

COURSE WISE BREAKUP

Third Year **Fifth Semester**

THEORY

COURSE CODE	TITLE	CREDIT HOURS	MARKS
CHEM-351	INORGANIC CHEMISTRY	03	100
CHEM-361	ORGANIC CHEMISTRY	03	100
CHEM-371	PHYSICAL CHEMISTRY	03	100
CHEM-311	ANALYTICAL CHEMISTRY	03	100
CHEM-331	BIOCHEMISTRY	03	100

PRACTICALS

COURSE CODE	TITLE	CREDIT HOURS	MARKS
CHEM-351	INORGANIC CHEMISTRY	01	25
CHEM-361	ORGANIC CHEMISTRY	01	25
CHEM-371	PHYSICAL CHEMISTRY	01	25
CHEM-311	ANALYTICAL CHEMISTRY	01	25
CHEM-331	BIOCHEMISTRY	01	25

- **Total Credits of the Semester = 16 (theory 12 & practicles 04 credits)**
- **Maximum Marks = 500 (theory 400 & practicles 100 marks)**

3rd Year; 5th Semester

Title of the Course: **INORGANIC CHEMISTRY**

Code: **CHEM-351**

Credit Hours: **03**

Marks: **100**

Objective of the Program

After completing this program students will be able to learn the following:

1. The historical development of transition element chemistry
2. The importance and applications of the transition elements
3. To learn about coordination chemistry and various theories developed to explain the structure and properties of these complexes
4. Reactions in non aqueous solvents.

Coordination Compounds

Historical back ground of coordination compounds, geometry of complexes having coordination number 2 to 9, nomenclature, theories of coordination compounds; Werner's theory, valence bond theory, crystal field and; molecular orbital theory; Jahn-Teller theorem; magnetic properties; spectrochemical series, isomerism and stereochemistry, stability constants, techniques for studying complexes, applications of coordination compounds.

Non Aqueous Solvents

Classification of solvents, types of reactions in solvents, effect of physical and chemical properties of solvent, detailed study of liq. NH₃, liq. H₂SO₄, liq HF, and liq. SO₂, BrF₃ and reaction in molten salts system.

3rd Year; 5th Semester

Title of the Practical: **INORGANIC CHEMISTRY**

Code: **CHEM-351**

Credit Hours: **01**

Marks: **25**

1. Semi-micro analysis and Separation of anions in a mixture by paper chromatography
2. Preparation of at least four coordination compounds in a pure state
3. Complexometric titrations

RECOMMENDED BOOKS:

1. Huheey, J. E., Keiter, E. A. and Keiter, R. L., "Inorganic Chemistry: Principles of Structure and Reactivity", 4th Ed., Harper and Row, New York, 2001

2. Cotton, F. A., Wilkinson, G. and Gaus, P. L., "Basic Inorganic Chemistry", 3rd Ed., Wiley, New York, 1995.
3. Atkins, P. and Jones, L., "Chemicals Principles" Freeman & Company, 2002.
4. F. A. Cotton, G. Wilkinson, C. A. Murillo and M. Bochmann, "Advanced Inorganic Chemistry", 6th Ed., Wiley-Interscience, New York, 1999.
5. A. K. Holliday, and A. G. Massey, "Inorganic Chemistry in Non- Aqueous Solvents", Pergamon Press, New York, 1990.
6. Larsen, E. M., "Transition Elements", W. A. Benjamin Inc., 1995
7. Bassette, J., Denney, G. H. and Mendham, J., "Vogel's Textbook of Quantitative Inorganic Analysis Including Elementary Instrumental Analysis" English Language Book Society, 4th Edition, 1981.
8. Vogel, A. I., "A Textbook of Micro and Semi-micro Qualitative Inorganic Analysis" Longman Green & Co. 1995.

