

**M.Phil. CHEMISTRY (FT / PT) PROGRAMME**

(For the candidates to be admitted from the academic year 2018-19 onwards)

Eligibility : M.Sc. Chemistry**PROGRAMME OBJECTIVES :**

- To impart advance knowledge of chemistry in different subjects which are required to understanding philosophy of chemistry.
- To train post graduates capable of undertaking higher level chemical research.
- To produce skilled postgraduates who can act in the increasingly wide research area of chemistry.
- To practice innovative teaching methods to communicate clearly and effectively, orally and in writing.
- This programme can also be extended to PhD studies by the addition of one year's worth of research.

PROGRAMME STRUCTURE

Sem-ester	Course	Title of the Course	Exam. Hours	Credits	Marks		
					IA	UE	Total
I	Course - I	Research Methodology	3	4	25	75	100
	Course - II	Advanced Topics in Chemistry	3	4	25	75	100
	Course – III	Teaching and Learning skills (Common Paper)	3	4	25	75	100
	Course - IV	Paper on Topic of Research (The syllabus will be prepared by the Guide and the examination will be conducted by the COE)	3	4	25	75	100
II	---	Dissertation and Viva-Voce Viva Voce 50 marks Dissertation 150 marks	--	8	--	--	200
Total				24	--	--	600

PROGRAMME OUTCOMES :

- The scholars will develop knowledge and understand the current issues, research and developments.
- M.Phil Scholar shall get new ideas about the current scenario by studying literature.
- The scholars will acquire knowledge in soft skill and it can be introduced for class room teaching.

COURSE I

RESEARCH METHODOLOGY

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 gain an idea about digital electronics and computer package

UNIT I : Literature Survey

Print : Sources of information – Primary, Secondary, Tertiary sources – Journals – Journal abbreviations – Abstracts – Current titles – Reviews – Monographs – Dictionaries – Textbooks – Current contents – 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 scientific research and writing scientific papers

General principles of research, inculcation of scientific temper, avoidance of prejudices and lax judgements, undue admiration of authority, false distinction between theoretical and applied research, impulses of a strong will to do research, persistent hard work and concentration, developing high-minded independence of judgement and thirst for scientific originality, various stages of scientific research, observation, experimentation, working hypotheses, proof etc.,

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 : Chemical Safety and 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 IV : 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 V : Electronics and Computer Packages

Basic aspects of electronic circuits and their components used in common instruments like spectrophotometers and electrochemical instruments like cyclic voltammeter. Elementary aspects of digital electronics.

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

References:

Unit I

1. <http://www.inflibnet.ac.in>
2. <http://spingerlink.com>
3. <http://rsc.org>
4. <http://www.pubs.acs.org>
5. J. March, 'Advanced Organic Chemistry; Reactions, Mechanisms and Structure', 6th Ed., Wiley- Interscience, 2016.

Unit II

1. Santiago Ramon y Cajol, (translated by Neely S Wanson and Larry W Swanson) 'Advice for a young Investigator' A Bradford Book, The MIY Press, Massachusetts, London, England 1999.

2. Maeve O'Connor, 'Writing successfully in science' Chapman and Hall, London, 1995.

Unit III

1. Chemical safety matters–IUPAC –IPCS, Cambridge Univ. Press, 1992.
2. Analytical Chemistry , K.Gopalan, S.Chand year

Unit IV

References:

1. D. B. Hibbert and J. J. Gooding, 'Data Analysis for Chemistry', Oxford University press, 2006.
2. J. Topping, 'Errors of Observation and Their Treatment', Fourth Edn., Chapman Hall, London, 1984
3. S. C. Gupta, 'Fundamentals of Statistics', Sixth Edn., Himalaya publ. House', Delhi, 2006
4. H. E. Solbers, 'Inaccuracies in Computer Calculation in Standard Deviation', Anal. Chem. 55, 1611 (1983)
5. P. M. Wanek et al., 'Inaccuracies in the Calculation of Standard Deviation with Electronic Calculators', Anal. Chem. 54, 1877 (1982)

Unit V

1. R. L. Tokheim, 'Digital Electronics–Principles and Applications', 5th Edn., Tata Mc Graw–Hill, New Delhi, 1999.
2. Alan Jhonson, 'Electronics, A Systems Approach' Hodder and Stoughton, London, 1987.
3. Robert Boylested, Louis Nashelsky, 'Electronic Devices and Circuit Theory', Prentice Hall, 9th Edn., May 2005.
4. Thomas L Floyd, 'Principles of Electric Circuits: Conventional Current Version', Prentice Hall, 7th Edn., Jan 2006.
5. For computer applications any commonly available books as well as common materials available in the web.

