M.Phil Programme in Chemistry

PROGRAMME OBJECTIVES

The M.Phil program is focused to equip scholars with skills to understand and appreciate chemistry. It is also aimed at helping the students to realize the importance of research work, develop skills to interpret. This programme can also be extended to PhD studies by the addition of one year's worth of research.

PROGRAMME STRUCTURE

Semester	Course code	Title of the course	Credits	Total Marks
I	MPC 6600	Dissertation	6	-
	MPC 6611	Research Methodology	6	120
	MPC 6613	Advanced topics in Chemistry	6	120
	MPC 6615	Indepth study	6	120
II	MPC 6600	Dissertation	6	240
			30	**600**

Curriculum

for

M.Phil Chemistry Programme

(For those who were admitted from the academic year 2019-2020 onwards)

Since 1881

Research Department of Chemistry

The American College

(An Autonomous Institution Affiliated to Madurai Kamaraj University)

Madurai, Tamilnadu, INDIA

MPC 6611 RESEARCH METHODOLOGY 6hrs/6cr

Course Objectives:

- To learn the computer application skill for teaching and research
- To understand the principles of research, literature survey and writing research paper and thesis writing
- To create the awareness on laboratory hygiene and safety
- To gain some knowledge about the statistical analysis of data which will be highly helpful for research
- To expose them in nano sample analysis

Course outcome:

At the end of the course, scholars will be able to:

1. explain different routes to carry out literature survey and apply digital platform for the same.
2. illustrate various terminology involved in scientific publication and design a scientific publication
3. illustrate data collection and presentation. Assess error and suggest solution for its minimization.
4. prescribed safe laboratory practices in handling glassware and chemicals
5. apply techniques for sample analysis

UNIT –I Literature survey

Print : Sources of information – Primary, Secondary, Tertiary sources – Journals – Journal abbreviations – Abstracts – Current titles – Reviews – Monographs – Dictionaries – Textbooks – Current contents – patent- Introduction to Chemical Abstracts and Beilstein – Subject Index, Substance Index, Author Index, Formula Index and other Indices with examples.

Digital : Web resources – E–Journal – Journal access – TOC alerts – Hot articles – Citation index – Impact factor – H–Index – E–Consortium – UGC infonet – E–Books – Internet discussion groups and communities – Blogs – Preprint server – Search engines, Scirus, Google Scholar, ChemIndustry, Wiki – Databases, ChemSpider, ScienceDirect, SciFinder, Scopus

UNIT II: Methods of writing scientific papers

On writing scientific papers – justification for scientific contributions, bibliography, justice and courtesy in decisions, description of methods, conclusions, the need for illustration, style, publications of scientific works,

Writing methods – Writing the first draft, revising the first draft on content and structure, revising the second draft on style, writing a thesis, writing review article and book reviews, preparing research proposals for grants– funding agencies

UNIT III: Data Analysis

Types of Error – Accuracy, precision, significant figures, use of calculation in the estimation of errors – Frequency distribution, the binomial distribution, the Poisson distribution and normal distribution – describing Data, population and sample, mean, variance, standard deviation, way of quoting uncertainty, robust estimators, repeatability and reproducibility of measurements – Hypothesis testing, levels of confidence and significance, test for an outlier, testing variances, means t–Test, paired t–Test – Analysis of variance (ANOVA) – Correlation and Regression – Curve fitting, Fitting of linear equations, simple linear cases, weighted linear case, analysis of residuals – General polynomial fitting, linearizing transformations, exponential function fit – r and its abuse – Basic aspects of multiple linear regression analysis.

UNIT IV: Chemical Safety, Ethical Handling of Chemicals

Safe working procedure and protective environment, protective apparel, emergency procedure and first aid, laboratory ventilation, Safe storage and use of hazardous chemicals, procedure for working with substances that pose hazards, flammable or explosive hazards, procedures for working with gases at above or below atmospheric pressures – safe storage and disposal of waste chemicals , recovery , recycling and reuse of laboratory chemicals, procedure for laboratory disposal of explosives , identification , verification and segregation of laboratory waste , disposal of chemicals in the sanitary sewage system , incineration and transportation of hazardous chemicals

UNIT V : Instrumentation techniques and computer packages

Scanning electron microscopy (SEM) – instrumentation – applications – surface area analysis, particle size determination – Scanning Probe Microscopes – Scanning Tunnelling microscope (STM) and Atomic Force Microscope (AFM) – Principles and applications. Diffraction techniques – single crystal - powder XRD, Neutron and electron diffraction – principles and applications. Emission spectrography and flame spectroscopy – Atomic absorption, atomic emission and atomic fluorescence spectroscopy

Applications of some computer packages like MS–Excel, Origin, ChemDraw, Sciplot, ISIS draw, ChemSketch and SPSS.

