SEMESTER - I

ANALYTICAL CHEMISTRY - I

1. Course Description

Programme: M.Sc. Organic Chemistry
Course Code: P24/CHE/DSC/104
Course Type: DSC-4
No. of credits: 3

Max. Hours: 45
Hours per week: 3
Max. Marks: 100

2. Course objectives:

- The objective is to learn principles and applications of various Chromatographic techniques.UV-Vis spectroscopy is used in analytical chemistry for quantitative determination of different analytes such as transition metal ions and conjugated organic compounds.
- Nuclear Magnetic Resonance spectroscopy is a powerful and theoretically complex analytical tool, to develop the understanding of number, positions, intensities and splitting of signals.
- Infrared spectroscopy, an analytical technique that takes advantage of the vibrational transitions of a molecule for identifying functional groups of organic compounds.

3. Course outcomes:

CO1: Discuss the techniques of chromatography and quantification of HPLC and GC Methods. Explain the principles of Ultraviolet/Visible Spectroscopy, Woodward-Fieser rules and their applications. **(UNDERSTANDING)**

CO2: Explain the principle of 1H NMR spectroscopy, instrumentation, chemical shifts, Factors affecting them, signal integration, Spin-spin coupling, Coupling constants and factors affecting them and applications of 1H NMR spectroscopy. **(APPLICATION)**

CO3: Explain the principles of Rotational spectroscopy and calculate bond lengths and atomic mass from rotational spectra of diatomic molecules, Isotope effect on rotational spectra Explain the principles of Vibrational spectroscopy, an harmonic nature of vibrations , Stereo chemical effects on the absorption pattern and Isotope effect on vibrational spectra **(UNDERSTANDING)**

4. Course Content:

MODULE 1: TECHNIQUES OF CHROMATOGRAPHY AND ELECTRONIC SPECTROSCOPY 15 hrs

i. Introduction, Classification of chromatographic techniques, differential migration rates, partition ratio, retention time, relation between partition ratio and retention time, capacity factor, selectivity factor. Efficiency of separation- resolution, diffusion, plate theory and rate theory.
ii. **GC:** Principle, instrumentation, detectors- TCD, FID, ECD. Derivatisation techniques, PTGC. GC Analysis of hydrocarbons in a mixture.
iii. **HPLC:** Principle, instrumentation, detectors- UV detectors, Photodiode array detector, fluorescence detector. HPLC assay of paracetamol in tablets.

UV Visible spectroscopy: Principle, selection rules, Woodward-Fieser rules. Conjugated dienes, trienes and polyenes, unsaturated carbonyl compounds, Benzene, mono substituted derivative (Ph-R), di substituted derivative (R-C_6H_4-R′) and substituted benzene derivatives (R-C_6H_4-COR′).

MODULE 2: NMR SPECTROSCOPY-I (^{1}H NMR) (15 hrs)

^{1}H NMR spectroscopy: Magnetic properties of nuclei, Principles of NMR Instrumentation, CW and pulsed FT instrumentation, equivalent and non equivalent protons, enantiotopic and diastereotopic protons, Chemical shifts, factors affecting the chemical shifts, electronegativity and anisotropy, shielding and deshielding effects, Signal integration, Spin-spin coupling: vicinal, germinal and long range, Coupling constants and factors affecting coupling constants. Chemically and magnetically equivalent protons.
Applications of 1H NMR spectroscopy: Reaction mechanisms (cyclic bromonium ion, electrophilic and nucleophilic substitutions, carbocations and carbanions), E, Z isomers, conformation of cyclohexane and decalins, keto-enol tautomerism, hydrogen bonding, proton exchange processes (alcohols, amines and carboxylic acids), C-N rotation. Magnetic resonance imaging (MRI). 1H NMR of organic molecules and metal complexes: ethyl acetate, 2- butanone, mesitylene, paracetamol, asprin, ethyl benzoate, benzyl acetate, 2-chloro propionic acid, [HNi(OPEt3)4]+, [HRh(CN)5] (Rh I=1/2), [Pt(acac)2].

MODULE 3: VIBRATIONAL SPECTROSCOPY (15 hrs)

Interaction of electromagnetic radiation with matter Factors affecting width and intensity of spectral lines
IR Spectroscopy: Vibrational energy levels of diatomic molecules, selection rules (derivation not required). Calculation of force constant from vibrational frequency. Anharmonic oscillator. Morse potential energy diagram. Fundamental bands, overtones and hot bands, Fermi resonance.

Vibration rotation spectra of diatomic and poly atomic molecules: Vibration - rotation spectroscopy, P, Q, R branches. Vibration rotation spectra of polyatomic molecules - linear, symmetric top and asymmetric top molecules. Principles of FTIR.

Vibrations of poly atomic molecules: Normal modes of vibration, concept of group frequencies. Characteristics of vibrational frequencies of functional groups: Stereochemical effects on the absorption pattern in carbonyl group, cis-trans isomerism and hydrogen bonding. Isotopic effect on group frequency.

Raman Spectroscopy- Classical and Quantum theories of Raman effect. Stokes and anti- Stokes lines. Complementary nature of IR and Raman spectra. Pure rotational, vibrational and Vibrational-rotational Raman spectra, Selection rules. Depolarization factors of Raman lines and their relevance. Instrumentation and applications of Raman spectroscopy.

5. References:

1. Fundamentals of Molecular Spectroscopy, Banwell and McCash.
2. Introduction to Molecular Spectroscopy, G.M. Barrow.
3. Absorption Spectroscopy of Organic Compounds, J.R. Dyer.
4. Biochemistry: Hames and Hooper.
5. Introduction to Spectroscopy, Pavia Lampman Kriz.
6. Pharmaceutical analysis, Watson
7. NMR in Chemistry- A multinuclear introduction, William Kemp.
8. Organic Spectroscopy, William Kemp.
9. Spectroscopy of organic compounds, P.S. Kalsi.
10. Structural methods n Inorganic chemistry, E.A.V Ebsworth.
11. Organic Spectroscopy, LDS Yadav
12. Organic Spectroscopy, Y.R. Sharma
13. Molecular Spectroscopy – Arhuldas
14. Vibrational spectroscopy – D.N. Satyanarayana

6. Syllabus Focus

a) Relevance to Local, Regional, National and Global Development Needs

Local /Regional/National /Global Development Needs	Relevance
LOCAL	The variety of analytical techniques such as chromatographic, spectroscopic, electrophoretic, and electrochemical and their corresponding methods are widely used in the analysis of drugs.
NATIONAL	Various spectroscopic techniques are used in industry to determine the quality of foodstuffs and pesticides
GLOBAL	Techniques like UV-Vis, IR, NMR, and mass spectrometry are used for identifying and characterizing compounds in qualitative and quantitative analysis.