Course outcomes:

- The scholars will know the different routes to design a research problem
- General terminology including various methods for the research shall be the outcome of the course.
- To improve the numerical aptitude and computational knowledge in the basic of collection and presentation of data.
- The scholars will acquire knowledge of safe laboratory practices by handling laboratory glassware, equipment, and chemical reagents.

Course II

ADVANCED TOPICS IN CHEMISTRY

Objectives:

- To appreciate the applications of various analytical tools for the characterization of materials
- To study the theoretical concepts and applications of NMR, ESR and mass spectroscopy
- To learn the theories and importance of potentiometry and electro analytical techniques
- To highlight the importance fluorescence spectroscopy

UNIT I : Microscopy Techniques

Principle and Instrumentation of Scanning Electron Microscopy(SEM)– Transmission Electron Microscopy (TEM) —Scanning Transmission Electron Microscopy (STEM)

Scanning probe microscopy – Atomic and Molecular Force Microscopes (AFM and MFM) – Fluorescence Microscopy, single–molecule fluorescence imaging, single molecule FRET (Fluorescence energy transfer) techniques

Unit II : RESONANCE SPECTROSCOPY – I

^1H NMR: Long–range coupling – Homotopic, enantiotopic and diastereotopic systems – Conformationally mobile, open–chain systems – Coupling of proton to fluorine, phosphorus – Nuclear Overhauser effect. ^{13}C NMR: Off resonance decoupling – Coupling of carbon to deuterium, fluorine, phosphorus – DEPT – Application of proton and carbon data in identifying small organic compounds. 2D NMR: Principles of 2D NMR spectroscopy – ^1H – ^1H COSY, ^1H – ^{13}C COSY and HMBC.

Unit III : RESONANCE SPECTROSCOPY – II

Basic concepts of ESR spectroscopy – g tensor– Factors affecting the magnitude of g and A tensors in metal complexes – Anisotropy in g and A values –Zero–field splitting and Kramer’s degeneracy – Applications of EPR to some simple systems like methyl and triphenyl methyl radicals, p–benzosemiquinone, naphthalene and anthracene anions, Cu(II), Fe(II), Mn(II) and Ni(II) complexes – Spin–trapping.

Basic principles of ENDOR spectroscopy and its applications in inorganic Chemistry

UNIT IV : ELECTROANALYTICAL 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.

Unit V : Mass Spectrometry and Fluorescence Spectroscopy

Basic Instrumentation – Resolution, EI, CI and APCI methods – base peak, isotopic peaks, metastable peak, parent peak – determination of molecular formula Techniques in Instrumentation – Soft Ionization Methods – Fast Atom–Ion Bombardment–Electrospray Ionization – Matrix–Assisted Laser Desorption/Ionization – Mass Analyzers – Detectors–Hyphenated techniques: GC–MS, LC–MS and Tandem Mass spectrometry– Applications to biomolecules – Molecular weight Determination – Protein Identification – Protein–Peptide Sequencing – Nucleic Acid Applications.

Emission spectra and excitation spectra, 2D – emission spectra, frequency–domain spectra and time–domain spectra– definition of lifetime of an excited state– multiexponential decays– time–correlated single–photon counting technique to obtain time–domain spectra– micro– nano– pico and femto second transient recordings using laser flash photolysis techniques– various laser sources and light–emitting diodes– Fluorescence quenching and its applications in some biological systems like proteins, membranes and DNA.

References :

Unit I

1. Acc. Chem. Res., July 2005.
2. Bengt Nolfing, 'Methods in Modern Biophysics', Springer, 2004.
3. T. Pradeep, Nano: The Essentials, Mc Graw–Hill Edn, New Delhi, 2007.
4. C.N.R.Rao, A.Muller, AK.Cheetham., The Chemistry of Nanomaterials , John Wiley & Sons, 2004.