References:

1. http://www.pubs.acs.org
2. http://www.inflibnet.ac.in
3. http://rsc.org
4. http://spingerlink.com
5. J. March, ‘Advanced Organic Chemistry; Reactions, Mechanisms and Structure’, 6th Ed., Wiley– Interscience, 2016.
6. Maeve O’Connor, ‘Writing successfully in science’ Chapman and Hall, London, 1995.
7. D. B. Hibbert and J. J. Gooding, ‘Data Analysis for Chemistry’, Oxford University press, 2006.
8. J. Topping, ‘Errors of Observation and Their Treatment’, Fourth Edn., Chapman Hall, London, 1984
9. S. C. Gupta, ‘Fundamentals of Statistics’, Sixth Edn., Himalaya publ. House’, Delhi, 2006
10. H. E. Solbers, ‘Inaccuracies in Computer Calculation in Standard Deviation’, Anal. Chem. 55, 1611 (1983)
11. P. M. Wanek et al., ‘Inaccuracies in the Calculation of Standard Deviation with Electronic Calculators’, Anal. Chem. 54, 1877 (1982)
12. Chemical safety matters–IUPAC –IPCS, Cambridge Univ. Press, 1992.
13. For computer applications any commonly available books as well as common materials available in the web.
14. D.A. Skoog and J.J. Leary, Principles of Instrumental Analysis, 4th Edn., Saunders College Publishing, 1992.
15. D.A. Skoog, F.S.Holler, S.R.Crouch, Principles of Instrumental Analysis, 6th Edn., Thomson Brooks/cole, 2007.
16. A.K. Cheetham, P.Day, Solid State Chemistry: Techniques, Oxford University Press, Oxford, 1987.
17. G. E. Bacon, Neutron diffraction, Oxford Universtiy Press, Oxford, 1975.
18. R.S. Drago, Physical Methods in Chemistry, Saunders, 1999.

Mapping of Bloom's Taxonomy with Course Outcome					
	Unit-I	**Unit-II**	**Unit-III**	**Unit-IV**	**Unit-V**
	CO1	**CO2**	**CO3**	**CO4**	**CO5**
K1: Remembering	**X**	**X**	**X**	**X**	**X**
K2: Understanding	**X**	**X**	**X**		**X**
K3: Applying		**X**	**X**		**X**
K4: Analyzing		**X**	**X**		**X**
K5: Evaluating			**X**		**X**
K6: Creating					

MPC 6613 ADVANCED TOPICS IN CHEMISTRY 6hrs/6cr

Course Objectives:

- To appreciate the applications of Organometallic and Bioinorganic chemistry
- To study the theoretical concepts and applications of Green Chemistry
- To learn the theories of Molecular machines
- To analyse spectral data
- To apply various Electro analytical Techniques

Course outcome:

At the end of the course, scholars will be able to:

1. appraise the various concepts of Organometallic and Bioinorganic that govern modern day research.
2. rationalize the usage of particular green approach for a reaction.
3. discuss the application of Molecular machines.
4. articulate the importance of all spectral information and solve conjoint spectra
5. describe the importance of potentiometry and electro analytical techniques and interpret the chemistry behind them

Unit –I Organometallic and Bioinorganic

The sixteen and eighteen electron rule - and bonded complexes-synthetic methods-Agnostic interaction-changes in ligand reactivity on Coordination- activation of small molecules-catalytic mechanism in industry-Olefin metathesis - metallacycles.

Metallo enzymes as acid, Base and redox catalyst-metallo proteins-ligand carriers- Metal carriers and metal storage proteins-metal ions as structure formes, structure robes and charge carriers – model systems –metals for diagnosis and chemotherapy -metal toxicity and environmental hazards.

