JSS MAHAVIDYAPEETHA

JSS COLLEGE OF ARTS, COMMERCE & SCIENCE

(An Autonomous College of University of Mysore
Accredited by NAAC with 'A'grade)
OOTY ROAD, MYSURU-570 025 KARNATAKA

DEPARTMENT OF CHEMISTRY

SYLLABUS

CHOICE BASED CREDIT SYSTEM

Fot BSc programmes

(I and II Semesters)

Physics,Chemistry,Mathematics
Chemistry,Botany,Zoology
Chemistry,Zoology,Boitechnology

w.e.f 2024-25

B.Sc.CHEMISTRY SYLLABUS

FIRST SEMESTER

Paper:Chemistry Practical -I **Code C:GCH 101**

ContactHours/ Week	Credits	SchemeofEvaluation:Max.Marks: 100		
		ContinuousInternalAssessment		SemesterEndExamination(SEE)
		C_1	C_2	C_3
03	03	10 Marks	10 Marks	80 Marks

Unit-I **Inorganic Chemistry** **[15 Hours]**

Atomic Structure:deBrogliematter waves-dual nature of electron.Heisenberg's uncertainty principle and its significance. Schrodinger wave equation-explanation of the terms involved (no derivation).Significance of ψand ψ^2.Atomic orbitals,shapesof s,p and orbitals.Quantum numbers and its significance. (n+l) rule, Aufbau Principle, Pauli's exclusion principle and Hund's rule of maximum multiplicity, electronic configuration of elements (up toZ = 30). Explanation for the stability of completely-filled and half-filled orbitals based on the concepts of pairing energy,promotional energy and symmetric charge distribution. Effective nuclear charge, screening effect- based on Slater's rules (problems to be solved). [**07 Hours**]

Periodic properties: Classification of elements in to s, p, d, and f blocks. Atomic radii**,** covalent, ionicand van derWaal's (explanation with examples). Additive nature of covalent radii. Variation of covalentradii down a group and across a period-explanation for the observed trends, isoelectronic ions,variation of ionic radii inisoelectronic ions.Determination of ionic radii by Pauling's method. Comparison of the size of atoms with corresponding anions and cations.

Ionization enthalpy: Explanation, successive ionization enthalpy, factors affecting ionization enthalpy, applications of ionization enthalpy. Variation down a group and across a period, explanation for the observed trends.

Electron gain enthalpy: Definition, successive electron gain enthalpy, variation of electron gain enthalpy across a period and down a group, explanation for the observed trends.

Electronegativity: Explanation, Variation of electronegativity in a group and in a period-explanation for the observed trends. Factors determining electro negativity (charge on the atomand hybridization). Pauling, Mulliken and Allred-Rochow scale of electronegativity (problems to be solved). Applications of electronegativity. [**08 Hours**]

Unit-II **Organic Chemistry** **[15 Hours]**

BasicConcepts: Arrow notations and their significance,bond cleavage,types of reagents-electrophiles and nucleophiles.Reaction intermediates-generation,stabilities,and reactions involving carbocations, carbanions, carbon free radicals, nitrenes and carbenes.

Electronic displacement effects: Inductive effect, electromeric effect, resonance, hyper conjugation and their significance. Strengths of organic acids and bases: Comparative study with emphasis on factors effecting pKvalues.Relative strength of carboxylicacids(formicacid,

acetic acid, chloroacetic acid, trichloroacetic acid, propionic acid, benzoic acid, *o*-nitrobenzoic acid, *m*-nitrobenzoic acid, *p*-nitrobenzoic acid, *o*-toluic acid, *m*-toluic acid and *p*-toluic acid. Relative strength of organic bases (methylamine, ethylamine, dimethylamine, trimethylamine, aniline, diphenylamine, triphenylamine, *o*-nitroaniline, *m*-nitroaniline, *p*-nitroaniline, *o*-toluidine, *m*-toluidine, and *p*-toluidine. [**07 Hours**]

Alkanes: Preparation (Corey-House, Wurtz method), Mechanism of free radical substitution of methane.

Alkenes: Preparation (Wittig's reaction), Reactions of ethylene and propene (reduction, hydroboration, epoxidation, oxidation with $KMnO_4$and $OsO_4$and ozonolysis). Mechanism of addition of HBr to ethylene and propene (Markovnikoff rule, and peroxide effect).