Unit II

1. P.M. Silverstein, F.X. Webster, Spectroscopic Identification of Organic Compounds, 6th Ed., Wiley 1998.
2. Jag Mohan, Organic Spectroscopy Principles and Applications, CRC; 2nd Ed., 2004.
3. W. Kemp, Organic Spectroscopy, 3rd Ed., MacMillon, 1994.

4. D.L. Pavia, G.M. Lampman and G.S. Kriz, Introduction to Spectroscopy, Brooks Cole, 3rd Ed., 2000.
5. H. Gunther, NMR Spectroscopy, Basic principles, concepts and application in Chemistry, John Wiley & Sons, 2nd Ed., 1995.

Unit III

1. R. S. Drago, Physical Methods in Chemistry, Saunders, 1977.
2. J. A. Weil, J. R. Bolton and J. E. Wertz, Electron Paramagnetic Resonance: Elementary theory and Practical Applications, John Wiley and sons, 1994.

Unit IV

1. Christopher M.A Brett and Ana Maria Oliveira Brett, "Electroanalysis" Oxford University Press, Oxford, 1998.
2. Daniel C. Harris, "Quantitative Chemical Analysis", Third Edn., W.H. Freeman and Company New York, 1996.
3. A.J. Bard L.F. Faulkner, Electrochemical methods – Fundamentals and Applications, Second Edn., Wiley-VCH, 1998.
4. Journal of Chemical Education, "State of Art Symposium:ElectroChemistry" Vol.60, issue No.4, 1983.
5. J. Janata, "Principles of Chemical Sensor", Plenum Press, New York, 1989.
6. Joseph Wang, "Analytical ElectroChemistry", Second Edn., Wiley-VCH, 2001

Unit V

1. Spectrometric Identification of Organic Compounds, 6th Edition, Robert M. Silverstein and Francis X. Webster, Publisher: John Wiley & Sons, Inc, 1998
2. Theme issue on "Frontiers in Mass Spectrometry", Chemical Reviews 2001, Vol. 101, Issue 2.
3. Bioanalytical Chemistry, S. K. Mikkelsen and Eduardo Corton, Publisher: Wiley-Interscience – John Wiley & Sons, Inc., 2004
4. Joseph R. Lakowicz "Principle of Fluorescence Spectroscopy" Third Edn. Springer, USA,2006

Course outcomes:

- Different analytical tools for the characterization of materials can be very well understood by the scholars.
- The scholars able to predict the concepts and applications of NMR, ESR and mass spectroscopy.
- The scholars will understand the importance of potentiometry and electro analytical techniques.
- The scholars will be able to articulate the importance of fluorescence spectroscopy.

COURSE III

Teaching and Learning Skills

Course Objectives :

- Acquaint different parts of computer system and their functions.
- Understand the operations and use of computers and common Accessories.
- Develop skills of ICT and apply them in teaching learning context and Research.
- Appreciate the role of ICT in teaching, learning and Research.
- Acquire the knowledge of communication skill with special reference to its elements, types, development and styles.
- Understand the terms communication Technology and Computer mediated teaching and develop multimedia /e- content in their respective subject.
- Understand the communication process through the web.
- Acquire the knowledge of Instructional Technology and its Applications.
- Develop different teaching skills for putting the content across to targeted audience.

Unit I : Computer Application Skills

Information and Communication Technology (ICT): Definition, Meaning, Features, Trends – Integration of ICT in teaching and learning – ICT applications: Using word processors, Spread sheets, Power point slides in the classroom – ICT for Research: On-line journals, e-books, Courseware, Tutorials, Technical reports, Theses and Dissertations-- **ICT for Professional Development**: Concept of professional development; institutional efforts for competency building; individual learning for professional development using professional networks, OERs, technology for action research, etc.

Unit II : Communications Skills

Communication: Definitions – Elements of Communication: Sender, Message, Channel, Receiver, Feedback and Noise – Types of Communication: Spoken and Written; Non-verbal communication – Intrapersonal, interpersonal, Group and Mass communication – Barriers to communication: Mechanical, Physical, Linguistic & Cultural – Skills of communication: Listening, Speaking, Reading and Writing – Methods of developing fluency in oral and written communication – Style, Diction and Vocabulary – Classroom communication and dynamics.