b) Components on Skill Development/Entrepreneurship Development/Employability

SD/ED/EMP	Syllabus Content	Description of Activity
SD	Module No. 1	Classroom discussion on the real-world applications of chromatography in fields such as forensics, environmental science, and chemistry.
EMP	Module No.2	Develop employability on spectroscopic techniques, including teamwork, critical thinking, data interpretation, and effective communication.
ED	Module No. 3	Organising field trips to various esteemed organisations for instrumental exposure

7.Pedagogy

S. No	Student Centric Methods Adopted	Type / Description of Activity
1.	Problem Solving	Case studies
2.	Participative Learning	Presentation
3.	Experiential Learning	Field Trips

8. Course Assessment Plan

a)Weightage of Marks in Continuous Internal Assessments and End Semester Examination

CO	Continuous Internal Assessments CIA - 40%	End Semester Examination-60%
CO1	CIA-1 - Written Exam	Written Exam
CO2	CIA-2 – Problems	
CO3	CIA-2 – Assignment	

b) Model Question Paper - **End Semester Exam**

ANALYTICAL TECHNIQUES & SPECTROSCOPY-I

Course Code: P24/CHE/DSC/104 Max Marks:60
Credits: 3 Max Hours:2½hrs

SECTION A - INTERNAL CHOICE **3Q X 12 M = 36M**

Question Number	Module	Question	CO	BTL
1	Module 1	(a) Describe the basic functioning of the HPLC system? b) Explain the principle of gas chromatographic technique?	CO 1	Level II Level II
2	Module 1	(a) Explain the Woodward Fieser rules? b) Illustrate the selection rules in electronic absorption spectroscopy?	CO 1	Level II Level II

3	Module 2	(a)What is a chemical shift? Explain factors that influence chemical shift with suitable examples. (b) ExplainWith the help of an example explain how NMR spectroscopy can be used to study	CO 2	Level I Level II
4	Module 2	(a) Outline the anisotropic effect of alkenes and alkynes. (b) What is spin-spin coupling? Explain germinal, vicinal and long-range couplings with suitable examples.	CO 2	Level II Level I
5	Module 3	(a) Explain complementary nature of IR and Raman spectra. (b) Deduce the isotopic effects on rotational spectra?	CO 3	Level II Level V
6	Module 3	a) Explain the following i) Fundamental bands ii) Overtones iii) Hot bands b) How do you distinguish the inter and intra molecular hydrogen bonding by IR spectra	CO 3	Level II Level I

SECTION B - ANSWER ANY 4 OUT OF 6 **4 Q X 6 M = 24 M**

(To compulsorily have Two question from each module)

7	Module 1	Describe a photodiode detector used in HPLC?	CO 1	Level I
8	Module 1	Justify the different methods of gas chromatographic technique?	CO 1	Level IV
9	Module 2	How is PMR useful in the study of reaction mechanism involving carbocation?	CO2	Level I
10	Module 2	Develop the 1HNMR spectrum of 2-butanone and explain.	CO 2	Level VI
11	Module 3	How many fundamental vibrational frequencies can be observed in the infrared absorption spectrum of H2O	CO 3	Level I
12	Module 3	How do you distinguish Cis-trans isomers by IR spectroscopy?	CO 3	Level I

CHEMISTRY LAB: DSC- 8
Program: M.Sc.
Course: DSC-8
Semester: I

LAB: ANLYTICAL CHEMISTRY
Subject Code P24/CHE/DSC/104/P
No. of Hrs. allotted: 4 Hrs / week
No. of Credits : 2

COURSE OUTCOMES:

CO1: Estimation of ions by complexometry, iodometry, Dichrometry
CO2 : Acquire the practical knowledge on TLC.
CO3 : The student will able to acquire the practical knowledge Assay of Drugs
CO4: Determination of Physical Properties of Solutions

1. Applied analysis:

1. Estimation of acetic acid in comunercial vinegar by acid base titration method
2. Estimation of iron in cement by dichrometry
3. Estimation of available chlorine in bleaching powder by lodometry
4. Estimation of calcium in calcium tablets by complexometry
5. Estimation of magnesium in talcum powder by complexometry

II. Thin layer chromatography

6. Determination of purity of the compounds
7. Monitoring the progress of chemical reactions for any of the two preparations

III. Assay of drugs:

8. Aspirin by acid base back-titration method
9. Ibuprofen by acid base titration method
10. Calcium in calcium gluconate by complexometry

IV. Determination of Physical Properties of Solutions:

11. Determination of molecular weight of a polymer by viscometry
12. Determination of critical solution temperature of phenol-water system
13. Effect of added electrolyte on the CST of phenol-water system

V. Colorimetry

14. Verification of Beer's law and calculation of molar extinction coefficient using $CuSO_4$ solution.
15. Verification of Beer's law and calculation of molar extinction coefficient using $KMnO_4$ solution

References

1. Advanced practical chemistry, R.Mukhopadhyay& P. Chatterjee, NCBA books (2016)
2. Advanced practical inorganic chemistry, Gurdeep Raj, GOEL publishing house (2015)
3. Advanced experimental Inorganic chemistry, Ayodhya Singh, Campus books Int. (2006)
4. Senior Practical Physical Chemistry: B.D. Khosla, V.C. Garg and A. Khosla
5. Advanced Practical Physical Chemistry, J.B. Yadav

ANALYTICAL CHEMISTRY
PRACTICAL MODEL PAPER

Course Code: P24/CHE/DSC/104/P
Credits: 2

Max Time:3hrs
Max marks :50 marks

1) Determine the number of Aspirin present in the given sample by acid base back-titration method Write the Principle involved **(CO3)** (15 Marks)

2) Estimation of calcium in calcium tablets by complexometry **(CO1)**(10 M)

3) a) Determination of purity of the compounds by Thin layer chromatography **(CO2) (10 M)**

OR

b). Effect of added electrolyte on the CST of phenol-water system (**CO1 & CO2) (10 M)**

4) Record and Attendance **(5 M)**

5) Viva **(CO1,CO2, CO3 & CO4)** **(10 Marks)**

SEMESTER - I

INORGANIC CHEMISTRY -I

1. Course Description

Programme: M.Sc Organic Chemistry
Course Code: P24/CHE/DSC/101
Course Type: DSC -1
No. of credits: 3

Max. Hours: 45
Hours per week: 3
Max. Marks:100

2. Course Objectives

- To determine the Symmetry operations of small and medium-sized molecule and classify the structures of molecules and crystals , understand chemical bonding predict vibrational spectra and determine the optical activity of molecules
- To make them understand about various theories such as CFT, LFT, MOT, Orgel and T-S diagrams to know the formation of complexes. • To interpret the electronic spectra of complexes and understand their magnetic properties.
- To understand the stability of coordination complexes by the instrumental techniques

3. Course Outcomes

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

CO1: Illustrate the concept of Symmetry elements, Symmetry operation and point groups , apply these concepts to predict Optical activity Dipolemoments of molecules etc.

