

GOVERNMENT ARTS COLLEGE (AUTONOMOUS), KUMBAKONAM.
Course Structure under CBCS for M.Phil., students (2020-2021 onwards)
M.Phil., Programme

SEM	COURSE	CREDIT	EXAM HOURS	MARKS		TOTAL
				Int	Ext	
I	Paper I – RESEARCH METHODOLOGY AND LABORATORY TECHNIQUES	4	3	25	75	100
	Paper II – PHYSICAL METHODS IN CHEMISTRY	4	3	25	75	100
	Paper III – TEACHING, COMMUNICATION AND ANALYTICAL SKILL	4	3	25	75	100
	Paper IV – (Guide Paper)	4	3	25	75	100
	Total	16	-	-	-	400
II	Dissertation	8	-	50	150	200
Net Total		24	-	-	-	600

M.Phil., Course Structure

Papers	-	4
Dissertation	-	1
Total	-	<u>5 Papers</u>

Question Paper Pattern:

Section A : 10 x 20 = 20

Section B : 5 x 5 = 25

Section C : 3 x 10 = 30

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Title of the Subject: PAPER – I: RESEARCH METHODOLOGY AND LABORATORY TECHNIQUES

Credits: 4

UNIT – I: Principles of Research and Literature Search Techniques

Observation, inference, hypothesis generation, testing of hypothesis, evolution of rules, theories and modification of theories and rules.

IUPAC rules for nomenclature - Introduction to Chemical Abstracts – Subject Index, Substance Index, Author Index, Formula Index and other Indices – Uses of these indices with examples – Current Contents – organization – methods of using the titles and index – Other similar abstracts for special topics such as photochemical and electrochemical synthesis. Use of Computer browsing for literature search and downloading basics of Internet services – various sources of abstract, articles and papers for browsing and downloading, Techniques of conversion from one format to another. Structure drawing programs and their uses – searches through structures.

UNIT – II: Documentation Techniques & Report Writing

Reports of research work: laboratory observation – records, manuscript preparation – formats for Indian Journal of Chemistry - Journal of Indian Chemical Society, Current Science as examples, formats for Journal of American Chemical Society, Journal of the Chemical Society (British), Tetrahedron and polyhedron as examples.

Document preparation using computers. Use of Microsoft Word, Word perfect and other packages for document preparation and formatting - knowledge about TXT, DOC, PDF, PS, HTML formats. Types of report – title and abstract – the text – writing the thesis.

UNIT – III: Error Analysis in Chemical Measurements and Results

Various types of errors – Precision and accuracy – significant figures, various statistical tests on the accuracy of results, positive and negative deviation from accurate results – the binomial distribution, the Gaussian distribution – the normal distribution of random errors, mean value, variance and standard deviation, reliability interval, deviations from the Gaussian law of error distribution, Student's t-distribution, and t-tests – comparison of the mean with the expected value, comparison of the results of two different methods, comparison of the precision of two methods by F-test, Gross errors and elimination of outlying results, graphical methods – Linear regression, regression line, standard deviation, correlation coefficient – Multiple Linear regression (one variable with two other variables).

UNIT – IV: Reagents for Reduction and Oxidation Reactions

Catalytic hydrogenation and dehydrogenation, reduction with NaH, LAH, NaBH₄, tritertiarybutoxy aluminium hydride, NaCNBH₃, trialkyl tinhydride, SiMe₃, reductions involving dissolved alkali metals; reductions with hydrazines - Osmium tetroxide, Chromyl chloride, Ozone, Periodic acid, Fremy salt, DD₂, Dioxirane, Lead tetra acetate and Selenium dioxide.

UNIT – V: Chromatography

Solvent extraction – ion exchange, paper, thin layer and column chromatography – Gas Chromatography techniques – columns, methods, McReynold's constants and their uses – HPLC techniques: Columns, detection methods, estimations, preparative column – GC-MS techniques. Methods – Principles – uses – Other separation techniques (questions need not appear on these techniques).

References

1. Jerry March, "Advanced Organic Chemistry: Reactions, Mechanisms And Structure", 5th ed., Wiley, 1996.
2. K. Eckschlager, "Errors, Measurement and Results in Chemical Analysis", Van Nostrand Reinhold Company, London, Chapters 1, 4 and 5.
3. R.E.Ireland, "Organic Synthesis", Prentice Hall (415).
4. R.K. Mackie and D.M. Smith, "Guide Book to Organic Synthesis", ELBS, 1982.
5. Stock & Rice, "Chromatography".

