

SYLLABUS
B.S. (Chemistry)
(4 Years)
Semester System



DEPARTMENT OF CHEMISTRY
UNIVERSITY OF MALAKAND
CHAKDARA, DIR (L)
2009

DETAILED BREAKUP

S#	Semester	Credit Hours			Marks		
		Theory	Practical	Total	Theory	Practical	Total
1	First Year First Semester	15	01	16	500	25	525
2	First Year Second Semester	17	01	18	550	25	575
3	Second Year Third Semester	16	01	17	525	25	550
4	Second Year Fourth Semester	15	03	18	525	75	600
5	Third Year Fifth Semester	15	05	20	500	125	625
6	Third Year Sixth Semester	15	05	20	500	125	625
7	Fourth Year Seventh Semester	09	06	15	300	150	450
8	Fourth Year Eighth Semester	09	06	15	300	200	500
Category Total		111	28	139	3700	750	4450

COURSE WISE BREAKUP

First Year

First Semester

THEORY

COURSE CODE	TITLE	CREDIT HOURS	MARKS
ENG-101	ENGLISH-I (FUNCTIONAL)	03	100
GEN-101	GENERAL-I	03	100
GEN-101	GENERAL-II	03	100
MATH-101	MATHEMATICS-I	03	100
BIO-101	FUNCTIONAL BIOLOGY-I	03	100
CHEM-151	INORGANIC CHEMISTRY	03	100

PRACTICALS

COURSE CODE	TITLE	CREDIT HOURS	MARKS
CHEM-151	INORGANIC CHEMISTRY	01	25

- Total Credits of the Semester = 16 (theory 15 & practicles 01 credits)
- Maximum Marks = 525 (theory 500 & practicles 25 marks)

1st Year; 1st Semester

Title of the Course: **ENGLISH-I (FUNCTIONAL)**

Code: **ENG-101**

Credit Hours: **03**

Marks: **100**

Objectives: Enhance language skills and develop critical thinking.

Course Contents:

Basics of Grammar, Parts of speech and use of articles, Sentence structure, active and passive voice, Practice in unified sentence, Analysis of phrase, clause and sentence structure, Transitive and intransitive verbs, Punctuation and spelling

Comprehension: Answers to questions on a given text

Discussion: General topics and every-day conversation (topics for discussion to be at the discretion of the teacher keeping in view the level of students)

Listening: To be improved by showing documentaries/films carefully selected by subject teachers

Translation Skills, Urdu to English

Paragraph Writing: Topics to be chosen at the discretion of the teacher

Presentation Wskills: Introduction, Extensive reading is required for vocabulary building

RECOMMENDED BOOKS:

1. Functional English

a) Grammar:

1. Practical English Grammar by A.J. Thomson and A.V., Martinet. Exercises 1. Third edition. Oxford University, Press. 1997. ISBN 0194313492.
2. Practical English Grammar by A.J. Thomson and A.V., Martinet. Exercises 2. Third edition. Oxford University, Press. 1997. ISBN 0194313506

b) Writing

1. Writing. Intermediate by Marie-Christine Boutin, Suzanne Brinand and Francoise Grellet. Oxford, Supplementary Skills. Fourth Impression 1993. ISBN 019 435405 7 Pages 20-27 and 35-41.

c) Reading/Comprehension

1. Reading. Upper Intermediate. Brain Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression, 1992. ISBN 0 19 453402 2.

1st Year; 1st Semester

Title of the Course: GENERAL-I

Code: GEN-101

Credit Hours: 03

Marks: 100

Social Issues of Pakistan:

Social problems: concept and approaches. Nature and scope of Pakistani social problems. Corruption, child labour, terrorism, gender bias, population growth, poverty and diseases, non-access to quality health, violation of human rights, honour killing, malnutrition, problems of working women, beggary, unemployment, drug abuse, dowry system, non-vaccination of children in rural areas, problems in rural girls education, non-empowerment of women in decision making. Causes and remedies.

1st Year; 1st Semester

Title of the Course: GENERAL-II

Code: GEN-101

Credit Hours: 03

Marks: 100

History of Science:

Concept of science, scientist and natural philosopher.

1. Early cultures: Empirical investigations of the natural world by Ancient Egypt, Ancient Mesopotamia and Ancient Greek philosophers (Aristotle, Plato etc). Science in the Roman world, India and China.
2. Science in the Middle Ages: Application of scientific methods for investigations. Science in the Islamic World (Ibn al-Haytham, Abu Rayhan al-Biruni, al-Razi, Muhammad ibn Musa al-Khwarizmi, Avicenna, al-Farabi, Nasir al-Din al-Tusi) and science in the Medieval Europe (Roger Bacon etc).
3. Modern science: 18th century onwards (scientific revolution), the birth of specific disciplines.

1st Year; 1st Semester

Title of the Course: **MATHEMATICS-I**

Code: **MATH-101**

Credit Hours: **03**

Marks: **100**

Specific Objectives of the Course: To prepare the students, not majoring in mathematics, with the essential tools of algebra to apply the concepts and the techniques in their respective disciplines.

Course Contents:

Preliminaries: Real-number system, complex numbers, introduction to sets, set operations, functions, types of functions.

Matrices: Introduction to matrices, types, matrix inverse, determinants, system of linear equations, Cramer's rule.

Quadratic Equations: Solution of quadratic equations, qualitative analysis of roots of a quadratic equations, equations reducible to quadratic equations, cube roots of unity, relation between roots and coefficients of quadratic equations.

Sequences and Series: Arithmetic progression, geometric progression, harmonic progression.

Binomial Theorem: Introduction to mathematical induction, binomial theorem with rational and irrational indices.

Trigonometry: Fundamentals of trigonometry, trigonometric identities.

RECOMMENDED BOOKS:

1. Dolciani MP, Wooton W, Beckenback EF, Sharron S, Algebra 2 and Trigonometry, 1978, Houghton & Mifflin,
2. Boston (suggested text) Kaufmann JE, College Algebra and Trigonometry, 1987, PWSKent Company, Boston
3. Swokowski EW, Fundamentals of Algebra and Trigonometry (6th edition), 1986, PWS-Kent Company, Boston

1st Year; 1st Semester

Title of the Course: FUNCTIONAL BIOLOGY-I

Code: BIO-101

Credit Hours: 03

Marks: 100

Course Contents:

Principles of Cellular Life: Chemical Basis Structure and Function, Principles of Metabolism, Energy Acquisition

Principles of Inheritance: Mitosis and Meiosis, Chromosomes, Observable Inheritance Patterns, DNA Structure and Function, RNA and Proteins, Genes, Genetic Engineering and Biotechnology

Biodiversity: Fundamental Concept of Biodiversity,

One or two examples of each of the following from commonly found organism

Prions, Viruses, Bacteria, Protistans, Algae, Fungi, Plants, Crops, Animals, Invertebrates, Vertebrates

RECOMMENDED BOOKS:

1. Roberts, M.M., Reiss and G. Monger. 2000. Advanced Biology, Nelson.
2. Starr, C, and R, Taggart, 2001. Biology: The Unity and Diversity, of Life Brooks and Cole.
3. Campbell, N.A., J.B, Reece, L.G. Mitchell, M.R, Taylor. 2001, Biology: Concepts and Connections. Prentice-Hall.

1st Year; 1st Semester

Title of the Course: INORGANIC CHEMISTRY

Code: CHEM-151

Credit Hours: 03

Marks: 100

Objectives:

1. The Development of periodic law and properties of elements in a systematic way.
2. The principal of chemical bonding
3. Chemistry of acid and bases
4. Chemistry of p-block Elements

Course Contents:

The Periodic Law and Periodicity

Development of Periodic Table; Classification of elements based on *s*, *p*, *d* and *f* orbitals; group trends and periodic properties in *s*, *p*, *d* and *f* block elements, i.e., atomic radii, ionic radii, ionization potential, electron affinities, electronegativities and redox potential.

Principles of Chemical Bonding

Types of chemical bonding; ionic bonding; the localized bond; approach: VB theory, hybridization and resonance; the delocalized approach to bonding: molecular orbital theory as applied to diatomic and polyatomic molecules, three center bonds, bonding theory of metals and intermetallic compounds; conductors, insulators and semiconductors; bonding in electron deficient compounds; hydrogen bonding.

Acids and Bases

Concepts of acids and bases including SHAB concept, relative strength of acids and bases, significance of pH, pK_a, pK_b and buffer solutions. Theory of Indicators; solubility; solubility product; common ion effect and their industrial applications.

Chemistry of p-block Elements

Chemistry and structure of *p*-block elements; main emphasis on the chemistry and structure of noble gases and their compounds; chemistry and structure of interhalogens; pseudohalogens and polyhalides. Prediction of shapes of molecules using VSEPR model and hybridization.

1st Year; 1st Semester

Title of the Practical: INORGANIC CHEMISTRY

Code: CHEM-151 Credit Hours: 01 Marks: 25

Course Contents

Laboratory Ethics and Safety Measures

Awareness about the toxic nature of chemicals and their handling, cleaning of glassware, safe laboratory operations

Qualitative Analysis

Analysis of four ions (two anions and two cations) from mixture of salts

Quantitative Analysis

Laboratory work illustrating topics covered in the lecture of Inorganic Chemistry.

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. Clyde Day, M. & Selbin, J., “Theoretical Inorganic Chemistry”, 2nd Ed., Van Nustrand Reinhold, 1969.
4. Lee, J.D., “Concise Inorganic Chemistry”, Chapman and Hall, 5th Edition, 1996.
5. Shriver, D. F., Atkins, P. W. and Langford, C. H., “Inorganic Chemistry”, Oxford University Press, 2nd Edition, 1994.
6. 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.
7. Vogel, A. I., “A Textbook of Micro and Semi-micro Qualitative Inorganic Analysis” Longman Green & Co. 1995.

COURSE WISE BREAKUP

First Year

Second Semester

THEORY

COURSE CODE	TITLE	CREDIT HOURS	MARKS
ENG-102	ENGLISH-II (FUNCTIONAL)	03	100
IS-102	ISLAMIC STUDIES	02	50
GEN-102	GENERAL-III	03	100
MATH-102	MATHEMATICS-II	03	100
BIO-102	FUNCTIONAL BIOLOGY-II	03	100
STAT-102	STATISTICS	03	100
CHEM-162	ORGANIC CHEMISTRY-I	03	100

PRACTICALS

COURSE CODE	TITLE	CREDIT HOURS	MARKS
CHEM-162	ORGANIC CHEMISTRY	01	25

- **Total Credits of the Semester = 18 (theory 17 & practicles 01 credits)**
- **Maximum Marks = 575 (theory 550 & practicles 25 marks)**

1st Year; 2nd Semester

Title of the Course: **ENGLISH-II (FUNCTIONAL)**

Code: **ENG-102**

Credit Hours: 03

Marks: 100

Objectives: Enable the students to meet their real life communication needs.

Course Contents

Paragraph Writing: Practice in writing a good, unified and coherent paragraph

Essay Writing: Introduction

CV and Job Application

Translation Skills: Urdu to English

Study Skills: Skimming and scanning, intensive and extensive, and speed reading, summary and précis writing and comprehension

Academic Skills: Letter/memo writing, minutes of meetings, use of library and internet

Presentation Skills: Personality development (emphasis on content, style and pronunciation)

RECOMMENDED BOOKS:

a) Grammar

1. Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 2. Third edition. Oxford University, Press 1986. ISBN 0 19 431350 6.

b) Writing

1. Writing. Intermediate by Marie-Christine Boutin, Suzanne Brinand and Françoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 019 435405 7 Pages 45-53.
2. Writing. Upper-Intermediate by Rob Nolasco. Oxford Supplementary Skills. Fourth Impression 1992. ISBN 019 435406 5 (particularly good for writing memos, introduction to presentations, descriptive and argumentative writing).

c) Reading

1. Reading. Advanced. Brian Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1991. ISBN 0 19 453403 0.
2. Reading and Study Skills by John Langan
3. Study Skills by Richard Yorky.

1st Year; 2nd Semester

Title of the Course: ISLAMIC STUDIES

Code: IS-102

Credit Hours: 02

Marks: 50

Objectives: This course is aimed at:

1. To provide Basic information about Islamic Studies
2. To enhance understanding of the students regarding Islamic Civilization
3. To improve Students skill to perform prayers and other worships
4. To enhance the skill of the students for understanding of issues related to faith and religious life.

Course Contents:

Introduction to Quranic Studies

1. Basic Concepts of Quran, 2. History of Quran, 3. Uloom-ul -Quran

Study of Selected Text of Holly Quran

1. Verses of Surah Al-Baqra Related to Faith (Verse No-284-286)
2. Verses of Surah Al-Hujrat Related to Adab Al-Nabi (Verse No-1-18)
3. Verses of Surah Al-Mumanoon Related to Characteristics of faithful (Verse No-1-11)
4. Verses of Surah al-Furqan Related to Social Ethics (Verse No.63-77)
5. Verses of Surah Al-Inam Related to Ihkam(Verse No-152-154)

Study of Selected Text of Holly Quran

1. Verses of Surah Al-Ihzab Related to Adab al-Nabi (Verse No.6, 21, 40, 56, 57, 58.)
2. Verses of Surah Al-Hashar (18, 19, 20) Related to thinking, Day of Judgment
3. Verses of Surah Al-Saf Related to Tafakar,Tadabar (Verse No. 1,14)

Seerat of Holy Prophet (S.A.W)-I

1. Life of Muhammad Bin Abdullah (Before Prophet Hood)
2. Life of Holy Prophet (S.A.W) in Makkah
3. Important Lessons Derived from the life of Holy Prophet in Makkah

Seerat of Holy Prophet (S.A.W)-II

1. Life of Holy Prophet (S.A.W) in Madina
2. Important Events of Life Holy Prophet in Madina
3. Important Lessons Derived from the life of Holy Prophet in Madina

Introduction to Sunnah

1. Basic Concepts of Hadith, 2. History of Hadith, 3. Kinds of Hadith, 4. Uloom-ul-Hadith, 5. Sunnah & Hadith, 6. Legal Position of Sunnah

Selected Study from Text of Hadith

Introduction to Islamic Law & Jurisprudence

1. Basic Concepts of Islamic Law & Jurisprudence
2. History & Importance of Islamic Law & Jurisprudence
3. Sources of Islamic Law & Jurisprudence
4. Nature of Differences in Islamic Law
5. Islam and Sectarianism

Islamic Culture & Civilization

1. Basic Concepts of Islamic Culture & Civilization
2. Historical Development of Islamic Culture & Civilization
3. Characteristics of Islamic Culture & Civilization
4. Islamic Culture & Civilization and Contemporary Issues

Islam & Science

1. Basic Concepts of Islam & Science
2. Contributions of Muslims in the Development of Science
3. Quranic & Science

Islamic Economic System

1. Basic Concepts of Islamic Economic System
2. Means of Distribution of wealth in Islamic Economics
3. Islamic Concept of Riba
4. Islamic Ways of Trade & Commerce

Political System of Islam

1. Basic Concepts of Islamic Political System
2. Islamic Concept of Sovereignty
3. Basic Institutions of Govt. in Islam

Islamic History

1. Period of Khlaft-E-Rashida, 2. Period of Ummayyads, 3. Period of Abbasids

Social System of Islam

1. Basic Concepts of Social System of Islam, 2. Elements of Family, 3. Ethical Values of Islam

REFERENCE BOOKS:

1. Hameed ullah Muhammad, “Emergence of Islam”, IRI, Islamabad
2. Hameed ullah Muhammad, “Muslim Conduct of State”
3. Hameed ullah Muhammad, ‘Introduction to Islam
4. Mulana Muhammad Yousaf Islahi,”
5. Hussain Hamid Hassan, “An Introduction to the Study of Islamic Law” leaf Publication Islamabad, Pakistan.
6. Ahmad Hasan, “Principles of Islamic Jurisprudence” Islamic Research Institute, International Islamic University, Islamabad (1993)
7. Mir Waliullah, “Muslim Jrisprudence and the Quranic Law of Crimes” Islamic Book Service (1982)
8. H.S. Bhatia, “Studies in Islamic Law, Religion and Society” Deep & Deep Publications New Delhi (1989)
9. Dr. Muhammad Zia-ul-Haq, “Introduction to Al Sharia Al Islamia” Allama Iqbal Open University, Islamabad (2001).

1st Year; 2nd Semester

Title of the Course: GENERAL-III

Code: GEN-102

Credit Hours: 03

Marks: 100

Social Psychology:

Social interaction, person perception, self defense, prejudice, social expectations, conformity and obedience, sociobiology, social learning, social economics, persuasion.

1st Year; 2nd Semester

Title of the Course: MATHEMATICS-II

Code: MATH-102

Credit Hours: 03

Marks: 100

Specific Objectives of the Course: To prepare the students, not majoring in mathematics, with the essential tools of calculus to apply the concepts and the techniques in their respective disciplines.

Course Outline:

Preliminaries: Real-number line, functions and their graphs, solution of equations involving absolute values, inequalities.

Limits and Continuity: Limit of a function, left-hand and right-hand limits, continuity, continuous functions.

Derivatives and their Applications: Differentiable functions, differentiation of polynomial, rational and transcendental functions, derivatives.

Integration and Definite Integrals: Techniques of evaluating indefinite integrals, integration by substitution, integration by parts, change of variables in indefinite integrals.

RECOMMENDED BOOKS:

1. Anton H, Bevens I, Davis S, *Calculus: A New Horizon* (8th edition), 2005, John Wiley, New York
2. Stewart J, *Calculus* (3rd edition), 1995, Brooks/Cole (suggested text) Swokowski EW, *Calculus and Analytic Geometry*, 1983, PWS-Kent Company, Boston
3. Thomas GB, Finney AR, *Calculus* (11th edition), 2005, Addison-Wesley, Reading, Ma, USA

1st Year; 2nd Semester

Title of the Course: FUNCTIONAL BIOLOGY-II

Code: BIO-102

Credit Hours: 03

Marks: 100

Course Contents:

Myths and Realities of Evolution: Microevolution; Speciation; Macroevolution

Level of Organization:

Plants: Tissues; Nutrition and Transport; Reproduction; Growth and Development.

Animals: Tissue, Organ System and Homeostasis; Information Flow and Neuron Nervous System; Circulation and Immunity; Nutrition and Respiration; Reproduction and Development

Ecology and Behavior: Ecosystems; Biosphere; Social Interactions; Community Interactions; Human Impact on Biosphere; Environment Conservation

RECOMMENDED BOOKS:

1. Roberts, M.M., Reiss and G. Monger. 2000. Advanced Biology, Nelson.
2. Starr, C, and R, Taggart, 2001. Biology: The Unity and Diversity, of Life Brooks and Cole.
3. Campbell, N.A., J.B, Reece, L.G. Mitchell, M.R, Taylor. 2001, Biology: Concepts and Connections. Prentice-Hall.

