)
- 3.5 Correlation - coefficient of correlation, linear regression - coefficient of regression. (K1, K2, K3 & K4)
- 3.6 Multiple linear regression. (K1, K2, K3 & K4)

## **Unit IV**

- 4.1 Writing a thesis: The general format - page and chapter format - the use of quotations - footnotes and figures - referencing - appendices - references. (K1, K2 & K3)
- 4.2 Research Ethics - academic honesty, intellectual ownership - copy right, royalty. (K1, K2 & K3)
- 4.3 Intellectual property rights and patent law. (K1, K2 & K3)
- 4.4 Plagiarism - responsibility, reproduction of published material and accountability of the researcher, situation that raises ethical issues, freedom and privacy from coercion. (K1, K2 & K3)
- 4.5 Ethics in relation to other people, role of research participant. (K1, K2 & K3)

4.6 Software for detecting plagiarism. (K1, K2 & K3)

## Unit V

5.1 Concepts of chemical safety: Chemical safety and ethical handling of chemicals. (K1, K2, K3 & K4)

5.2 Safe working procedure and protective environment. (K1, K2, K3 & K4)

5.3 Emergency procedure and first aid, laboratory ventilation, safe storage and handling of hazardous chemical. (K1, K2, K3 & K4)

5.4 Procedure for working with substances that pose hazards, flammable or explosive hazards. (K1, K2, K3 & K4)

5.5 Procedures for working with gases at pressures above or below atmosphere. (K1, K2, K3 & K4)

5.6 Safe storage and disposal of waste chemicals, recovery, recycling and reuse of laboratory chemicals. (K1, K2, K3 & K4)

## Reference Books:

1. Anderson, Thesis and Assignment Writing, Wiley Eastern Ltd., 1<sup>st</sup> Edition, Eighth Reprint 1987.
2. C. R. Kothari, Research Methodology, Wiley Eastern Ltd., Fourth Reprint 1989.
3. R. P. Misra, Research Methodology, Concept Publishing Company, New Delhi, 2002.
4. R. Gopalan, Thesis Writing, Vijay Nicole Imprints Private Limited, 2005.
5. P. Ramadass and A. Wilson Aruni, Research and Writing: Across the Disciplines, MJP Publishers, 2009.
6. N. Gurumani, Scientific Thesis Writing and Paper Presentation, MJP Publishers, Chennai, 2010.
7. S. C. Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi, 1999.
8. G. W. Snedecor and W. G. Cochran, Statistical Methods, Iowa State University Press, 1967.
9. R. Panneerselvam, Research Methodology, Prentice Hall of India Private Ltd., New Delhi, Abridged, 1<sup>st</sup> January 2013.
10. Satarkar, S. V., Intellectual Property Rights and Copyrights, Ess Ess Publications, 2003.
11. Anthony M Graziano and Michael L Rau, Research Methods: A Process of Inquiry, Prentice Hall, 2006.
12. P. Rajammal and P. Devadoss, A Hand Book of Methodology of Research, R. M. M. Vidya Press, 1976.
13. H. F. Ebel, C. Bliefert and W. E. Russey, The Art of Scientific Writing: From Students Reports to Professional Publications in Chemistry and Related Fields, VCH, Weinheim, New York, 1987.

## OER:

1. [https://www.google.com/url?sa=t&source=web&rct=j&url=https://dinus.ac.id/repository/docs/ajar/Kothari\\_-\\_Research\\_Methodology\\_Methods\\_and\\_Techniques\\_-\\_2004.pdf&ved=2ahUKEwiS3M7WsMzrAhWDcn0KHZU7AV8QFjAKegQICBAB&usq=AOvVaw00Lf\\_VgXYG-96PVmSGC0DG](https://www.google.com/url?sa=t&source=web&rct=j&url=https://dinus.ac.id/repository/docs/ajar/Kothari_-_Research_Methodology_Methods_and_Techniques_-_2004.pdf&ved=2ahUKEwiS3M7WsMzrAhWDcn0KHZU7AV8QFjAKegQICBAB&usq=AOvVaw00Lf_VgXYG-96PVmSGC0DG)
2. [http://www.insaindia.res.in/pdf/Ethics\\_Book.pdf](http://www.insaindia.res.in/pdf/Ethics_Book.pdf) - pages 35-43
3. <http://ccc.chem.pitt.edu/wipf/Web/HCH.pdf>

