M.Sc. CHEMISTRY CBCS PATTERN IN SEMESTER SYSTEM

DEPARTMENT OF CHEMISTRY

KAKATIYA UNIVERSITY WARANGAL – 506 009

Department of Chemistry, Kakatiya University introduces Choice Based Credit System (CBCS) for M.Sc. (2 Year course) chemistry for the students admitted in M.Sc. Chemistry course from 2016-17 academic year onwards.

Scheme for CBCS, the workload for each paper, distribution of marks, the number of credits and scheme of examination are attached herewith.

Internal Assessment examination will be conducted twice in every Semester. The main examination (theory and practical) will be conducted at the end of each semester.

One open elective in III semester and one is in IV semester are offered by Department of Chemistry for all the PG-students.

Students joined in M.Sc. Chemistry should choose one open elective offered by Department of chemistry or any other Department of Kakatiya University.

The syllabi of theory and practical papers of I, II III, and IV semesters are enclosed. The syllabi of open elective offered in IV semester will be kept available for the next academic year.

– Prof. Gade Dayakar
Chairperson
Board of Studies in Chemistry

DEPARTMENT OF CHEMISTRY - KAKATIYA UNIVERSITY

[with effect from the academic year 2016-17 Under CBCS system]

Semester –I

Curriculum						Scheme of Examination		
S. No	Paper Code	Paper no.	Title of the paper	Instruction Hrs/ Week	No. of Credits	Marks		Total marks
						External	Internal	
1	ICHT1	Paper-I	Inorganic Chemistry	4	4	80	20	100
2	ICHT2	Paper-II	Organic Chemistry	4	4	80	20	100
3	ICHT3	Paper-III	Physical Chemistry	4	4	80	20	100
4	ICHT4	Paper- IV	Applied Chemistry	4	4	80	20	100
5	1CHP1	Paper-V	Inorganic Practicals	6	3	75	----	75
6	1CHP2	Paper-VI	Organic Practicals	6	3	75	----	75
7	ICHP3	Paper-VII	Physical Practicals	6	3	75	----	75
8	----	----	Seminar	----	1	----	----	25
	Total	----	----	34	26	----	----	650

Semester –II

Curriculum						Scheme of Examination		
S. No	Paper Code	Paper no.	Title of the paper	Instruction Hrs/ Week	No. of Credits	Marks		Total marks
						External	Internal	
1	2CHT5	Paper-I	Inorganic Chemistry	4	4	80	20	100
2	2CHT6	Paper-II	Organic Chemistry	4	4	80	20	100
3	2CHT7	Paper-III	Physical Chemistry	4	4	80	20	100
4	2CHT8	Paper- IV	Spectroscopy	4	4	80	20	100
5	2CHP4	Paper-V	Inorganic Practicals	6	3	75	----	75
6	2CHP5	Paper-VI	Organic Practicals	6	3	75	----	75
7	2CHP6	Paoer-VII	Physical Practicals	6	3	75	----	75
8	----	----	Seminar	----	1	----	----	25
	Total	----	----	34	26	----	----	650

Dean

Prof. Gade Dayakar, Chairperson, BOS in Chemistry, KU,

IV Semester-Organic chemistry

Curriculum						Scheme of Examination		
S. No	Paper Code	Paper no.	Title of the paper	Instruction Hrs/ Week	No. of Credits	Marks		Total marks
						External	Internal	
1	4CHT17	Paper-I	Analytical and Physical Chemistry	4	4	80	20	100
2	4CHT18	Paper-II	Synthetic Organic Chemistry-II	4	4	80	20	100
3	4CHT21	Paper-III	General Organic Chemistry-II	4	4	80	20	100
4	4CHT22A / 4CHT22B	Paper- IVA / Paper- IVB	Natural products (Elective-I) / Medicinal chemistry (Elective-II)	4	4	80	20	100
5	4CHP15	Paper-V	Estimations and Principles of chromatography	9	4	100	----	100
6	4CHP16	Paper-VI	Isolation and purification of natural products and Advanced organic preparations					
7	4CHOE	Paper-VII	Open elective	4	4	80	20	100
		Seminar		----	1	25	----	25
	Total			38	29			725