CO2: Discuss the postulates of Crystal Field Theory and interpret Crystal Field splitting diagrams for different geometries of metal complexes. This theory can be applied to calculate magnetic moment & crystal field stabilization energy of Metal complexes.

CO3: Describe the different experimental methods to determine the Stability Constants of Metal Complexes and give a correlation between the stepwise and Overall Stability constants

Head
Department of Chemistry
UCS, Osmania University
Hyderabad-500 007.

Chairperson
Board of Studies in Chemistry
Dept of Chemistry
Osmania University, Hyd-07.

4. Course Content

MODULE I: SYMMETRY OF MOLECULES: **(15 hrs)**

Concept of Symmetry in Chemistry – Symmetry Operations – Symmetry Elements: Rotational Axis of Symmetry and Types of Rotational Axes, Plane of Symmetry and types of Planes, Improper Rotational Axis of Symmetry , Inversion Center and Identity Element – More about Symmetry Elements – Molecular Point Groups: Definition and Notation of Point Groups, Classification Molecules in to C1, Cs, Ci, Cn,Cnv, Cnh, C∞v, Dn, Dnh, Dnd, D∞h, Sn (n=even), Td, Oh, Ih, Kh,C_{60}(Fullerenes) Groups. Descent in Symmetry with Substitution – Exercises in Molecular Point Groups – Symmetry and Dipole moment – Symmetry criteria for Optical activity

MODULE II: BONDING IN METAL COMPLEXES- I **(15hrs)**

Crystal Field Theory: Salient features of CFT. d-orbital splitting patterns in regular Octahedral, tetragonally distorted octahedral, Jahn-Tellartheorem, trigonal bipyramidal, trigonal planar, Pentagonal bipyramidal, and linear geometries. Concept of weak field and strong fields. - Calculation of crystal field stabilization energies (CFSE's) in six and four coordinate complexes. Applications of CFSE Normal and Inverse Spinels

Magnetic Properties of Transition Metal complexes :- Types of magnetic behaviour – magnetic susceptibility – calculation of magnetic moment from magnetic susceptibility spin only formula, Quenching of orbital angular momentum – Determination of magnetic moment from Guoy's method.. Applications of magnetic moment data for the determination of oxidation states, bond type and stereochemistry. Spin Crossover

MODULE III: COORDINATION EQUILIBRIA: **(15 hrs)**

Solvation of metal ions- Metal complex formation in Solution-Binary metal complexes. Stability constants (types and relationships between them). – Factors influencing the stability constants: Metal ion effects (charge/size, IP, crystal field effect, John-Teller effect, Pearson theory of hard and soft acids and bases (HSAB), elecronegativity and hardness and softness, symbiosis. (ii) Ligand effects (Basicity, Substituent effect, Steric, chelate (size and number of chelate rings), Macrocyclic and Cryptate effects- crown ethers, crypton, size match selectivity or concept of hole size, limitations, Macrocycles with pendent groups– Methods used for the determination of Stability

constants (Basic Principles only): pH metric, Spectrophotometric and Polarographic methods. Ternary Metal Complexes – definition – Formation of ternary metal complexes – Step- wise and simultaneous equilibria with simple examples

5. References

1.Mark, Ladd. (2000).Symmetry and Group theory in Chemistry. London: Marwood Publishers.
2. Carter, R. L.(1998).Molecular Symmetry and Group Theory. John Wiley & Son.
3. Veera Reddy, K.(1999). Symmetry and Spectroscopy of Molecules. New Age International (P) Limited.
4. Cotton, F.A., Wilkinson,G., Murillo, C.A.,and Bochmann,M.(1999). Advanced Inorganic Chemistry(6th ed).N.Y.Wiley Interscience.
5. Huheey,J.E.,Keiter K.A., and Keiter, R.L.(1993).Inorganic Chemistry(4th ed.). Harper Cottens College Publications.
6. Brian,N. F., and Michael,A.H.Ligand Field Theory and Its Applications (Special Topics in Inorganic Chemistry).Wiley-VCH.
7.Taqui Khan,M. M., and Martell,A.E. (1974). Homogeneous Catalysis by Metal complexes. (VolI).NY :Academic Press.
8. Purcell, K.F., and Kotz, J.C.(1977). Inorganic Chemistry. London: Holt-Saunders International Editions.
9. Greenwood,N.N., and Earn Shaw, A.E. (1997). Chemistry of the elementals (2nd ed.).Butterworth Heinemann.
10. To be, M.L., and John Burgess. (1999). Inorganic Mechanisms. Addison Wesley Longman.
11.Veera Reddy,K.Metal ions in Reaction Mechanisms. Golgotia Publications (P) Ltd.
12. Henderson,R. A.(1993).Mechanisms of Reactions in Transition Metal Sites.London: Oxford Science Publications.
13. Principles of Inorganic Chemistry ,Puri , Sharma , Kalia , 33rd Edition Vishal Publications 2022.
14.Metal Complexes in Aqueous Solutions ,A.E Martel, Robert Hankock ,Springer Science(1996)

1. Syllabus Focus

a) Relevance to Local , Regional , National and Global Development Needs

Local /Regional/National /Global Development Needs	Relevance
Global	Study of symmetry elements is profound importance extending across various domains like: Cultural Significance, Scientific Foundations Technological applications.
National	The global relevance of coordination compounds with specific colors lies in their significant impact on industries, to impart colors to fabrics.
Regional	Understand the basics of stability constants of Metal complexes to design synthesis of metal complexes in Pharma Industries.

b) Components on Skill Development/Entrepreneurship Development/Employability

SD/ED/EMP	Syllabus Content	Description of Activity
SD	Module -1 Symmetry of Molecules	Models of different geometries prepared by students
ED	Module -II	Synthesis of Metal complexes which are used in Medicine as Therapeutic Agents
EMP	Module III	Transition Metals like Copper,Iron used in biological processes from electron transfer to catalysis

2. Pedagogy

S. No	Student Centric Methods Adopted	Type / Description of Activity
1.	Experiential Learning	Preparation of Models -Art Project
2.	Participative Learning	Seminar
3.	Problem Solving	Research projects

3.Course Assessment Plan

a) Weightage of Marks in Continuous Internal Assessments and End Semester Examination

CO	Continuous Internal Assessments CIA – 40%	End Semester Examination-60%
CO1	CIA-2	Models
CO2	CIA -2	Written Exam
CO3	CIA-2	Seminar /Google form