**SEMESTER IV****PCCHP20 - PRACTICAL IV: ORGANIC CHEMISTRY - II**

<b>Year:</b> II <b>SEM:</b> IV	<b>Course Code</b> PCCHP20	<b>Title of the Course</b> Practical IV: Organic Chemistry – II	<b>Course Type</b> Practical	<b>Course Category</b> Core	<b>H/W</b> 3	<b>Credits</b> 3	<b>Marks</b> 100
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**Course Outcomes:**

The Learners will be able to

1. Develop skills to perform two stage preparations of organic compounds and crystallize them.
2. Calculate the saponification value of oil.
3. Estimate the amount of the given organic compound.
4. Demonstrate simple chromatographic techniques.
5. Interpret the structure of organic compounds by analyzing spectral data.

CO	PSO					
	1	2	3	4	5	6
CO1	H	H	H	H	H	H
CO2	H	H	H	H	H	H
CO3	H	H	H	H	H	H
CO4	H	H	H	H	H	H
CO5	H	H	H	H	H	H

CO	PO					
	1	2	3	4	5	6
CO1	H	H	H	H	H	H
CO2	H	H	H	H	H	H
CO3	H	H	H	H	H	H
CO4	H	H	H	H	H	H
CO5	H	H	H	H	H	H

**H-High (3), M-Moderate (2), L-Low (1)**

**Estimations:**

1. Estimation of aniline
2. Estimation of phenol
3. Estimation of ethyl methyl ketone
4. Estimation of glucose (Bertrand's method)

5. \*Estimation of amide
6. Estimation of glycine
7. Saponification value of an oil

**Preparations:**

1. Benzanilide from benzophenone
2. m-nitrobenzoic acid from methyl benzoate
3. m-nitrobenzoic acid from benzaldehyde
4. 2,4-dinitrophenylhydrazine from chlorobenzene
5. Acetyl salicylic acid from methyl salicylate
6. Benzilic acid from benzoin

**\* Chromatographic Separations:**

1. Column chromatography- separation of dyes
2. Paper chromatography - separation of mixture of amino acids
3. Thin layer chromatography - separation of mixture of amino acids

**Interpretation of spectra of 10 organic compounds****\* Not to be given for examination****Reference Books:**

1. Mann and Saunders, Laboratory Manual of Organic Chemistry, Pearson Education, 4<sup>th</sup> Edition, 2009.
2. Vogel's Textbook of Practical Organic Chemistry, Pearson Education, 5<sup>th</sup> Edition, 2003.
3. Raj K. Bansal, Laboratory Manual of Organic Chemistry, New Age International Publishers, 5<sup>th</sup> Edition, 2009.
4. Gnanaprakasam, Ramamurthy, Organic Chemistry Manual, Viswanathan S. Printers and Publishers Pvt. Ltd., New Edition, 2009.

**OER:**

1. [https://sdfs.db.aist.go.jp/sdfs/cgi-bin/direct\\_frame\\_top.cgi](https://sdfs.db.aist.go.jp/sdfs/cgi-bin/direct_frame_top.cgi)
2. <http://www.chemspider.com/>
3. <https://cssp.chemspider.com>
4. <https://www.khanacademy.org/science/class-11-chemistry-india/xbbb6cb8fc2bd00c8:in-in-organic-chemistry-some-basic-principles-and-techniques/xbbb6cb8fc2bd00c8:in-in-methods-of-purification-of-organic-compounds/v/calculating-retention-factors-for-tlc>