IV Semester- Physical chemistry

Curriculum						Scheme of Examination		
S. No	Paper Code	Paper no.	Title of the paper	Instruction Hrs/ Week	No. of Credits	Marks		Total marks
						External	Internal	
1	4CHT17	Paper-I	Analytical and Physical Chemistry	4	4	80	20	100
2	4CHT18	Paper-II	Synthetic Organic Chemistry-II	4	4	80	20	100
3	4CHT23	Paper-III	Catalysis	4	4	80	20	100
4	4CHT24A / 4CHT24B	Paper- IVA / Paper- IVB	Nanomaterials, Macromolecules and Data analysis (Elective-I) / Supramolecular, Material Sciences, Lasers and Computational Chemistry (Elective-II)	4	4	80	20	100
	4CHP17	Paper-V	Practicals -Kinetics	9	4	100	----	100
7	4CHP16	Paper-VI	Practicals-Instrumentation	9	4	100		100
8	4CHOE	Paper-VII	Open elective	4	4	80	20	100
		Seminar		----	1	25	----	25
	Total			38	29			725

Dean Prof. Gade Dayakar, Chairperson, BOS in Chemistry, KU,

Paper – V INORGANIC CHEMISTRY - PRACTICALS (1CHP1)

(6 Hours per week)

1. a) Determination of total, permanent and temporary hardness of water
   b) Determination of COD of water
   c) Back titration of Ni^{+2} by EDTA
   d) Back titration of Al^{+3} by EDTA
   e) Substitution titration of Ca^{+2} by EDTA
2. One component gravimetric estimations
   i) Estimation of Zn^{2+}
   ii) Estimation of Ba^{2+} (as $BaSO_4$)
3. Preparation of the following complexes and their characterization by metal estimation and conductance measurement
   i) $[Cu(NH_3)_4]SO_4$ ii) $Hg[Co(SCN)_4]$ iii) $K_3[Fe(C_2O_4)_3]$
   iv) $[Ni(en)_3]S_2O_3$ v) $[Co(NH_3)_5Cl]Cl_2$ vi) $[Mn(acac)_3]$

Scheme of valuation

Marks: 75 Time: 4Hrs

Standardization	– 18
Estimation of sample	– 30
Preparation of sample	– 12
Viva, Record and samples	– 15

Recommended Books:

1. Vogel's Text Book of quantitative chemical analysis (6^{th} edition)
2. Analytical chemistry- Gary D. Christian (6^{th} edition)

PAPER- VI: ORGANIC CHEMISTRY - PRACTICALS (1CHP2)

(6 Hours per week)

I. **Some important techniques in practical organic chemistry**: Recrystallization, mixed melting point, drying of solvents and steam distillation.

II. Preparation of

i) Methyl orange ii) Coumarin

iii) Pyrazolone iv)Azalactone

III. Preparation of

i) Benzanilide by Beckmann's rearrangement:

(a) Preparation of benzophenone oxime

(b) Beckmann's rearrangement to benzanilide

ii) Benzilic acid from benzoin:

(a) Benzil from benzoin

(b) Benzilic acid from benzil

iii) Anthranilic acid from phthalic anhydride:

(a) Phthalimide from Phthalic anhydride

(b) Hoffmann's rearrangement to anthranilic acid

iv) m-Nitroaniline from Nitrobenzene:

(a) m-Dinitrobenzene from Nitrobenzene

(b) m-Nitroaniline from m-Dinitrobenzene

Scheme of valuation

Marks: 75 Time: 4Hrs

Single step preparation and Recrystallization	–	20
Two step preparation and Recrystallization	–	40
Viva, Record and Samples	–	15

Recommended books:

1) Vogel's textbook of practical organic chemistry – Arthur Israel Vogel, B. S. Furniss
2) Practical Organic Chemistry – Frederick George Mann and Bernard Charles Saunders
3) Advanced Practical Organic Chemistry – N K Vishnoi
4) Laboratory Manual of Organic Chemistry - R. K. Bansal