1st Year; 2nd Semester

Title of the Course: STATISTICS

Code: STAT-102

Credit Hours: 03

Marks: 100

Unit 1. What is Statistics?

Definition of Statistics, Population, sample Descriptive and inferential Statistics, Observations, Data, Discrete and continuous variables, Errors of measurement, Significant digits, Rounding of a Number, Collection of primary and secondary data, Sources, Editing of Data. Exercises.

Unit 2. Presentation of Data Introduction, basic principles of classification and Tabulation, Constructing of a frequency distribution, Relative and Cumulative frequency distribution, Diagrams, Graphs and their Construction, Bar charts, Pie chart, Histogram, Frequency polygon and Frequency curve, Cumulative Frequency Polygon or Ogive, Histogram, Ogive for Discrete Variable. Types of frequency curves. Exercises.

Unit 3. Measures of Central Tendency

Introduction, Different types of Averages, Quantiles, The Mode, Empirical Relation between Mean, Median and mode, Relative Merits and Demerits of various Averages.

properties of Good Average, Box and Whisker Plot, Stem and Leaf Display, definition of outliers and their detection. Exercises.

Unit 4. Measures of Dispersion

Introduction, Absolute and relative measures, Range, The semi- Inter-quartile Range, The Mean Deviation, The Variance and standard deviation, Change of origin and scale, Interpretation of the standard Deviation, Coefficient of variation, Properties of variance and standard Deviation, Standardized variables, Moments and Moments ratios. Exercises.

Unit 5. Probability and Probability Distributions.

Discrete and continuous distributions: Binomial, Poisson and Normal Distribution. Exercises

Unit 6. Sampling and Sampling Distributions

Introduction, sample design and sampling frame, bias, sampling and non sampling errors, sampling with and without replacement, probability and non-probability sampling, Sampling distributions for single mean and proportion, Difference of means and proportions. Exercises.

Unit 7. Hypothesis Testing

Introduction, Statistical problem, null and alternative hypothesis, Type-I and Type-II errors, level of significance, Test statistics, acceptance and rejection regions, general procedure for testing of hypothesis. Exercises.

Unit 8. Testing of Hypothesis- Single Population

Introduction, Testing of hypothesis and confidence interval about the population mean and proportion for small and large samples, Exercises

Unit 9. Testing of Hypotheses-Two or more Populations Introduction, Testing of hypothesis and confidence intervals about the difference of population means and proportions for small and large samples, Analysis of Variance and ANOVA Table. Exercises

Unit 10. Testing of Hypothesis-Independence of Attributes Introduction, Contingency Tables, Testing of hypothesis about the Independence of attributes. Exercises.

Unit 11. Regression and Correlation Introduction, cause and effect relationships, examples, simple linear regression, estimation of parameters and their interpretation. r

and R2. Correlation. Coefficient of linear correlation, its estimation and interpretation. Multiple regression and interpretation of its parameters. Examples

RECOMMENDED BOOKS:

1. Walpole, R. E. 1982. "Introduction to Statistics", 3rd Ed.,
2. Macmillan Publishing Co., Inc. New York.
3. Muhammad, F. 2005. "Statistical Methods and Data Analysis",
4. Kitab Markaz, Bhawana Bazar Faisalabad.

1st Year; 2nd Semester

Title of the Course: ORGANIC CHEMISTRY-I

Code: CHEM-162

Credit Hours: 03

Marks: 100

Course Contents:

Introduction to Organic Chemistry

Organic chemistry-the chemistry of carbon compounds; the nature of organic chemistry-a historical perspective.

Chemical Bonding and Properties of Organic Molecules

Localized and delocalized chemical bonding; concept of hybridization leading to bond angles, bond lengths, bond energies and shape of organic molecules; dipole moment; inductive and field effects; resonance; aromaticity; tautomerism; hyperconjugation; hydrogen bonding; acids and bases; factors affecting the strengths of acids and bases.

Classes and Nomenclature of Organic Compounds

Classification of organic compounds; development of systematic nomenclature of organic compounds; IUPAC nomenclature of hydrocarbons and heteroatom functional groups.

Functional Group Chemistry

A brief introduction to the chemistry of hydrocarbons, alkyl halides, alcohols, phenols, ethers, aldehydes, ketones, amines, and carboxylic acids and their derivatives.

1st Year; 2nd Semester

Title of the Practical: ORGANIC CHEMISTRY

Code: **CHEM-162**

Credit Hours: **01**

Marks: **25**

RECOMMENDED BOOKS:

1. Clayden, J., Greeves, N., Warren, S. and Wothers, P., "Organic Chemistry", Oxford University Press, New York.
2. Loudon, G. M., "Organic Chemistry", Oxford University Press, New York
3. Sorrell, T. N., "Organic Chemistry", Viva Books Private Ltd., New Delhi.
4. Finar, I. L., "Organic Chemistry", Vol. 1, Pearson Education, Delhi.
5. Carey, F. A., "Organic Chemistry", McGraw-Hill, New York.
6. Ahluwalia, V. K. and Goyal, M., "A Text Book of Organic Chemistry", Narosa Publishing House, New Delhi
7. March, J., "Advanced Organic Chemistry", John Wiley & Sons, New York.
8. Bansal, R. K., "Organic Reaction Mechanisms", Tata McGraw-Hill Publishing Company Ltd., New Delhi.
9. Pine, S. H., "Organic Chemistry", National Book Foundation, Islamabad.
10. Bailey Jr., P. S. and Bailey, C. A., "Organic Chemistry-A Brief Survey of Concepts and Applications", Prentice-Hall, New Jersey.

COURSE WISE BREAKUP

Second Year

Third Semester

THEORY

COURSE CODE	TITLE	CREDIT HOURS	MARKS
ENG-201	ENGLISH-III (FUNCTIONAL)	03	100
PS-201	PAKISTAN STUDIES	02	50
GEN-201	GENERAL-IV	03	100
GEN-201	GENERAL-V	03	100
CHEM-241	ENVIRONMENTAL CHEMISTRY	02	75
CHEM-271	PHYSICAL CHEMISTRY	03	100

PRACTICALS

COURSE CODE	TITLE	CREDIT HOURS	MARKS
CHEM-271	PHYSICAL CHEMISTRY	01	25

- **Total Credits of the Semester = 17 (theory 16 & practicles 01 credits)**
- **Maximum Marks = 550 (theory 525 & practicles 25 marks)**

2nd Year; 3rd Semester

Title of the Course: **ENGLISH-III (REPORT WRITING)**

Code: **ENG-201**

Credit Hours: **03**

Marks: **100**

Objectives: Enhance language skills and develop critical thinking

Course Contents

Presentation skills

Essay Writing: Descriptive; narrative; discursive; argumentative

Academic Writing: How to write a proposal for research paper/term paper.

How to write a research paper/term paper (emphasis on style, content, language, form, clarity, consistency).

Technical Report Writing

Progress Report Writing

RECOMMENDED BOOKS:

a) Essay Writing and Academic Writing

1. Writing. Advanced by Ron White. Oxford Supplementary Skills. Third Impression, 1992. ISBN 0 19 435407 3 (particularly suitable for discursive, descriptive, argumentative and report writing).
2. College Writing Skills by John Langan. Mc-Graw-Hill Higher Education. 2004.
3. Patterns of College Writing (4th edition) by Laurie G. Kirszner and Stephen R. Mandell. St. Martin's Press.

b) Presentation Skills

c) Reading

The Mercury Reader. A Custom Publication. Compiled by northern Illinois University. General Editors: Janice Neulib; Kathleen Shine Cain; Stephen Ruffus and Maurice Scharton. (A reader which will give students exposure to the best of twentieth century literature, without taxing the taste of engineering students).

2nd Year; 3rd Semester

Title of the Course: **PAKISTAN STUDIES**

Code: PS-201

Credit Hours: **02**

Marks: 50

Objectives:

1. Develop vision of historical perspective, government, politics, contemporary Pakistan, ideological background of Pakistan.
2. Study the process of governance, national development, issues arising in the modern age and posing challenges to Pakistan.

Course Contest:

Historical Perspective

- a. Ideological rationale with special reference to Sir Syed Ahmed Khan, Allama Muhammad Iqbal and Quaid-i-Azam Muhammad Ali Jinnah.
- b. Factors leading to Muslim separatism
- c. People and Land: i. Indus Civilization; ii. Muslim advent; iii. Location and geo-physical features.

Government and Politics in Pakistan

Political and constitutional phases: a. 1947-58; b. 1958-71; c. 1971-77; d. 1977-88; e. 1988-99; f. 1999 onward

Contemporary Pakistan

- a. Economic institutions and issues; b. Society and social structure; c. Ethnicity; d. Foreign policy of Pakistan and challenges; e. Futuristic outlook of Pakistan

RECOMMENDED BOOKS:

1. Burki, Shahid Javed. State & Society in Pakistan, The Macmillan Press Ltd, 1980.
2. Akbar, S. Zaidi. Issue in Pakistan's Economy. Karachi: Oxford University Press, 2000.
3. S. M. Burke and Lawrence Ziring. Pakistan's Foreign policy: An Historical Analysis. Karachi: Oxford University Press, 1993.
4. Mehmood, Safdar. Pakistan Political Roots & Development. Lahore, 1994.

5. Wilcox, Wayne. The Emergence of Bangladesh., Washington: American Enterprise, Institute of Public Policy Research, 1972.
6. Mehmood, Safdar. Pakistan Kayyun Toota, Lahore: Idara-e-Saqafat-e-Islamia, Club Road, nd.
7. Amin, Tahir. Ethno - National Movement in Pakistan, Islamabad: Institute of Policy Studies, Islamabad.
8. Ziring, Lawrence. Enigma of Political Development. Kent England: WmDawson & Sons Ltd, 1980.
9. Zahid, Ansar. History & Culture of Sindh. Karachi: Royal Book Company, 1980.
10. Afzal, M. Rafique. Political Parties in Pakistan, Vol. I, II & III. Islamabad: National Institute of Historical and cultural Research, 1998.
11. Sayeed, Khalid Bin. The Political System of Pakistan. Boston: Houghton Mifflin, 1967.
12. Aziz, K.K. Party, Politics in Pakistan, Islamabad: National Commission on Historical and Cultural Research, 1976.
13. Muhammad Waseem, Pakistan Under Martial Law, Lahore: Vanguard, 1987.
14. Haq, Noor ul. Making of Pakistan: The Military Perspective. Islamabad: National Commission on Historical and Cultural Research, 1993.

2nd Year; 3rd Semester

Title of the Course: GENERAL-IV

Code: GEN-201

Credit Hours: 03

Marks: 100

Principles of Management:

Concept of management and organization, Managers and their functions. Management environment both external and internal and adaptation to environments. Decision making, organization planning, human resource management, managing team work. Motivating and rewarding employees. Leadership and management. Communication and interpersonal skills. Organization control techniques. Productivity and quality.

2nd Year; 3rd Semester

Title of the Course: GENERAL-V

Code: GEN-201

Credit Hours: 03

Marks: 100

Community Development:

Concept of community and community development, Dynamics of change and analysis of community situation, producing a project plan and consulting with relevant stakeholders, sponsors or agencies and conducting community project meeting for solution of the problems. Developing a fund raising strategy. Identifying potential donors and creating a data base. Managing the projects and establishing controls. Monitoring and evaluation of the project. Some examples of projects, Deforestation, over fishing, Disposal of waste, sewerage system. Vaccination against deadly diseases. Rehabilitation of the community affected by natural disasters.

2nd Year; 3rd Semester

Title of the Course: ENVIRONMENTAL CHEMISTRY

Code: CHEM-241

Credit Hours: 02

Marks: 75

Objectives of the Course:

From this course, the students should be able to:

- Understand the fundamental principles of environmental chemistry.
- Apply these principles in pollution related subjects.
- Demonstrate the understanding of environmental chemistry principles via experimental exercises in the laboratory.

Course Contents:

Atmospheric Chemistry

The air around us, atmospheric temperature and pressure profile, Temperature inversion and photochemical smog, particulate matter in the atmosphere, Industrial pollutants, radioactivity, atmospheric aerosols, Acid rain – major sources, mechanism, control measures and effects on buildings and vegetation, Global warming – major green house

gases, mechanism, control measures and global impact, The stratospheric ozone – the ozone hole, CFCs, ozone protection, biological consequences of ozone depletion.

Water Pollution and Water Treatment

Sources of water pollution, industrial sources and agricultural sources, heavy metals contamination of water, Eutrophification, detergents and phosphates in water, water quality criteria, Water purification – primary, secondary and advanced treatment, Removal of nitrogen and phosphorous compounds from polluted water, organic matter in water and its decomposition.

Soil Pollution

Soil and mineral resources, general principles of metal extraction, Heavy metals contamination of soil, toxicity of heavy metals, bio-accumulation of heavy metals, Organic matter in soil, Macro and micro-nutrients in soil, ion-exchange in soil, soil pH and nutrients availability.

Green Revolution

Pest control, pesticides, toxicity of pesticides, integrated pests management.

Energy Production and Environment – Liquid and gaseous fuel, hydrogen economy.

Renewable Energy – Nuclear energy, solar energy, geothermal and tidal energy.

RECOMMENDED BOOKS:

1. Collin Baird, Environmental Chemistry, W. H. Freeman and company, New York, 1995.
2. John W. Moore and Elizabeth A. Moore, Environmental Chemistry, Academic Press Inc., New York, 1976.
3. Anil Kumar De, Environmental Chemistry, Wiley Eastern Ltd. New Delhi, 1989.
4. R. W. Raiswell, P. Brimblecombe, D. L. Dent and P. S. Liss, Edward Arnold Ltd., London, 1980.
5. Staneley E. Manahan, Environmental Chemistry, Brooks, California.
6. Peter O. Neill, Environmental Chemistry, Chapman and Hall, London, 1993.
7. Derek M. Elsom, Atmospheric Pollution, Blackwell Publishers, Oxford, 1992.
8. Geoffrey Lean and Don Hinrichsen, Atlas of the Environment, Helicon Publishing Ltd., Oxford, 1992.

2nd Year; 3rd Semester

Title of the Course: **PHYSICAL CHEMISTRY**

Code: **CHEM-271**

Credit Hours: **03**

Marks: **100**

Course Contents:

Physical States of Matter

Ideal and real gases; equations of state, critical phenomenon and critical constants. Molecules in motion: collision diameter and mean free path. Physical properties of liquids: surface tension, viscosity, refractive index etc. and their applications. Brief account of interactions among the molecules in liquids. Packing of atoms in solids. Unit cells and crystal systems. Method of crystal structure analysis. Brief account of polymers and composite materials with special emphasis on superconductors, semi-conductors etc. Introduction to plasma.

Chemical Thermodynamics

Laws of thermodynamics and their applications. Thermodynamic functions: internal energy, enthalpy, entropy and free energy. Relation between thermodynamic functions. van't Hoff's equation. Heat capacities, concept of entropy and probability.

Chemical Kinetics

Rate of reaction. Rate law, order and molecularity of the reactions. Zero, first and second order reactions. Determination of reaction order and its rate constant. Effect of temperature on the reaction rate. Concepts of chemical equilibrium. Le-Chatelier's principle and its applications. Elementary concepts underlying complex and fast reactions.

Solution Chemistry

Ideal and non-ideal solutions. Raoult's and Henry's laws and their applications. Molecular interactions in solutions. Colligative properties. Distillation and concept of azeotropic mixture.

Surface Chemistry

Concept of interfaces. Adsorption and adsorption isotherms: Freundlich and Langmuir adsorption isotherms. Catalysis, colloids emulsion and their industrial applications.

Electrochemistry

Basic concepts of electrochemistry. Ions in solution. Measurement of conductance and Kohlrausch's law. Debye-Hueckel theory and activity coefficient. Application of conductance measurement. Electrode potential. Electrochemical cell. Application of electrode potential

2nd Year; 3rd Semester

Title of the Practical: PHYSICAL CHEMISTRY

Code: CHEM-271 Credit Hours: 01 Marks: 25

Course Contents:

1. Determination of viscosity and parachor values of liquids.
2. Determination of percent composition of liquid solutions viscometrically.
3. Determination of refractive index and molar refractivity.
4. Determination of percent composition of liquid solutions by refractive index measurements.
5. Determination of molecular weight of a compound by elevation of boiling point (ebullioscopic method).
6. Determination of molecular weight of a compound by lowering of freezing point (cryoscopic method).
7. Determination of heat of solution by solubility method.
8. Determination of heat of neutralization of an acid with a base.
9. Kinetic study of acid catalyzed hydrolysis of ethyl acetate.
10. Determination of partition coefficient of a substance between two immiscible liquids.

RECOMMENDED BOOKS:

1. Alberty R. "Physical Chemistry" 17th ed., John Wiley and Sons (1987).
2. Atkins, P.W. "Physical Chemistry" 6th ed., W.H. Freeman and Co. New York (1998).
3. Laidler K.J. "The World of Physical Chemistry" 1st ed., Oxford University Press (1993).

4. Laidler K.J., John H.M. and Bryan C.S. "Physical Chemistry" 4th ed., Houghton Mifflin Publishing Company Inc. (2003).
5. Peter P.A. "Chemical Thermodynamics" Oxford University Press (1983).
6. Brain S.E. "Basic Chemical Thermodynamics" 4th ed., E.L.B.S. Publishers (1990).
7. Barrow G.M. "Physical Chemistry" 5th ed., McGraw Hill (1992).
8. Jaffar M. "Experimental Physical Chemistry" University Grants Commission (1989).
9. Levitt B.P. "Findlay's Practical Physical Chemistry" 9th ed., Longman Group Limited (1978).
10. Shoemaker D. "Experiments in Physical Chemistry" 5th ed., McGraw Hill Publishing Company Limited (1989).

COURSE WISE BREAKUP

Second Year

Fourth Semester

THEORY

COURSE CODE	TITLE	CREDIT HOURS	MARKS
ENG-202	ENGLISH-IV/UNIVERSITY OPTIONAL	03	100
GEN-202	GENERAL-VI	03	100
GEN-202	GENERAL-VII	03	100
CHEM-212	ANALYTICAL CHEMISTRY	02	75
CHEM-222	APPLIED CHEMISTRY	02	75
CHEM-232	BIOCHEMISTRY	02	75

PRACTICALS

COURSE CODE	TITLE	CREDIT HOURS	MARKS
CHEM-212	ANALYTICAL CHEMISTRY	01	25
CHEM-222	APPLIED CHEMISTRY	01	25
CHEM-232	BIOCHEMISTRY	01	25

- **Total Credits of the Semester = 18 (theory 15 & practicles 03 credits)**
- **Maximum Marks = 600 (theory 525 & practicles 75 marks)**

2nd Year; 4th Semester

Title of the Course: **ENGLISH-IV/UNIVERSITY OPTIONAL**

Code: **ENG-202**

Credit Hours: **03**

Marks: **100**

2nd Year; 4th Semester

Title of the Course: **GENERAL-VI**

Code: **GEN-202**

Credit Hours: **03**

Marks: **100**

Teaching and Learning:

Focusing on preparing yourself, your course and your students for a constructive learning. Creating an active, interactive and motivating learning environment for your students. Identifying student difficulties and encouraging students participation in seminars, workshop and declamation contests. Monitoring and evaluation of students learning through home assignments, tests, essays, reports, publications, presentations on course related work. Arranging study tours. Students feed back for the evaluation of teacher by students.