3rd Year; 5th Semester

Title of the Course: **ORGANIC CHEMISTRY**

Code: **CHEM-361**

Credit Hours: **03**

Marks: **100**

Isomerism

Introduction; classification of isomerism; optical isomerism: optical activity, chirality and optical activity, symmetry elements and optical inactivity, relative and absolute configuration, R,S notation, method of determining configuration, racemic mixtures and their resolution, asymmetric synthesis, optical activity in biphenyls, allenes and spiro compounds, stereospecific and stereoselective reactions; geometrical isomerism: determination of configuration of geometrical isomers, Z,E convention and *cis trans* isomerism in cyclic systems; conformational isomerism: conformational analysis of mono-substituted cyclohexanes, di-substituted cyclohexanes and decalin systems.

Introductory Organic Spectroscopy

Introduction to IR, UV, ¹H-NMR and Mass spectrometric methods, and their usage for structure elucidation of some simple organic compounds.

Aliphatic Substitution Reactions

Aliphatic Nucleophilic Substitution Reactions: Mechanisms—study of

SN₂, SN₁, SN_i, SN₂' , SN₁' , SN_i' mechanisms; neighbouring group participation—intramolecular displacement by neighbouring oxygen, nitrogen, sulphur and halogen; structure and reactivity—effects of the substrate structure, entering group, leaving group and reaction medium on the mechanisms and rates of substitution reactions.

Aliphatic Electrophilic Substitution Reactions: Mechanisms—study of SE₁, SE₂ (front), SE₂ (back) and SE_i mechanisms; structure and reactivity—effects of substrate, leaving group and medium on the rates of these reactions.

Elimination Reactions

Eliminations Proceeding by Polar Mechanisms: Study of E₁, E_{1cB} and E₂ mechanisms; orientation: Saytzeff and Hofmann rules; structure and reactivity—the effects of substrate structure, attacking base, leaving group and the reaction medium on the rates and mechanisms of elimination reactions; competition between elimination and substitution reactions.

Eliminations Proceeding by Non-polar Mechanisms: Pyrolytic eliminations—study of E_i and free-radical mechanisms; orientation in pyrolytic eliminations.

3rd Year; 5th Semester

Title of the Practical: **ORGANIC CHEMISTRY**

Code: **CHEM-361**

Credit Hours: **01**

Marks: **25**

Laboratory work illustrating topics covered in the lecture of Chem-261

RECOMMENDED BOOKS:

1. Eliel, E. L., Wilen, S. H. and Doyle, M. P., “Basic Organic Stereochemistry”, Wiley-Interscience, New York.
2. Loudon, G. M., “Organic Chemistry”, Oxford University Press, New York.
3. March, J., “Advanced Organic Chemistry”, John Wiley & Sons, New York.
4. Sykes, P., “A Guide Book to Mechanism in Organic Chemistry”, Longman, London.
5. Norman, R. O.C. and Coxon, J. M., “Principles of Organic Synthesis”, Nelson Thornes, Cheltenham.
6. Kalsi, P.S. “Spectroscopy of Organic Compounds”, Wiley Eastern Ltd., New Delhi.

7. Pavia, D. L., Lampman, G. M. and Kriz, G. S., "Introduction to Spectroscopy: A Guide for Students of Organic Chemistry", Saunders Golden Sunburst Series, London.
8. Morrison, R. T. and Boyd, R. N., "Organic Chemistry", Prentice-Hall of India, New Delhi.
9. McMurry, J., "Organic Chemistry", Brooks/Cole Publishing Company, California.
10. Carey, F. A., "Organic Chemistry", McGraw-Hill, New York.
11. Solomons, T. W. G. and Fryhle, C. B., "Organic Chemistry", John Wiley & Sons, New York.

3rd Year; 5th Semester

Title of the Course: **PHYSICAL CHEMISTRY**

Code: **CHEM-371**

Credit Hours: **03**

Marks: **100**

Kinetic Theory of Gases

Maxwell's law of molecular velocities. Calculation of molecular velocities and binary collisions. Maxwell-Boltzmann's law of energy distribution. Method for the determination of the Avogadro number (NA).

Chemical Thermodynamics

Relation of entropy and energy with equilibrium constant, and their dependence on temperature. Clausius-Clapeyron's equation. Chemical potential. Partial molar quantities. Free energy change. Fugacity of gases. Phase diagram and stability of a single component system.