Paper – VII PHYSICAL CHEMISTRY PRACTICALS (1CHP3)

(6 Hours per week)

1. Kinetics:

(i) Acid catalyzed Acetone – Iodine reaction.
(Comparison of rate constants at different acid concentrations)

(ii) Acid catalyzed hydrolysis of methyl acetate.
(Comparison of rate constants at different acid concentrations)

(iii) Persulphate – Iodide reaction.
(Comparison of rate constants at different iodide concentrations)

2. Polarimetry:

(i) Specific rotation of sucrose and glucose.

(ii) Acid catalysed inversion of sucrose-Pseudo first order rate constants.
(Comparison of rate constants at different acid concentrations)

3. Conductometry: Titrations of

a. (i) Strong acid and weak acid with Strong base.
(ii) Mixture of strong and weak acids with Strong base.
(iii) Strong acid and weak acid with Weak base.
(iv) Salt with Strong base.

b. Verification of Ostwald's dilution law and determination of Ka.

c. Solubility product of AgCl.

4. a. Density and viscosity of liquids.

b. Determination of molecular weights of polyethylene glycol or polyvinyl alcohol.

5. Determination of heat of solution of benzoic acid by solubility method.

Scheme of valuation

Marks: 75 Time: 4Hrs

Experiments (2)	30 + 30	60
Principle record and viva	–	15

Recommended books:

1. Practical Physical Chemistry by A. Findlay, Longman-London.
2. Practical Physical Chemistry by B. Vishwanathan and P.S. Raghavan,
3. Practical Physical Chemistry by B.D.Khosla and V.C. Garg.
4. Systematic Experimental Physical Chemistry -S.W. Raj Bhoj and Dr. T.K. Chondhekar

Paper – V INORGANIC CHEMISTRY PRACTICALS (2CHP4)

I. Estimations:

1. Glucose by using Fehling's solution
2. Vitamin – C
3. Calcium in Milk
4. Iodine value of Oil
5. Chlorine in Bleaching Powder

II. Analysis of Binary Mixtures:

1. Determination of Cu^{2+} and Ni^{2+}
2. Determination of Fe^{3+} and Al^{3+}
3. Determination of Cu^{2+} and Zn^{2+}
4. Determination of Ca^{2+} and Mg^{2+}
5. Determination of Ferrocyanide & Ferricyanide

Scheme of valuation

Marks: 75 Time: 4Hrs

Standardization	–	24
Estimation of sample	–	36
Viva, Record and samples	–	15

Recommended Books:

1. A Text Book of quantitative inorganic analysis (3rd and 6th editions)

Paper – VII PHYSICAL CHEMISTRY - PRACTICALS (2CHP6)

1. **Potentiometry:**
   a. **Acid –base titrations:**
      (i) Strong acid with strong base.
      (ii) Weak acid with strong base and determination of P^{ka} of weak acid.
      (iii) Mixture of acids with strong base.
   b. **Redox titrations:**
      (i) Ferrous ion with $KMnO_4$ or $K_2Cr_2O_7$
      (ii) Ferrous ion with Ce^{+4}
   c. **Precipitation titrations:**
      (i) KCl or KI with $AgNO_3$
      (ii) Mixture of (KCl + KI) with $AgNO_3$
2. **Colorimetry:**
   Verification of Lambert-Beer's law and determination of molar extinction coefficient of $KMnO_4$, $CuSO_4$, $K_2Cr_2O_7$, Cu $(NH_4)_6$ SO_4
3. Verification of Freundlich adsorption isotherm-Acetic acid–activated charcoal system
4. Distribution of Iodine between CCl_4 and aqueous KI. (determination of unknown concentration of KI)
5. Determination of partial molar volume of methanol in aqueous methanol.