SECTION A - INTERNAL CHOICE			3 Q X 12 M = 36 M	
Question Number	**Module**	**Question**	**CO**	**BTL**
1	Module 1	(a) Define Plane of Symmetry. Explain the types of Symmetry planes with suitable Examples. (b)Explain the Improper Axis of Symmetry on BF_3	CO 1	(Level-I) (Level-II)
2	Module 1	(a) Explain the classification of Molecules into Point groups. (b)Explain the Descent in symmetry in ML_6 octahedral molecule with Substitution.	CO 1	(Level-II) (Level-II)
3	Module 2	(a) Discuss the consequences of Jahn-Teller distortion with any two examples. (b)Calculate the crystal field splitting energy in i) $[Fe(CN)_6]^{4-}$ and ii) $[Ni(H_2O)_6]^{2+}$	CO 2	(Level-II) (Level-II)
4	Module 2	(a) Explain Guoy's methods for the determination of magnetic moment values. (b)Discuss Quenching of orbital angular momentum and magnetic moment values.	CO 2	(Level-II) (Level-II
5	Module 3	(a) Explain the Polarographic method for the determination of stability constants. (b)Write a short note on Macrocyclic and Cryptate effects.	CO 3	(Level-II) (Level-I)
6	Module 3	(a)Discuss the following i) HSAB principle ii) Irving-William's order. (b)Explain the Spectrophotometric method of determination of Stability Constant of Metal complexes.	CO 3	(Level II) (Level II)
SECTION B - ANSWER ANY 4 OUT OF 6 (To compulsorily have Two question from **each** module)			**4Q X 6 M = 24 M**	
7	Module 1	Explain the difference between Principal axis and Secondary axes with an example.	CO 1	(Level-II)
8	Module 1	Determine the Point group of Ferrocene (staggered) listing all symmetry elements.	CO 1	(Level-III)
9	Module 2	Draw the crystal field splitting diagram in Square Planar Complexes.	CO 2	(Level-IV)

SEMESTER-I PRACTICALS

CHEMISTRY LAB: DSC- I **LAB: INORGANIC CHEMISTRY**

Program: M.Sc. Organic Chemistry
Course: DSC-1
Semester: I

Subject Code P24/CHE/DSC/101/P
No. of Hrs. allotted: 4 Hrs / week
No. of Credits : 2

COURSE OUTCOMES:

CO1: Understand the importance of Inorganic Qualitative and Quantitative Analysis and its use in
Research and industry.

CO2: Synthesize Metal complexes by simple Procedures. Gravimetric Estimation of Metal ions

Lab course 1 **Inorganic Chemistry** **4 hrs/week**

Practicals

1. Preparation of complexes

1. Hexaammine nickel (II) chloride.
2. Tris (acetylacetanato) manganese(III).
3. Tris(ethylenediamine) nickel(11) thiosulphate.

II. Calibrations

4. Calibration of weights
5. Calibration of pipettes.
6. Calibration of standard flasks.
7. Calibration of burette

Chairperson
Board of Studies in Chemistry
Dept of Chemistry
Osmania University, Hyd-07

Head
Department of Chemistry
Osmania University
Hyderabad-500 007.

III. Titrimetric Analysis

8. Estimation of Fe2+ by Cerimetry

9. Estimation of Ni^{2+} by complexometry (direct titration method)

10. Estimation of Cu2+ by complexometry (direct titration method)

11. Estimation of Ca^{2+} by complexometry (substitution titration method)

12. Estimation of Ni^{2} by complexometry (back titration method)

13. Estimation of Al by complexometry (back titration method)

IV. One component Gravimetric Analysis

14. Estimation of Zn^{2+}

15. Estimation of Ba^{2+}

References

1. Text book of Quantitative Inorganic Analysis, 3rd edition, A.I. Vogel, ELBS (1969)
2. Vogel's text book of Quantitative Inorganic analysis, 4th edition, Jeffery etal, ELBS (1988).
3. Vogel's text book of Quantitative Inorganic Analysis, 6th edition, J. Mendham etal, Pearson education ltd (2002).
4. Practical Inorganic chemistry, G.Marr and B.W.Rockett, Van Nostrand Reinhold (1972).
5. Experimental Inorganic/Physical Chemistry - An Investigative integrated approach to practical Project work, Mounir A.Malati, Woodhead publishing ltd (1999).
6. Advanced experimental Inorganic chemistry, Ayodhya Singh, Campus books international (2006)
7. Practical Inorganic Chemistry. G. Pass & H. Sutcliffe, University science books (1999)

INORGANIC CHEMISTRY
PRACTICAL MODEL PAPER

Course Code : P24/CHE/DSC/101/P
Credits: 2

Max Time:3hrs
Max marks :50 marks

Answer all questions

1. Explain the principle and procedure for the Synthesis of the metal complex (CO2) 10 M
   OR
2. Explain the Principle in the Estimation of metal ions (Barium / Zinc) by Gravimetric Analysis (CO2)
3. Estimatethe amount of metal ions in a given solution by a systematic procedure of Complexometric / Redox Titration) 25 M. (CO1)
4. Record and Attendance 5 M
5. Viva Voce

Prepared by	Checked &Verified by	Approved by
Name and Signature of the teaching faculty	Name and Signature of HoD	Name and Signature of Principal
D. Sumalatha Dr D. Sumalatha	D. Sumalatha Dr D. Sumalatha	Dr. Uma Joseph

SEMESTER - I

ORGANIC CHEMISTRY-1

1. Course Description

Programme: M.Sc. Organic Chemistry
Course Code: P24/CHE/DSC/102
Course Type: DSC-2
No. of credits: 3

Max. Hours: 45
Hours per week: 3
Max. Marks: 100

2.Course objectives:

- To learn various concepts of stereochemistry by applying symmetry operations.
- To understand the mechanisms involved in Additions and Elimination reactions.
- Deals with different types of strains, energy and stability of different conformers.

3. Course Outcomes

CO1: Explain the criteria for chirality and discuss axial, planar and helical Chirality **(UNDERSTANDING)**

CO2: Discuss the various methods of determination of reaction mechanism **(APPLICATION)**

CO3: Discuss the conformations in saturated and unsaturated acyclic compounds and the factors affecting the stability and reactivity of conformations**(UNDERSTANDING)**

4. Course Content

MODULE 1: STEREOCHEMISTRY (15 hrs)

Molecular representations: Wedge, Fischer, Newman and Saw-horse formulae, their description and interconversions.

Molecular Symmetry & Chirality: Symmetry operations and symmetry elements (Cn & Sn). Criteria for Chirality.Desymmetrization.

Axial, planar and helical chirality: Axially chiral allenes,spiranes,alkylidene cycloalkanes, chiral biaryls, atropisomerism, planar chiral ansa compounds and trans- cyclooctene, helically chiral compounds and their configurational nomenclature

Relative and absolute configuration: Determination of configuration by chemical correlation methods.

Racemisation and resolution techniques: Racemisation, resolutions by direct crystallization, diastereoisomer salt formation chiral chromatography and asymmetric transformation.

