ETHIRAJ COLLEGE FOR WOMEN

(AUTONOMOUS)

CHENNAI - 600 008

DEPARTMENT OF CHEMISTRY

Syllabus for

M.Phil. CHEMISTRY

CHOICE BASED CREDIT SYSTEM

OUTCOME BASED EDUCATION

(Syllabus effective from the Academic year 2018 -2019)

CONTENTS

ETHIRAJ COLLEGE FOR WOMEN (AUTONOMOUS)

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DEPARTMENT OF CHEMISTRY

MASTER OF PHILOSOPHY IN CHEMISTRY

The M.Phil Chemistry Syllabus offered by the Department of Chemistry with effect from the academic year 2018-2019 is as specified by the Government of Tamil Nadu. The components of the course will seek to build the research and analytical capabilities of the students. The modern methods of teaching and learning with emphasis on student's psychology give special impetus to teaching career. The modified pattern of evaluation of continuous assessment and the rubrics developed for the evaluation of continuous assessment components approved in the Academic Council would be followed from the academic year 2018-2019 onwards.

The duration of the course for full time is one academic year and every academic year is divided into two semester sessions. The duration of the course for Part time is two years. Teaching is organized into a modular pattern of credit courses. Credit is normally related to the number of hours a teacher teaches a particular subject. It is also related to the number of hours a student spends learning a subject and carrying out a project.

REGULATIONS

1. ELIGIBILITY FOR ADMISSION:

Candidates for admission to the Degree of Master of Philosophy in Chemistry course should have passed two year M.Sc degree course in Chemistry after three year B.Sc degree course in Chemistry and Higher Secondary of twelve years duration- Pre-University under eleven year S.S.L.C + one year or 10+2 pattern. The minimum eligibility mark shall be as prescribed in the guidelines for admission to the M.Phil degree in Chemistry by the University of Madras.

2. ELIGIBILITY FOR THE AWARD OF DEGREE:

A candidate shall be eligible for the award of the Degree only if she has undergone the prescribed course of study for a period of not less than one academic year(for full time and two academic years for part time), passed all the examinations as prescribed and earned a total of 36 credits.

3. COURSE OF STUDY:

The main subject of study for M.Phil Degree in Chemistry shall consist of the following.

		No. of Courses	Credits
Core papers	:	2	5+5
Elective paper	:	1	5
Dissertation	:	1	21
		Total Credits	**36**

4. PASSING MINIMUM:

A Candidate shall be declared to have passed in each theory / project of the Core subject of study wherever prescribed, if she secured NOT LESS THAN 50 % of the marks prescribed for the end semester examination and there is no passing minimum for Continuous Assessment (CA).

5. CLASSIFICATION OF SUCCESSFUL CANDIDATES:

Successful candidates passing the examination and securing the marks

(i) 60 % and above and

(ii) 50 % and above but below 60 % in the aggregate shall be declared to have passed the examination in the FIRST CLASS and SECOND CLASS respectively.

Candidates who pass all the examinations prescribed for the course in the FIRST APPEARANCE ITSELF ALONE are eligible for ranking.

6. QUESTION PAPER PATTERN:

Unless and otherwise specified in the syllabus for each paper, the pattern of question paper shall be as follows:

CORE & ELECTIVE COURSE:

COMPONENT	NATURE OF THE QUESTION	MAXIMUM MARKS
One	Descriptions / Application / Analysis / Synthesis	100

5 questions to be answered out of 8 questions covering all the 5 units with the maximum of 4 subdivisions (a,b,c,d). 5Q X 20 = 100 Marks

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

On obtaining a research degree the scholar will be able to:

PEO1 Demonstrate advanced domain knowledge competencies and display high order discerning and synthesizing capabilities to address local, regional and national concerns through innovative well researched solutions.

PEO 2 Continue to serve the community of professionals and experts as both independent and team player with a strong grounding in ethics, inclusivity, gender parity and environmental sustainability.