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Title of the Subject: PAPER – II: PHYSICAL METHODS IN CHEMISTRY
Credits: 4

UNIT – I

Infrared and Raman Spectroscopy

Vibrations in simple molecules (H_2O , CO_2) and their symmetry notation - Group vibrations and the limitations – Applications of Raman Spectroscopy – combined uses of IR and Raman Spectroscopy in the structural elucidation of simple molecules like N_2O , ClF_3 , NO_3^- , ClO_4^- – effect of coordination on ligand vibrations – uses of group vibrations in the structural elucidation of metal complexes of urea, thiourea, cyanide, thiocyanate, nitrate, sulphate and dimethyl sulfoxide – Effect of isotopic substitution on the vibrational spectra of molecules – vibrational spectra of metal carbonyls with reference to the nature of bonding, geometry and number of C-O stretching vibrations (group theoretical treatment) – Applications of Raman Spectroscopy.

UNIT – II

NMR Spectroscopy: Principles and Methods

Definition of nuclear angular momentum and the nuclear magnetic moment: Idea about the rotating axis system, Bloch equations, the quantum mechanical description of the NMR experiment, transition probabilities, Relaxation effects, Fourier transform NMR – measurement of T_1 and T_2 . Effect of quadrupolar nuclei evaluation of thermodynamic and kinetic data using NMR techniques, second order spectra – Quantum mechanical treatment of coupling, effects of relative magnitudes of J on the spectrum of an AB molecule, Double resonance experience. Spectral simplification and determination of signs of coupling constants.

Examples for different spin systems – chemical shifts and coupling constants (Spin-spin coupling) involving different nuclei (^1H , ^{19}F , ^{31}P , ^{13}C) interpretation and applications to inorganic compounds – Effect of quadrupolar nuclei (^2H , ^{10}B , ^{11}B) on the ^1H NMR spectra satellite spectra.

Systems with chemical exchange – evaluation of thermodynamic parameters in simple systems – study of fluxional behavior of molecules – an elementary treatment of second order spectra – examples – NMR of paramagnetic molecules – isotropic shifts contact and pseudo-contact interactions - Lanthanide shift reagents. Characteristics of quadrupolar nucleus – effects of field gradient and magnetic field upon quadrupolar energy levels – NMR transitions – applications.

^{13}C NMR spectroscopy. Basic theory of FT-NMR Relaxation – Broad band decoupling. Off resonance decoupling and chemical shift correlations (CH , CH_2 , CH_3 , $=\text{CH}_2$, $=\text{C}$, aromatic).

UNIT – III

EPR spectroscopy

Factors affecting the magnitudes of g and A tensors in metal species – Zero field splitting and Kramers degeneracy – spectra of VO(II), Mn(II), Fe(II), Co(II), Ni(II) and Cu(II) complexes – applications of EPR to a few biological molecules containing Cu(II), Fe(II) and Fe(III) ions – spin densities and McConnell relationship – Applications of EPR to some simple systems such as benzo semiquinone, Xe^{2+} .

Mass Spectrometry – instrumentation – resolution, EI and CI methods – base peak, isotopic peaks, metastable peak, parent peak, determination and use of molecular formula, recognition of molecular ion peak – FAB. Fragmentation – general rules – pattern of fragmentation for various classes of compounds, McLafferty rearrangement, Importance of metastable peaks.

UNIT – IV

Mossbauer Spectroscopy

Isomer shifts – Magnetic interactions – Mossbauer emission spectroscopy – applications to iron and tin compounds.

Photoelectron Spectroscopy

Principles – Auger electron spectroscopy – electron spectra in chemical analysis.

UNIT – V

Diffraction Methods

Crystal symmetry – combination of symmetry elements – crystal classes – screw axis and glide planes – space group – crystal axes – crystal systems, unit cell, Bravais lattices, asymmetric unit – space group – Equivalent positions – Relationship between molecular symmetry and crystallographic symmetry – basic, concepts and examples. The concept of reciprocal lattice and its applications – X-ray diffraction by single crystals – structure factor – determination of space group by symmetric – phase problem in structure analysis – heavy atom method – Fourier synthesis – refinement of structure.