Scheme of valuation

Marks: 75 Time: 4Hrs

Experiments (2)	–	30+30	–	60
Viva, Record and samples			–	15

Recommended Books:

1. Practical Physical Chemistry -A. Findlay, Longman-London.
2. Practical Physical Chemistry -B. Vishwanathan and P.S. Raghavan,
3. Practical Physical Chemistry - B.D.Khosla and V.C. Garg. R.Chand & Co. Delhi.
4. Systematic Experimental Physical Chemistry by S.W. Raj Bhoj and Dr. T.K. Chondhekar, Anjali Publications, Aurangabad.

III Semester –Inorganic Chemistry Practicals (Specialization)

Paper-V Preparation of Complexes and their characterization by Physiochemical techniques (3CHP7) (Marks 100, 9 Hours per week)

1. $[Cu(NH_3)_4]SO_4.H_2O$
2. $[Ni(DMG)_2]$
3. $[Mn(acac)_2]$
4. $Na[Cr(NH_3)_2(SCN)_4]$
5. Prussian blue, Turnbull's blue
6. $[Co(NO_2)(NH_3)_5]^{2+}$ and $[Co(ONO)(NH_3)_5]^{2+}$

Paper-VI Analysis of Ternary mixtures and Complex materials (3CHP8)

(Marks 100, 9 Hours per week)

I. Analysis of Ternary mixtures

1. Ag^+, Cu^{2+}, and Ni^{2+}
2. Cu^{2+}, Ni^{2+} and Zn^{2+}
3. Fe^{3+}, Mg^{2+}, and Ca^{2+}

II. Analysis of Complex materials

1. Brass
2. Devarda's alloy
3. Cement

Recommended Books:

1. Vogel's Text Book of Quantitative Chemical Analysis, 6th Edition.
2. Comprehensive experimental chemistry- V.K. Ahluwalia, New publication
3. Analytical Chemistry- Theory and Practice-R.M. Verma, CBS Publishers

Scheme of Valuation

Marks 100	Time: 4Hours
Experiments (2)	80 Marks
Record/ Sample & Viva	20 Marks

III Semester -Organic Chemistry practicals (Specialization)

Paper-V Preparation of organic compounds and Spectral analysis (3CHP9)

(Marks 100, 9 Hours per week)

(A) Two step preparation:

1. *o*-chlorobenzoic acid form anthranilic acid
2. p-Bromoaniline from acetanilide
3. p-Nitroaniline from acetanilide
4. Tribromobenzene from aniline: (a) Aniline to tribromoaniline (b) tribromoaniline to tribromo benzene
5. Preparation of 2,4-DNP: (a) Chlorobenzene to 2,4-dinitrochlorobenzene (b) Preparation of 2,4-DNP from 2,4-dinitrochlorobenzene
6. Preparation of Iosin: (a) Fluorosin from phthalic anhydride (b) Iosin from fluorosin.

(B) Spectroscopic identification of some organic compounds:

A set of spectral analytical data for at least 20 compounds will be analyzed by each student and two out of the same compounds will be chosen for the examination from which the student will analyze and identify one compound.

Scheme of Valuation

Marks 100	Time: 4Hours
Experiments (2)	80 Marks
Record/ Sample & Viva	20 Marks

Paper-VI: Organic mixture analysis (with two component mixture) (3CHP10)

(Marks 100, 9 Hours per week)

Organic mixture analysis (With two component mixture): Seperation of the two component mixture of organic compounds in a systematic procedure and systematic identification of each of the component organic compounds by using: Preliminary examination, identification of extra elements, common functional group tests, specific functional group tests, preparation of at least two rational derivatives and finally identifying the given compounds by checking the melting points of its derivatives with those in literature.

III Semester-Physical Chemistry (Specialization)

PAPER-IV Group Theory & Spectroscopy (3CHT16)

(Marks 100,Total Hours 60)

Unit-I Group Theory:

Symmetry operations forming a group. Matrix representation of symmetry operations and point groups, isomorphism, Reducibleand irreducible representation.The great orthogonality theorm (without proof) and its properties for reducible and irreducible representation. Relation between reducible and irreducible representation. Character tables – construction of character tables for C_2V and C_3V groups- Direct product rule,Group theoretical aprroach for UV tranissions in ethylene and formaldehyde. IR and Raman active modes of water molecule.