Dienes: Definition, types with examples. Conjugated dienes: 1,3 butadiene – preparation, 1,2 and 1,4-addition reactions with HX and X_2, Diel's Alder reaction with an example.

Alkynes: Methods of preparation (Dehydrohalogenation), reactions (with HCN, H_2, HX, and H_2O). Acidic character of terminal alkynes.

Alkyl halides: Elimination reactions (Mechanism of E1, E2, and E1cb reactions). Saytzeff and Hoffmann's elimination. Substitution reactions (S_N1 and S_N2 reactions with energy profile diagram). Effect of nature of alkyl groups, leaving groups, nucleophiles, and solvents on substitution reactions. [**08 hours**]

Unit-III **Physical Chemistry** **[15 Hours]**

Gaseous State: Elementary aspects of kinetic theory of gases,ideal and real gases(Noderivation).

MolecularVelocities: Distribution of molecular velocities and molecularenergies(graphical representation-derivation not required) and their importance. Effect of temperature on distribution of molecular velocities using distribution curve. Energy distribution as a function of temperature. Types of MolecularVelocities-Most probable, average, and root mean square velocities definition and equation (no derivation) and their relationship. Law of equiportion of energy.

Behavior of real gases: Deviation from ideal gas behavior,compressibility factor(Z) and its variation with pressure. Causes of deviation from ideal behavior. [**04 Hours**]

Critical Phenomenon:Andrews experiments on CO_2.Critical constants:-critical temperature (T_c), critical pressure (P_c) and critical volume (V_c) – definitions. Experimental determination of $T_C$and $P_C$using Cagniard-de-laTours apparatus. Determination of critical volume (Vc) by Cailletet and Mathias method. Relationship of vander- Waals constant (a and b) with critical constants Tc, Pc andVc(derived using isotherm of CO_2),Law of corresponding state and reduced equation state. Numerical problems on Tc, Pc and Vc vander Waals constant (a and b). [**04 Hours**]

Liquification of gases: Intermolecular forces,Vander-waal'sforces of attraction,brief accountof dipole-dipole, dipole-induced dipole, induced dipole-induced dipole interactions (London forces). Principle underlying liquefaction of gases-JouleThomson effect,Joule Thomson experiments, show that joule Thomson effect is an iso-enthalpic process($\Delta H=0$),Joule-Thomson coefficient, inversion temperature definition and its relation betweenVanderWaal's constants a and b.numerical problems. [**04 Hours**]

Adsorption: Introduction, principle involved, sorption, absorption, and adsorption (definition, examples and differences). Types of adsorptions - Physical and Chemical adsorption ((definition, examples and differences). Adsorption of gases on solids- Factors which influence the adsorption onsolids,adsorption isotherms,mathematical expression for Frieundlich and Langmuir adsorption isotherms (to be derived), mention application of adsorption. [**03 Hours**]

Paper:ChemistryPracticals-I **Code:GCH102**

ContactHours/ Week	Credits	SchemeofEvaluation:Max.Marks:50		
		ContinuousInternalAssessment		SemesterEndExamination(SEE)
		C_1	C_2	C_3
04	02	05 Marks	05 Marks	40 Marks

LIST OFEXPERIMENTS

PartA:VolumetricAnalysis

1. Preparation of standard sodium carbonate solution, standardization of hydrochloric acid solution, and estimation of sodium hydroxide present in the given solution.
2. Preparation of standard oxalic acid solution, standardization of sodium hydroxide solution, and estimation of sulphuric acid present in the given solution.
3. Preparation of standard potassium biphthalate solution, standardization of sodium hydroxide solution, and estimation of oxalic acid present in the given solution.
4. Preparation of standard oxalic acid solution, standardization of potassium permanganate solution, and estimation of ferrous ammonium sulphate present in the given solution.
5. Preparation of standard ferrous ammonium sulphate solution, standardization of potassium permanganate solution, and estimation of hydrogen peroxide present in the solution.
6. Preparation of standard potassium dichromate solution, and estimation of ferrous and ferric iron in the given solution mixture.
7. Preparation of standard potassium dichromate solution, and estimation of ferrous ammonium sulphate present in the given solution (potassium ferrocyanide as an external indicator).
8. Preparation of standard sodium carbonate solution, standardization of hydrochloric acid solution, and estimation of sodium hydroxide and sodium carbonate in a mixture(orcaustic soda) by double indicator method.