**Continuous Assessment - 40 marks**

I C.A.	- 50 Marks
II C.A.	- 50 Marks
Average	- 25 Marks

Performance during regular practicals - 10 Marks

Regularity in submission of observation note-book and Record - 5 Marks

**CA Practical Examination - 50 Marks**

Spectra - 5 Marks

Record - 5 Marks

Viva - 5 Marks

Estimation - 15 Mark

Preparation - 20 Marks

(Stage1 - Quantity (5 Marks), Quality (5 Marks), Stage2 - Quantity (4 Marks), Quality (4 Marks), Recrystallization - 2Marks)

**Semester Practical Examination - 60 Marks**

Spectra - 5 Marks

Record - 5 Marks

Viva - 5 Marks

Preparation - 20 Marks

Estimation - 25 Marks

**Quantitative Estimation**

Upto 2% - 25 Marks

2 - 3% - 20 Marks

3- 4% - 15 Marks

&gt; 4% - 10 Marks

**SEMESTER IV****PCCHQ20 - PRACTICAL V: INORGANIC CHEMISTRY - II**

<b>Year:</b> II <b>SEM:</b> IV	<b>Course Code</b> PCCHQ20	<b>Title of the Course</b> Practical V: Inorganic Chemistry - II	<b>Course Type</b> Practical	<b>Course Category</b> Core	<b>H/W</b> 4	<b>Credits</b> 3	<b>Marks</b> 100
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**Course Outcomes**

The Learners will be able to

1. Estimate the amount of metal ions in inorganic mixtures by volumetric and gravimetric methods.
2. Estimate the percentage of metals in ores and alloys by volumetric and gravimetric methods.
3. Prepare selected inorganic complexes.
4. Interpret the spectra of selected inorganic compounds.

CO	PSO					
	1	2	3	4	5	6
CO1	H	H	H	H	H	H
CO2	H	H	H	H	H	H
CO3	H	H	H	H	H	H
CO4	H	H	H	H	H	H

CO	PO					
	1	2	3	4	5	6
CO1	H	H	H	H	H	H
CO2	H	H	H	H	H	H
CO3	H	H	H	H	H	H
CO4	H	H	H	H	H	H

**H-High (3), M-Moderate (2), L-Low (1)**

**Estimations:**

1. Estimation of copper and nickel
2. Estimation of copper and zinc
3. Estimation of iron and nickel
4. Estimation of iron and magnesium
5. Estimation of iron and zinc

**Preparations:**

1. Hexaamminenickel(II) chloride

2. Bis(acetylacetonato)copper(II)
3. Hexaamminecobalt(III) chloride
4. Pentamminechlorocobalt(III) chloride
5. Tris(thiourea)copper(I) sulphate
6. Potassium tetrachlorocuprate(II)
7. \*Potassium tris(oxalato)aluminate(III) trihydrate

**\*Analysis of alloys:**

1. Determination of percentage of copper and zinc in brass
2. Determination of percentage of chromium and nickel in stainless steel

**\*Analysis of ores:**

1. Determination of percentage of calcium and magnesium in dolomite
2. Determination of percentage of MnO<sub>2</sub> in pyrolusite

**Interpretation of spectra of 10 inorganic compounds**

**\* Not to be given for examination**

**Reference Books:**

1. V. Venkateswaran, R. Veeraswamy, A.R. Kulandaivelu, Basic Principles of Practical Chemistry, Sultan Chand & Sons, Educational Publishers, 2012.
2. G. Svehla, B. Sivasankar, Vogel's Qualitative Inorganic Analysis, Pearson Publication, 7<sup>th</sup> Edition, 2012.
3. R. Mukhopadhyay and P. Chatterjee, Advanced Practical Chemistry, Arunabha Sen Books and Allied (P) Ltd., Kolkatta, Third Edition, 2007.