Unit III : Pedagogy

Instructional Technology: Definition, Objectives and Types – Difference between Teaching and Instruction – Lecture Technique: Steps, Planning of a Lecture, Delivery of a Lecture – Narration in tune with the nature of different disciplines – Lecture with power point presentation – Versatility of Lecture technique – Demonstration: Characteristics, Principles, planning

Implementation and Evaluation – Teaching-learning Techniques: Team Teaching, Group discussion, Seminar, Workshop, Symposium and Panel Discussion.

Unit IV : E- Learning, Technology Integration and Academic Resources in India

Concept and types of e-learning (synchronous and asynchronous instructional delivery and means), m-learning (mobile apps); blended learning; flipped learning; E-learning tools (like LMS; software's for word processing, making presentations, online editing, etc.); subject specific tools for e-learning; awareness of e-learning standards- Concept of technology integration in teaching- learning processes; frameworks guiding technology integration (like TPACK; SAMR); Technology Integration Matrix- Academic Resources in India: MOOC, NMEICT; NPTEL; e-pathshala; SWAYAM, SWAYAM Prabha, National academic depository, National Digital Library; e-Sodh Sindhu; virtual labs; eYantra, Talk to a teacher, MOODLE, mobile apps, etc.

Unit V : Skills of Teaching and Technology based assessment

Teaching skills: Definition, Meaning and Nature- Types of Teaching Skills: Skill of Set Induction, Skill of Stimulus Variation, Skill of Explaining, Skill of Probing Questions, Skill of Black Board Writing and Skill of Closure – Integration of Teaching Skills – Evaluation of Teaching Skills- **Technology for Assessment:** Concept of assessment and paradigm shift in assessment; role of technology in assessment 'for' learning; tools for self & peer assessment (recording devices; e-rubrics, etc.); online assessment (open source software's; e-portfolio; quiz makers; e- rubrics; survey tools); technology for assessment of collaborative learning like blogs, discussion forums; learning analytics.

References

1. Bela Rani Sharma (2007), Curriculum Reforms and Teaching Methods, Sarup and sons, New Delhi
2. Brandon Hall , E-learning, A research note by Namahn, found in: www.namahn.com/resources/.../note-e-learning.pdf, Retrieved on 05/08/2011
3. Don Skinner (2005), Teacher Training, Edinburgh University Press Ltd., Edinburgh
4. Information and Communication Technology in Education: A Curriculum for schools and programmed of Teacher Development, Jonathan Anderson and Tom Van Weert, UNESCO, 2002.
5. Jereb, E., & Šmitek, B. (2006). Applying multimedia instruction in e-learning. Innovations in Education & Teaching International, 43(1), 15-27.
6. Kumar, K.L. (2008) Educational Technology, New Age International Publishers, New Delhi.
7. Learning Management system : https://en.wikipedia.org/wiki/Learning_management_system , Retrieved on 05/01/2016

8. Mangal, S.K (2002) Essential of Teaching – Learning and Information Technology, Tandon Publications, Ludhiana.
9. Michael,D and William (2000), Integrating Technology into Teaching and Learning: Concepts and Applications, Prentice Hall, New york.
10. Pandey,S.K (2005) Teaching communication, Commonwealth Publishers, New Delhi.
11. Ram Babu,A abd Dandapani,S (2006), Microteaching (Vol.1 & 2), Neelkamal Publications, Hyderabad.
12. Singh,V.K and Sudarshan K.N. (1996), Computer Education, Discovery Publishing Company, New York.
13. Sharma,R.A., (2006) Fundamentals of Educational Technology, Surya Publications,Meerut
14. Vanaja,M and Rajasekar,S (2006), Computer Education, Neelkamal Publications, Hyderabad.

Course Outcomes

After completing the course, the students will:

- Develop skills of ICT and apply them in Teaching Learning context and Research.
- Be able to use ICT for their professional development.
- Leverage OERs for their teaching and research.
- Appreciate the role of ICT in teaching, learning and Research.
- Develop communication skills with special reference to Listening, Speaking, Reading and Writing.
- Learn how to use instructional technology effectively in a classroom.
- Master the preparation and implementation of teaching techniques.
- Develop adequate skills and competencies to organize seminar / conference / workshop / symposium / panel discussion.
- Develop skills in e-learning and technology integration.
- Have the ability to utilize Academic resources in India for their teaching.
- Have the mastery over communication process through the web.
- Develop different teaching skills for putting the content across to targeted audience.
- Have the ability to use technology for assessment in a classroom.
