

**CURRICULUM
FOR**

Bachelor of Science in Applied Chemistry



**BS Applied Chemistry
Session 2019 to Onwards
Department of Chemistry
UNIVERSITY OF OKARA**

University of Okara, Department of Chemistry

Syllabus for BS Applied Chemistry Program

Vision Statement

The Department of Chemistry is dedicated to

- Providing a comprehensive, relevant curriculum at all post-secondary levels,
- Producing knowledgeable graduates for careers in academia, industry and government,
- Conducting significant research in chemistry,
- Promoting a diverse population of faculty, staff and students, and
- Promoting the collegial exchange of ideas, independent thought, and the highest ethical standards.

Mission Statements

The Department of Chemistry pledges itself to encourage in the broadest and most liberal manner, the advancement of science and particularly Applied Chemistry in all of its areas through its education, research, and service missions.

Education Mission

The Department of Chemistry is committed to helping each student achieve his/her personal academic potential by creating an environment that promotes

- Frequent interactions between faculty and students,
- Independent thought, collegial exchange of ideas and high ethical standards,
- Development of innovative instructional techniques,
- Use of modern educational technology in lecture and laboratory courses, and
- Increased opportunities and greater participation by under-represented minorities.

Research Mission

The Department of Chemistry is committed to conducting research on fundamental and applied problems by

- Supporting scientific inquiry of a significant nature by individual faculty and student investigators, and
- Promoting the development of innovative interdisciplinary research programs.

Service Mission

The Department of Chemistry is committed to enhancing the public welfare and economic development of the country and in particular of the area through

- Outreach programs to Applied chemistry students and educators
- Participation and leadership in professional organizations and
- Development of strategic partnerships with other departments, academic institutions and chemical industry.

Aims and objectives

Chemistry is a central subject of science. It is also closely related to daily life. The broad aims are to help students to

1. Acquire some knowledge of the empirical world.
2. Acquire an ability to observe accurately and objectively.
3. Acquire an ability to solve problem.
4. Acquire an ability to think scientifically, independently and to make rational discussion.
5. Acquire an ability to communicate, using the language of applied chemistry.
6. Develop an appreciation of applied chemistry and its application in daily life.
7. Promote an awareness of the social, economic, environmental and technological implication of applied chemistry.

Objectives:

1. To encourage students to take an active part in class.
2. To encourage students to develop curiosity and a spirit of enterprise.
3. To teach good laboratory practice and skills.
4. To teach students to be aware of the safety of oneself and others in the laboratory and be committed to safe practices in daily life.
5. To teach students to analyze data from experiments or from other sources.
6. To acquire students a readiness in becoming responsible citizens in a changing world.
7. To provide students with some insight into future career prospect in the fields related to Chemistry.

RATIONALE

The Faculty of Science at the University of Okara is proposing a modern, contemporary and forward-looking course in Applied Chemistry. The Applied Chemistry course is built upon the strong foundations and traditions of applied chemistry that have historically been integral to the Faculty's curriculum. The new course combines this tradition with the latest advances in chemical technologies and applications. The need for applied chemists has always been recognized and is exemplified by Applied Chemistry courses at Technical Universities throughout the world. The University of Okara currently does not offer a specific course in Applied Chemistry. Hence, the Applied Chemistry Course is designed to address the needs of modern knowledge-based industries, where the need for applied scientific skills is being driven by expansion of high-technology industries such as pharmaceuticals, biotechnology, energy, environment, and advanced manufacturing. Students, completing the undergraduate and masters degree courses in Applied Chemistry, will develop into professionals with wide-ranging technical and scientific skills, who are able to communicate effectively at all levels with engineers, scientists, industrialists and business leaders.

It is anticipated that graduates of the Applied Chemistry course will be able to move freely to related postgraduate courses in Applied Chemistry, Chemical Engineering, Materials Science and Engineering, Environmental Engineering, Chemistry, Pharmacy and Biochemistry, Biotechnology both within the University system in Pakistan, and throughout the world.

ELIGIBILITY CRITERIA FOR BS APPLIED CHEMISTRY

At Least 2nd Division F.Sc. (Pre-Medical / Pre-Engineering) / 12 years of schooling with 200 marks Chemistry in Intermediate.