Chemical Kinetics

Integrated rate laws: Third order reactions with same and different initial concentrations of reactants. Effect of temperature on the reaction rate. Elementary and complex reactions: opposing, parallel, consecutive bimolecular reactions and chain reactions. Steady state approximation, Lindemann's theory of unimolecular reactions. Bimolecular collision theory, transition state theory, kinetics of thermal and photochemical reactions.

Quantum Chemistry

Limitation of classical mechanics, Wave and particle nature of matter, de Broglie's equation, Heisenberg's uncertainty principle. Schrodinger wave equation and its solution for particle in 1-

dimensional and 3- dimensional boxes. Concept of quantization of energy, introduction to spectroscopy of molecules, spectra of hydrogen and hydrogen like atoms.

3rd Year; 5th Semester

Title of the Practical: **PHYSICAL CHEMISTRY**

Code: **CHEM-371**

Credit Hours: **01**

Marks: **25**

1. Equilibrium constant of the $KI + I_2 = KI_3$ reaction
2. Kinetics of saponification of ethyl acetate
3. Acid catalyzed hydrolysis of sucrose
4. Study of the adsorption isotherms of acetic acid-charcoal system
5. Study of the charge transfer complex formation between iodine and benzene
6. Determination of activation energy for the acid catalyzed
7. Hydrolysis of ethyl acetate
8. Determination of partial molar volumes
9. Characterization of the given compound by UV-Vis spectroscopy

RECOMMENDED BOOKS:

1. Alberty, R. A., Robert J.S. and Mounji G. B. “ Physical Chemistry”. 4th ed, John Wiley and Sons (2004).
2. Ball, D W., “Physical Chemistry” 1st ed., Brooks/Cole Co. Inc. (2003).
3. Engel, Thomas and Reid p., “Thermodynamics, Statistical Thermodynamics, and Kinetics” 1st ed., Benjamin Cummings (2006).
4. James K. and Wothers, P., “Why Chemical Reactions Happen”. Oxford University Press (2003).
5. Smith, E. Brain, “Basic Chemical Thermodynamics” 5th ed., Imperial College Press (2004).
6. Stephen B. R., Rice S. A. and Roses J., “Physical Chemistry” 2nd ed., Oxford University Press (2000).
7. Jurg W., “Basic Chemical Thermodynamics” W. A. Benjamin (1969).
8. Chorkendorff, I. and Niemantsverdriet, J.W. “Concept of Modern Catalysis and Kinetics” 1st ed., John Wiley and Sons (2003).

9. Espenson, J. H. "Chemical Kinetics and Reaction Mechanism" 2nd ed., McGraw Hill (2002).
10. Berry R. S., Stuart A.R., and Roses J. "Physical and Chemical Kinetics" 2nd ed., Oxford University Press (2000).
11. Helpen Arthur M., "Experimental Physical Chemistry: A Laboratory Textbook" 2nd ed., Prentice Hall (1997).
12. Bassette J., Denney C., Jeffery G. H. and Mendham J. "Vogel's Textbook of Quantitative Inorganic Analysis Including Elementary Instrumental Analysis" English Language Book Society. 4th ed. (1978).
14. Daniel, F., "Experimental Physical Chemistry" McGraw Hill (1962).
15. Shoemaker, D., "Experimental Physical Chemistry" McGraw Hill (1989)

3rd Year; 5th Semester

Title of the Course: **ANALYTICAL CHEMISTRY**

Code: **CHEM-311**

Credit Hours: **03**

Marks: **100**

Course Contents:

Principles and Application of Chemical Equilibrium Systems in Quantitative Analysis

1. Gravimetric Methods of Analysis

Solubility and solubility product of sparingly soluble salts, separation by precipitation, formation and particle size of precipitates, types of precipitates, impurities in precipitates, quantitative calculations, stoichiometric reactions.

2. Neutralization Titration

Theory of neutralization titration, titration curves, theories of indicators, choice of indicator, buffer, preparation of buffer, buffer capacity, buffer mechanism. Application of neutralization titration. Hydrolysis of salts and pH calculations.