PROGRAMME OUTCOMES (POs)

On completion of the programme the students will be able to:

PO1: Acquire in depth knowledge in their area of specialization and integrate into the research culture of the department

PO2: Gain expertise and confidence in handling of all analytical tools, interpretation of spectra to characterize materials by using software and theoretical knowledge

PO3: Recognize and integrate life-long learning skills to become pro-active in personal and professional life

PO4: Pursue Ph.D programme in their field of research and enhance leadership and teaching skills

PO5: Apply the scientific knowledge to develop innovative ideas, products and methods for the benefit of biosphere at large

PROGRAMME SPECIFIC OUTCOMES (PSOs)

On completion of the specific programme the student will be able to:

PSO1: Apply knowledge and demonstrate professional skills in their own field of research

PSO2: Demonstrate originality in the application of knowledge, conduction of experimental work and pursue quality research

PSO3: Critically evaluate current research, research techniques, methodologies and design energy efficient & green experiments, scale up processes which have immense application to common man

PSO4: Develop confidence and self-direction in tackling and solving problems, critical thinking and act independently in the planning and implementation of research

PSO5: Use innovative and ICT enabled teaching methodology , communicate clearly and effectively, publish their research findings in peer reviewed journals and present research findings in international/ national forums

M.Phil. CHEMISTRY

(Syllabus effective from the academic year 2018-2019)

1. OBJECTIVES OF THE COURSE:

(i) The syllabus of the M.Phil course is designed in such a way that the student would have a thorough knowledge on the advancements in chemistry and also expose herself to research.

(ii) To enable the students to acquire teaching skills, to plan the experimental projects and execute them.

(iii) All the topics in the NET/SLET syllabus for chemistry are incorporated as passing the NET/SLET is a pre-requisite for UGC/CSIR Research Fellowship, an added qualification for many research positions and qualification for recruitment of college teachers.

(iv) After completion of the course with a M.Phil degree in Chemistry, career opportunities are available in the following areas.

(a) Take up a teaching job at a college for science and engineering courses.

(b) Take up a job in a scientific laboratory and R&D institution.

(c) Pursue a research career in an academic institution or a National Institute/Laboratory.

2. PREAMBLE:

- To retain the course contents of courses based on feedback.
- To retain the modern teaching and learning methods.
- Project work based on current topics.

3. COURSE PROFILE:

COURSE	COURSE CONTENT	CREDITS	COURSE CODE
1	Core 1 -Scientific Research Methodology	5	6M18/SRM
2	Core 2- Instrumental Methods of Analysis	5	6M18/IMA
3	Elective – Internal Paper	5	6M18/INT
4	Core 3 - Dissertation	21	6M18/PRO
	Total	**36**	

4. EVALUATION PATTERN:

Theory

CA Marks	:	40
End Semester Examination Marks	:	60
Total Marks	:	100

Theory: Continuous Assessment (CA)

Pattern for Continuous Assessment

			CA
Test I	2 hrs.	50 marks	10 marks
II	2 hrs.	50 marks	10 marks
Seminar			20 marks

		Total	**40 marks**

CA Question Paper Pattern - M. Phil.

Knowledge level	Section	Word Limit	Marks	Total
K5,K6	A – 5/8 x 10 Marks	1500	50	50

End Semester Examination (ESE)

End Semester Examination question papers for cores are to be set by the External Examiner and evaluated by both Internal and External Examiners.

Elective syllabus and question paper is set and evaluated by Internal Examiner (Guide).

Duration of examination is 3 hours and Maximum mark is 100.

Rubrics for Seminar: Organization/ Subject knowledge /Visual aids/ Confidence level/ Presentation

DISSERTATION & VIVA-VOCE:

CA Marks	:	50
End Semester Examination Marks	:	150
Total Marks	:	200

External Examination	**MARKS**
Final Report and Presentation (Guide and External)	100
Viva-Voce (Guide and External)	50
Total	**150**

	MARKS
Project work and presentation (Guide)	40
Viva- Voce (Guide)	10
Total	**50**

Title of the Course: Core 1-Scientific Research Methodology

Teaching hours: 15 x 4 = 60 Hrs **Credits: 5**

Course Code: 6M18/SRM

Objectives:

1. To impart knowledge to do literature survey
2. To learn the experimental techniques for research work
3. To analyze and interpret research data using statistical Techniques
4. To impart knowledge in conventions of thesis and assignment writing
5. To introduce modern teaching methodologies