PartB

1. Demonstration of laboratory practices [safety, glassware/chemicals handling, chemical nature understanding, chemical/glassware waste management, error analysis], calibration of laboratory glassware [pipettes and burettes].
2. Practical concept of Molarity, Molality, Normality, Weight %. Preparation of standard solutions, normal solutions, dilution of stock solutions (0.1M) to different concentrations.
3. Separation of pigments in leaves/flowers by thinl ayer chromatography(Demonstration).

4. Separation of *o*- and *p*-nitroanilines in a mixture by column chromatography (Demonstration).
5. Estimation of calcium content in chalk ascalcium oxalate using decinormal potassium permanganate solution.
6. Estimation of ammonium chloride using 0.05N sodium hydroxide and 0.1N hydrochloric acid solutions (back titration).
7. Estimationof sulphuric acid and oxalicacid in the given mixture using standard sodium hydroxide and standard potassium permanganate solutions.
8. Estimation of carbonate and bicarbonate in the given mixture by double indicator method.

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SECOND SEMESTER

Paper:Chemistry-II **Code:GCH 201**

ContactHours/ Week	Credits	SchemeofEvaluation:Max.Marks: 100		
		ContinuousInternalAssessment		SemesterEndExamination(SEE)
		C_1	C_2	C_3
03	03	10 Marks	10 Marks	80 Marks

Unit-I **Inorganic Chemistry** **[15 Hours]**

Chemical bonding-I: Ionic bond: General characteristics of ionic compounds, radius ratio and crystal coordination number, limitations of radius ratio rule. Lattice energy and Born-Haber cycle, setting up of Born-Habercycle,numerical calculations of Latticeenergy and electron affinity based on Born-Haber cycle for 1:1 ionic solids, Theoretical calculation of lattice energy by Born- Lande equation (no derivation). Role of lattice energy and hydration energy in solubility of ionic solids. Polarization of ions, Fajan's rules. [**05 Hours**]

Covalentbond: Factors favoring the formation ofcovalent bond(ionizationenergy,electron affinity, electronegativity, nuclear charge, inter nuclear distance and number of valence electrons). Valence bond approach– explanation with examples (H_2, F_2, HF, $O_2$and N_2) to illustrate valence bondapproach.SigmaandPibonds–explanation by taking H_2,O_2 and N_2 as examples.Bond length, bond order, bond energy and their significance, polarity of covalent bonds, polar and non- polar molecules, Dipole moment and polarity of molecules to be explained by taking HCl, CO_2,CCl_4 and H_2O as examples. [**04 Hours**]

Chemical bonding-II: Hybridization-directional property and geometry of sp, sp^2, sp^3, sp^3d and sp^3d^2 hybrid orbitals taking $BeCl_2$, C_2H_2 BF_3, C_2H_4, $SiCl_4$, CH_4 $PCl_5$and SF_6as examples. VSEPR theory- postulates with SO_2, NH_3, H_2O, SF_4, $ClF_3$and ICl^{2-} as examples.

Molecular Orbital Theory: An elementary account of MOT, linear combination of atomic orbitals (no mathematical approach). Bonding and antibonding molecular orbitals, conditions for the combination,energy levels of molecular orbitals.Molecular orbital structure sand bond orders

of species like H_2, He_2, He_2^+, N_2, O_2,F_2,HF, LiH, NO and CO. Prediction of magnetic propertiesof these species. [**06 Hours**]

Unit-II Organic Chemistry [15 Hours]

Cycloalkanes: Nomenclature of cycloalkanes, Synthesis of cycloalkanes(From calcium salts of dicarboxylic acids).Reactionsof cycloalkanes(withCl_2, H_2,andHBr).Sachse-Mohr theoryof strainless rings.Conformation of cyclohexanes and their stabilities(monoanddisubstituted). Conformational analysis of ethane and butane and their energy profile diagrams.