2nd Year; 4th Semester

Title of the Course: **GENERAL-VII**

Code: **GEN-202**

Credit Hours: **03**

Marks: **100**

Environmental Sciences:

Concept of ecology and ecosystem, conservation of ecosystem. Population growth, poverty and diseases. Depletion of natural resources and its effect on environment. Contamination of water, soil and air. Climate change: past, present and future. Acid rain, global warming and its effects on earth. Ozone depletion. Earth atmospheric system.

2nd Year; 4th Semester

Title of the Course: **ANALYTICAL CHEMISTRY**

Code: **CHEM-212**

Credit Hours: 02

Marks: 75

Course Goals

1. This course will introduce you to the vocabulary and concepts used in basic Analytical Chemistry.
2. You will learn the details of steps involved in the preparation and analysis of a sample, the chemical basis and various techniques of analysis.
3. You will also learn and use statistical methods to determine the precision and accuracy of experimental results.
4. Graded assignments, quizzes, class tests and a *final exam* will test your understanding of the material dealing with these goals.
5. To develop skills needed to solve analytical problems in a quantitative manner, particularly with the aid of the spreadsheet tools.
6. Teaching laboratory skills that will give students confidence in their ability to obtain high-quality analytical data.

Course Contents:

1. Introduction to Analytical Chemistry

Scope and applications of Analytical Chemistry, quantitative reactions, stoichiometric relationships, solution chemistry, expression of quantities and concentrations. Basic approach to equilibrium.

2. Sampling

Types of sampling techniques, sampling of gas, liquid and solid, treatment of samples to obtain homogeneous solutions.

3. Errors in Chemical Analyses and Minimization

Steps in analytical procedures, errors, precision, accuracy, types of errors, steps involved in minimization of errors.

4. Statistical Evaluation of Data

Ways of expressing accuracy, mean, median, mode, deviation, standard deviation, mean deviation, relative standard deviation. The confidence limit, confidence interval, rejection of the results, limit of detection and quantification.

2nd Year; 4th Semester

Title of the Practicals: **ANALYTICAL CHEMISTRY**

Code: **CHEM-212**

Credit Hours: **01**

Marks: **25**

RECOMMENDED BOOKS:

1. Analytical Chemistry by Gary D. Christian; 6th ed. 2004; John Wiley & Sons, Inc.
2. Douglas A. Skoog, Donald M. West, F. James Holler, Stanley R. Crouch, "Fundamentals of Analytical Chemistry" 8th ed. 2003; Saunders College Publishing, Philadelphia.
3. Instrumental Methods of Analysis by Hobert H. Willard D.L. Merrit & J.R.J.A. Dean, Frank A. Settle; 7th Sub edition 1988; Wadsworth Publishing Company.
4. Laboratory Manual of Analytical Chemistry by C. Reilly; Allyn and Bacon, London.
5. Quantitative Analysis by W. J. Blaedal and V. W. Medloche; Harper & Row, N.Y.
6. J.G. Dick, Analytical Chemistry, McGraw-Hill, Tokyo.

2nd Year; 4th Semester

Title of the Course: **APPLIED CHEMISTRY**

Code: **CHEM-222**

Credit Hours: **02**

Marks: **75**

Fundamentals of Chemical Industry

Basic principles and parameters for industrial plant location; Elementary treatment of general unit operations commonly used in industries such as size reduction; evaporation, filtration, distillation, crystallization and drying; Chemical unit processes like carbonation, sulfitation, defecation, nitration, etc. in chemical process industries.

Basic and Heavy Chemical Industries

Raw materials and chemicals; Flow sheet diagrams and commercial production of sulphuric acid, nitric acid, hydrochloric acid, oxalic acid, formic acid, caustic soda and washing soda; Applications of these chemicals in chemical industries.

Glass Industry

Raw materials and manufacture of glass; Chemistry involved in the production of glass; Types of glass; Glassy state phenomena and annealing of glass; Photochromic and photographic lasses; Production of safety glasses.

Ceramics Industry

Raw material used for ceramics; Chemistry involved in the production of ceramics articles and wares; Types and classification of ceramic products; Manufacture of ceramics products.

Cement Industry

Raw materials used for cement production; Chemistry involved in the production of cement; Manufacture of cement by wet and dry processes; Types of cement and composition of clinker. Chemical phenomena and chemistry involved in the hardening and setting of cement.

Water Treatment, Steam Production and Scale Removal

Sources of water; Hardness of water; Water treatment and conditioning for municipal and industrial purposes. Steam production and its utilization for power and energy generation; Boiler water treatment; Chemistry involved in the formation of scale; Prevention of scale formation.

2nd Year; 4th Semester

Title of the Practicals: **APPLIED CHEMISTRY**

Code: **CHEM-212**

Credit Hours: **01**

Marks: **25**

RECOMMENDED BOOKS:

1. Badger L.W. and T.J. Banchero. (1955) "Introduction to Chemical Engineering" Student ed. McGraw-Hill Book Company, New york.
2. Riegel, E.R. (1956)." Industrial Chemistry" 5th ed. Reinhold Publishing Corporation, New York.
3. R. N. Shreve, The chemical process industries, McGraw-Hill Book Company.

4. Vogel, I. A., Text Book Quantitative Inorganic Analysis, 7rd Ed., Longman, Green and Co. Ltd. UK (1961) and (1978).
5. E D Mahin, Chemical analysis McGraw-Hill Book Company, New york.
6. G.H.Jenkins, Intoduction to Sugarcane Technology (1965).
7. Howard L. White, Introduction to Industrial Chemistry (1992).
8. P. F. Stanbury & A. Whitaker, Principles of fermentation Technology, (1987).
9. G. C. Bye., Portland Cement, (1983).
10. We Worrall, Clays, (1968).
11. Academy of Science USSR, The Structure of glass, (1953).
12. G. O. Jones, Glass, 2nd Ed., (1971).

2nd Year; 4th Semester

Title of the Course: **BIOCHEMISTRY**

Code: **CHEM-232**

Credit Hours: **02**

Marks: **75**

Prerequisites: Basic courses of Organic Chemistry and Biology

Objective of the Course: This course provides fundamental concepts in biochemistry, which focuses upon the major macromolecules and chemical properties of living systems. Primary topics include the structures, properties and functions of amino acids, proteins, carbohydrates, lipids and nucleic acids.

Course Contents:

Introduction to Biochemistry

Brief introduction, to the scope and history of Biochemistry. Molecular logic of the living organism. Cell structures and their functions. Origin and nature of biomolecules

Carbohydrates

Definition and classification, Chemistry, physical and chemical properties of various classes of carbohydrates. Biological functions of starch, glycogen, cellulose and cell wall polysaccharides, acid mucopolysaccharides and proteoglycans.

Lipids

Definition and classification of lipids. Chemistry and biological importance of fatty acids, waxes, glycerides, phospholipids, sphingolipids, glycolipids, sterols and prostaglandins.

Significance of liquids in biological membranes and transport mechanism

Proteins

Chemistry and Classification of Amino acids, Physical and chemical properties of amino acids. Biological significance of amino acids, peptides. Proteins; their classification, properties and biological significance, Primary, secondary tertiary and *quaternary* structure of proteins. Denaturation of proteins.

Nucleic Acids

Chemical composition of nucleic acids. Structure and biological significance of nucleic acids. Chemical synthesis of oligonucleotides. Nucleic acids hydrolysis. Isolation and separation of Nucleic acids. Introduction to recombinant DNA technology.

2nd Year; 4th Semester

Title of the Practicals: **BIOCHEMISTRY**

Code: **CHEM-212**

Credit Hours: **01**

Marks: **25**

RECOMMENDED BOOKS:

1. Lehninger, A. L, "Principles of Biochemistry", Worth Publisher, New York, (2001).
2. Voet, D. and Voigt 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).
5. Zubay, G., Biochemistry, 4th Ed., Macmillan Publishing Co. (1999).
6. Bhagavan. N. V., Biochemistry, 2nd Ed., J.B. Lippincott Company (1978)

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 = 20 (theory 15 & practicles 05 credits)**
- **Maximum Marks = 625 (theory 500 & practicles 125 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. NH_3 , liq. H_2SO_4 , liq. HF , and liq. SO_2 , BrF_3 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. Schroedinger 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. Helpern 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).

COURSE WISE BREAKUP

Third Year

Sixth Semester

THEORY

COURSE CODE	TITLE	CREDIT HOURS	MARKS
CHEM-352	INORGANIC CHEMISTRY	03	100
CHEM-362	ORGANIC CHEMISTRY	03	100
CHEM-372	PHYSICAL CHEMISTRY	03	100
CHEM-312	ANALYTICAL CHEMISTRY	03	100
CHEM-332	BIOCHEMISTRY	03	100

PRACTICALS

COURSE CODE	TITLE	CREDIT HOURS	MARKS
CHEM-352	INORGANIC CHEMISTRY	01	25
CHEM-362	ORGANIC CHEMISTRY	01	25
CHEM-372	PHYSICAL CHEMISTRY	01	25
CHEM-312	ANALYTICAL CHEMISTRY	01	25
CHEM-332	BIOCHEMISTRY	01	25

- **Total Credits of the Semester = 20 (theory 15 & practicles 05 credits)**
- **Maximum Marks = 625 (theory 500 & practicles 125 marks)**

3rd Year; 6th Semester

Title of the Course: **INORGANIC CHEMISTRY**

Code: **CHEM-352**

Credit Hours: **03**

Marks: **100**

Objective of the Program

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

1. Chemistry of Lanthanides, their purification and properties.
2. Chemistry of actinide and their characteristics.
3. Chemistry of metal carbonyls their synthesis structure and properties.

Chemistry of f-Block Elements

- (i) Lanthanides: Electronic structure and position in the periodic table, Lanthanide's contraction, oxidation states, spectral and magnetic properties, general characteristics, occurrence, extraction and general principles of separation, complexes and uses.
- (ii) Actinides: Electronic structure and position in the periodic table, oxidation states, general characteristics, half life and decay law.

Acceptor Complexes

Mononuclear and polynuclear metal carbonyls: the eighteen electron rule as applied to metal carbonyls; rationalization of molecular structure; evaluation of structures based on spectroscopic evidences; chemistry of metal carbonyls and their derivatives (nitosyls, halides and hydrides)

3rd Year; 6th Semester

Title of the Practical: **INORGANIC CHEMISTRY**

Code: **CHEM-352**

Credit Hours: **01**

Marks: **25**

1. Semi-micro analysis and Separation of cations in a mixture by paper chromatography.
2. Redox Titration.
3. Estimation of at least two halides by adsorption indicator.
4. Gravimetric estimation of Ba^{2+} and $\text{C}_2\text{O}_4^{2-}$ ions.

RECOMMENDED BOOKS

1. Huheey, J. E, Keiter, E. A. and Keiter, R. L., "Inorganic Chemistry: Principles of Structure and Reactivity", 4th Ed., Harper & Row, New York, 2001.
2. Cotton, F. A., Wilkinson, G., Murillo, C. A. and Bochmann. M., "Advanced Inorganic Chemistry", 6th Ed., Wiley-Interscience, New York, 1999.
3. Greenwood, N. N., and Earnshaw, A., "Chemistry of the Elements", 2nd Ed., Pergamon Press, New York, 1992.
4. William W. Porterfield. Inorganic chemistry, Unified approach, Elsevier company, Delhi, (2005)
5. Mackay, K. M., Mackay, R. A. and Henderson, W., "Introduction to Modern Inorganic Chemistry", 5th Edition, Stanley Thomas Publisher Ltd. 1996
6. 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.
7. Vogel, A. I., "A Textbook of Micro and Semi-micro Qualitative Inorganic Analysis" Longman Green & Co. 1995.

3rd Year; 6th Semester

Title of the Course: **ORGANIC CHEMISTRY**

Code: **CHEM-362**

Credit Hours: **03**

Marks: **100**

Addition Reactions

Electrophilic and Nucleophilic Addition to C=C: Their mechanisms, orientation and stereochemistry; electrophilic addition of halogens and hydrogen halides to C=C; electrophilic addition to conjugated dienes; nucleophilic addition to C=C and C=C-C=O linkage.

Nucleophilic Addition to C=O: Structure and reactivity of carbonyl group; simple addition reactions i.e. addition of water, alcohol, hydrogen cyanide and bisulphite; addition/elimination reactions: addition of derivatives of ammonia; stereoselectivity in carbonyl addition reactions.

Organometallic Compounds

Principles; organomagnesium, organosodium, organolithium, organocopper, organocadmium, organomercury and organozinc compounds: their structure and reactivity, methods of preparation and synthetic applications.

Chemistry of Enolate Ions and Enols

Acidity of carbonyl compounds; enolization of carbonyl compounds; α -halogenation of carbonyl compounds; aldol-addition and aldolcondensation; condensation reactions involving ester enolate ions; alkylation of ester enolate ions.

Aromatic Substitution Reactions

Electrophilic Substitution Reactions: Mechanisms of substitution; orientation and reactivity; electrophilic substitution reactions i.e. nitration, halogenation, sulphonation, Friedel-Craft's reaction, diazocoupling, formylation and carboxylation.

Nucleophilic Substitution Reactions: Mechanisms - study of S_NAr, S_N1 and benzyne mechanisms; structure and reactivity - the effects of substrate structure, leaving group and the attacking nucleophile on the rates of substitution reactions.

3rd Year; 6th Semester

Title of the Practical: **ORGANIC CHEMISTRY**

Code: **CHEM-362**

Credit Hours: **01**

Marks: **25**

Laboratory work illustrating topics covered in the lecture of CHEM-361

RECOMMENDED BOOKS:

1. Norman, R. O.C. and Coxon, J. M., "Principles of Organic Synthesis", Nelson Thornes, Cheltenham.
2. Clayden, J., Greeves, N., Warren, S. and Wothers, P., "Organic Chemistry", Oxford University Press, New York.
3. Sykes, P., "A Guide Book to Mechanism in Organic Chemistry", Longman, London.
4. March, J., "Advanced Organic Chemistry", John Wiley & Sons, New York.
5. Loudon, G. M., "Organic Chemistry", Oxford University Press, New York.

- Carey, F. A., "Organic Chemistry", McGraw-Hill, New York.
- Morrison, R. T. and Boyd, R. N., "Organic Chemistry", Prentice-Hall of India, New Delhi.
- Solomons, T. W. G. and Fryhle, C. B., "Organic Chemistry", John Wiley & Sons, New York.
- Pine, S. H., "Organic Chemistry", National Book Foundation, Islamabad.
- Bruckner, R., "Advanced Organic Chemistry-Reaction Mechanisms", Harcourt Science & Technology Company, New York.
- Carroll, F. A., "Perspectives on Structure and Mechanism in Organic Chemistry", Brooks/Cole Publishing Company, New York.
- Ege, S., "Organic Chemistry", A.I.T.B.S. Publishers & Distributors, Delhi.
- Parkins, A. W. and Poller, R. C., "An Introduction to Organometallic Chemistry", Macmillan, London.

3rd Year; 6th Semester

Title of the Course: **PHYSICAL CHEMISTRY**

Code: **CHEM-372**

Credit Hours: **03**

Marks: **100**

Course Contents:

Electrochemistry

An introduction to electrochemistry, chemical reactions and redox potentials, electrochemical cells and types of electrodes. Nernst's equation and its application. Predicting reactions, stability of oxidation states, cell potential and thermodynamics. Theory of metallic conduction. Electrode potential, liquid junction potential, transference number. Ions in aqueous solution. Ionic activity and Debye Hückel theory.

Nuclear Chemistry

Atomic nucleus, nuclides, nuclear stability, modes of decay, nuclear energetics, nuclear models (shell + liquid drop model), fusion and fission, non-spontaneous nuclear processes, nuclear reactors, beta decay systematic, nuclear spins.

Group Theory

Symmetry and symmetry operations. Point groups. Properties of groups, matrices, transformation of matrices, character tables and their applications in molecular spectroscopy.

Photochemistry

Principles of photochemistry. Laws of photochemistry. Einstein's law of photochemical equivalence. Rates of intramolecular processes. Chemical reactions and their quantum yields. Hydrogen – bromine and hydrogen – chlorine reactions.

3rd Year; 6th Semester

Title of the Practical: **PHYSICAL CHEMISTRY**

Code: **CHEM-372**

Credit Hours: **01**

Marks: **25**

1. Spectroscopic determination of Cu % in the given sample.
2. Conductometric determination of Cu (II)- EDTA mole ratio in the complex.
3. To determine the effectiveness of an extraction of I₂ solution by using Solvent Extraction method.
4. Determination of molecular weight of a polymer by viscosity method.
5. Determination of percentage composition of KMnO₄/ K₂Cr₂O₇ in a given solution by spectrophotometry.
6. Evaluation of pK_a value of an indicator by spectrometric method.
7. Conductometric determination of hydrolysis constant (K_h) of conjugate base of a weak acid.

RECOMMENDED BOOKS:

1. Cotton F.A. "Chemical Applications of Groups Theory" Interscience Publishers (1963).
2. Lowell Hall H. "Group Theory and Symmetry in Chemistry" McGraw Hill Book Company (1969).
3. Albert R.A., Robert J.S. and Mounji G.B. "Physical Chemistry". 4th ed., John Wiley and Sons (2004).
4. Ball D.W. "Physical Chemistry" 1st ed., Brooks/Cole Co. Inc. (2003).

5. Calvert J.G. and Pitts J.N. "Photochemistry" John Wiley, New York (1966).
6. Suppan P. "Principles of Photochemistry", The Chemical Soc., UK (1973).
7. Vertes A. "Basics of Nuclear Science" Kluwer Academic Publisher London (2003).
8. Friedlander G. and Kennedy J.W. "Nuclear and Radiochemistry" 3rd ed., Wiley, New York (1981).
9. Bassetts 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).
10. Hatch R.C. "Experimental Chemistry" van Nostrand Reinhold Company (1972).
11. Halpern, Arthur M. "Experimental Physical Chemistry: A Laboratory Textbook" 2nd ed., Prentice Hall (1962).
12. Shoemaker D. "Experimental Physical Chemistry" McGraw Hill (1989).

3rd Year; 6th Semester

Title of the Course: **ANALYTICAL CHEMISTRY**

Code: **CHEM-312**

Credit Hours: **03**

Marks: **100**

Course Contents:

A. Separation Techniques

Introduction and Classification of Separation Techniques

1. Masking
2. Precipitation
3. Filtration
4. Distillation
5. Volatilization
6. Solvent Extraction
7. Chromatography
8. Electrophoresis

B. Thermal Analysis

Basic principles, instrumentation and applications of Thermogravimetry (TGA) and Differential Thermal Analysis (DTA).