COURSE OUTLINE:

UNIT I: **Introduction to Research:** Importance of research- Aims, objectives, Selection of research problems-Survey of scientific literature-Primary and secondary sources. Funding agencies **12 hrs**

UNIT II: **Conduct of Research Work**: Physical properties useful in analysis and method of separation prior to analysis-Isolation techniques-Extraction, crystallization, sublimation, distillation, - High vacuum distillation techniques - cyclic distillation, analytical distillation, thermal hazards of these techniques- chromatography-column, paper , thin layer, gas chromatography - reaction techniques to include high dilution, vacuum line reaction, reactions aided by azeotropic distillation, recycling, pyrolysis, Soxhlet extraction, continuous reactions, reactions at low temperatures, reactions in non aqueous media and molten salts, micro quantity handling and use of globe box . Special methods in modern chemistry-methods for vaccum sublimation and quasi sublimation, technique and apparatus for reactions in inert atmosphere and at under low temperature, working with compressed gases, heating under pressure, chemistry of working with hazardous materials- air / water sensitive, corrosive, toxic explosive and radioactive materials. **12 hrs**

UNIT III: **Statistical treatment of Analytical Results**: Precision and Accuracy-Reliability-Determinate and random errors-Distribution of random errors-Normal distribution curve. Statistical treatment of finite samples - the student's T test and F test-criteria for rejection of an observation Q test. Significant figures and computation rules. Data plotting - Least square analysis-significance of correlation coefficient. **12 hrs**

UNIT IV: **Thesis writing**: Conventions of writing - General format-page and chapter format-use of quotations and foot notes-preparation of tables and figures-referencing-appendices-revising, editing and evaluating the final material-proof reading-meanings and examples of commonly used abbreviations .Plagiarism ,importance control and checking of Plagiarism through software tools **12 hrs**

UNIT V: **Modern Teaching methodology**: Methods of teaching chemistry: Inductive, deductive, analytic, synthetic, heuristic, project problem solving and lab methods.

Chemistry Curriculum:

i. Organization-logical psychological, topical, spiral and integrated approaches-correlating with life, nature, other disciplines and different branches in chemistry.
ii. Individualized techniques-homework assignments, programmed instruction and computer aided instruction (CAI), Group methods-Seminar, Symposium, and Workshop.

Working style in teaching and learning-giving and getting feedback, relationship of learning to education-liberal, progressive and humanistic. Learning resources and equipment - Textbook, workbook, library, audio-visual aids, mass media, chemistry club activities. **12 hrs**

REFERENCE BOOKS:

1. Advanced organic chemistry: Reactions, Mechanism and structure, J. March, McGraw – Hill International Student edition, 1977.
2. Instrumental methods of chemical analysis (4^{th} edition), G.W. Ewing, McGraw–Hill International Student edition, 1975.
3. Quantitative Analysis (3^{rd} edition), R.A. Jr. and A.L. Underwood, Prentice – Hall of India Pvt. Ltd. (1977).
4. Techniques of Organic Chemistry, Ed. A. Weissberger (series of volumes) Wiley – Intersciences.
5. Statistical Analysis in Chemistry and Chemical Industry, C.A Bennett and N.L.Franklin, John Wiley (1954).
6. Correlation Analysis in organic chemistry - An introduction to linear free energy relationships, J. Shorter, Olarendon Press. Oxford (1973), [Oxford chemistry series 11].
7. Thesis and Assignment writing, J. Anderson, B.H. Durston and M.Poole, Wiley Eastern Ltd (1970).
8. Tactist – Rosemary Napper and Trudy Newton, TA resources, U.K 2003

PERIODICALS:

1. Resonance- Journal of science education
2. Span
3. Indian academy of sciences-proceedings- Chemical Sciences
4. Current Science
5. Journal of Indian chemical education
6. Journal of American chemical society
7. Bulletin of material science

WEBSITES & e-LEARNING SOURCES:

1. http://smallseotools .com/Plagirism- checker
2. http://www.plagtracker.com/
3. mooc.org
4. http://nptel.ac.in
5. http:/swayam.gov.in