Determination of configuration in E, Z-isomers: Spectral and Chemical methods of configuration determination of E,Z isomers. Determination of configuration in aldoximes and ketoximes.

MODULEII: REACTION MECHANISM-I (15 Hrs)

Determination of reaction mechanism: Determination of reaction mechanism: Energy profiles of addition and elimination reactions, transition states, product isolation and structure of intermediates, use of isotopes, chemical trapping and crossover experiments. Use of IR and NMR in the investigation of reaction mechanism.

Electrophilic addition to carbon carbon double bond: Stereoselective addition to carbon carbon double bond; anti addition- Bromination and epoxidation followed by ring opening. Syn addition of OsO4 and KMnO4.

Elimination reactions Elimination reactions E2, E1, E1CB mechanisms.Orientation and stereoselectivity in E2 eliminations. Pyrolytic syn elimination and α-elimination, elimination Vs substitution.

Nucleophilic Aromatic substitution: Aromatic Nucleophilic substitution:SN1(Ar),SN2(Ar), and benzyne mechanisms ;evidence for the structure of benzyne.

MODULE III: CONFORMATIONAL ANALYSIS (ACYCLIC SYSTEMS)(15 hrs)

Conformational isomerism: Introduction to the concept of dynamic stereochemistry. Conformational diastereoisomers and conformational enantiomers. Conformational Nomenclature, conventional method limitation. Klyne-Prelog terminology . Study of conformations in dihaoethanes , halohydrin, ethylene glycol, butane-2, 3-diol amino alcohols and 1,1,2,2-tetrahalobutanes.

Conformations of unsaturated acyclic compounds: Propylene, Acetaldehyde and Butanone.

Physical methods in conformational analysis. Use of Dipole moment, UV, IR and NMR spectral methods in conformational analysis.

Conformational effects on the stability and reactivity of acyclic diastereoisomers: Steric and stereoelectronic factors-examples. Conformation and reactivity (E2 Elimination, NGP, Stereochemistry rearrangements. Curtin – Hammett principle

5.References:

1. Stereochemistry of carbon compounds by ErnestL .Eliel and Samuel H. Wilen
2. Stereochemistry of organic compounds-Principles and Applications by D. Nasipuri
3. Advanced Organic Chemistry by Jerry March
4. Mechanism and Structure in Organic Chemistry S. Mukerjee

6. Syllabus Focus

a) Relevance to Local, Regional, National and Global Development Needs

Local /Regional/National /Global Development Needs	Relevance
LOCAL	Local chemical industries often focus on producing specific compounds with desired stereochemistry for applications like pharmaceuticals, agrochemicals, and specialty chemicals.
REGIONAL	Regional healthcare relies on stereochemistry for drug design and development.
NATIONAL	This knowledge is foundation for innovation in drug discovery, material science, and other applications.
GLOBAL	Addressing global issues such as public health and environmental sustainability.

b) Components on Skill Development/Entrepreneurship Development/Employability

SD/ED/EMP	**Syllabus Content**	**Description of Activity**
SD	Module No. 1	Invite entrepreneurs, professionals, or researchers who apply stereochemistry to share their experiences and insights
ED	Module No.2	A fully detailed mechanism would correlate the original structure of the reactants with the final structure of the products.
EMP	Module No. 3	Encourage critical thinking on research methodologies and applications from publications in journals

7.Pedagogy

S. No	Student Centric Methods Adopted	Type / Description of Activity
1.	Problem Solving	Case studies
2.	Experiential Learning	Field Trips
3.	Participative Learning	Presentation

8. Course Assessment Plan

a) Weightage of Marks in Continuous Internal Assessments and End Semester Examination

CO	Continuous Internal Assessments CIA - 40%	End Semester Examination-60%
CO1	CIA-1 - Written Exam	Written Exam
CO2	CIA-2 - Presentation	
CO3	CIA-2 - Assignment	

b) Model Question Paper - End Semester Exam

ORGANIC CHEMISTRY-II
MODEL QUESTION PAPER
THEORY

Course Code: P24/CHE/DSC/102
Credits: 3

Max Marks:60
Max Hours:2½hrs

SECTION A - INTERNAL CHOICE			**3Q X 12 M = 36M**	
Question Number	**Module**	**Question**	**CO**	**BTL**
1	**Module 1**	1. a) Explain about the four symmetry elements with one example each. b) Describe axial chirality in allenes.	**CO 1**	**Level II** **Level I**
2	**Module 1**	a) How do you determine the configuration of aldoximes and ketoximes? b) Explain resolution of racemic mixture by Diastereomeric salt method in detail.	**CO 1**	**Level I** **Level II**
3	**Module 2**	a) Give a short note on Chemical trapping. b) Explain orientation in elimination reactions	**CO 2**	**Level I** **Level II**
4	**Module 2**	a) How Crossover experiments are used in determining the reaction mechanisms b) Explain the stereochemistry involved in E2 Eliminations	**CO 2**	**Level I** **Level II**

5	Module 3	Write a note on how physical and spectral methods are useful in conformational analysis	CO 3	Level II
6	Module 3	a) Write about Klyne Prelog terminology? Illustrate with examples b) Outline the preferred conformations of ethylene chlorohydrin, and 1- Butene	CO 3	Level II Level II

SECTION B - ANSWER ANY 4 OUT OF 6 **4 Q X 6 M = 24 M**
(To compulsorily have Two questions from each module)

7	Module 1	Give a short note on ANSA compounds	CO 1	Level I
8	Module 1	Explain any three spectral methods used to distinguish cis and Trans isomers.	CO 1	Level II
9	Module 2	Illustrate about syn and anti-addition with one example each.	CO2	Level II
10	Module 2	Explain about E1CB elimination reactions	CO 2	Level II
11	Module 3	Explain Curtin Hammet principle. Explain with a suitable example.	CO 3	Level II
12	Module 3	Explain the conformational analysis of Tetra halo butanes	CO3	Level II

c) Question Paper Blueprint

Modules	Hours Allotted in the Syllabus	COs Addressed	Section A (No. of Questions)	Total Marks	Section B (No. of Questions)	Total Marks
1	15	1	2	12	2	4X6=24
2	15	2	2	12	2	
3	15	3	2	12	2	

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9. CO-PO Mapping

CO	PO	Cognitive Level	Classroom sessions(hrs)
1	1	Understanding	15
2	5	Evaluating	15
3	6	Create	15

SEMESTER-I PRACTICALS

CHEMISTRY LAB: DSC- 6 **LAB: ORGANIC CHEMISTRY -I**

Program: M.Sc.
Course: DSC-6
Semester: II

Subject Code P24/CHE/DSC/102/P
No. of Hrs. allotted: 4 Hrs / week
No. of Credits : 2

COURSE OUTCOMES:

CO1: Understand the importance of organic compound synthesis and its use in research and industry. Understand the procedures for the different steps for the organic compound synthesis .