**OER:**

1. <https://www.khanacademy.org/science/chemistry/chemical-reactions-stoichiome/limiting-reagent-stoichiometry/a/gravimetric-analysis-and-precipitation-gravimetry>. (Gravimetric Analysis)
2. [https://chem.libretexts.org/Courses/Northeastern\\_University/08%3A\\_Gravimetric\\_Methods/8.2%3A\\_Precipitation\\_Gravimetry](https://chem.libretexts.org/Courses/Northeastern_University/08%3A_Gravimetric_Methods/8.2%3A_Precipitation_Gravimetry). (Precipitation Gravimetry).
3. <http://vlab.amrita.edu/?sub=2&brch=193&sim=348&cnt=1> (Estimation of Nickel).

**Continuous Assessment - 40 Marks**

I C.A. - 50 Marks

II C.A. - 50 Marks

Average - 25 Marks

Performance during regular practical - 10 Marks

Regularity in submission of observation note-book and Record - 5 Marks

**CA Practical Examination - 50 Marks**

Spectra -5 Marks

Record -5 Marks

Viva -5 Marks

Preparation -10 Marks (Quantity – 5 Marks, Quality – 5 Marks)

Quantitative Estimation - 25 Marks (Volumetric - 10 Marks & Gravimetric - 15 Marks)

**Semester Practical Examination - 60 Marks**

Spectra	- 5 Marks
Record	- 5 Marks
Viva-Voce	- 5 Marks
Preparation	- 20 Marks (Quantity - 10 Marks, Quality - 10 Marks)
Quantitative Estimation	- 25 Marks (Volumetric - 10 Marks & Gravimetric - 15 Marks)

**Gravimetric Estimation**

up to 2%	- 15 Marks
2 - 3%	- 13 Marks
3- 4%	- 10 Marks
> 4%	- 7 Marks

**Volumetric Estimation**

up to 1%	- 10 Marks
1% to 2%	- 8 Marks
2% to 3%	- 5 Marks
>3%	- 4 Marks



**SEMESTER IV****PCCHR20 - PRACTICAL VI: PHYSICAL CHEMISTRY - II**

<b>Year:</b> II <b>SEM:</b> IV	<b>Course Code</b> PCCHR20	<b>Title of the Course</b> Practical VI: Physical Chemistry - II	<b>Course Type</b> Practical	<b>Course Category</b> Core	<b>H/W</b> 3	<b>Credits</b> 3	<b>Marks</b> 100
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**Course Outcomes:**

The Learners will be able to

1. Apply laboratory skills to perform physico-chemical experiments.
2. Demonstrate acid-base, redox and precipitation titrations using conductometry and potentiometry.
3. Determine the pH of buffer solution potentiometrically and verify Ostwald dilution law and Onsager's equation.
4. Interpret the experimental results obtained by conductometric and potentiometric titrations.
5. Describe spectral methods to calculate force constant and interpret UV, IR and NMR spectra.

CO	PSO					
	1	2	3	4	5	6
CO1	H	H	H	H	H	H
CO2	H	H	H	H	H	H
CO3	H	H	H	H	H	H
CO4	H	H	H	H	H	H
CO5	H	H	H	H	H	H

CO	PO					
	1	2	3	4	5	6
CO1	H	H	H	H	H	H
CO2	H	H	H	H	H	H
CO3	H	H	H	H	H	H
CO4	H	H	H	H	H	H
CO5	H	H	H	H	H	H

**H-High (3), M-Moderate (2), L-Low (1)**

**Experiments:**

1. Determination of the strength of given weak acid by titrating potentiometrically with a strong base and determine dissociation constant of the weak acid to 1/4, 1/2 and 3/4 neutralization.