Aromatic hydrocarbons: Concept of aromaticity, Huckel rule with respect to benzenoids, (benzene, naphthalene, anthracene and phenanthracene), heterocycles (pyrrole, furan, thiphene, pyridine, quinoline, isoquinoline, indole), and non-benzenoid compounds (cyclopentadiene, cyclopentadienyl anion, cycloheptadienyl cation). Annulenes (10 to 18 carbon atoms) and their aromaticity. [**07 Hours**]

Reaction of aromatic compounds

Electrophilic substitution: Mechanisms of nitration, sulphonation, halogenation, Friedel-Crafts alkylation, and acylation reactions of benzene. Electronic interpretation of orientating influence of electron donating groups (-CH_3, -Cl, -$NH_2$and -OH groups) and electron withdrawing groups (-NO_2, -CHO, -COOH and –SO_3H groups) on further electrophilic substitution reactions. **Nucleophilic substitution**:Benzyne mechanism. **Oxidation:** Toluene to benzaldehyde and benzoic acid, naphthalene to benzoquinone, anthracene to anthraquinone. **Reduction:** Benzene to cyclohexane, β-naphthol to tetrahydro-β-naphthol. Naphthalene to cis and trans decalin,anthracene to 9,10-dihydroanthracene and perhydroanthracene, phenanthracene to 9,10-dihydrophenanthracene, and Birch reduction. [**08 Hours**]

Unit-III Physical Chemistry [15 Hours]

Liquid State - Surface tension- definition and its explanation, determination of surface tension using stalagmometer,effect of temperature and soluteon surface tension.Viscosity-definition, coefficient of viscosity,determination of viscosity using Ostwald viscometer,effectof temperature, size, weight, shape of molecules and inter molecular forces. [**03 Hours**]

Solidstate:Introduction-amorphousandCrystalinesolidsandtheirdifferences.Lawsof crystallography:(i) Lawof constancy of interfacial angles (ii) Law ofrotational indices-WeissandMillerindices,unitcell,Latticepoint,Latticeplanesincubiccrystals.Lawsofsymmetry-Symmetry elements – plane, axis and center of symmetry, element of symmetry in cubic crystal.Crystalsystem,BraviasLattices–typescubiclatticesandidentificationoflatticeplanes.X-ray diffraction by crystals - Braggs law, derivation of Braggs equation, determination of structure ofsingle crystal by rotating crystalmethod ,and powder method. Defects in solids.Numerical problems. [**06 Hours**]

Distribution law: Nernst distribution law - Statement and its derivation, distribution constant, factors affecting distribution constant, validity of distribution law, limitations of distribution law, verification of distribution law taking distribution of I_2 in H_2O and CCl_4. Modification of distribution law when molecules undergo association and dissociation.Application of distribution

law in solvent extraction process and Parke's process (de-silverisation of lead). Numerical problems.

Catalysis: Definition, general characteristics, action of catalytic promoters and inhibitors. Homogeneous catalysis (definition and examples), Heterogeneous catalysis- definition and examples, mechanism of heterogeneous catalysis based on adsorption theory. Enzyme catalysis- definition and example, lock and key mechanism of enzyme catalyzed reaction. Mechalis-Menten equation (to be derived), Mechalis-Menten constant and its significance. [**06 Hours**]

Paper:Chemistry Practicals-II **Code:GCH202**

ContactHours/ Week	Credits	SchemeofEvaluation:Max.Marks:50		
		ContinuousInternalAssessment		SemesterEndExamination(SEE)
		C_1	C_2	C_3
04	02	05 Marks	05 Marks	40 Marks

LIST OF EXPERIMENTS

PartA:Qualitativeanalysisoforganic compounds

Thefollowing classes of organic compounds(atleast one compound from each class)be given for systematic analysis.

Carbohydrates: Glucose, sucrose; Amides: Urea, thiourea; Amines: Aniline, *N*-Methylaniline,*N*,*N*-Dimethylaniline,*p*-toluidine;Carboxylicacids:Benzoicacid,cinnamicacid;Phenols:phenol, *p*-cresol, β-napthlol; Aldehydes: Benzaldehyde; Ketones: Benzophenone, acetophenone; Hydrocarbons: Naphthalene, biphenyl; Halogenated hydrocarbons: Chlorobenzene, dichlorobenzene; Nitro compounds: Nitrobenzene, *m*-dinitrobenzene; Anilides: Acetanilide; Bifunctional compounds: Salicylic acid. Nitro aniline.