COURSE OUTCOMES

On completion of the course the student will be able to:

CO No.	CO Statement
CO 1	Utilize basic concepts of research and its methodology, perform literature survey, select and define appropriate research problem
CO 2	Demonstrate knowledge on various methods of separation and chemistry of hazardous materials
CO 3	Formulate and appreciate the terms precision and accuracy, interpret statistical tests and random errors
CO 4	Write research report - thesis and check for plagiarism using software
CO 5	Apply modern teaching methodology which is learner – centric and activity based. Develop skills in e-learning and technology integration

Mapping : Course Outcomes with Programme Specific Outcomes

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	3	1
CO2	3	1	3	3	1
CO3	3	1	2	2	1
CO4	3	3	1	2	1
CO5	1	2	1	1	3
Average	**2.6**	**2**	**1.6**	**2.2**	**1.4**

KEY : Strongly correlated – 3 Moderately correlated -2 Weakly correlated -1 No Correlation – 0

Teaching Methodology : Lecture (Chalk & Talk) ,Seminar

ESE Question Paper Pattern - M. Phil.

Knowledge level	Section	Word Limit	Marks	Total
K5,K6	A – 5/8 x 20 Marks	1500	100	100

Title of the Course: Core 2- Instrumental Methods of Analysis

Teaching hours: 60 Hrs **Credits: 5**

Course Code: 6M18/IMA

Objectives:

1. To understand the principle and applications of optical, magnetic and mass spectroscopy
2. To learn to interpret the above spectral data
3. To know the significance of Thermo and Electro analytical methods in research
4. To study the surface morphology techniques.
5. To apply the techniques to organic and inorganic systems.

COURSE OUTLINE

UNIT I: Spectroscopy: Optical Spectroscopy: UV, Visible and IR Spectroscopy with reference to radiation source , Optical materials, monochromators and detectors-principles of design of single beam and double beam spectrophotometers-application of optical spectroscopy in qualitative and quantitative analysis. **12 hrs**

UNIT II: Magnetic Resonance Spectroscopy: Nuclear magnetic and electron magnetic resonance spectroscopy-Basic features of the NMR and EPR spectrometers. NMR: chemical shift, spin-spin coupling, double resonance, NMR shift reagents-Applications of NMR spectroscopy in qualitative and quantitative analysis-wide line and FT NMR, C^{13} NMR. EPR: Hyper fine splitting-g value – factors affecting the magnitude of g value – zero field splitting. EPR spectra of organic radicals and transition metal complexes**.** **12 hrs**

UNIT III: Mass Spectroscopy: Mass spectrometer instrumentation – The ion sources, mass analyzers, detectors and vacuum system data processing and sample handling-applications of mass spectrometry in qualitative and quantitative analysis, EI, ESI, FAB. Photo electron spectroscopy: X ray photo electron Spectroscopy (XPS) and UV photoelectron spectroscopy (UPS) Instrumentation: radiation sources energy analyzers and detectors-use of XPS and UPS as analytical tools. **12 hrs**

UNIT IV: Thermoelectric Methods: Thermogravimetric analysis (TGA) Thermobalances-derivative thermogravimetric analysis (DTG) – Differential Thermal Analysis (DTA) The DTA apparatus-Scanning calorimetric DTA, Thermometric titrations. Potentiometry: Ion selective membrane electrode ,the glass electrode, liquid membrane electrodes, double membrane electrodes, solid state membrane electrodes and reference electrodes, constant potential titration. **12 hrs**

UNIT V: Surface Study: Principle, theory, working and Applications: Scanning electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Field Emission Scanning Electron Microscopy (FESEM), High Resolution Transmission Electron Microscopy (HRTEM), Selected Area Electron Diffraction (SAED), Atomic Force Microscopy, X-ray Diffraction, Dynamic light Scattering, Surface Enhanced Raman Spectroscopy (SERS). **12 hrs**

REFERENCE BOOKS:

1. Instrumental methods of analysis (5th edition) H.H. Willard, L.L Merrit- Jr.. and J.A. Dean affiliated east west press (1974).
2. Instrumental methods of chemical analysis (4th edition), G. W. Ewing, MC Graw – Hill International students edition (1975).
3. Chemical instrumentation: A systematic approach to instrumental analysis, H.A. Strobel, Addison – Wesley publishing Co., Inc (1960).
4. Principles of Instrumental Analysis (2nd edition) D.M. Skoog and D.M.West, Holt-Saunders, Japan (1980).
5. Physical methods in chemistry, R.S. Drago.
6. Physical Principles of Electron Microscopy, R.F. Egerton.