CO2: Understand the mechanisms for the synthesis of organic compounds in different steps. Understand the recrystallisation of organic compound in variioussteps for the organic compound synthesis.

Organic Chemistry **4 hours/ week**

Synthesis of the following compounds: Tetrahydrocarbazole, 7-hydroxy-4-methyl coumarin, m-dinitrobenzene, m-nitroaniline, hippuric acid, azlactone, anthracene-maleic anhydride adduct, Phthalimide, 2,4-dihydroxyacetophenone. 2,3 Diphenyl quinoxalines, Benzimidazoles, 7- hydroxy 2 – methyl chromone.

References

1. Text book of practical organic chemistry, Vogel
2. Text book of practical organic chemistry, Mann and Saunders.

3. Spectral identification of organic compounds Bassler, Silverstein 5th Edition

MODEL PRACTICAL QUESTION PAPER
ORGANIC CHEMISTRY-I

TIME: 3 hrs

Course Code: P20/CHE/DSC/102/P

Max. Marks: 50

Q1. Write the principle involved in the synthesis of given organic compound. **(CO1, CO2)10M**

Q2. Synthesise the given organic compound and perform recrystallisation.**25M (CO1, CO2)**

Q3. Record + Attendance **5M**

Q4. Viva **10M**

Prepared by	Checked & Verified by	Approved by
Name and Signature of the teaching faculty **Dr.M.Bhargavi** **Dr.K.Susmitha**	**Name and Signature of HoD** **Dr. D. Sumalatha**	**Name and Signature of Principal** **Dr. Uma Joseph**

SEMESTER – I

PHYSICAL CHEMISTRY-I

1. Course Description

Programme: M.Sc. Organic Chemistry
Course Code: P24/CHE/DSC/103
Course Type: DSC-3
No. of credits: 3

Max. Hours: 45
Hours per week: 3
Max. Marks: 100

2. Course Objectives

- To evaluate absolute entropy and heat capacity data for solids, liquids, and gases, to understand the phase equilibrium, and outline the partial molar properties.
- To derive the Liquid junction potential, to describe applications of EMF measurements and electrode polarization, to describe the concept of activity and activity coefficient and to calculate mean activity coefficient.
- To explain the concept of operators, Postulates and Theorems of quantum mechanics, to describe the concept of particle in a box and to apply it for spectral calculation of conjugated molecule.

3. Course Outcomes

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

CO1: Compute absolute entropy from heat capacity data; illustrate the partial molar properties; solve the chemical potential and formulate the Gibbs-Duhem equation. **(UNDERSTANDING)**

CO2: Compare the concentration cells, derive the expression for liquid junction potential; analyse electrode polarization and infer Debye – Huckel – Onsagar equation. **(UNDERSTANDING)**

CO3: Assess various operators, choose the postulates and theorems of quantum mechanics; deduce the expression of wave function and energy of particles moving in one- and three-dimensional box. **(APPLICATION)**

4. Course Content

MODULE I: THERMODYNAMICS (15 Hrs)

Third law of thermodynamics: Evaluation of absolute entropies from heat capacity data for solids, liquids and gases. Standard entropies.

Gibbs equations for non-equilibrium systems. Material equilibrium. Phase equilibrium. Clausius-Clapeyron equation. Conditions for equilibrium in a closed system. The chemical potential. Chemical potential of ideal gases. Ideal-gas reaction equilibrium-derivation of equilibrium constant. Temperature dependence of equilibrium constant-the van't Hoff equation.

Solutions: Partial molar properties-significance. Variation of chemical potential with T and P. Gibbs-Duhem equation-derivation and significance.

Ideal solutions: Thermodynamic properties of ideal solutions. Mixing quantities. Vapour pressure -Raoult's law. Thermodynamic properties of ideally dilute solutions. Vapour pressure- Henry's law.

Non ideal systems: Concept of fugacity, fugacity coefficient. Determination of fugacity. Non ideal solutions. Activities and activity coefficients. Standard-state conventions for non-ideal solutions.

Multicomponent phase equilibrium: Vapour pressure lowering, freezing point depression and boiling point elevation.

MODULE II: ELECTROCHEMISTRY (15 Hrs)

Electrochemical Cells: Derivation of Nernst equation – problems. Chemical and concentration cells (with and without transference). Liquid junction potential (LJP) – derivation of the expression for LJP – its determination and elimination.

Types of electrodes-Gas electrodes, Metal-metal ion electrodes, reference electrodes, indicator electrode, Ion selective electrodes, Metal-insoluble salt-anion electrodes, Redox electrodes.

Applications of EMF measurements: Solubility product, potentiometric titrations, determination of pH using glass electrode, equilibrium constant measurements. Decomposition potential and its significance. Electrode polarization – its causes and elimination. Concentration over-potential. Concept of activity and activity coefficients in electrolytic solutions. The mean ionic activity coefficient.

Debye-Huckel theory of electrolytic solutions: Debye-Huckel limiting law (derivation not required). Calculation of mean ionic activity coefficient. Limitations of Debye-Huckel theory. Extended Debye-Huckel's law. Theory of electrolytic conductance. Derivation of Debye-Huckel-Onsager equation – its validity and limitations.

MODULE III: QUANTUM CHEMISTRY-I

(15 Hrs)

Wave particle duality and uncertain principle-significance of these for microscopic entities. Emergence of quantum mechanics

Wave mechanics and Schrödinger wave equation: Operators- Operator algebra. Commutation of operators, linear operators. Complex functions. Hermitian operators. Operators ∇ and ∇^2. Eigen functions and eigenvalues. Degeneracy. Linear combination of eigenfunctions of an operator. Well-behaved functions Normalized and orthogonal functions.

Postulates of quantum mechanics: Physical interpretation of wave function. Observables and Operators. Measurability of operators. Average values of observables. The time-dependent Schrodinger equation. Separation of variables and the time-independent Schrodinger equation.

Theorems of quantum mechanics: Real nature of the eigen values of a Hermitian operator significance. Orthogonal nature of the eigen values of a Hermitian operator-significance of orthogonality. Expansion of a function in terms of eigenvalues. Eigen functions of commuting operators-significance. Simultaneous measurement of properties and the uncertainty principle.

Particle in a box- one dimensional and three dimensional: Plots of ψ and ψ^2 -discussion. Degeneracy of energy levels. Calculations using wave functions of the particle in a box, orthogonality, measurability of energy, position and momentum, average values and probabilities. Application to the spectra of conjugated molecules.