Unit-II Diffraction Studies:

X–Ray diffraction : Bragg condition . Miller indices. Expermentel methods of x - ray diffraction laue method and Debye - Scherrer method. Primitive and non primitive unit cell. Index reflextion. Identification of unit cells from systamatic absences in diffraction pattern for cubic crystals. Structre factor and its relaton to intensity and electron density. Description of the procedure for an X- ray structure analysis . Tipical examples.

Electron diffraction: Scattering intensity versus scattering angle. Wierl equation. Measurement technique. Elucidation of structure of simple gas phase molecules.

Neutron diffraction : Scatterring of nuetrons, magnetic scattring, Elucidation of structure of magnetically ordered unit cell. Application and limitations.

Unit-III Spectroscopy –I:

Photoelectron spectroscopy : Basic principles, photo-electric effect, ionization process, Koopmans theorem, PES of Simple molecules , XPES , Chemical shift applications and ESCA.

Photo acoustic spectroscopy : Basic Principles of PAS-PAS of gases and condensed systems chemical and surface applications.

Electron-Spin resonance spectroscopy: Zero-field splitting- kramer's degeneracy – Mcconnell relationship , double resonance technique (ENDOR). ESR spectra of transition metal complexes

ORD and CD Spectroscopy : Basic concepts of optical rotatory dispersion (ORD) and circular dichroism (CD), Deduction of absolute configuration–Cotton effect–Octant rule for ketones. Applications of ORD and CD spectroscopy.

III Semester Physical Chemistry-Practicals (Specialization)

Paper-V –Kinetics (3CHP11)

(Marks 100, 9 Hours per week)

1. Persulphate -Iodide reaction –Determination of
   a. Order b. Solvent Effect c. Salt effect d. Temperature effect
   e. Catalytic effect using Ferric in presence of Copper.

III Semester Physical Chemistry-Practicals (Specialization)

Paper-VI Instrumentation (3CHP12) (Marks 100, 9 Hours per week)

I. Potentiometry / P^H Metry

1. Titration involving dibasic and tribasic acids.
2. Redox reactions and mixture of metal ions.
   a. (V^{5+} + Mn^{7+}) by Fe^{2+}
   b. (V^{5+} + Ce^{4+}) by Fe^{2+}
3. Single Electrode potential
4. Precipitation titration
   a. KCl Vs $AgNO_3$ **b.** (KCl +KI) Vs $AgNO_3$
   c. (KCl +KBr + KI) Vs $AgNO_3$
5. Isoelectric point of Glycine.
6. Verification of Gibbs- Helmohltz equation.
7. P^{Ka} of Chloro acetic acid.

II. Colorimetry:

1. Estimation of Cu^{2+} by EDTA (Mono and bivariation methods)
2. Estimation of Ni^{2+} by EDTA (Mono and bivariation methods)
3. Estimation of Fe^{2+} by complexing with (1,10 phenanthrolin)
4. Determination of Cu^{2+} and Fe^{3+} in the given mixture by EDTA

IV Semester-Inorganic Chemistry practicals (Specialization)

Paper-V Ion exchange and Solvent Extraction Methods (4CHP13)

(Marks 100, 9 Hours per week)

Ion exchange and Solvent Extraction Methods

I. **Ion exchange Methods**

1. Determination of capacity of an anion exchange resin
2. Determination of capacity of a cation exchange resin
3. Separation and determination of Zinc and Magnesium using a cation exchange resin
4. Separation and determination of Chloride and Bromide using an anion exchange resin
5. Determination of the total cation concentration in a water sample.