3rd Year; 6th Semester

Title of the Practical: **ANALYTICAL CHEMISTRY**

Code: **CHEM-312**

Credit Hours: **01**

Marks: **25**

Experiments based on theory topics as per facilities available.

RECOMMENDED BOOKS:

1. Analytical Chemistry by Gary D. Christian; 6th ed. 2004; John Wiley & Sons, Inc.
2. G. D. Christian and J.E. Reilly; "Instrumental analysis" Allyn and Bacon, Inc.
3. Douglas A. Skoog, and D.M. West, "Principle of Instrumental analysis" einholt, New York.
4. Douglas A. Skoog, Donald M. West, F. James Holler, Stanley R. Crouch, "Fundamentals of Analytical Chemistry" 8th ed. 2003; Saunders College Publishing, Philadelphia.
5. Instrumental Methods of Analysis by Hobert H. Willard D.L. Merrit & J.R.J.A. Dean, Frank A. Settle; 7th Sub edition 1988; Wadsworth Publishing Company.
6. Laboratory Manual of Analytical Chemistry by C. Reilly; Allyn and Bacon, London.
7. Quantitative Analysis by W. J. Blaedal and V. W. Medloche; Harper & Row, N.Y.
8. J.G. Dick, Analytical Chemistry, McGraw-Hill, Tokyo.

3rd Year; 6th Semester

Title of the Course: **BIOCHEMISTRY**

Code: **CHEM-332**

Credit Hours: **03**

Marks: **100**

Objective of the Course:

Course will emphasize the all aspects of the biochemistry of enzymes. Importance of coenzyme and cofactors of the enzymes will also be covered. This course will also emphasize on the acid-base regulation in human body.

Course Contents:

Enzymes

Chemical nature, nomenclature and classification of enzymes, Cofactors, Substrate specificity, enzyme-substrate interactions and nature of active site, Mechanism of enzyme action with specific reference to chymotrypsin and ribonuclease, Kinetics of single substrate reactions, Effect of different factor on enzyme activity, Bisubstrate reactions, Quantative assays of enzyme activity, Enzyme Inhibition, Regulatory enzymes; Allostric enzymes, Multienzyme system, Zymogens, and Isozymes, Enzymatic control of metabolic pathways, Immobilized enzymes; synthesis, properties and uses.

Acid-Base and Electrolyte Chemistry

Intracellular and Extracellular Electrolytes, Body fluids as electrolyte solutions, pH, Henderson-Hasselbalch Equation and Buffers, Acids and bases, Actual and titratable acidities, Equilibrium reactions of acids, bases and protons, Buffer action, Effect of other ions on acid-base equilibria, Amino acids, peptides and proteins as acids and bases, Acid and base production in human metabolism, Regulation of Acid-Base Balance; Control of acidity and physiologic buffer action, Buffer capacity, Buffers of body fluids, Respiratory regulation of acid-base balance, Haemoglobin as an acid-base system, Renal control of Acid4 base balance, Acid- Base disorders; Acidosis, Alkalosis, Effect of acidbase disturbances on electrolytes, Homeostasis, Variation of Na⁺, K⁺, and Cl⁻ in acid-base disturbances.

3rd Year; 6th Semester

Title of the Practical: **BIOCHEMISTRY**

Code: **CHEM-332**

Credit Hours: **01**

Marks: **25**

PRACTICALS

Laboratory work illustrating topics covered in the lecture of CHEM. 331.

1. Determination of pH, Preparation of buffers,

2. Enzyme catalysis, Progress curve for enzyme catalyzed reactions,
3. Determination of K_m values, To study the effect of different factors on the rate of enzyme catalyzed reactions.

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. West, Text Book of Biochemistry", 4th Ed., (2000) .
4. Zubay, G., Biochemistry, 4th Ed., Macmillan Publishing Co. (1999).
5. Wilhelm R. Frisell, "Human Biochemistry", Macmillan Publishing Co., Inc. New York (1982)
6. Guyton AC and Hall JE, "Text Book of Medical Physiology", 9thEd, W. B. Saunders Company, Tokyo, (1996).
7. Plummer, D.T., An introduction to practical biochemistry, TATA McGraw-Hill Publishing Company LTD. Sawhney, S. K. and R. Sing (Editors), Introductory Practical Biochemistry, Narosa Publishing House, New Delhi, (2005).

COURSE WISE BREAKUP

Fourth Year

Seventh Semester

SPECILIZATION

INORGANIC CHEMISTRY

THEORY

COURSE CODE	TITLE	CREDIT HOURS	MARKS
CHEM-451	PAPER-I: INORGANIC CHEMISTRY	03	100
CHEM-452	PAPER-II: INORGANIC CHEMISTRY	03	100
CHEM-453	PAPER-III: INORGANIC CHEMISTRY	03	100

PRACTICALS

COURSE CODE	TITLE	CREDIT HOURS	MARKS
CHEM-451	PAPER-I: INORGANIC CHEMISTRY	02	50
CHEM-452	PAPER-II: INORGANIC CHEMISTRY	02	50
CHEM-453	PAPER-III: INORGANIC CHEMISTRY	02	50

- **Total Credits of the Semester = 15 (theory 09 & practicles 06 credits)**
- **Maximum Marks = 450 (theory 300 & practicles 150 marks)**

4th Year; 7th Semester

PAPER-I

Title of the Course: INORGANIC CHEMISTRY

Code: CHEM-451

Credit Hours: 03

Marks: 100

Objective of the Program

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

1. Periodic Anomalies and Bonding in Electron deficient Compounds
2. Kinetics and Reaction Mechanism of Inorganic Reactions
3. Electron Transfer Reaction

Course Contents:

Periodic Anomalies and Bonding in Electron deficient Compounds

First- and second- row anomalies; the use of *d*- orbitals by non-metals; reactivity and *d*-orbital participation; $p\pi-d\pi$ bonds; the use of *p*- orbitals in π - bonding; periodic anomalies of non-metals and post-transition metals. Multicenter bonding in electron deficient molecules, three centre two electron bond (3c-2e) and three-center, four-electron (3c-4e) bond model.

Kinetics and Reaction Mechanism of Inorganic R e actions

Classification of reaction mechanisms; rate laws; steady state approximation; inert and labile complexes; substitution reactions; octahedral complexes: acid hydrolysis, acid catalyzed aquation, anation reactions, base hydrolysis, attack on ligands, steric effects of inert ligands; square planar complexes: nucleophilic reactivity, trans-effect, cis-effect, effect of leaving group, mechanism of substitution, racemization reactions.

Electron Transfer Reactions

Electron transfer reactions in co-ordination compounds, mechanism of electron transfer reactions, outer sphere or tunneling mechanism, inner sphere or ligand bridge mechanism, factors effecting the rate of electron transfer reactions, two electrons transfer reactions, complementary or non complementary electron transfer reactions, oxidation reduction reactions of metal ions

RECOMMENDED BOOKS:

1. Basolo, F., and Pearson, R. G., "Mechanism of Inorganic Reactions", Wiley, New York, 1982.
2. Huheey, J. E, Keiter, E. A. and Keiter, R. L., "Inorganic Chemistry: Principles of Structure and Reactivity", 4th Ed., Harper & Row, New York, 2001.
3. Benson, D., Mechanisms of Inorganic Reactions in solution: McGraw Hill. 1968.
4. Purcell, K.F. and Kotz, J.C., "Inorganic Chemistry" W.B. Saunders Company Holt-Saunders Internal editions 1977.
5. Shirve D.F. Atkins P.W. and Langford C.H. "Inorganic Chemistry", Oxford University Press 1990.
6. Wilkins R.G. "Kinetics and Mechanism of Reactions of Transition Metal Complex" VCH Publishers, Inc., 1991.
7. William. J., Modern inorganic chemistry second edition McGraw Hill Company 1991.
8. Porter Field. W.W., Inorganic Chemistry a Unified Approach 2nd ed. Elsevier Publishers, 2005 Douglas, McDaniel & John Alexander. "Concepts and Models of Inorganic Chemistry" by John Willey and Sons, 1994.
9. R.B. Jordan, Reaction Mechanisms of Inorganic and Organometallics Systems. Oxford University Press, New York, 1991. An excellent introduction.
10. R.G. Wilkins, The study of kinetics and Mechanisms of Reactions of transition metal complexes 2nd ed., VCH Publishers, New York, 1991.

4th Year; 7th Semester

PAPER-II

Title of the Course: **INORGANIC CHEMISTRY**

Code: **CHEM-452**

Credit Hours: **03**

Marks: **100**

Objective of the Program

After completing this program students will be able to learn and had a sound knowledge of the following:

1. Organic Reagents used in Inorganic Analysis, their selectivity, specificity etc.
2. Polymer Chemistry

Course Contest:

Organic Reagents Used in Inorganic Analysis

Types of reagent, specificity and sensitivity of the reagents, methods of application with specific examples, complexometric and gravimetric methods involving various reagents, chelates and chelate-effect.

Polymer Chemistry

Molecular species: Introduction, homoatomic and heteroatomic inorganic polymers, chains and cages of Boron, Silicon, Nitrogen, Phosphorous and Sulphur; their synthesis, reactivity and applications, metal clusters. Polyionic species: Isopoly and heteropoly anions of transition metals, Silicates, borates, condensed phosphates, zeolites.

RECOMMENDED BOOKS:

1. Malcoim, P.S. "Polymer Chemistry" Oxford University Press 2005.
2. Mandelkern "An Introduction to Macromolecules" 2nd Springer 1983
3. Ravue, "Principles of Polymer Chemistry" 2nd edition Plenum Publishers 2000.
4. Emeleus and Sharpe., "Modern Aspects of Inorganic Chemistry". Huheey, J. E, Keiter, E. A. and Keiter, R. L., "Inorganic Chemistry: Principles of Structure and Reactivity", 4th Ed., Harper & Row, New York, 2001.
5. F. W. Billmeyer. "A Text book of Polymer Science" John Willey & Sons, New Delhi, 2002.
6. P.Powell. "Non Metal Chemistry", Chopman & Hall., 1974.
7. Miessler G.L. and Tar Donald, A. "Inorganic Chemistry" Prentice Hall Int. edition, 1991.
8. Douglas, McDaniel & John Alexander. "Concepts and Models of Inorganic Chemistry" by John Willey and Sons, 1994.

4th Year; 7th Semester

PAPER-III

Title of the Course: **INORGANIC CHEMISTRY**

Code: **CHEM-453**

Credit Hours: **03**

Marks: **100**

Objective of the Program

After completing this program students will be able to learn and able to interpret simple spectra.

1. Nuclear Magnetic Resonance Spectroscopy.
2. Ultra violet spectroscopy
3. Infrared spectroscopy
4. Mass Spectrometry
5. Thermal Analysis

Course Contents:

Instrumental Methods of Analysis

Physical methods in Inorganic Chemistry, TGA & DTA, NMR, IR, UV Spectroscopy, Mass Spectroscopy; Basic principles, Instrumentation and Applications

RECOMMENDED BOOKS:

1. Vogel, A. I., "A Text book of Quantitative Inorganic Analysis", English language Book Society 4th edition, 1978.
2. Daniels, T., "Thermal Analysis" 1998.
3. Pavia, D. L., Lampman, G. M. and Kriz, G.S., "Introduction to Spectroscopy", Saunders College Publishing, 1980
4. Silverstein, R. M., Barler, C. G. and Mogrill, T. C., "Spectrometric Identification of Organic Compounds",
5. Kemp, W., "NMR in Chemistry A Multi Nuclear Introduction", McMillan Press Ltd., 1986.
6. Drago, R. S., "Physical Method in Inorganic Chemistry", W.B. Saunders Company, 1997.
7. Bassetta, 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 edition, 1978.
8. Douglas, A. Skoog, F. James Holler, Trmothy, A., "Principles of Instrumental Analysis", 5th edition, Saunders College Publishing, New York, 1997.

9. Ewing, G.W., "Instrumental Methods of Chemical Analysis", 5th edition, McGraw Hill, New York, 1985.

4th Year; 7th Semester

PAPER-I

Title of the Practical: **INORGANIC CHEMISTRY**

Code: **CHEM-451**

Credit Hours: **02**

Marks: **50**

1. Use of some organic reagents for the estimation of various elements
2. Preparation of at least six compounds/organometallic compounds in a pure state and determination of their state of purity
3. The experiments may be set making use of conductivity meter and potentiometer depending upon the availability.

4th Year; 7th Semester

PAPER-II

Title of the Practical: **INORGANIC CHEMISTRY**

Code: **CHEM-452**

Credit Hours: **02**

Marks: **50**

1. Spectroscopic determination of some metal ions.
2. Recording and characterization of at least five organometallic compounds by IR and UV spectrophotometer to the subject of availability of facilities.
3. Estimation of different metals in food, tap water and brass etc. by Atomic Absorption Spectrometer/ flame photometer / UV / Visible spectrophotometer, subject to the availability of facilities.

4th Year; 7th Semester

PAPER-III

Title of the Practical: **INORGANIC CHEMISTRY**

Code: **CHEM-453**

Credit Hours: **02**

Marks: **50**

RECOMMENDED BOOKS:

1. 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.
2. Fritz, J. S. and Schenk, G. H., "Quantitative Analytical Chemistry", Allyn and Bacon Inc., 4th Edition, 1979.
3. Pass, G and Sutcliffe, H., "Practical Inorganic Chemistry", Van Nostrand Reinhold Company, 1972

COURSE WISE BREAKUP

Fourth Year

Seventh Semester

SPECILIZATION

ORGANIC CHEMISTRY

THEORY

COURSE CODE	TITLE	CREDIT HOURS	MARKS
CHEM-461	PAPER-I: ORGANIC CHEMISTRY	03	100
CHEM-462	PAPER-II: ORGANIC CHEMISTRY	03	100
CHEM-463	PAPER-III: ORGANIC CHEMISTRY	03	100

PRACTICALS

COURSE CODE	TITLE	CREDIT HOURS	MARKS
CHEM-461	PAPER-I: ORGANIC CHEMISTRY	02	50
CHEM-462	PAPER-II: ORGANIC CHEMISTRY	02	50
CHEM-463	PAPER-III: ORGANIC CHEMISTRY	02	50

- Total Credits of the Semester = 15 (theory 09 & practicles 06 credits)
- Maximum Marks = 450 (theory 300 & practicles 150 marks)

4th Year; 7th Semester

PAPER-I

Title of the Course: **ORGANIC CHEMISTRY**

Code: **CHEM-461**

Credit Hours: **03**

Marks: **100**

Course Contents:

Oxidation and Reduction

Oxidation: Introduction; reactions involving elimination of hydrogen, cleavage of C-C bond, replacement of hydrogen by oxygen and addition of oxygen to the substrate; oxidative coupling.

Reduction: Introduction; reactions involving replacement of oxygen by hydrogen, removal of oxygen from the substrate and reduction with cleavage; reductive coupling.

Protective Groups

Use of hydroxyl-, amino-, carboxyl- and carbonyl- protecting groups in organic synthesis.

Pericyclic Reactions

Principles; cycloadditions; electrocyclic reactions; cheletropic reactions; sigmatropic rearrangements; the ene-reaction and related reactions.

RECOMMENDED BOOKS:

1. Norman, R. O.C. and Coxon, J. M., "Principles of Organic Synthesis", Nelson Thornes, Cheltenham.
2. Rinehart Jr., K. L., "Oxidation and Reduction of Organic Compounds", Prentice-Hall, London.
3. Loudon, G. M., "Organic Chemistry", Oxford University Press, New York.
4. Smith, M. B., "Organic Synthesis", McGraw-Hill, New York.
5. March, J., "Advanced Organic Chemistry", John Wiley & Sons, New York.
6. Sykes, P., "A Guide Book to Mechanism in Organic Chemistry", Longman, London.
7. Clayden, J., Greeves, N., Warren, S. and Wothers, P., "Organic Chemistry", Oxford University Press, New York.
8. Carey, F. A. and Sundberg, R. J. "Advanced Organic Chemistry Part B: Reactions and Synthesis", Plenum Press, New York.

9. Morrison, R. T. and Boyd, R. N., "Organic Chemistry", Prentice- Hall of India, New Delhi.
10. Bruckner, R., "Advanced Organic Chemistry-Reaction Mechanisms", Harcourt Science & Technology Company, New York.
11. March, J., "Advanced Organic Chemistry", John Wiley & Sons, New York.
12. House, H. O., "Modern Synthetic Reactions", The Benjamin/Cummings Publishing Company, California.
13. Finar, I. L., "Organic Chemistry", Vol. 1, Pearson Education, Delhi.
14. Greene, T. W., "Protective Groups in Organic Synthesis", John Wiley & Sons, New York.

4th Year; 7th Semester

PAPER-II

Title of the Course: **ORGANIC CHEMISTRY**

Code: **CHEM-462**

Credit Hours: **03**

Marks: **100**

Course Contents:

Molecular Rearrangements

Types of rearrangements; general mechanisms of nucleophilic, free radical and electrophilic rearrangements; reactions: hydrogen and/or carbon migration to electron-deficient carbon, nitrogen and oxygen; carbon migration to electron-rich carbon; aromatic rearrangements: interand intra-molecular carbon migration from oxygen to carbon.

Free Radicals

Introduction; radical generation; radical detection; radical shape and stabilization; radical reactions: addition reactions - addition of halogens, hydrogen halides, halomethanes, other carbon radicals and S-H compounds; substitution reactions-halogenation, oxidation and substitution involving aryl radicals.

Reactive Intermediates

Carbenes, nitrenes, and arynes: Their generation, stability, reactions and synthetic applications.

RECOMMENDED BOOKS:

1. March, J., "Advanced Organic Chemistry", John Wiley & Sons, New York
2. Norman, R. O.C. and Coxon, J. M., "Principles of Organic Synthesis", Nelson Thornes, Cheltenham.
3. Bruckner, R., "Advanced Organic Chemistry-Reaction Mechanisms", Harcourt Science & Technology Company, New York.
4. Morrison, R. T. and Boyd, R. N., "Organic Chemistry", Prentice- Hall of India, New Delhi.
5. Carey, F. A. and Sundberg, R. J., "Advanced Organic Chemistry Part A: Structure and Mechanisms", Kluwer Academic /Plenum Publishers, New York.
6. Sykes, P., "A Guide Book to Mechanism in Organic Chemistry", Longman, London.
7. Clayden, J., Greeves, N., Warren, S. and Wothers, P., "Organic Chemistry", Oxford University Press, New York.
8. Gilchrist, T. L. and Rees, C. W., "Carbenes, Nitrenes and Arynes", Nelson, London.
9. Pine, S. H., "Organic Chemistry", National Book Foundation, Islamabad.
10. Loudon, G. M., "Organic Chemistry", Oxford University Press, New York.
11. McMurry, J., "Organic Chemistry", Brooks/Cole Publishing Company, California.
12. Finar, I. L., "Organic Chemistry", Vol. 1, Pearson Education, Delhi.
13. Smith, M. B., "Organic Synthesis", McGraw-Hill, New York.
14. Lwowski, W., "Nitrenes", Interscience Publishers, New York.