PERIODICALS:

1. Resonance- Journal of science education
2. Span
3. Indian academy of sciences-proceedings- Chemical Sciences
4. Current Science
5. Journal of Indian chemical education
6. Journal of American chemical society
7. Bulletin of material science

WEBSITES & e-LEARNING SOURCES:

1. www.virtlab.com
2. mooc.org
3. http://nptel.ac.in
4. http:/swayam.gov.in

COURSE OUTCOMES

On completion of the course the student will be able to:

CO No.	CO Statement
CO 1	Demonstrate an understanding on the instrumentation and application of optical spectroscopy in qualitative and quantitative analysis
CO 2	Revise and interpret NMR spectra of higher order 2D and analyse the EPR spectrum and correlate with antioxidant properties.
CO 3	Formulate knowledge in instrumentation and applications of Mass Spectrometer, X-PES and UV spectrophotometer
CO 4	Explain the principle of thermo analytical techniques like TGA & DTA and Electro analytical technique like Potentiometry
CO 5	Utilize advanced knowledge pertaining to principle, theory, working and applications of various characterisation techniques

Mapping : Course Outcomes with Programme Specific Outcomes

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	2	3
CO2	3	3	2	3	3
CO3	3	3	2	3	3
CO4	3	3	2	2	3
CO5	3	3	2	3	3
Average	**3**	**3**	**2**	**2.6**	**3**

KEY : Strongly correlated – 3 Moderately correlated -2 Weakly correlated -1 No Correlation – 0

Teaching Methodology: Lecture (Chalk & Talk) , Seminar

ESE Question Paper Pattern - M. Phil.

Knowledge level	Section	Word Limit	Marks	Total
K5,K6	A – 5/8 x 20 Marks	1500	100	100

Title of the Course: Core 3- Dissertation

Teaching hours: 60 Hrs **Credits: 5**

Course Code: 6M18/PRO

COURSE OUTCOMES

On completion of the course the student will be able to:

CO No.	CO Statement
CO 1	Identify a research problem and demonstrate appropriate research methodologies to execute the project
CO 2	Plan and perform the experiments associated with the research problem
CO 3	Analyse and interpret research findings in a scientific manner
CO 4	Demonstrate an understanding of the ethical issues associated with research problem.
CO 5	Apply research skills to work independently in an effective manner, setting and meeting deadlines, communicate confidently and constructively the research findings and defend their research work to a panel of experts

Mapping : Course Outcomes with Programme Specific Outcomes

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Average	3	3	3	3	3

KEY : Strongly correlated – 3 Moderately correlated -2 Weakly correlated -1 No Correlation – 0

Teaching Methodology: Dissertation writing, Seminar

ETHIRAJ COLLEGE FOR WOMEN [Autonomous]

CHENNAI- 08

END SEMESTER EXAMINATION

M.Phil. Chemistry

TEMPLATE OF THE QUESTION PAPER

ANSWER ANY FIVE QUESTIONS OUT OF EIGHT (5 x 20 = 100)

Eight questions to be given with a maximum of 4 subdivisions (a,b,c,d), giving equal weightage to all the 5 units in the syllabus for the following papers

Scientific Research Methodology **6M18/SRM**

Instrumental Methods of analysis **6M18/IMA**

Elective – Internal paper **6M18/INT**

Template of the question papers:

COMPONENT	NATURE OF THE QUESTION	MAXIMUM MARKS
One	Descriptions / Application / Analysis / Synthesis	100

ESE Question Paper Pattern - M.Phil

Knowledge level	Section	Word Limit	Marks	Total
K5,K6	A – 5/8 x 20 Marks	1500	100	100