PartB:Organicpreparations:

1. Preparationofacetanilidefromaniline (Acetylation).
2. Preparationofbenzoic acidfrombenzaldehyde(Oxidation).
3. Preparationofosazonefromglucose(Condensation).
4. Preparationof*p*-cresylbenzoatefrom*p*-cresol(Esterification).
5. Preparationof*p*-bromoacetanilidefromacetanilide (Bromination).
6. Preparationofbenzoic acidfromethylbenzoate (Hydrolysis).
7. Preparation2,4-dinitrophenylhydrazoneofbenzaldehyde (Condensation).

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QUESTIONPAPER:THEORYEXAMINATION

(Applicableto**DSC-1**and**DSC-2**)

Time:03 Hours **Max.Marks:80**

Instructions:Draw a neat labeled diagrams wherever necessary.

PART-A

Answer all of the following 8X 1=08

1 a)
b)
c)
d)
e)
f)
g)
h)

PART-B:InorganicChemistry

Answer any three of the following 3X 8=24

2
3
4
5

PART-C:OrganicChemistry

Answer any three of the following 3X 8=24

6
7
8
9

PART-D:PhysicalChemistry

Answer any three of the following 3X 8=24

10
11
12
13

Thesub-questionsinQ2-Q13shallbeof(3+3+2)or(5+3)or(4+4)Marks

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SCHEMEOFVALUATION

DSCP-1:CHEMISTRY-1(PRACTICALS):

Time:03Hours **Max.Marks:40**

Note: Duly certified practical record shall be submitted at the examination for evaluation.

DistributionofMarks

Record	5 Marks
PartA	25Marks
PartB	10 Marks

PartA

Experiments (**1,2, 3,4,5**)	Preparation of standard solution and calculation of its normality		04Marks
	Titration values		
	Discrepancy	Standardization	Estimation
	± 0.2cm^3	08Marks	10Marks
	± 0.3cm^3	06Marks	08Marks
	±0.4cm^3	04Marks	06Marks
	Anyother value	02Mark	03 Marks
	Calculation	Normality of link solution=01Mark Normality of given solution=01Mark Weight/dm^3or 250cm^3= 01 Mark	

Experiments **6, 7**	Preparation of standard solution and calculation Of its normality		03Marks
	Titration values		
	Discrepancy	Firstti tration	Second titration
	± 0.2cm^3	09Marks	09Marks
	± 0.3cm^3	07Marks	07Marks
	±0.4cm^3	05Marks	05Marks
	Anyother value	02 Marks	02Marks
	Calculation	02Marks	02Marks

Experiment (**8**)	Preparation of standard solution and calculation of its normality			03Marks
	Titration values			
	Discrepancy	Standardization	First titration	Second titration
	± 0.2cm^3	03Marks	07 Marks	07Marks
	± 0.3cm^3	02Marks	05 Marks	05Marks
	Anyother value	01Mark	02 Marks	02Marks
	Calculation	Normality of link solution = 01 Mark Normality of given solution=01+01Mark Weight/dm^3or250cm^3=01+01Mark		

PartB

Procedure writing from the experiments listed in partB	04 Marks
Three questions/problems be given on the concept of laboratory practices, calibration, error analysis, molarity, molality, normality, weight %, preparation of standard solutions, normal solutions, dilution of stock solutions (0.1M) to different concentrations.	3 X 2 =06 Marks

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DSCP-2:CHEMISTRY-2(PRACTICALS)

Time:03Hours **Max.Marks:40**

Note: Duly certified practical record shall be submitted at the examination for evaluation.

Distribution of Marks

Record	5 Marks
PartA	25Marks
PartB	10 Marks

PartA:Organic Analysis		**PartB:Organic preparations**	
Preliminary Examinations	04Marks	Equation	02 Marks
Physical Constant	02Marks	Preparation	05Marks
Elemental Analysis including procedure For preparation of sodium fusion extract	04Marks	Yield	01Mark
Solubility(Completechart)	04Marks	Recrystallization	01Mark
Functionalgroupanalysis (minimum of two tests)	06Marks	Meltingpoint	01 Mark
Naming and structure	03Marks		
Solid Derivative	02Marks		
Total	**25Marks**	**Total**	**10Marks**

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