4th Year; 7th Semester

PAPER-III

Title of the Course: **ORGANIC CHEMISTRY**

Code: **CHEM-463**

Credit Hours: **03**

Marks: **100**

Course Contents:

Organic Spectroscopy

A brief review of introductory organic spectroscopy. ¹H-NMR and ¹³C-NMR
Chemical shift; factors affecting chemical shift; spin relaxation; spin-spin coupling;
coupling constants; factors affecting coupling constants; 2-D NMR.

Mass Spectrometry

Introduction; mass spectrometers; ionization and ion sources: electron impact and
chemical ionization; field ionization; field desorption; fast atom bombardment; plasma
desorption, thermospray and electrospray mass spectra; fragmentation pattern of common
functional groups. Combined usage of IR, UV, NMR and Mass spectrometric methods
for structure elucidation of organic compounds having medium complexity.

Aromatic Heterocycles

Introduction; nomenclature; structure and aromaticity; basicity and acidity of the nitrogen
heterocycles; chemistry of furan, pyrrole and thiophene; synthesis of indoles and
isoindoles; chemistry of pyridine, quinoline and isoquinoline; occurrence of heterocyclic
compounds.

4th Year; 7th Semester

PAPER-I

Title of the Practical: **ORGANIC CHEMISTRY**

Code: **CHEM-461**

Credit Hours: **02**

Marks: **50**

Laboratory work illustrating topics covered in the lecture of papers I.

4th Year; 7th Semester

PAPER-II

Title of the Practical: **ORGANIC CHEMISTRY**

Code: **CHEM-462**

Credit Hours: **02**

Marks: **50**

Laboratory work illustrating topics covered in the lecture of papers II.

4th Year; 7th Semester

PAPER-III

Title of the Practical: **ORGANIC CHEMISTRY**

Code: **CHEM-462**

Credit Hours: **02**

Marks: **50**

Laboratory work illustrating topics covered in the lecture of papers III.

RECOMMENDED BOOKS:

1. Kemp, W., "Organic Spectroscopy", Palgrave, New York.
2. Silverstein, R. N., Barrler, G. C. and Morrill, T. C., "Spectrometric Identification of Organic Compounds", John Wiley & Sons, New York.
1. Williams D. H. and Fleming, I., "Spectroscopic Methods in Organic Chemistry", Athlone Press, London.
3. Atta-ur-Rehman, "Nuclear Magnetic Resonance Spectroscopy", UGC, Islamabad.
4. Davis, R. and Freason, M., "Mass Spectrometry", John Wiley & Sons, New York.
5. Bansal, R. K., "Heterocyclic Chemistry", Wiley Eastern Ltd., New Delhi.
6. Loudon, G. M., "Organic Chemistry", Oxford University Press, New York.
7. Lambert, J. B, Shurvell, H. F., Lightner, D. A. and Cooks, R. G., "Introduction to Organic Spectroscopy", Macmillan Publishing Company, New York.
8. Anderson, R. J., Bendell, D. and Groundwater, P., "Organic Spectroscopic Analysis", The Royal Society of Chemistry, Cambridge.
9. Gilchrist, T. L., "Heterocyclic Chemistry", Longman, Singapore.
10. Joule, J. A. and Mills, K., "Heterocyclic Chemistry", Blackwell Science, Tokyo.

COURSE WISE BREAKUP

Fourth Year

Seventh Semester

SPECILIZATION

PHYSICAL CHEMISTRY

THEORY

COURSE CODE	TITLE	CREDIT HOURS	MARKS
CHEM-471	PAPER-I: PHYSICAL CHEMISTRY	03	100
CHEM-472	PAPER-II: PHYSICAL CHEMISTRY	03	100
CHEM-473	PAPER-III: PHYSICAL CHEMISTRY	03	100

PRACTICALS

COURSE CODE	TITLE	CREDIT HOURS	MARKS
CHEM-471	PAPER-I: PHYSICAL CHEMISTRY	02	50
CHEM-472	PAPER-II: PHYSICAL CHEMISTRY	02	50
CHEM-473	PAPER-III: PHYSICAL CHEMISTRY	02	50

- **Total Credits of the Semester = 15 (theory 09 & practicles 06 credits)**
- **Maximum Marks = 450 (theory 300 & practicles 150 marks)**

4th Year; 7th Semester

PAPER-I

Title of the Course: **PHYSICAL CHEMISTRY**

Code: **CHEM-471**

Credit Hours: **03**

Marks: **100**

Course Contents:

Statistical Thermodynamics

Description of various systems. Concepts of states, accessible states and distribution. Probability concepts. Maxwell - Boltzmann's statistics for the systems of independent particles. Partition functions. The relationship of partition function to the various thermodynamic functions. Transitional, vibrational and rotational partition functions and equilibrium constant. Statistical thermodynamics. Applications to equilibrium and chemical kinetics. Bose-Einstein's and Fermi-Dirac's statistics.

Electrochemistry

Electrical Double Layer: Interface. A look into the interface; OHP and IHP. Contact adsorption Gibbs Surface Excess. Potential differences across metal solution interfaces. Outer and surface potential differences. Galvani potential difference. Electrochemical potential difference. Interfacial tension. Electro capillary thermodynamics. Lippmann's equation. Helmholtz-perrin model, Gouy-Chapmann model. Stern model, and BDM (Bockris-Devanathan-Muller) model. Charge density. Differential capacitance. Shape of capacitance-charge curve. The Capacitance hump.

Electrode Kinetics

Electrochemical devices. Charge transfer processes in the absence and presence of electrical field. The Over potential. Butler-Volmer's equation. The Idea of equilibrium exchange current density. The Symmetry factor. High field and low field approximation. Tafel's equation. Cyclic voltammetry and its applications. Fuel cell, corrosion and its prevention. Electrochemical impedance spectroscopy.

RECOMMENDED BOOKS:

1. Gasser R.P.H. and Richards W.G. "Entropy and Energy Levels" Oxford University Press (1974).

2. Wayatt P.A.H. "The Molecular Basis of Entropy and Chemical Equilibrium" Royal Institute of Chemistry London (1971).
3. Smith E.B. "Basic Chemical Thermodynamics" 4th ed. Oxford University Press (1990).
4. Bockris J.O.M. and Reddy A.K.N. "Modern Electrochemistry" Vol-I and II, 4th ed. Plenum Press, London (2003).
5. Muhammad M. and Amjad M. "Principles of Electrode Kinetics" Rooha Printers, Lahore (2001).
6. Seddon J.M. and Gale J.D. "Thermodynamics and Statistical Mechanics" Royal Soc Chem, UK (2002).
7. Aston J.G. and Fritz J.J. "Thermodynamics and Statistical Thermodynamics" John-Wiley, New York (1987).
8. Albery J., Electrode Kinetics, Clarendon, Oxford (1975).
9. Engel, Thomas and Philip Reid, "Thermodynamics, Statistical Thermodynamics", and Kinetics 1st ed., Benjamin Cummings (2006).
10. Bard A.J. and Faulkner L.R. "Electrochemical Methods" John Wiley & Sons (2001).

4th Year; 7th Semester

PAPER-II

Title of the Course: **PHYSICAL CHEMISTRY**

Code: **CHEM-472**

Credit Hours: **03**

Marks: **100**

Course Contents:

Polymer Chemistry

Introduction to Polymers. Step-growth Polymerizations. Polymer chain growth. Kinetics of polymer chain growth. Copolymerization. Emulsion Polymerization. Natural and Inorganic Polymers. Physical Aspects of polymers. Molecular Weight of Polymers: Distribution, averages, and methods of determination. Viscosity. Osmometry. Light scattering method. Diffusion. Sedimentation. Optical rotation method. Structure of Polymer Chain: Introduction to chain isomerism, stereochemistry, configurations, and

conformations. (not in Hiemenz). Amorphous State of Polymers: In depth examination of polymer conformation, microstructure, and dynamics in the amorphous state. Polymer viscoelasticity: Stress relaxation, mechanical models of polymer behavior, time-temperature superposition, perhaps rheology. Crystalline State of Polymers: crystallization and kinetics, crystalline structures, experimental methods. Polymer Solutions and Blends:

RECOMMENDED BOOKS:

1. Hiemenz P.C. "Polymer Chemistry: The Basic Concepts" Marcel Dekker (1984).
2. Stevens M.P. "Polymer Chemistry: An Introduction" Oxford University Press (1999).
3. Allcock H.R. and Lampe F.W. "Contemporary Polymer Chemistry" Prentice-Hall (1990).
4. Rudin "The Element of Polymer Science and Engineering" Academic Press (1990).
5. Sperling L.H. "Introduction to Physical Polymer Science" Wiley Interscience (1992).
6. Boyd R.H. and Phillips P.J. "The Science of Polymer Molecules" Cambridge (1993).
7. Malcolm P.S. "Polymer Chemistry" Oxford University Press (2005).
8. Ravue, "Principles of Polymer Chemistry" 2nd ed. Plenum Publishers (2000).

4th Year; 7th Semester

PAPER-III

Title of the Course: **PHYSICAL CHEMISTRY**

Code: **CHEM-473**

Credit Hours: **03**

Marks: **100**

Course Contents:

Quantum Chemistry

Operators and their properties. Angular momentum. Central field problem. Approximate methods. Perturbation methods and variation principle. Many electron systems.

Treatment of simple harmonic oscillator, diatomic rigid rotor. Valence bond and molecular orbital theories. pi-electron calculations.

Molecular Spectroscopy

Interaction of electromagnetic radiation with matter. Symmetry properties of molecules. Microwave and infrared spectroscopy. Rotational, vibrational and rotational-vibrational spectra of diatomic and polyatomic molecules. Electronic spectra of simple molecules. Nuclear magnetic resonance spectroscopy.

RECOMMENDED BOOKS:

1. Micheal D.F. "Elements of Quantum Mechanics" Oxford University Press (2005).
1. Whiffen D. H. "Spectroscopy" Longmans Green and Co. London, (1966).
2. Barrow G. "Molecular Spectroscopy" McGraw Hill (1962).
3. Becker E. D. "High Resolution NMR; Theory & Chemical Application", New York, Academic Press (1980).
4. Graybal J.D. "Molecular Spectroscopy", New York, McGraw-Hill (1988).
5. Griffiths, David J., "Introduction to Quantum Mechanics" 2nd ed., Prentice Hall (2004).
6. Hayward, David O., "Quantum Mechanics for Chemists" 1st ed., John Wiley (2003).
7. House, James E., "Fundamentals of Quantum Mechanics" 2nd ed., Elsevier-Academic Press (2003)

4th Year; 7th Semester

PAPER-I

Title of the Practical: **PHYSICAL CHEMISTRY**

Code: **CHEM-471**

Credit Hours: **02**

Marks: **50**

1. Determination of partial molar quantities.
2. Determination of free energy changes, standard free energies.
3. Verification of Kohlrausch law.
4. Study of temperature dependence of electrode potentials.

5. Determination of heat of solution, ionic reactions and other experiments from thermochemistry.
6. Determination of molecular weight of a polymer by viscosity method.
7. Precipitation value of electrolytes.
8. Measurement of IR spectra of simple compound and their interpretation.
9. Measurement of cyclic voltammogram of an organic compound and its interpretation.
10. Determination of dipole moment of an organic liquid.
11. Determination of percentage composition of KMnO_4 - $\text{K}_2\text{Cr}_2\text{O}_7$ in given solution by spectrometry.
12. Evaluation of pKa value an indicator by spectrometric method.
13. Synthesis of metal oxide nanoparticles and their characterization using IR and XRD techniques.

4th Year; 7th Semester

PAPER-II

Title of the Practical: **PHYSICAL CHEMISTRY**

Code: **CHEM-472**

Credit Hours: **02**

Marks: **50**

1. Study of multistep reactions.
2. Sugar analysis and inversion studies by polarimetry.
3. Study of isotherms and experiments of surface chemistry.
4. Kinetics of fading of phenolphthalein in alkaline solution.
5. Study of the effect of pH on the rate constant of the reaction between iodide and persulphate ions.
6. Study of the salt effect on the rate constant of the reaction between similar charges of ions.
7. Kinetics of autocatalytic reaction between permanganate and oxalate ions.
8. Determination of energy of activation of the reaction between similar charges of ions.

9. Kinetics of the reaction between methylorange and peroxodisulphate ions in presence of bromide ions.
10. Stoichiometry of a complex in solution by Job's method.

4th Year; 7th Semester

PAPER-III

Title of the Practical: **PHYSICAL CHEMISTRY**

Code: **CHEM-473**

Credit Hours: **02**

Marks: **50**

RECOMMENDED BOOKS:

1. Braun R.D. and Walters F. "Application of Chemical Analysis" (1982).
2. David P. "Experiments in Physical Chemistry" 5th ed. (1989).
3. Shoemaker C.W., Nibler G.J.W. and Christian G.D. "Analytical Chemistry" 6th ed. (2004).
4. James A.M. and Prichard F.E. "Practical Physical Chemistry" 3rd ed. Longman (1974).
5. Mowry S. and Ogren P.J., J. Chemical Education, 76(7) (1999).
6. Shoemaker D.P., Garland C.W. and Nibler J.W. "Experiments in Physical Chemistry" McGraw Hills, New York (1989).

COURSE WISE BREAKUP

Fourth Year

Seventh Semester

SPECILIZATION

APPLIED CHEMISTRY

THEORY

COURSE CODE	TITLE	CREDIT HOURS	MARKS
CHEM-421	PAPER-I: APPLIED CHEMISTRY	03	100
CHEM-422	PAPER-II:APPLIED CHEMISTRY	03	100
CHEM-423	PAPER-III:APPLIED CHEMISTRY	03	100

PRACTICALS

COURSE CODE	TITLE	CREDIT HOURS	MARKS
CHEM-421	PAPER-I: APPLIED CHEMISTRY	02	50
CHEM-422	PAPER-II:APPLIED CHEMISTRY	02	50
CHEM-423	PAPER-III:APPLIED CHEMISTRY	02	50

- Total Credits of the Semester = 15 (theory 09 & practicles 06 credits)
- Maximum Marks = 450 (theory 300 & practicles 150 marks)

4th Year; 7th Semester

PAPER-I

Title of the Course: **APPLIED CHEMISTRY**

Code: **CHEM-421**

Credit Hours: **03**

Marks: **100**

Course Contents:

Sugar Industry

Scope of sugar industry; Manufacture of raw sugar from cane and beet; Refining of raw sugar; Methods of clarification of cane juice and chemistry involved in the clarification processes: Defecation Remelt Carbonation (DRC), Defecation Remelt Sulphitation (DRS), Defecation Remelt Phosphitation (DRP) and Double Carbonation Double Sulphitation (DCDS); Utilization of by-products of sugar industry.

Starch Industry

Scope of starch industry; Raw materials for starch production; Manufacture of starch from various raw materials such as corn, rice, wheat, potatoes; Industrial applications of starch; Chemistry involved in the conversion of starch; Synthesis of d-glucose and dextrin from starch.

Leather Industry

Leather, gelatine and adhesives; Preparation of hides; Methods of tanning, Vegetable and chrome tanning processing of leather; Production of glue and gelatine.

4th Year; 7th Semester

PAPER-II

Title of the Course: **APPLIED CHEMISTRY**

Code: **CHEM-422**

Credit Hours: **03**

Marks: **100**

Course Contents:

Fertilizers

Importance of chemical fertilizers; Classification of chemical fertilizers; Manufacture and chemistry involved in the production of various fertilizers i.e. Urea, Single Super phosphate (SSP), Triple super phosphate (TSP), Nitrophos (NP), Diammonium phosphate

(DAP), Calcium ammonium nitrate (CAN), Ammonium nitrate (AN), Ammonium sulphate (AS), Zinc sulphate (ZS) and Complex fertilizers.

Agrochemical Industry

Classification of pesticides; Formulation and toxicity of pesticides; Future trends of pest control; Control of weeds; Household agrochemicals; Plant growth regulators and background chemistry; Hazards associated with the use of agrochemicals and environmental aspects.

Industrial Pollution and Environmental Protection

Sources of air, water and soil pollution; Industrial waste and its control for environmental protection; Modern trends for waste treatment; Industrial gases and pollution control methods; Role and production of free radicals and atmospheric chemistry.

4th Year; 7th Semester

PAPER-III

Title of the Course: **APPLIED CHEMISTRY**

Code: **CHEM-423**

Credit Hours: **03**

Marks: **100**

Course Contents:

Oils, Fats, Waxes and Vegetable Ghee Industry

Oils, Fats and Waxes; Extraction of oils such as soybean and cotton seed oils; Purification and refining of oils; Chemistry involved in the production of vegetable ghee; Selective hydrogenation of oil and fats during the manufacture of vegetable ghee; Interesterification of crude fats.

Soaps and Detergents

Raw materials for the manufacture of soap and detergents; Chemistry involved in the production of soap and detergents; Action of builders, additives brighteners and surfactants; Cleansing action of soaps; Effect of acidic species and hard water on soap; Production of transparent soap.

Surface Coating Industry

Raw materials for paints and pigments; Classification and properties of surface-coating constituents; Classification and manufacture of pigments; Production of paints, varnishes,

distempers, enamals and lacquers; Chemistry involved in the drying phenomena of paints; Drying oils for paint and classification of drying oils.

4th Year; 7th Semester

PAPER-I

Title of the Practicals: **APPLIED CHEMISTRY**

Code: **CHEM-421**

Credit Hours: **02**

Marks: **50**

Water analysis; Analysis of oil and fats; Testing and analysis of vegetable ghee; Synthesis of soap and its analysis; Analysis of bleaching powder; Fertilizer analysis and testing of raw materials such as phosphate rock and ores; Various other practicals may be added in accordance with the available facilities.

4th Year; 7th Semester

PAPER-II

Title of the Practicals: **APPLIED CHEMISTRY**

Code: **CHEM-422**

Credit Hours: **02**

Marks: **50**

Analysis of coal and petroleum fuels; Cement analysis and testing of raw materials; Milk analysis; Analysis of lime stone; Preparations of various cosmetics such as cold cream, shaving cream, nail polish, shoe polish etc. Various others of practicals may add in accordance with the available facilities.