Neutron diffraction – magnetic scattering – applications and comparison with X-ray diffraction. Electron diffraction – basic principles and applications to simple molecules - XeF_6 , $\text{Be}(\text{BH}_4)_2$, ferrocene, $\text{Cr}(\text{II})$ acetate.

References

1. R.S. Drago, "Physical Methods in Chemistry", W.B. Sanders Company, Philadelphia, London.
2. C.N. Banwell, "Fundamentals of Molecular Spectroscopy", 3rd ed., McGraw Hill, 1983, New Delhi.
3. G.H. Stout and L.H. Jenson, "X-ray Structure Determination – a Practical Guide".
4. T.C. Gibbs, "Principles of Mossbauer Spectroscopy", Chapman and Hall, London, 1976.

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Title of the Subject: PAPER – III: TEACHING, COMMUNICATION SKILLS
AND ANALYTICAL SKILLS

Credits: 4

UNIT – I: Teaching Methodology:

Teaching competence: Objectives-Teaching Competence and Skills: Meaning and nature- Classification of skills- Training in teaching skills-Training strategies and Micro teachings. Skills associated with teachers-Controlled instinct-Questioning skills-Probing skills-Skill of explaining-Skill of stimulus variation-Skill of reinforcement.

UNIT – II: Communication skills and Writing skills:

Paragraph writing -Report writing-Subject-Verb agreement-Public speaking-Group discussion- Interview-Synonyms and Antonyms.

UNIT – III: Basic Computer Knowledge and C Programming:

Introduction to Computer. Introduction to C, Constants, variables, functions: logical and arithmetic statements – transfer and control structures – arrays. Introduction to pointers. File handling procedures with examples (other components, that are required for the discussion should be included in the lectures but questions need not appear on those topics that are not listed).

UNIT – IV Flame photometry, Colourimetry, Nephelometry and Turbidometry:

Instrumentation, application – analyzing water, glasses, biological fluids and metallurgical products – interferences – chemical and spectral.

Lambert's law, Beer's law and Beer-Lambert law – deviations from Beer's law – factors responsible for the same – photoelectric colourimeter (schematic diagram) – criteria for satisfactory colourimetric analysis – determination of Fe and Ni – determination of composition of complexes by Job's method of continuous variation and mole ratio method.

Similarities and differences between the two – choice between nephelometry and turbidometry – theory – reflection Vs scattering – factors affecting the measurements – instruments for nephelometry and turbidometry (schematic diagram) – determination of sulphate and phosphate – applications in organic, inorganic, biochemical and pollution analysis – turbidometric titrations – determination of molecular mass of high polymers.

UNIT – V: Thermal methods

Thermo gravimetric analysis, differential thermal analysis and differential scanning colourimetry – thermal analysis of silver nitrate, cupric nitrate, silver chromate, mercurous chromate, calcium oxalate monohydrate, magnesium oxalate etc. – methods of obtaining the thermograms – derivative thermo gravimetry – DTG curve of $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ – factors affecting thermograms – schematic diagram of TGA unit – applications – analysis of binary mixtures – DTA and DSC – instrumentation (schematic diagram) – DTA curves for calcium oxalate monohydrate and calcium acetate monohydrate – thermometric titrations.

References

1. G. Christian, "Analytical Chemistry", John Wiley, 5th ed., 1994.
2. Principles of Instrumental Analysis 5/e, D.A.Skoog, F.J.Holler, T.A.Nieman, Thomson Asia Pvt. Ltd., Singapore.
3. Instrumental Method of Analysis 7/e, H.H.Willard, L.L.Merritt, J.A.Dean, F.A.Settle, CBS Publishers and Distributors, New Delhi.
4. G.H. Stout and L.H. Jenson, "X-ray Structure Determination – a Practical Guide".
5. Kulkarni, SS. 1986. Introduction to educational technology,. IBH publishing Co. New Delhi.
6. K.V. Raman, "Computers in Chemistry", Tata McGraw Hill, New Delhi, 1993.
7. V.Saraswathi and Maya K.Mudbhatkal, "English for competitive examinations" Emerald Publishers, Chennai, 2009.
8. DassR.C.,Passi B.K.& Singh L.C (1975): Effectiveness of Micro-Teaching in Training of Teachers, NCERT, New Delhi.