3. Complexometric and Precipitation Titrations

Complex formation reactions, titration with chelating agents, indicators used in complexometric titrations, precipitation titration, end-point location in precipitation titration, application of complexometric and precipitation titrations.

4. Redox Titrations

Oxidizing and reducing agents, titration curves, choice of indicator, colour change mechanism, application of redox titrations.

3rd Year; 5th Semester

Title of the Practical: ANALYTICAL CHEMISTRY

Code: CHEM-311

Credit Hours: 01

Marks: 25

1. Calibration of volume measuring glasswares.
2. Calibration of electronic analytical balance.
3. Calibration of conductivity meter and potentiometer.
4. Two experiments demonstrating the use of gravimetry in quantitative analysis.
5. Two experiments based on acid-base titrations.
6. Two experiments based on complexometric titrations.
7. Two experiments based on redox titrations.

3rd Year; 5th Semester

Title of the Course: BIOCHEMISTRY

Code: CHEM-331

Credit Hours: 03

Marks: 100

Objective of the Course:

This course provides fundamental concepts about the energy production and the mechanisms of the major macromolecules metabolism. Regulation and inhibition of the metabolic pathways are also addressed. This course will also integrate knowledge of bioenergetics and the metabolic pathways of amino acids, proteins, carbohydrates, nucleic acids and lipids to solve biological problems.

Course Contents:

Intermediary Metabolism and Bioenergetics

Biological oxidation—Reduction including respiratory carriers. Cell bioenergetics. Oxidative Phosphorylation. Free energy change and redox System.

Metabolism of Carbohydrates

Digestion, Absorption and Transport of sugars into cell. Glycolysis, Citric Acid Cycle, HMP pathway and its significance. Uronic acid pathway. Gluconeogenesis, Glycogenesis, Glycogenolysis, Photosynthesis.

Metabolism of Lipids

Digestion of Lipids. Absorption and Transport of lipids and fatty Acids. Oxidation of saturated, Un saturated. Odd Chain and Branched chain fatty acids. Biosynthesis of Fatty Acids and eicosanoids Biosynthesis of triglycerides, phospholipids, steroids and Bile Acids. Biosynthesis and utilization of Ketone bodies.

Metabolism of Proteins

Digestion of proteins. Absorption and Transport of Amino acids to the cell. Biochemical reaction of amino acids: Decarboxylation Deamination, Transamination and transmethylation etc. Metabolism of Essential Amino Acids, Metabolic disorders, Urea cycle. Creatine and uric Acid Synthesis, Inter-relationship between carbohydrate, lipid and protein metabolism.

Metabolism of Nucleic Acids

Biosynthesis and Catabolism of purines and Pyrimidines and their regulation. Synthesis of Catabolism, of Nucleosides DNA Polymerases and other enzymes involved in metabolism.

3rd Year; 5th Semester

Title of the Practical: **BIOCHEMISTRY**

Code: **CHEM-331**

Credit Hours: **01**

Marks: **25**

Qualitative and Quantitative analysis of carbohydrates, lipids and proteins

RECOMMENDED BOOKS:

1. Lehninger, A. L, "Principles of Biochemistry", Worth Publisher, New York, (2001).
2. Voet, D. and Voet J. G., "Biochemistry", John Wiley & Sons, New York, (2000).
3. Murray, R. K., Mayes P. A., Granner, D. K. and Rodwell, V. W., Harper's Biochemistry", Appleton & Lange (2000).
4. Robert, Harper's Biochemistry", 25th Ed, (2000).
5. West, Text Book of Biochemistry", 4th Ed., (2000).
6. Zubay, G., Biochemistry, 4th Ed., Macmillan Publishing Co. (1999).

7. Bhagavan. N. V., Biochemistry, 2nd Ed., J.B. Lippincott Company (1978).
8. Plummer, D.T., An introduction to practical biochemistry, TATA McGraw-Hill Publishing Company LTD.
9. Sawhney, S. K. and R. Sing (Editors), Introductory Practical Biochemistry, Narosa Publishing House, New Delhi, (2005).