4th Year; 7th Semester

PAPER-III

Title of the Practicals: **APPLIED CHEMISTRY**

Code: **CHEM-423**

Credit Hours: **02**

Marks: **50**

RECOMMENDED BOOKS

1. Billmeyer, F. W. Jr., Text Book of Polymer Science, 3rd Ed., John Wiley and Sons Inc. Singapore, (1994).
2. L.H Sperlring "Introduction to Physical Polymer Sciences", 2nd Ed., John Wiley & Sons
3. Joel R. Fried "Polymer Science & Technology", Prentice Hall, Inc. (1995).
4. G. Odioin "Principles of Polymerization", 2nd Ed. John Wiley & Sons .
5. Cowie J. M.G., Polymers Chemistry and Physics of Modern Material, 1st Ed. Intertext Book New York, (1973).
6. R. N. Shreve, The chemical process industries, McGraw-Hill Book Company.
7. Terold M. Schultz, Polymer Materials Science, (1974).
8. Riegel, E.R. (1956)." Industrial Chemistry" 5th ed. Reinhold Publishing Corporation, New York.
9. W Francis, Fuels and fuel technology, Pergamon press, New yourk.
10. Theodore Dumas Walter Bulani, Oxidation of Petrochemicals Chemistry and Technology, (1974).
11. Urbanski, T., Chemistry and Technology of Explosives Vol-1, Authorised Translation by I. Jeczalikowa ad S. Laverton, 2nd Ed., Pergamon Press London, (1983).
12. Urbanski T., Chemistry and Technology of Explosives Vol-II, Authorised Translation by W. Ornaf and S. London, 2nd Ed., Pergamon Press London, (1983).
13. Urbanski, T., Chemistry and Technology of Explosives Vol-III, 1st Ed., Pergamon Press London (1984).
14. Urbanstri, T., Chemistry and Technology of Explosives, (1985).
15. P. C. Deb, Soaps and Detergents, 1st Edition, C. B. S. Publisher and distributes, (1996).
16. P. C. Deb., Modern Trends in Formulating Soaps and Detergents, (1996).
17. R. M. Christie, Colour Chemistry, The Royal Society of Chemistry, (2001).

COURSE WISE BREAKUP

Fourth Year

Seventh Semester

SPECILIZATION

ANALYTICAL CHEMISTRY

THEORY

COURSE CODE	TITLE	CREDIT HOURS	MARKS
CHEM- 411	PAPER-I: ANALYTICAL CHEMISTRY	03	100
CHEM- 412	PAPER-II: ANALYTICAL CHEMISTRY	03	100
CHEM- 413	PAPER-III: ANALYTICAL CHEMISTRY	03	100

PRACTICALS

COURSE CODE	TITLE	CREDIT HOURS	MARKS
CHEM- 411	PAPER-I: ANALYTICAL CHEMISTRY	02	50
CHEM- 412	PAPER-II: ANALYTICAL CHEMISTRY	02	50
CHEM- 413	PAPER-III: ANALYTICAL CHEMISTRY	02	50

- Total Credits of the Semester = 15 (theory 09 & practicles 06 credits)
- Maximum Marks = 450 (theory 300 & practicles 150 marks)

4th Year; 7th Semester

PAPER-I

Title of the Course: **ANALYTICAL CHEMISTRY**

Code: **CHEM-411**

Credit Hours: **03**

Marks: **100**

Course Contents:

Spectroscopic Methods of Analysis

1. Molecular Absorption Spectroscopy:

Electromagnetic radiations, electronic excitation, absorption by molecules, magnitude of absorption of radiations, instrumentation, various sources of light, filters and monochromators and their efficiency, Detectors, single beam and double beam spectrophotometers. Sources of error and optimum conditions. Analytical applications in quantitative analysis of organic, inorganic and Bioanalytical compounds.

2. Photoluminescence Spectroscopy:

Principles of photoluminescence, spectrofluorometry, and spectrophosphometry, excitation and de-excitation processes, variables affecting fluorescence and phosphorescence, measurement of fluorescence, instruments and analytical applications of photoluminescence.

3. Atomic Absorption Spectroscopy:

Basic principle of atomic absorption phenomena, Instrumentation, different light-courses, atomizers, flame and flameless atomizers, photometric system and detectors. Modulation and analytical applications.

4th Year; 7th Semester

PAPER-II

Title of the Course: **ANALYTICAL CHEMISTRY**

Code: **CHEM-412**

Credit Hours: **03**

Marks: **100**

Course Contents:

Electrochemical Methods

1. Electrode Phenomena:

The electrochemical cell, Oxidation and reduction potentiometric methods, various types of electrodes and their use, over potentials, membrane potentials, some well known Redox reactions of analytical importance, ion-selective electrodes, direct potentiometric measurements, potentiometric titration.

2. Principles of Voltametry

Principles of voltammetry, instrumentation, different modes of Voltametry. Applications for the analyses of inorganic and organic compounds.

4th Year; 7th Semester

PAPER-III

Title of the Course: **ANALYTICAL CHEMISTRY**

Code: **CHEM-413**

Credit Hours: **03**

Marks: **100**

Course Contents:

Emission Spectroscopy and Radioelectrochemical Methods

1. Atomic Emission Spectroscopic Methods

Types of emission spectroscopic techniques. Flame Emission Spectroscopy: basic principle, instrumentation and applications. Atomic Fluorescence Spectroscopy: basic principle, instrumentation and applications. Plasma Emission Spectroscopy, Inductively Coupled Plasma (ICP) and Direct Current (DC) Plasma, Applications of plasma emission spectroscopy, Comparison of atomic emission spectroscopic techniques.

2. Radioelectrochemical Methods:

Nuclear emissions: alpha particles, beta particles and gamma rays. Detectors: Gas ionization, scintillation and semi-conductor detectors. Radiochemical analysis: neutron activation analysis, isotope dilution method, radiometric titrations, radioactive tracers.

4th Year; 7th Semester

PAPER-I

Title of the Practicals: **ANALYTICAL CHEMISTRY**

Code: **CHEM-411**

Credit Hours: **02**

Marks: **50**

1. Calibration of a uv-visible spectrophotometer as per requirements of British Pharmacopoeia
2. Experimental determination of limits of detection and quantitation by use of spectrophotometry
3. Experimental determination of precision, accuracy and specificity
4. Two experiments for quantitative determination of analytes of interest by spectrophotometry
5. Two experiments for quantitative determination of analytes of interest by atomic spectrometry
6. Three experiments based on electrochemical techniques

4th Year; 7th Semester

PAPER-II

Title of the Practicals: **ANALYTICAL CHEMISTRY**

Code: **CHEM-412**

Credit Hours: **02**

Marks: **50**

4th Year; 7th Semester

PAPER-III

Title of the Practicals: **ANALYTICAL CHEMISTRY**

Code: **CHEM-413**

Credit Hours: **02**

Marks: **50**

RECOMMENDED BOOKS:

1. Analytical Chemistry by Gary D. Christian; 6th ed. 2004; John Wiley & Sons, Inc.
2. Fundamentals of Analytical Chemistry by Douglas A. Skoog, Donald M. West, F. James Holler, Stanley R. Crouch; 8th ed. 2003; Saunders College Publishing, Philadelphia.

3. Instrumental Methods of Analysis by Hobert H. Willard D.L. Merrit & J.R.J.A. Dean, Frank A. Settle; 7th Sub edition 1988; Wadsworth Publishing Company.
4. British Pharmacopoeia
5. United States Pharmacopoeia
6. Laboratory Manual of Analytical Chemistry by C. Reilly; Allyn and Bacon, London.
7. Quantitative Analysis by W. J. Blaedal and V. W. Medloche; Harper & Row, N. Y.
8. Most of the experiments prescribed can be found on various websites.

COURSE WISE BREAKUP

Fourth Year

Seventh Semester

SPECILIZATION

BIOCHEMISTRY

THEORY

COURSE CODE	TITLE	CREDIT HOURS	MARKS
CHEM-431	PAPER-I: BIOCHEMISTRY	03	100
CHEM-432	PAPER-II: BIOCHEMISTRY	03	100
CHEM-433	PAPER-III: BIOCHEMISTRY	03	100

PRACTICALS

COURSE CODE	TITLE	CREDIT HOURS	MARKS
CHEM-431	PAPER-I: BIOCHEMISTRY	02	50
CHEM-432	PAPER-II: BIOCHEMISTRY	02	50
CHEM-433	PAPER-III: BIOCHEMISTRY	02	50

- **Total Credits of the Semester = 15 (theory 09 & practicles 06 credits)**
- **Maximum Marks = 450 (theory 300 & practicles 150 marks)**

4th Year; 7th Semester

PAPER-I

Title of the Course: **BIOCHEMISTRY**

Code: **CHEM-431**

Credit Hours: **03**

Marks: **100**

Course Contents:

Prerequisites: Course I and concept of basic human physiology

Objective of the Course: This course provides fundamental concepts biochemical and molecular aspects of endocrinology and chemistry of blood and other extracellular fluids. Emphasis is on relation of the above topics to medicine.

Course Contents:

Endocrinology

General Introduction, Chemical Nature of Hormones, Common Characteristics. Mode of action of hormones, Hormones receptors. Chemistry. Biosynthesis, Metabolism and biological functions of pituitary, Adrenal, Thyroid, parathyroid, pancreatic and gonadal hormones. Hormones of GIT, Renal and Pinal glands.

Blood and Other Body Fluids.

General composition of blood. Function of blood. Blood plasma, Plasma proteins; composition and functions, Composition, development and functions of red blood cells, white blood cells and platelets, Haemoglobin; chemistry, properties, synthesis, functions and derivatives, Degradation of haemoglobin, respiration and gas transport. Blood Coagulation and clotting of blood. Blood pressure. Blood groups Composition of Urine, Extracellular Fluids Like: cerebrospinal fluid, lymph, Sweat, Tears, Synovial and interstitial fluid.

RECOMMENDED BOOKS:

1. Lehninger, A. L, “ Principles of Biochemistry”, Worth Publisher, New York, (2001).
2. Voet, D. and Voigt 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. Guyton, C and Hall J. C., Text Book of Medical Physiology, 9th., W. B. Saunders Company, (1996)
5. Orten, J. M. & Neuhasus, O. W., Human Biochemistry, 9th Ed., The C. V. Mosby Company, Saint Louis (1975).
6. Devlin, T. M. (Editor), The Text Book of Biochemistry with Clinical Correlation, Wiley- Liss, New York (1997).
7. Wilhelm R. Frisell, "Human Biochemistry", Macmillan Publishing Co., Inc. New York (1982).

4th Year; 7th Semester

PAPER-II

Title of the Course: **BIOCHEMISTRY**

Code: **CHEM-432**

Credit Hours: **03**

Marks: **100**

Course Contents:

Course Outlines Extraction, Fractionation and Purification of Macromolecules

Homogenization, Solubilization and Concentration including ultrasonication, lyophilization and ultracentrifugation, Purification based on differential solubility techniques, Ion-Exchange chromatography, Gel chromatography, Affinity chromatography, Paper & Thin layer chromatography and HPLC.

Electrophoresis

Paper and Gel electrophoresis. Two-dimensional electrophoresis. Capillary electrophoresis.

Electrofocusing

Preparative and Analytical electrofocusing.

Centrifugation

Principle. Preparative centrifugation. Application of density gradient and differential centrifugation. Ultracentrifugation. Sedimentation equilibrium and sedimentation velocity methods. Application of analytical centrifugation.

Tracer techniques

Detection and measurement of radioactivity. Application of radioisotopes in biological system.

U.V. and Visible Spectroscopy

Basic principles. Instrumentation and applications.

ELISA Techniques

RECOMMENDED BOOKS:

1. The tools of Biochemistry by Cooper
2. Principles and techniques of practical Biochemistry by William Edward and Arnold
3. Qualitative problems in Biochemistry by Dawas
4. A biologist's Physical chemistry by J.Gareth Morris
5. Protein purification, principle and practice by Robert.K.Scope.

4th Year; 7th Semester

PAPER-III

Title of the Course: **BIOCHEMISTRY**

Code: **CHEM-433**

Credit Hours: **03**

Marks: **100**

Course Contents:

Molecular Biology

DNA; the primary genetic material. Structure, Replication in prokaryotes and comparison with eukaryotes. DNA sequencing. Chemical synthesis of polynucleotides. DNA repair and recombination. Different types of RNA and their role in protein synthesis. Transcription and its regulation. Genetic code. Post transcriptional processing. Structure of transfer RNA. Protein synthesis inhibitors. Control of translation . Post translational modification. Plasmids, bacteriophage and cosmids. In vitro mutagenesis: Deletion, Insertion and Substitution. Recombinant DNA and genetic diseases.

RECOMMENDED BOOKS:

1. Watson, J.D., Baker, T.A., Bell, S.P., Gann, Molecular Biology of the Gene 2004, Pearson Education, Inc.
2. Watson, J.D. Tooze, J and Kurtz, D.T. Recombinant DNA Scientific American Books. Freeman
3. Lewin B. Gene VII. Oxford University Press
4. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter Molecular Biology of the Cell 5th Edition Taylor & Francis
5. T. A. Brown. Genomes 3rd Edition Taylor & Francis

4th Year; 7th Semester

PAPER-I

Title of the Practicals: **BIOCHEMISTRY**

Code: **CHEM-431**

Credit Hours: **02**

Marks: **50**

Laboratory work illustrating topics covered in the lecture of papers I.

4th Year; 7th Semester

PAPER-II

Title of the Practicals: **BIOCHEMISTRY**

Code: **CHEM-432**

Credit Hours: **02**

Marks: **50**

Laboratory work illustrating topics covered in the lecture of papers II.

4th Year; 7th Semester

PAPER-III

Title of the Practicals: **BIOCHEMISTRY**

Code: **CHEM-433**

Credit Hours: **02**

Marks: **50**

Laboratory work illustrating topics covered in the lecture of papers III.

RECOMMENDED BOOKS:

6. Watson, J.D., Baker, T.A., Bell, S.P., Gann, Molecular Biology of the Gene 2004, Pearson Education, Inc.
7. Watson, J.D. Tooze, J and Kurtz, D.T. Recombinant DNA Scientific American Books. Freeman
8. Lewin B. Gene VII. Oxford University Press
9. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter Molecular Biology of the Cell 5th Edition Taylor &Francis
10. T. A. Brown. Genomes 3rd Edition Taylor &Francis

COURSE WISE BREAKUP

Fourth Year

Eighth Semester

SPECILIZATION

INORGANIC CHEMISTRY

THEORY

COURSE CODE	TITLE	CREDIT HOURS	MARKS
CHEM-454	PAPER-IV: INORGANIC CHEMISTRY	03	100
CHEM-455	PAPER-V: INORGANIC CHEMISTRY	03	100
CHEM-456	PAPER-VI: INORGANIC CHEMISTRY	03	100

PRACTICALS

COURSE CODE	TITLE	CREDIT HOURS	MARKS
CHEM-452	INORGANIC CHEMISTRY (RESEARCH PROJECT)	06	200

- **Total Credits of the Semester = 15 (theory 09 & practicles 06 credits)**
- **Maximum Marks = 500 (theory 300 & practicles 200 marks)**

4th Year; 8th Semester

PAPER-IV

Title of the Course: **INORGANIC CHEMISTRY**

Code: **CHEM-454**

Credit Hours: **03**

Marks: **100**

Objective of the Program

After completing this program students will be able to learn and have knowledge of the following:

1. Chemistry of Organometallics with especially with reference to their types and bonding.
2. Reactivity of Organometallic Compounds in Homogenous Catalytic

Course Contents:

Chemistry of Organometallics

History and introduction to organometallic compounds, types of bonding. Transition metals; single, double and triple bonds to carbon (compound types, acyls, alkylidene complexes and alkylidyne complexes), delocalized hydrocarbon systems (alkenes, olefins, allyl and butadienes), alkyne complexes, cyclic π -complexes (five- and six-member rings).

Organometallic Compounds in Homogenous Catalytic Reactions

Homogenous catalytic hydrogenation, dimerization, oligomerization, polymerization, oxidation, hydrosilation, hydroformylation of olefins. Catalytic polymerization of acetylenes, insertion reactions, use of organometallic compounds in organic synthesis.

RECOMMENDED BOOKS:

1. Powell, P., "Principles of Organometallics Chemistry", 2nd edition London, 1995.
2. Akio Yamamoto "Organotransition Metal Chemistry", Printice Hall, 1992.
3. F. A. Cotton, G. Wilkinson, C. A. Murillo and M. Bochmann, "Advanced Inorganic Chemistry", 6th Ed., Wiley-Interscience, New York, 1999.
4. Miessler G.L. and Tar Donald, A. "Inorganic Chemistry" Prentice Hall Int. edition, 1991.
5. Douglas, McDaniel & John Alexander. "Concepts and Models of Inorganic Chemistry" by John Willey and Sons, 1994.

- Zuckerman, H., "Basic Organometallic Chemistry", 2nd Ed, 1985.
- William. J., Modern inorganic chemistry second edition McGraw Hill Company, 1991.
- Porter Field. W.W., Inorganic Chemistry a Unified Approach 2nd ed. Elsevier Publishers, 2005.

4th Year; 8th Semester

PAPER-V

Title of the Course: **INORGANIC CHEMISTRY**

Code: **CHEM-455**

Credit Hours: **03**

Marks: **100**

Objective of the Program

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

- Magneto Chemistry
- Oxidative Addition and Reductive Elimination

Course Contents:

Magnetochemistry

Theory of magnetism, diamagnetism, paramagnetism, ferro-, ferri- and antiferromagnetism, magnetic susceptibility, magnetic moments, Faraday's & Gouy's methods, orbital contribution to magnetic moment, Russell-Sanders coupling scheme, derivation of term symbols of for $p^1 - p^6$ and $d^1 - d^{10}$ systems, pigeon holes diagram, effect of temperature on magnetic properties of complexes. Magnetic moment of lengthenise.

Oxidative Addition and Reductive Elimination

Oxidative Addition: one electron oxidative addition, addition of oxygen, addition of bimetallic species, hydrogen addition, HX addition, organic halides, Reductive Elimination Reactions.

RECOMMENDED BOOKS:

- Douglas, B., McDaniel, D. and Alexander, J., "Concepts of Models of Inorganic Chemistry", John Wiley & Sons Inc., 3rd Edition, 1994

2. Huheey, J. E, Keiter, E. A. and Keiter, R. L., "Inorganic Chemistry: Principles of Structure and Reactivity", 4th Ed., Harper & Row, New York, 2001.
3. Mackay, K. M., Mackay, R. A. and Henderson, W., "Introduction to Modern Inorganic Chemistry", 5th Edition, Stanley Thomas Publisher Ltd. 1996
4. Miessler, G. L. and Tarr Donald, A., "Inorganic Chemistry", Prentice Hall International, 1991.
5. Purcell, K.F. and Kotz, J.C., "An Introduction to Inorganic Chemistry" W.B. Saunders Company Holt-Saunders Internal editions, 1980.
6. F. A. Cotton, G. Wilkinson, C. A. Murillo and M. Bochmann, "Advanced Inorganic Chemistry", 6th Ed., Wiley-Interscience, New York, 1999.
7. William. J., Modern inorganic chemistry second edition McGraw Hill Company 1991.