5. References

1. Atkin's Physical Chemistry, Peter Atkins and Julio de Paula, Oxford University press
2. Physical Chemistry, Ira N. Levine, McGraw Hill
3. Physical Chemistry-A Molecular approach, D.A. McQuarrie and J.D. Simon, Viva Books Pvt. Ltd.
4. Molecular Thermodynamics, D.A. McQuarrie and J.D. Simon, University Science Books
5. Introduction to Electrochemistry, S. Glasstone; East-West Press (Pvt.) Ltd.
6. Modern Electrochemistry, J. O. M. Bockris & A. K. N. Reddy, Plenum
7. Principles of physical chemistry, Samuel H. Maron and Carl F. Prutton, Oxford& IBH
8. Physical Organic Chemistry, N. S. Isaacs, ELBS
9. Elementary Quantum Chemistry, F. L. Pilar, McGraw Hill.
10. Quantum Chemistry – D.A. McQuarrie, Viva Publication
11. Quantum Chemistry, Ira N. Levine, Prentice Hall
12. Introduction to Quantum Chemistry, A.K. Chandra, Tata McGraw Hill
13. Quantum Chemistry, R K Prasad, New Age International Pvt Ltd Publishers

1. Syllabus Focus

a) Relevance to Local, Regional, National and Global Development Needs

Local /Regional/National /Global Development Needs	Relevance
LOCAL	Optimizing energy systems, advancement of electrochemical processes, development of new materials with enhanced properties
REGIONAL	Designing power plants, behavior of electrolytic solutions for water management, drive innovation in computational chemistry
NATIONAL	Formulating energy policies, understanding ion activities in the regulation of pollutants, fostering innovation in healthcare
GLOBAL	Improved energy efficiency and sustainability, development of sustainable strategies, broad implications for industries and technologies

b) Components on Skill Development/Entrepreneurship Development/Employability

SD/ED/EMP	**Syllabus Content**	**Description of Activity**
SD	Module No. 1	Deriving equations, solving theoretical problems, and interpreting results
EMP	Module No.2 (Concentration cells and Liquid Junction Potential, Applications of EMF measurements)	Present case studies from industries where concentration cells and applications of EMF measurements are crucial such as in sensors, batteries, or electrochemical cells
ED	Module No. 3	Invite entrepreneurs, professionals, or researchers who apply quantum chemistry to share their experiences and insights

2. Pedagogy

S. No	Student Centric Methods Adopted	Type / Description of Activity
1.	Problem Solving	Case studies
2.	Participative Learning	Presentation
3.	Experiential Learning	Field Trips

3. Course Assessment Plan

a) Weightage of Marks in Continuous Internal Assessments and End Semester Examination

CO	Continuous Internal Assessments CIA - 40%	End Semester Examination-60%
CO1	CIA-1 - Written Exam	Written Exam
CO2	CIA-2 - Presentation	
CO3	CIA-2 - Assignment	

PHYSICAL CHEMISTRY-I
MODEL QUESTION PAPER
THEORY

Course Code: P24/CHE/DSC/103
Credits: 3

Max Marks:60
Max Hours:2½hrs

SECTION A - INTERNAL CHOICE — **3 Q X 12 M = 36 M**

Question Number	Module	Question	CO	BTL
1	Module 1	(a) Derive Van't Hoff's equation. (b) State third law of thermodynamics. Explain the evaluation of absolute entropy of gases from heat capacity data.	CO 1	(Level-II) (Level-II)
2	Module 1	(a) What is chemical potential? Write Gibbs equations for non-equilibrium systems. (b) What is multicomponent phase equilibrium? Explain depression in freezing point.	CO 1	(Level-I) (Level-II)
3	Module 2	(a) What is electrode polarization? How can it be eliminated? (b) What is liquid junction potential? Derive an expression for LJP. How is it determined experimentally?	CO 2	(Level-I) (Level-II)
4	Module 2	(a) What is a Quinhydrone electrode? How is pH of a solution determined using this Electrode? (b) Derive Debye-Huckel-Onsagar equation.	CO 2	(Level-I) (Level-II)
5	Module 3	(a) State and explain the postulates of quantum mechanics. (b) Derive Schrodinger wave equation for particles in 1D box	CO 3	(Level-II) (Level-II)
6	Module 3	(a) Explain the terms: i) Hermitian Operator ii) Linear operator. (b) Show that the function Sin 3x is an Eigenfunction of the d^2/dx^2. Evaluate the Eigenvalue?	CO 3	(Level II) (Level V)

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SECTION B - ANSWER ANY 4 OUT OF 6 (To compulsorily have Two questions from **each** module)			4Q X 6 M = 24 M	
7	**Module 1**	Write short notes on Raoult's law and Henry's law.	**CO 1**	**(Level-I)**
8	**Module 1**	Explain partial molar properties by slope method.	**CO 1**	**(Level-II)**
9	**Module 2**	Write a short note on decomposition potential and its significance.	**CO 2**	**(Level-I)**
10	**Module 2**	Deduce the Nernst equation for Half-cell potential.	**CO 2**	**(Level V)**
11	**Module 3**	Explain the following: Well behaved function ii) Normalized wave function	**CO 3**	**(Level-II)**
12	**Module 3**	Explain the concept of wave-particle duality.	**CO 3**	**(Level-II)**

c) Question Paper Blueprint

Modules	**Hours Allotted in the Syllabus**	**COs Addressed**	**Section A (No. of Questions)**	**Total Marks**	**Section B (No. of Questions)**	**Total Marks**
1	15	1	2	12	2	**4X6=24**
2	15	2	2	12	2	
3	15	3	2	12	2	

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4. CO-PO Mapping

CO	PO	Cognitive Level	Classroom sessions(hrs)
1	1	Understanding	15
2	1	Understanding	15
3	5	Problem solving	15

SEMESTER-I PRACTICALS

CHEMISTRY LAB: DSC- 3

Program: M.Sc.
Course: DSC-3
Semester: I

LAB: PHYSICAL CHEMISTRY

Subject Code P24/CHE/DSC/103/P
No. of Hrs. allotted: 4 Hrs / week
No. of Credits : 2

COURSE OBJECTIVES:

- To determine the rate constants and order of various reactions
- To apply the instrumentation techniques like conductometry and potentiometry in acid-base titrations
- To determine the specific rotation of sugars using a polarimeter

COURSE OUTCOMES:

This course will help the students to

CO1: Analyze the overall order of various reactions.
CO2: Determine the concentration of acids using a conductometer and potentiometer.
CO3: Obtain the specific rotation of sugars using a polarimeter.