II. Solvent Extraction Methods

1. Determination of Ni as anion NiDMG complex
2. Determination of Chloride ion and Iodide ion by $AgNO_3$
3. Determination of Pb as Pb-dithiazone complex

Paper-VI Instrumental Methods (4CHP14)

(Marks 100, 9 Hours per week)

III. Analysis of Ternary mixtures

4. Ag^{+}, Cu^{2+}, and Ni^{2+}
5. Cu^{2+}, Ni^{2+} and Zn^{2+}
6. Fe^{3+}, Mg^{2+}, and Ca^{2+}

IV. Analysis of Complex materials

4. Brass
5. Devarda's alloy
6. Cement

Recommended Books:

4. Vogel's Text Book of Quantitative Chemical Analysis, 6th Edition.
5. Comprehensive experimental chemistry- V.K. Ahluwalia, New publication
6. Analytical Chemistry- Theory and Practice-R.M. Verma, CBS Publishers

Scheme of Valuation

Marks 100	Time: 4Hours
Experiments (2)	80 Marks
Record/ Sample & Viva	20 Marks

Paper-V-Organic Chemistry practicals (4CHP15)

(Marks 100, 9 Hours per week)

(A) Estimations:

1) Estimation of acetone /ethyl methyl ketone
2) Estimation of asprin
3) Estimation of acid value
4) Estimation of amino acid
5) Estimation of unsaturation
6) Estimation of glucose

(B) Principles of chromatography:

Determination of RF value – Ascending and descending techniques – Circular paper chromatography – Selection of solvents in paper chromatography – Location of spots in paper chromatography

Experiments in chromatography:

(a) Separation of leaf pigments – chlorophyll-'a' & 'b' xanthophylls

(b) Separation of amino acids by paper chromatography

(c) Determination of RF value of glycine by ascending paper chromatography

(d) Determination of various impurities by thin layer chromatography

(e) Purification of commercial anthracene by column chromatography using benzene

Paper-VI Organic chemistry practicals (4CHP16)

(Marks 100, 9 Hours per week)

(A) Isolation and purification of the following natural products:

1) Caffeine 2) Embelin 3) Piperine 4) Lycopine 5) Nicotine 6) Rutin
7) Lachnolic acid 8) Mangiferin

(B) Advanced organic preparations:

1) 2-methyl indole
2) 2,5-dihydroxyacetophenone (Fries reaction)
3) Photoreduction of benzophenone
4) Glucose to glucose penta acetate
5) Ammonium thiocyanate to urea
6) 1,2,3,4-Tetrahydrocarbazole.
7) Antipyrin
8) Benzocaine
9) Benzimidazole
10) Paracetamol

Scheme of Valuation

Marks 100	Time: 4Hours
Experiments (2)	80 Marks
Record/ Sample & Viva	20 Marks

IV Semester-Physical chemistry Practicals

Paper-V Kinetics experiments (4CHP17) (Marks 100, 9 Hours per week)

1. Kinetics of i) Actone- Iodine reaction: Determination of

a) Order b) Acid effect

c) Solvent effect d) Temperature effect.

ii) Inversion of sucrose-Effect of acidity functions.

Paper–VI Instrumentation (4CHP18)

(Marks 100, 9 Hours per week)

Instrumentation:

I. Conductometry:

1. Mixture of acids and $CuSO_4$ vs NaOH
2. Dibasic acids Vs NaOH
3. Mixture of chloroacetic acids vs NaOH
4. Replacement Reactions
5. Determination of p^{Ka} of chloroacetic acid
6. Verification of Onsagers euations with KCl
7. Determination of composition of complex (Cu(II) Vs EDTA)
8. Kinetics of Saponification of ethylacetate.

II. Potentiometry /P^H Metry:

1. Determination of dissociation constants of moaobasic / dibasic acids by Albert-Serjeant method.
2. Determination of dissociation constant of acetic acid in DMSO, acetone and dioxane.
3. Determination of thermodynamic constans, ΔG, ΔS and ΔH for the following reaction by e.m.f. method.

$$Zn + H_2SO_4 \rightarrow ZnSO_4 + 2H$$

III. Polarography:

1. Estimation of Pb^{2+}, Cd^{2+} and Ni^{2+} separately and in a complex.

Scheme of Valuation

Marks 100 Time: 4 Hours

Experiments (2) 80 marks

Record/Samples &Viva 20 marks