4th Year; 8th Semester

PAPER-VI

Title of the Course: **INORGANIC CHEMISTRY**

Code: **CHEM-456**

Credit Hours: **03**

Marks: **100**

Objective of the Program

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

1. The chemistry of radio isotopes, their reactions and applications.
2. Nuclear reactions

Course Contents:

Nuclear Chemistry

Introduction, theory of disintegrations, positive ray analysis, mass spectrograph, Astam mass spectrograph, Dempster mass spectrograph, Jordan double focusing mass spectrograph, Bain bridge mass spectrograph, structure of the nucleus, half life nuclear binding energy, artificial disintegration. Fission and Fusion reactions, Accelerators of charged particles, applications of Radio Isotopes

RECOMMENDED BOOKS:

1. Fried Landler, Kennedy and Miller, "Nuclear and Radiochemistry", John Willey and Sons, Inc. 2nd edition, 1964.
2. Choppin, G. R. and Rydber, J., "Theory and Applications", Pergamon 1980.
3. Arnikan, H. J., "Essentials of Nuclear Chemistry", 4th edition, 1990.
4. Harvey, B.G. "Nuclear Physics and Chemistry", Prentice-Hall Inc., 1990.
5. Naqvi, I. I., "Radiochemistry", University Grants Commission, 1990.

4th Year; 8th Semester

Title of the Practicals: **INORGANIC CHEMISTRY (RESERAHC PROJECT)**

Code: **CHEM-452**

Credit Hours: **06**

Marks: **200**

RECOMMENDED BOOKS:

1. 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.
2. Vogel, A. I., "A Textbook of Micro and Semi-micro Qualitative Inorganic Analysis" Longman Green & Co. 1995.
3. Fritz, J. S. and Schenk, G. H., "Quantitative Analytical Chemistry", Allyn and Bacon Inc., 4th Edition, 1979.
4. Pass, G and Sutcliffe, H., "Practical Inorganic Chemistry", Van Nostrand Reinhold Company, 1972.

COURSE WISE BREAKUP

Fourth Year

Eighth Semester

SPECILIZATION

ORGANIC CHEMISTRY

THEORY

COURSE CODE	TITLE	CREDIT HOURS	MARKS
CHEM-464	PAPER-IV: ORGANIC CHEMISTRY	03	100
CHEM-465	PAPER-V: ORGANIC CHEMISTRY	03	100
CHEM-466	PAPER-VI: ORGANIC CHEMISTRY	03	100

PRACTICALS

COURSE CODE	TITLE	CREDIT HOURS	MARKS
CHEM-462	ORGANIC CHEMISTRY (RESEARCH PROJECT)	06	200

- **Total Credits of the Semester = 15 (theory 09 & practicles 06 credits)**
- **Maximum Marks = 500 (theory 300 & practicles 200 marks)**

4th Year; 8th Semester

PAPER-IV

Title of the Course: **ORGANIC CHEMISTRY**

Code: **CHEM-464**

Credit Hours: **03**

Marks: **100**

Course Contents:

Mechanisms and Methods of Determining Them

Review of kinds and mechanism of organic reactions; thermodynamic and kinetic requirements for reactions: kinetic and thermodynamic control; The Hammond postulate; microscopic reversibility; methods of determining mechanisms; identification of products; determination of the presence of an intermediate; the study of catalysis; crossover experiments; isotopic labeling; stereochemical and kinetic studies; solvent effect.

Lipids, Proteins, Carbohydrates and Nucleic Acids

Chemistry of lipids, proteins, carbohydrates, nucleic acids and their importance in living systems.

Drugs-Pharmaceutical Compounds

Introduction; classification; chemistry of analgesics and antipyretics, sulpha drugs/sulphonamides, antimalarials and antibiotics.

RECOMMENDED BOOKS:

1. Carroll, F. A., "Perspectives on Structure and Mechanism in Organic Chemistry", Brooks/Cole Publishing Company, New York.
2. Jones, R. A. Y., "Physical and Mechanistic Organic Chemistry", Cambridge University Press, Cambridge.
3. Carey, F. A. and Sundberg, R. J., "Advanced Organic Chemistry Part B: Reactions and Synthesis", Plenum Press, New York.
4. March, J., "Advanced Organic Chemistry", John Wiley & Sons, New York.
5. Gould, E. S., "Mechanism and Structure in Organic Chemistry", Holt, Rinehart and Winston, New York.
6. Clayden, J., Greeves, N., Warren, S. and Wothers, P., "Organic Chemistry", Oxford University Press, New York.

7. Loudon, G. M., "Organic Chemistry", Oxford University Press, New York.
8. Brown, W. H., "Introduction to Organic Chemistry", Saunders College Publishing, Tokyo.
9. Ahluwalia, V. K. and Goyal, M., "A Text Book of Organic Chemistry", Narosa Publishing House, New Delhi.
10. Finar, I. L., "Organic Chemistry", Vol. 2, Pearson Education, Delhi.
11. Blei, I. and Odian, G., "General, Organic and Biochemistry", W.H. Freeman & Company, New York.
12. Solomons, T. W. G. and Fryhle, C. B., "Organic Chemistry", John Wiley & Sons, New York.
13. Burger, A., "Medicinal Chemistry Part I & II", John Wiley & Sons, New York.
14. Wolff, M. E., "Burger's Medicinal Chemistry Part II", John Wiley & Sons, New York.
15. Williams, D. A. and Lemke, T. L., "Foye's Principles of Medicinal Chemistry", Lippincott Williams & Wilkins, New York.
16. Sykes, P., "A Guide Book to Mechanism in Organic Chemistry", Longman, London.
17. Pine, S. H., "Organic Chemistry", National Book Foundation, Islamabad.
18. Norman, R. O. C. and Coxon, J. M., "Principles of Organic Synthesis", Nelson Thornes, Cheltenham.
19. Isaacs, N. S., "Physical Organic Chemistry", Longman, London.

4th Year; 8th Semester

PAPER-V

Title of the Course: **ORGANIC CHEMISTRY**

Code: **CHEM-465**

Credit Hours: **03**

Marks: **100**

Course Contents:

Alkaloids

Introduction; classification; isolation; general methods for structure elucidation; discussion with particular reference to structure and synthesis of ephedrine, nicotine atropine, quinine, papaverine and morphine.

Terpenoids

Introduction; classification; isolation; general methods for structure elucidation; discussion with particular reference to structure and synthesis of citral, α -terpineol, α -pinene, camphor and α -cadinene.

Steroids

Introduction; nomenclature and stereochemistry of steroids; structure determination of cholesterol and bile acids; introduction to steroidal hormones with particular reference to adrenal cortical hormones.

RECOMMENDED BOOKS:

1. Finar, I. L., "Organic Chemistry", Vol. 2, Pearson Education Ltd., Delhi.
2. Shoppee, C. W., "Chemistry of the Steroids", Butterworths, London.
3. Hesse, M., "Alkaloid Chemistry", John Wiley & Sons, New York.
4. Fieser, L. F. and Fieser, M., "Steroids", Asia Publishing House, London.
5. Morrison, R. T. and Boyd, R. N., "Organic Chemistry", Prentice-Hall of India, New Delhi.
6. Solomons, T. W. G. and Fryhle, C. B., "Organic Chemistry", John Wiley & Sons, New York.

4th Year; 8th Semester

PAPER-VI

Title of the Course: **ORGANIC CHEMISTRY**

Code: **CHEM-466**

Credit Hours: **03**

Marks: **100**

Course Contents:

Transition Metal Catalyzed Coupling Reactions

Transition metals and their complexes; oxidation states; the *dn* notations; electron counting: the 16- and 18- electron rules; fundamental reactions of transition metal complexes; the Heck reaction and other examples of transition metal catalyzed reactions.

Reterosynthesis

Introduction to reterosynthesis and disconnection approach; synthesis of aromatic compounds with one and two group carbon C-X disconnections; donor and acceptor synthons; C-C disconnections and 1,2-, 1,3-, 1,4-, 1,5- and 1,6- difunctionalized compounds.

Synthetic Polymers

Introduction to polymer chemistry; step growth polymerization; free radical polymerization; ionic polymerization; stereochemistry in polymers; polymerization using Ziegler-Natta catalyst; stereo-regulation and conformation polymers; molecular weight determination of polymers; structure-property relationship; reactions of synthetic polymers; degradation and stability with special emphasis on thermal and photodegradation.

RECOMMENDED BOOKS:

1. Bruckner, R., "Advanced Organic Chemistry-Reaction Mechanisms", Harcourt Science & Technology Company, New York.
2. Loudon, G. M., "Organic Chemistry", Oxford University Press, New York.
3. Powell, P., "Principles of Organometallic Chemistry", Chapman & Hall, New York.
4. Parkins, A. W. and Poller, R. C., "An Introduction to Organometallic Chemistry", Macmillan, London.
5. Waren, S., "Organic Synthesis-The Disconnection Approach", John Wiley & Sons, New York.
6. Waren, S., "Workbook for Organic Synthesis-The Disconnection Approach", John Wiley & Sons, New York.
7. Smith, M. B., "Organic Synthesis", McGraw-Hill, New York.
8. Clayden, J., Greeves, N., Warren, S. and Wothers, P., "Organic Chemistry", Oxford University Press, New York.

9. Parker, D. B. V., "Polymer Chemistry", Applied Science Publishers, London.
10. Billmeyer Jr., F. W., "Textbook of Polymer Science", John Wiley & Sons, New York.
11. Challa, G., "Polymer Chemistry–An Introduction", Ellis Horwood, New York.
12. Stevens, M. P., "Polymer Chemistry–An Introduction", Addison-Wesley Publishing Company, London.
13. Wade Jr., L. J., "Organic Chemistry", Pearson Education, Delhi.
14. Morrison, R. T. and Boyd, R. N., "Organic Chemistry", Prentice-Hall of India, New Delhi.

4th Year; 8th Semester

Title of the Practicals: **ORGANIC CHEMISTRY (RESEARCH PROJECT)**

Code: **CHEM-462**

Credit Hours: **06**

Marks: **200**

RECOMMENDED BOOKS:

1. Clarke, H. T., "A Handbook of Organic Analysis-Qualitative and Quantitative", CBS Publishers & Distributors, New Delhi.
2. Mann, F. G. and Saunders, B. C., "Practical Organic Chemistry", Longman, London.
3. Vogel, A. I., "Elementary Practical Organic Chemistry Part 3: Quantitative Organic Analysis", Longman, London.
4. Vishnoi, N. K., "Advanced Practical Organic Chemistry", Vikas Publishing House Pvt. Ltd., New Delhi.
5. Furniss, B. S., Hannaford, A. J., Smith, P. W. G. and Tatchell, A.R., "Vogel's Text Book of Practical Organic Chemistry", National Book Foundation, Islamabad.

6. Shriner, R. L., Hermann, C. K. F., Morrill, T. C., Curtin, D. Y. and Fuson, R. C., "The Systematic Identification of Organic Compounds", John Wiley & Sons, New York.
7. Mendham, J., Denney, R. C., Barnes, J. D. and Thomas, M. J. K., "Vogel's Text Book of Quantitative Chemical Analysis", Pearson Education, New Delhi.
8. Beckett, A. H. and Stenlake, J. B., "Practical Pharmaceutical Chemistry", Athlone Press, London.
9. 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.
10. Silverstein, R. N., Barrler, G. C. and Morrill, T. C., "Spectrometric Identification of Organic Compounds", John Wiley & Sons, New York.
11. Kalsi, P.S. "Spectroscopy of Organic Compounds", Wiley Eastern Ltd., New Delhi.
12. Palleros, D. R., "Experimental Organic Chemistry", John Wiley & Sons, New York.
13. Keese, R, Muller, R. K. and Toube, T. P., "Fundamentals of Preparative Organic Chemistry", John Wiley & Sons, New York.
14. Gurtu, J. N. and Kapoor, R., "Advanced Experimental Chemistry", S. Chand & Company Ltd., New Delhi.
15. Newman, M. S., "An Advanced Organic Laboratory Course", Macmillan, New York.
16. Zubrick, J. W., "The Organic Chem Lab Survival Manual: A Student's Guide to Techniques", John Wiley & Sons, New York.
17. Kemp, W., "Organic Spectroscopy", Palgrave, New York.
18. Lambert, J. B, Shurvell, H. F., Lightner, D. A. and Cooks, R. G., "Introduction to Organic Spectroscopy", Macmillan Publishing Company, New York.
19. Williams D. H. and Fleming, I., "Spectroscopic Methods in Organic Chemistry", Athlone Press, London.
20. Atta-ur-Rehman, "Nuclear Magnetic Resonance Spectroscopy", UGC, Islamabad.
21. Davis, R. and Freason, M., "Mass Spectrometry", John Wiley & Sons, New York.

COURSE WISE BREAKUP

Fourth Year

Eighth Semester

SPECILIZATION

PHYSICAL CHEMISTRY

THEORY

COURSE CODE	TITLE	CREDIT HOURS	MARKS
CHEM-474	PAPER-IV: PHYSICAL CHEMISTRY	03	100
CHEM-475	PAPER-V: PHYSICAL CHEMISTRY	03	100
CHEM-476	PAPER-VI: PHYSICAL CHEMISTRY	03	100

PRACTICALS

COURSE CODE	TITLE	CREDIT HOURS	MARKS
CHEM-472	PHYSICAL CHEMISTRY (RESEARCH PROJECT)	06	200

- **Total Credits of the Semester = 15 (theory 09 & practicles 06 credits)**
- **Maximum Marks = 500 (theory 300 & practicles 200 marks)**

4th Year; 8th Semester

PAPER-IV

Title of the Course: **PHYSICAL CHEMISTRY**

Code: **CHEM-474**

Credit Hours: **03**

Marks: **100**

Course Contents:

Chemical Kinetics

Derivation of the rate equations. Theory of absolute reaction rate. Reversible reactions, parallel reactions and consecutive reactions. Correlation between physical properties and concentration. Comparison of collision and absolute reaction theories. Advanced theories of unimolecular reactions. Potential energy surfaces. Thermodynamic formulation of reaction rates. Calculation of entropy and enthalpy changes. Thermal decomposition of nitrogen pentaoxide. Reactions in solutions. Influence of ionic strength on the reaction rate. Effect of dielectric constant of the medium on the rate of the reaction. Single sphere activated complex model. Double sphere activated complex model. Complex reactions. Chain reactions. Single chain carrier with second order breaking. One chain carrier with first order breaking. Two chain carrier with second order breaking. Experimental techniques for fast reactions.

RECOMMENDED BOOKS:

1. Albery J., Electrode Kinetics, Clarendon, Oxford (1975).
2. Espenson, J. H. Chemical Kinetics and Reaction Mechanism 2nd ed., McGraw Hill London (2002).
3. Espenson J.H. "Chemical Kinetics and Reaction Mechanisms" 2nd ed. McGraw Hill, New York (1995).
4. Frost A.A. and Pearson R.G. "Kinetic and Mechanism" 2nd ed. John Wiley and Sons Inc, New York (1961).
5. Laidler K.J. "Chemical Kinetics" 3rd ed. Pearson Education Company, New York (1987).
6. Laidler L.J. "Reaction Kinetic VII, II Reaction in Solution" Pergamon Press, New York (1963).

4th Year; 8th Semester

PAPER-V

Title of the Course: **PHYSICAL CHEMISTRY**

Code: **CHEM-475**

Credit Hours: **03**

Marks: 100

Course Contents:

Radiation Chemistry

Development and advancement in radiation chemistry. Radiation dosimetry. Fricke dosimeter, dosimetry in pulse radiolysis. Energy states in radiation chemistry. Excited states, production formation through excited states. Fragmentation, predissociation, photochemical decay. Evidence for the existence of excited state and its types. Ions and electrons, radiolysis of gases. radiolysis of liquids, solids, and frozen liquids and gases behaviour of ions in radiation chemistry. General energy transfer. characteristic and applications of gas, liquid and solid phase radiolysis. Instrumentation, purity of chemicals and methods. Recent application of radiation chemistry.

Photochemistry

Scope of photochemistry. Energy transfer in photochemical reaction. Quantum yield of emission process radiation and nonradiation process. Kinetics and Quantum yields of radiative and nonradiative process (fluorescence, phosphorescence, inter system crossing, internal conversion, quenching), and Stern-Volmer reactions. Photosensitized reactions. Photochemical reaction in gas phase and in solutions. Flash photolysis. Advance approach to kinetics of photochemical reactions. Applied photochemistry. atmospheric photochemistry. Photosynthesis, photochemistry of polymers, photomedicines. Techniques in photochemistry, introduction, light source. Incandescent filament lamps, discharge lamps, lasers, synchrotron reaction,

4th Year; 8th Semester

PAPER-VI

Title of the Course: **PHYSICAL CHEMISTRY**

Code: **CHEM-476**

Credit Hours: **03**

Marks: **100**

Course Contents:

Solid State Chemistry

Intermolecular forces. Symmetry of condensed systems. Properties of solids (electrical, mechanical and optical). Lattice defects, doping for defects. Electron-gas model, heat capacity paradox, electrical conductivity. Band theory of metallic state. Conductors semiconductors and insulators. Controlled valency and hopping phenomena, p & n-type conductivity, p, n-junctions. Solid-state reactions. Developments in superconductivity.

Surface Chemistry and Catalysis

Solid surfaces. Gas solid interface. Thermodynamics of adsorption. Heterogeneous catalysis. Kinetic and mechanisms of catalyzed reactions. Adsorption at liquid surfaces. Enzymatic catalysis. Organized molecular assemblies. Colloidal solutions. Catalyst preparation methods. Industrial catalysts.

RECOMMENDED BOOKS:

1. Calvert J.G. and Pitts J.N. "Photochemistry" John Wiley, New York (1966).
2. Wayne and Richard P. "Photochemistry" Macmillan (1988).
3. Hughes G. "Radiation Chemistry" Oxford Series, UK (1973).
4. Spinks J.W.T. and Woods R.J. "An introduction to Radiation Chemistry" Wiley Inter Sci. Pub, USA (1976).
5. O'Donnell J.H. and Sangster D.F. "Principle of Radiation Chemistry" Edward Arnold Pub, UK (1970).
6. Baco Z.M. and Alexander P. "Fundamentals of Radiobiology" CLBS, UK (1972).
7. Suppan P. "Principle of Photochemistry" The Chemical Soc. UK (1973).
8. Aziz F. and Rodgers M.A.J., "Radiation Chemistry Principles and Application" Ed., VCH Publishers, Inc. (1987)
9. Wayne R.P. "Principles and Application of Photochemistry", University Press Oxford London (1988).

10. Segal H. "Enzyme Kinetics" John Wiley New York (1975).
11. Schlutz A.R. "Enzyme Kinetics" (1964) Cambridge University Press England.
12. Wetson R. and Schwavz H.A. "Chemical Kinetics" Prentice Hall Inc, New Jersey (1972).
13. West A.R. "Solid State Chemistry", J. Wiley, New York (1989).