2. Determination of the strength of weak acid by titrating conductometrically against a standard sodium hydroxide solution.
3. Determination of pH values of the given buffer solutions by potentiometric method. You are provided with a buffer of known pH.
4. Determination of the strength of potassium iodide by titrating against standard potassium permanganate potentiometrically.
5. Verify the Onsager equation using the given solution and determine the equivalent conductance at infinite dilution.
6. Determination of the strength of ferrous ammonium sulphate solution by titrating against standard potassium permanganate potentiometrically.
7. Verify the Ostwald's dilution law and determine the dissociation constant of given acid.
8. Determination of the strength of potassium chloride by precipitation titration potentiometrically.
9. Titrate conductometrically the given mixture of strong and weak acids against a standard sodium hydroxide solution and determine the individual strength of the two acids in the mixture.
10. Determination of the strength of given strong acid by titrating potentiometrically with a strong base.
11. Determination of the strength of mixture of halides (KCl & KI) by precipitation titration potentiometrically.
12. Determination of the strength of given strong acid by titrating conductometrically with a strong base.
13. \*Titrate conductometrically the given mixture of HCl, CH<sub>3</sub>COOH and CuSO<sub>4</sub> · 5H<sub>2</sub>O against NaOH and determine the individual strengths of the mixture.

\* Not to be given for examination.

#### **Interpretation of spectra:**

- Interpretation of UV-Visible spectra of simple molecules for the calculation of molecular data and identification of functional groups (5 typical spectra will be provided).
- IR and NMR spectral calculations of force constant - identification and interpretation of spectra (5 each in IR and NMR will be provided).

#### **Reference Books:**

1. V. Venkateswaran, R. Veeraswamy, A. R. Kulandaivelu, Basic Principles of Practical Physical Chemistry, Sultan Chand and Sons Educational Publishers, Reprint 2012.
2. V. K. Ahluwalia, Sunita Dhingra Adarsh Gulati, College Practical Chemistry, University Press (India) Private Limited, Reprint 2008.
3. B. Viswanathan, P. S. Raghavan, Practical Physical Chemistry, Viva Publishers, 2014.
4. J. B. Yadav, Advanced Practical Physical Chemistry, Krishna Prakashan Media (P) Ltd, 2015.

**OER:**

1. [https://docs.google.com/presentation/d/1tc5iAxF-Kjt\\_P\\_IXeyFCQl2m-UHnY\\_t6CcLmdRBX1Ug/edit?usp=sharing](https://docs.google.com/presentation/d/1tc5iAxF-Kjt_P_IXeyFCQl2m-UHnY_t6CcLmdRBX1Ug/edit?usp=sharing)
2. [https://chem.pg.edu.pl/documents/175260/14212622/chf\\_epm\\_lab\\_1.pdf](https://chem.pg.edu.pl/documents/175260/14212622/chf_epm_lab_1.pdf)
3. [http://web.iyte.edu.tr/~serifeyalcin/lectures/chem306/cn\\_3.pdf](http://web.iyte.edu.tr/~serifeyalcin/lectures/chem306/cn_3.pdf)

**Continuous Assessment - 40 Marks**

I C.A. - 50 Marks

II C.A. - 50 Marks

Average - 25 Marks

Performance during regular practicals - 10 Marks

Regularity in submission of observation notebook and Record - 5 Marks

**CA Practical Examination - 50 Marks**

Spectra - 5 Marks

Conductometry - 17.5Marks

Potentiometry - 17.5 Marks

Record - 5 Marks

Viva-Voce - 5 Marks

**Conductometry / Potentiometry (17.5 Marks)**

Tabulation, Calculation, Graph - 7.5 Marks

Result - 10 Marks

**Semester Practical Examination - 60 Marks**

Spectra - 5 Marks

Conductometry - 20 Marks

Potentiometry - 20 Marks

Record - 10 Marks

Viva-Voce - 5 Marks

**Conductometry / Potentiometry (20 Marks)**

Tabulation, Calculation, Graph - 10 Marks

Result - 10 Marks

**Error:**

Upto 2% - 10 Marks

2% to 4% - 8 Marks

4% to 6% - 6 Marks

&gt;6% - 5 Marks