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Lab course 3 **Physical Chemistry** **4 hrs/week**

I. Data Analysis I: Significant figures, Precision, and accuracy

II. Chemical kinetics:

1. Acid-catalysed hydrolysis of methyl acetate with 1N HCl
2. Acid-catalysed hydrolysis of methyl acetate with 2N HCl
3. Peroxydisulphate- I- reaction (overall order)
4. Oxidation of iodide ion by hydrogen peroxide- iodine clock reaction

III. Conductometry:

5. Determination of cell constant
6. Titration of strong acid vs strong base
7. Titration of weak acid vs strong base
8. Determination of dissociation constant of a weak acid

IV. Potentiometry:

9. Titration of strong acid vs strong base
10. Titration of weak acid vs strong base and determination of dissociation constant of a weak acid
11. Determination of single electrode potential

V. Polarimetry:

12. Determination of specific rotation of sucrose
13. Determination of specific rotation of glucose
14. Determination of specific rotation of fructose

VI. Adsorption:

15. Adsorption of acetic acid on animal charcoal or silica gel

References:

1. Senior Practical Physical Chemistry: B.D. Khosla, V.C. Garg and A. Khosla
2. Experimental Physical Chemistry: V. Athawale and P. Mathur.
3. Practical Physical Chemistry: B. Vishwanathan and P.S. Raghavan.
4. Practical in Physical Chemistry: P.S. Sindhu
5. Advanced Practical Physical chemistry: J.B.Yadav

PHYSICAL CHEMISTRY
PRACTICAL MODEL PAPER

Course Code: P24/CHE/DSC/103/P
Credits: 2

Max Time:3hrs
Max marks :50 marks

Answer all questions.

1. Write the Principle involved in the given experiment. **(CO1, CO2, CO3) 10 M**
2. a) Determine the strength of the given acid using Conductometer/Potentiometer. **(CO2)**

   OR

   b) Determine the specific rotation of Optically active Compounds **(CO3).**

   OR

   c) Kinetic Study of 1st Order / 2nd Order Reactions **(CO1) 25 M**
3. Record and Attendance **5 M**
4. Viva Voce **(CO1, CO2, & CO3) 10 M**

Prepared by	Checked &verified by	Approved by
Name and Signature of the teaching faculty	Name and Signature of HoD	Name and Signature of Principal
Uma Rani Dr. B. Uma Rani	D. Sumalatha Dr. D. Sumalatha	Dr. Uma Joseph

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SEMESTER-I

1. Course Description

Programme: M.Sc. Organic Chemistry
Course Code: P24/CHE/OE/101
Course Type: OE
No. of credits: 2

Max. Hours: 30
Hours per week: 2
Max. Marks: 100

2. Course Objectives

The main objective of this course is to introduce the basic concepts in research methodology in Social science. This course addresses the issues inherent in selecting a research problem and discuss the techniques and tools to be employed in completing a research project. This will also enable the students to prepare report writing and framing Research proposals.

3. Course Outcomes

CO1: Students who complete this course will be able to understand and comprehend the basics in research methodology and applying them in research/ project work. **(APPLICATION)**
CO2: This course will help them to select an appropriate research design. **(UNDERSTANDING)**
CO3: With the help of this course, students will be able to take up and implement a research project/ study. **(APPLICATION)**
CO4: The course will also enable them to collect the data, edit it properly and analyze it accordingly. Thus, it will facilitate students' prosperity in higher education. **(APPLICATION)**

4. Course Content

MODULE 1:INTRODUCTION TO RESEARCH METHODOLOGY (15 Hrs)

Introduction to Research Methodology Meaning and importance of Research – Types of Research – Descriptive Vs Analytical, Applied Vs Fundamental, Quantitative Vs Qualitative, Conceptual Vs Empirical, selection and formulation of Research Problem Research Design –Analysis of Literature Review – Primary and Secondary Data collection methods, Literature Review, Hypothesis Significance – Development of Working Hypothesis, Null hypothesis.

MODULE II: SCIENTIFIC REPORT WRITING (15 Hrs)

Research report and its structure, journal articles – Components of journal article. Explanation of various components. Structure of an abstract and keywords. Thesis and dissertations. components of thesis and dissertations. Referencing styles and bibliography. Calculations of Impact factor of a journal, Pictures and Graphs, citation styles, Reproduction of published material – Plagiarism – Citation and Acknowledgement.

5. References:

1. Donald Cooper and PS Schindler (2009) Business Research Methods, 9th edition, Tata McGraw Hill.
2 Kothari C. R Research Methodology
3 Uma Sekaran (2010) Research Methods for Business, 4th edition, Wiley.
4 Ranjit Kumar (2009) Research Methodology, 2nd edition, Pearson Education
5 Naresh Malhotra and S Dash (2009) Marketing Research, 5th edition, Pearson Prentice Hall.
6 Michael V. P Research Methodology.

6. Syllabus Focus

a) Relevance to Local, Regional, National and Global Development Needs

Local /Regional/National /Global Development Needs	Relevance
LOCAL	Build a strong foundation for future research work in a systematic manner by applying notions of Research Methodology.
REGIONAL	Build a strong foundation for future research work in a systematic manner by applying notions of Research Methodology
NATIONAL	Gain ability to apply knowledge of Computer Science to research in real-world issues
GLOBAL	Read, comprehend, and explain research articles in their academic discipline

b)Components on Skill Development/Entrepreneurship Development/Employability

SD/ED/EMP	Syllabus Content	Description of Activity
SD	Module No. 1	Discuss the concepts and procedures of sampling, data collection, analysis and reporting
EMP	Module No.2	Equip themselves with ethical issues related to Research and Publication.

7.Pedagogy

S. No	Student Centric Methods Adopted	Type / Description of Activity
1.	Problem Solving	Case studies
2.	Participative Learning	Presentation
3.	Experiential Learning	Survey

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8. Course Assessment Plan

a) Weightage of Marks in Continuous Internal Assessments and End Semester Examination

CO	Continuous Internal Assessments CIA - 40%	End Semester Examination-60%
CO1	CIA-1 - Assignment	Written Exam
CO2	CIA-1 – Assignment	

Model Paper

Generic Elective, Research Methodology

(P.G Courses of Psychology, Computer Science, Management, Commerce, Mass Communication, Chemistry and Microbiology

Time: 1 Hr **Course Code: P20/CHE/GE/101**

SECTION A - Answer any six questions			6 x 5 = 30M	
Question Number	**Module**	**Question**	**CO**	**BTL**
1	Module 1	Explain the given terms a) Variables and types of variables with examples b) Qualitative and quantitative research	CO 1	Level I
2	Module 1	Describe briefly about the following a) Questionnaire b) Case study	CO 1	Level II
3	Module 1	Elaborate different graphical methods of representation of data collection methods (CO2)	CO 1	Level VI
4	Module 1	Explain hypothesis significance Development of Working Hypothesis, Null hypothesis.	CO 1	Level I
5	Module 2	Explain the steps involved in research report writing	CO 2	Level I
6	Module 2	Explain a) Bibliography b) Plagiarism	CO 2	Level II
7	Module 2	Explain about literature survey	CO 2	Level II