Unit –II Green Chemistry

Need for green chemistry – solvent free reactions –microwave assisted synthesis-role of ionic liquids in green chemistry-cleaner technology with super critical fluids - catalytic approach to green chemistry (use of zeolites, clays, mesoporons materials) waste water treatment by oxidation technology at ambient conditions – remediation methods for textile effluents-bio catalytic reaction.

Unit –III Molecular and Supramolecular machines

Concept of a machine at the molecular level-definition-natural molecular machines-artificial molecular machines – interlocked molecules as prototypes - pseudorotaxanes based on conformational motions – photochemically induced conformational motions – electrochemically induced conformational motions- photochemically controllable complexes – molecular shuttles - chemically, photochemically controllable shuttles.

Digital processing with molecular switches – Gates - YES, NOT, OR logic operations – molecular gates for YES, NOT, OR, NAND, NOR, XOR and XNOR operations.

Unit –IV Spectral techniques

Application of spectral techniques like UV-Vis, fluorescence, IR, NMR, CD studies, Mass Spectrometry with thrust in problem Solving skills, related to organic molecules (instrumentation not necessary)

UNIT V: Electro analytical Techniques

Potentiometric sensors– criteria for choosing these sensors, selective electrodes– primary ion–selective electrodes encompassing crystalline and non–crystalline electrodes– membrane ion–selective electrodes including gas–sensing and enzyme substrate electrodes– all solid state ion–selective electrodes – Voltammetric sensors. Chronoamperometry– potential sweep techniques (cyclic Voltammetry including study of reaction mechanisms)– step and pulse techniques– Normal pulse and differential pulse Voltammetry– square wave Voltammetry– AC techniques– stripping Voltammetry (anodic and cathodic)– stripping analysis.

References

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6. Sanghi, R., Srivastva, M., Green Chemistry, Narosa, 2003
7. Delvin, S., Green Chemistry, IV Y publishing house, 2006
8. Leach, A. R., Molecular modeling principles and applications. 2nd Edition, Prentice Hall, 200I.
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11. Joseph B. Lambert, Herbert F. Shurvell, Lawrence Verbit, R. Graham Cooks, George H. Stout, Organic structural analysis, Macmillan Publishing CO, Inc, 1976
12. H.H.Willard, L.L. Merritt, L.A. Dean, F.A. Settle, Instrumental methods of analysis, CBS publication & Distributors , 1986
13. Christopher M.A Brett and Ana Maria Oliveira Brett, "Electroanalysis" Oxford University Press, Oxford, 1998.
14. Daniel C. Harris, "Quantitative Chemical Analysis", Third Edition., W.H. Freeman and Company New york, 1996.
15. A.J. Bard L.F. Faulkner, Electrochemical methods – Fundamentals and Applications, Second Edition., Wiley–VCH, 1998.
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18. Joseph Wang, "Analytical ElectroChemistry", Second Edition., Wiley–VCH, 2001

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K4: Analyzing	**X**			**X**	**X**
K5: Evaluating				**X**	**X**
K6: Creating					

MPC 6615 INDEPTH STUDY OF RELATED LITERATURE

Course objective

- To gain knowledge in the proposed/relevant area of research and apply in their projects

This paper is based on the project work proposed by the guide for each student. Guide shall select 10 research articles including review related to the project work from reputed international journals. A written test will be conducted for 3 hours and evaluated by the guide. The students are expected to give a seminar which would be jointly evaluated by all guides. There will be no end of semester examination

MPC 6600 DISSERTATION

Dissertation work is a two semester sequential course. The objective of this course is to enable the scholar to carry out the project selected in the first semester supplemented by experimental investigations. The scholar may be given an option to carry out investigation or analysis in CSIR laboratories, NITs and universities.

- Progress report: the first progress report should be presented to the department before the 60^{th} working day of the second semester.
- Preview of dissertation: the scholar will present the preview of the dissertation by the 75^{th} working day of the semester to the department
- Submission of the dissertation: the scholar has to submit 4 hard copies of the dissertation by the 85^{th} working day of the second semester to the department. A copy of this dissertation will be sent to the external examiner for review.
- Evaluation of the dissertation: the Head of the PG department will be the Chairman and the convener of the research committee. Internal valuation will be done by the guide. The Viva -Voce examination will be conducted by panel of examiners, which consists of chairman, external examiner (who valued the dissertation) and the guide, during the examination period of the second semester and the results will be announced