4th Year; 8th Semester

Title of the Course: **PHYSICAL CHEMISTRY (RESEARCH PROJECT)**

Code: **CHEM-472**

Credit Hours: **06**

Marks: **200**

RECOMMENDED BOOKS:

1. Braun R.D. and Walters F. "Application of Chemical Analysis" (1982).
2. David P. "Experiments in Physical Chemistry" 5th ed. (1989).
3. Shoemaker C.W., Nibler G.J.W. and Christian G.D. "Analytical Chemistry" 6th ed. (2004).
4. James A.M. and Prichard F.E. "Practical Physical Chemistry" 3rd ed. Longman (1974).
5. Mowry S. and Ogren P.J., J. Chemical Education, **76(7)** (1999).
6. Shoemaker D.P., Garland C.W. and Nibler J.W. "Experiments in Physical Chemistry" McGraw Hills, New York (1989).

COURSE WISE BREAKUP

Fourth Year

Eighth Semester

SPECILIZATION

APPLIED CHEMISTRY

THEORY

COURSE CODE	TITLE	CREDIT HOURS	MARKS
CHEM-424	PAPER-IV: APPLIED CHEMISTRY	03	100
CHEM-425	PAPER-V: APPLIED CHEMISTRY	03	100
CHEM-426	PAPER-VI: APPLIED CHEMISTRY	03	100

PRACTICALS

COURSE CODE	TITLE	CREDIT HOURS	MARKS
CHEM-422	APPLIED CHEMISTRY (RESEARCH PROJECT)	06	200

- **Total Credits of the Semester = 15 (theory 09 & practicles 06 credits)**
- **Maximum Marks = 500 (theory 300 & practicles 200 marks)**

4th Year; 8th Semester

PAPER-IV

Title of the Course: **APPLIED CHEMISTRY**

Code: **CHEM-424**

Credit Hours: **03**

Marks: **100**

Course Contents:

Paper and Pulp Technology

Raw materials for pulp and paper industries; Classification of paper products; Chemistry involved in the processing of kraft pulp, sulphite pulp and semi-chemical pulp; Manufacture of paper and regeneration of spent liquor.

Industrial Polymerization and Polymers

General classification and characterization of polymers; Mechanism and chemistry of polymerization; Thermoplastic and thermosetting polymerization; A brief outline for the production and applications of polymers i.e. polyethylene, polystyrene, polyurethanes, polyesters and urea phenol formaldehyde resins; Production of drug delivery polymers.

Cosmetics and Perfumes

Chemistry and production of hair products and shampoos; Chemistry involved in hair curling and styling products; Hair tonics and depilatory products; Production of cold cream, vanishing cream, bleach cream and shaving creams; Tooth paste and face powders; Production of nail polish, lipsticks and mascaras.

Production of Explosives, Propellants and their Applications

Raw materials; Manufacture of industrial explosives and propellants; Types of explosives and their safety measures; Chemistry involved in production of military explosives.

4th Year; 8th Semester

PAPER-V

Title of the Course: **APPLIED CHEMISTRY**

Code: **CHEM-425**

Credit Hours: **03**

Marks: **100**

Course Contents:

Petroleum Refinery and Petrochemicals

Origin of petroleum; Constituents and classification of petroleum; Cracking and distillation of various fractions in distillation towers; Control of distillation tower in refinery; Manufacture of monomers such as acetylene, ethylene, propylene; Separation and purification of benzene, toluene and xylene.

Pharmaceutical Industry

Classification of pharmaceutical products and pharmaceutical processing; Manufacture of paracetamol/disprol and aspirin; Chemistry involved in the production and manufacture of various antibiotics such as streptomycin, erythromycin, penicillin etc.

Fermentation and Biotechnology

Micro-organisms, conditions for their growth and biochemical activity. Production of ethanol, acetic acid, citric acid, penicillin and amylase; Microbial growth rate and its modelling.

Nuclear Industry and Peaceful Applications

Extraction of uranium from rocks; Importance of nuclear technology; Nuclear energy and its peaceful applications; Production of nuclear energy and control of nuclear reactors; Chemistry of fission and fusion reactions; Reprocessing of nuclear spent fuel; Industrial application of nuclear radiations.

4th Year; 8th Semester

PAPER-VI

Title of the Course: **APPLIED CHEMISTRY**

Code: **CHEM-426**

Credit Hours: **03**

Marks: **100**

Course Contents:

Iron, Steel and Alloyes Industries

Iron ores, constituents and their classification; Manufacture of iron and steel; Types of iron and steel; Metal Extractions and production of Alloys.

Corrosion and its Prevention

Chemistry and causes of corrosion phenomena; Types and theories of corrosion; Corrosion prevention and inhibitors; Surfaces coating and Electroplating.

Colour Chemistry

Organic dyes, sources and classification of dyes; Chemistry and production of various organic dyes, Methods of dyeing, Finishing and dyeing of textiles.

Coal Cleaning and Utilizations

Origin and types of coal; Coal cleaning and its utilization; Coal combustion, carbonization and gasification; Production of various fuel gases from coal such as water gas, producer gas etc.

4th Year; 8th Semester

Title of the Practicals: **APPLIED CHEMISTRY (RESEATRCH PROJECT)**

Code: **CHEM-422**

Credit Hours: **06**

Marks: **200**

RECOMMENDED BOOKS:

1. George T. Auston., Shreve's Chemical Process Industries, 5th Edition., McGraw Hill Book Company Inc. New York, (1984).
2. Riegel, E. R., Industrial Chemistry, 5th Ed., Reinhold Publishing Corporation NewYork, (1997).
3. J. C Kuriacase & J Rajaran, Chemistry in Engineering and Technology, 2nd Ed., (1984).
4. Chuis A. Clauses III Guy Matison, Principles of Industrial Chemistry, (1978).
5. P. C. Jain., A Textbook of Applied Chemistry, (1993).
6. G. N. Pandey, A Text Book of Chemical Technology, 2nd Edition, Vikas Publishing house, (2000).

7. R. Lambourne., Paint & Surface Coatings Theory & Practice, (1987).
8. Mattsson, E. Basic Corrosion Technology for Scientists and Engineers, 1st Ed., Ellis Horwood, Ltd. UK (1989).
9. Leighou, R. B., Chemistry of Engineering Materials, Fourth Edition 1953, McGraw-Hill Book Company Inc. New York, (1953).
10. Octave Levenspiel, Chemical Reaction Engineering, 2nd Ed., (1979).
11. Groggins, P.H., Unit Process in Organic Synthesis, 5th Ed, McGraw Hill Book Company Inc. York (1958).
12. Furnas, C. C., Industrial Chemistry, Vol-II 6th Ed., D. Van Nostrand Company, Inc. Princeton New Jersey, New York (1957).
13. Vogel, I. A., Text Book Quantitative Inorganic Analysis, 7rd Ed., Longman, Green and Co. Ltd. UK (1961) and (1978).
14. Jeffrey, G. H., J. Bassett, J. Mandham and R. C. Denney, Vogel's Textbook of Qualitative Chemical Analysis, 5th Ed., ELBS Longman Scientific and Technical Group, England (1989), Reprinted (1994).
15. Vogel, I. A., Text Book Quantitative Inorganic Analysis, 3rd Ed., Longman, Green and Co. Ltd. UK (1961) and (1978).
16. A. K. Spivas Tava, Chemical Analysis, 3rd Ed., (1997).

COURSE WISE BREAKUP

Fourth Year

Eighth Semester

SPECILIZATION

ANALYTICAL CHEMISTRY

THEORY

COURSE CODE	TITLE	CREDIT HOURS	MARKS
CHEM-414	PAPER-IV: ANALYTICAL CHEMISTRY	03	100
CHEM-415	PAPER-V: ANALYTICAL CHEMISTRY	03	100
CHEM-416	PAPER-VI: ANALYTICAL CHEMISTRY	03	100

PRACTICALS

COURSE CODE	TITLE	CREDIT HOURS	MARKS
CHEM-412	ANALYTICAL CHEMISTRY (RESEARCH PROJECT)	06	200

- **Total Credits of the Semester = 15 (theory 09 & practicles 06 credits)**
- **Maximum Marks = 500 (theory 300 & practicles 200 marks)**

4th Year; 8th Semester

PAPER-IV

Title of the Course: **ANALYTICAL CHEMISTRY**

Code: **CHEM-412**

Credit Hours: **03**

Marks: **100**

Course Contents:

Hyphenated Techniques

- A.** Introduction to Hyphenated Techniques
- B. Hyphenated Techniques for Complex Organic Mixtures and Pharmaceutical Analysis**
 - 1. Gas Chromatography-Mass Spectrometry (GC-MS)
 - 2. Gas Chromatography-Mass Spectrometry-Mass Spectrometry (GC-MS-MS)
 - 3. Liquid Chromatography-Mass Spectrometry (LC-MS)
 - 4. Liquid Chromatography-Fourier Transform Infrared Spectroscopy (LC-FTIR)
- C. Hyphenated Techniques for Elemental Speciation Studies**
 - 1. ICP-MS
 - 2. LC-ICP-MS
 - 3. LC-AAS
 - 4. LC-AFS
 - 5. IC-ICP-MS
- D. Hyphenated Techniques in Polymer Characterizations**
 - 1. TG-IR
 - 2. TG-MS
 - 3. DSC-FTIR

4th Year; 8th Semester

PAPER-V

Title of the Course: **ANALYTICAL CHEMISTRY**

Code: **CHEM-412**

Credit Hours: **03**

Marks:100

Course Contents:

Advanced Chromatography

1. General Description of Chromatography

Migration rate of solutes, retention time, column efficiency, zone shapes, effect of column variables on zone broadening and column efficiency.

2. Gas Chromatography (GC)

Basic principle and instrumentation; Carrier gas, Injection systems: valve method, head-space method, injection through septum. Columns: Packed columns, open tubular columns, support coated open tubular columns, wall coated open tubular columns and porous layer column preparation, Detectors: Electron capture detector (ECD), thermal conductivity detector (TCD), flame ionization detector (FID), flame photometer as a detector (FPD), Nitrogen-Phosphorous detector (NPD), mass spectrometer as a detector (MS). Capillary gas chromatography. Types of chromatogram. Qualitative and Quantative analyses in gas chromatography

3. High Pressure/Performance Liquid Chromatography (HPLC)

Principle, choice of column materials for HPLC, preparation of column, selection of the support, selection of the mobile phase. Instrumentation of HPLC, Pumps, columns, injection systems, detectors (U.V., Refractive index, fluorimetric and electrochemical detectors). Normal and reverse phase chromatography. Isocratic and gradient elution chromatography. Applications of HPLC. High-pressure/performance thin layer chromatography (HP-TLC).

4. Ion Chromatography

Ion exchange resins, applications of ion exchange resins to chromatography, ion chromatography based on suppressors, single column ion chromatography, detectors in ion chromatography, selection of the mobile phase. Applications of

ion chromatography. Comparison of HPLC with gas liquid chromatography (GLC).

4th Year; 8th Semester

PAPER-VI

Title of the Course: **ANALYTICAL CHEMISTRY**

Code: **CHEM-412**

Credit Hours: **03**

Marks: **100**

Course Contents:

Special Topics

1. Electrochemical Sensors

Biosensors, enzyme-based electrode, affinity biosensors, gas sensors, solid state devices, sensor arrays, new material for sensors.

2. Mass Spectrometry (MS)

Basic principle, instrumentation, various sources of ionization, analyzers and detectors. Types of mass spectrometry. Applications to biological and environmental chemistry.

3. Process, Instrument and Automzation in Chemical Analysis

Principle of automation, automated instruments in process control, automatic instruments, flow-injection analyzers, micro-processor coltrolled instruments.

4th Year; 8th Semester

Title of the Practicals: **ANALYTICAL CHEMISTRY (RESEARCH PROJECT)**

Code: **CHEM-412**

Credit Hours: **06**

Marks: **200**

RECOMMENDED BOOKS:

1. Analytical Chemistry by Gary D. Christian; 6th ed. 2004; John Wiley & Sons, Inc.

2. Fundamentals of Analytical Chemistry by Douglas A. Skoog, Donald M. West, F. James Holler, Stanley R. Crouch; 8th ed. 2003; Saunders College Publishing, Philadelphia.
3. Instrumental Methods of Analysis by Hobert H. Willard D.L. Merrit & J.R.J.A. Dean, Frank A. Settle; 7th Sub edition 1988; Wadsworth Publishing Company.
4. British Pharmacopoeia
5. United States Pharmacopoeia
6. Laboratory Manual of Analytical Chemistry by C. Reilly; Allyn and Bacon, London
7. Quantitative Analysis by W. J. Blaedal and V. W. Medloche; Harper & Row, N. Y.
8. Most of the experiments prescribed can be found on various websites.

COURSE WISE BREAKUP

Fourth Year

Eighth Semester

SPECILIZATION

BIOCHEMISTRY

THEORY

COURSE CODE	TITLE	CREDIT HOURS	MARKS
CHEM-434	PAPER-IV: BIOCHEMISTRY	03	100
CHEM-435	PAPER-V: BIOCHEMISTRY	03	100
CHEM-436	PAPER-VI: BIOCHEMISTRY	03	100

PRACTICALS

COURSE CODE	TITLE	CREDIT HOURS	MARKS
CHEM-432	BIOCHEMISTRY (RESEARCH PROJECT)	06	200

- **Total Credits of the Semester = 15 (theory 09 & practicles 06 credits)**
- **Maximum Marks = 500 (theory 300 & practicles 200 marks)**

4th Year; 8th Semester

PAPER-IV

Title of the Course: **BIOCHEMISTRY**

Code: **CHEM-434**

Credit Hours: **03**

Marks: **100**

Course Contents:

Physiological Chemistry

Respiration

Structure and function of lungs, Physical exchange of gases, Transport of oxygen by blood, Transport of CO₂ in blood, Buffer system of the blood, Acid-Base balance.

Kidney

Structure and function of nephrons, Formation of urine, Filtration, Glomerular filtration rate, Action of the tubule, Reabsorption of Na, Cl and water, Loop of Henle. Structure and function of muscle tissues, Nerve tissues and Connective tissues, Nerve conduction and sensory system. Circulatory system.

Chemotherapy

Structure and mode of action of antipyretics analgesic, antimalarial, supha-drugs, antibiotics with special reference to pencillin, sulphanilamides. Mechanism of drugs action and resistance.

RECOMMENDED BOOKS:

1. Principles of Biochemistry by White Hundler and Smith.
2. Biochemistry by Lehninger.
3. Review of Physiological Chemistry by H.A.Harper.
4. Text Book of Biochemistry by West Todd/Mason/Von Brugge.
5. Text Book of Biochemistry by Mazur/Harrow.
6. The Pharmacological basis of Therapeutics edited by L.S.Goodman and A.Gilman (Macmillan).

4th Year; 8th Semester

PAPER-V

Title of the Course: **BIOCHEMISTRY**

Code: **CHEM-435**

Credit Hours: **03**

Marks: **100**

Course Contents:

Fundamentals of Microbiology

Prokaryotic cell structure and function, Prokaryotic growth and nutrition. Prokaryotic genetics.

Virus and Eukaryotic Microorganisms

Virus, Bacteria, fungi and parasites

Bacterial Diseases

Airborne, Foodborne and waterborne bacterial diseases.

Industrial Microbiology and Biotechnology

Microorganisms in industry. Alcoholic beverages. Other important microbial products

Immunology

Chemistry of immunoglobulins, myeloma and hybridoma immunoglobulins. Immune system and its abnormalities. Allergy and inflammation. Complement system, peripheral leucocytes and macrophages.

Immune Disorders

Type I IgE-Mediated Hypersensitivity, other types of hypersensitivity, Autoimmune disorders, Immunodeficiency disorders.

RECOMMENDED BOOKS:

1. Nester, E.W. D.G. Anderson, C.E. Roberts, N.N Pearsall and M.T. Nester. Microbiology 4th Ed. McGraw Hill Companies Inc.
2. Doan T., R.Melvold, S.Viselli and C. Waltenbaugh. Immunology: Lippincott Illustrated Reviews Lippincott Williams& Wilkins.
3. Stroll, W.A. H.Rouse, P.C. Champe, and R.A. Harvey. Microbiology Lippincott Illustrated Reviews Lippincott Williams& Wilkins.
4. Prescott, L.M. J.P. Harley and D.A.Klein Microbiology McGraw Hill Companies Inc.

4th Year; 8th Semester

PAPER-VI

Title of the Course: **BIOCHEMISTRY**

Code: **CHEM-436**

Credit Hours: **03**

Marks: **100**

Course Contents:

Major Dietary Constituents

Nutritional importance of Carbohydrates, Proteins and Amino Acids, Lipids , and Dietary fiber Energy Needs, Assessment and requirement of energy in different age groups. Nutrition in Growth and Aging Nutritional requirement during infancy and childhood. Diet, nutrition and adolescence. Nutrition in the Elderly. Minerals: Biochemical role of Calcium, Chromium, Copper, Iron, Iodine, Magnesium, phosphorous, Selenium, and Zinc. Their dietary sources, daily requirements and deficiency diseases.

Vitamins

Role of vitamins as coenzymes. Structure, physiological functions, deficiency diseases and recommended dietary allowances of the following vitamins. Fat Soluble vitamins: A, D, E, and K Water Soluble vitamins: Thiamine, Riboflavin, Niacin Pantothenic acid, Folic acid, Biotin and Ascorbic acid.

RECOMMENDED BOOKS:

1. Shils, M.E., J.A. Olson and M. Shike. Modern Nutrition in Health and Disease. Lea & Febiger USA
2. Passmore, R and M.A. Eastwood. Human Nutrition and Dietetics. Churchill Livingstone.
3. Murray, R.K., D.K. Grannar, P.A.Mayes and V.W. Rodwell. Harper's illustrated Biochemistry McGraw-Hill Companies Inc.
4. Smith, E.L., R.L. Hill, I.R. Lehman, R.J. Lefkowitz, P. Handler, and A. White. Principles of Biochemistry (Mammalian Biochemistry) McGraw-Hill Companies Inc.

4th Year; 8th Semester

Title of the Practicals: **BIOCHEMISTRY (RESEARCH PROJECT)**

Code: **CHEM-432**

Credit Hours: **01**

Marks: **200**

RECOMMENDED BOOKS:

1. Plummer, D.T., An introduction to practical biochemistry, TATA McGraw-Hill Publishing Company LTD.
2. Deyer, R. L. and G. F. Lata, Experimental Biochemistry, Oxford University Press.
3. Gowenlock, A. H., Varley's Practical Clinical Biochemistry, 6th Ed., Heinemann Professional Publishing, Oxford (1988).
4. Sawhney, S. K. and R. Sing (Editors), Introductory Practical Biochemistry, Narosa Publishing House, New Delhi, (2005)
5. Gosling, J. P., Immunoassay: Laboratory Analysis and Clinical application (1994).