ADMISSION CRITERIA

Merit lists will be prepared in accordance with the criteria given in “Admission Regulations”.

ASSESSMENT MECHANISM

Assessment and evaluation of students will be according to the “Assessment and Evaluation Regulations” of the University of Okara.

TITLE OF THE DEGREE

The title of the degree will be “Bachelor of Science in Applied Chemistry”.

Semester Wise Break Up

BS Applied Chemistry (Total Credit Hrs. = 138)

Course Code	Course Title	Credit Hours
BS Semester – I		
ENG 2111	English I (3+0)	3
PHYS 2051/ BOT 2011	Physics I/Botany I (2+1)	3
PST 2111	Pakistan Studies (2+0)	2
ZOOL 2015/ MATH 3011	Zoology I (2+1)/ Mathematics I (3+0)	3
COMP 2001	Computer and its Applications in Chemistry (2+1)	3
ACHM 2051	Fundamentals of Inorganic Chemistry-I (3+1)	4
	Total	18
BS Semester – II		
ENG 2112	English II (Functional) (3+0)	3
ISL 2111	Islamic Studies/Ethics (2+0)	2
BOT 2021/ PHYS 2052	Botany II /Physics II (2+1)	3
ZOOL 2016/ MATH 3012	Zoology II (2+1)/ Mathematics II (3+0)	3
ACHM 2061	Fundamentals of Organic Chemistry-I (3+1)	4
ACHM 2041	Fundamentals of Environmental Chemistry (3+0)	3
	Total	18
BS Semester – III		
ENG 2113	English III (Communication skill) (3+0)	3
STAT 100	Statistics (3+0)	3
BOT 2031/ PHYS-2053	Botany III /Physics III (2+1)	3
ZOOL 2023/ MATH 3013	Zoology III (2+1)/Mathematics (3+0)	3
ACHM 2071	Fundamentals of Physical Chemistry-I (3+1)	4
ACHM 2031	Fundamentals of Biochemistry (2+1)	3
	Total	19
BS Semester – IV		
ENG 2114	English IV (Report writing)/ University optional (3+0)	3
BOT 2041/ PHYS-2054	Botany IV/Physics IV (2+1)	3
ZOOL 2033/ MATH 3014	Zoology IV (2+1)/ Mathematics (2+1)	3
ACHM 2011	Fundamentals of Analytical Techniques (2+1)	3
ACHM 2081	Fundamentals of Applied Chemistry (Industrial Chemistry) (3+1)	4
	Total	16

BS Semester – V		
ACHM 3051	Applied Inorganic Chemistry-I (3+1)	4
ACHM 3061	Applied Organic Chemistry-I (3+1)	4
ACHM 3071	Applied Physical Chemistry-I (3+1)	4
ACHM 3011	Analytical Techniques and Quality Control (3+1)	4
ACHM 2044	Chemometrics (3+0)	3
	Total	19
BS Semester – VI		
ACHM 3052	Applied Inorganic Chemistry-II (3+1)	4
ACHM 3062	Applied Organic Chemistry-II (3+1)	4
ACHM 3072	Applied Physical Chemistry-II (3+1)	4
ACHM 3012	Chemical Process Industries (3+1)	4
	Total	16
BS Semester – VII		
SPECIALIZED COURSES (GENERAL APPLIED CHEMISTRY)		
ACHM 4041	Oils, Fats and Waxes (3+1)	4
ACHM 4042	Inorganic Chemical Industries (3+0)	3
ACHM 4043	Food and Allied Industries (3+0)	3
ACHM 4044	Paper and Leather Industries (3+0)	3
ACHM 4119R/A/P	Research thesis/ Research Project/ Advance Practical/ Position Paper (0+3)	3
	Total	16
OR		
BS Semester – VII		
SPECIALIZED COURSES (POLYMER SCIENCES AND TECHNOLOGY GROUP)		
ACHM 4091	Synthetic Polymers (3+1)	4
ACHM 4092	Introduction to Composite Materials (3+0)	3
ACHM 4093	Synthetic Fibers (3+0)	3
ACHM 4094	Mechanism and Kinetics of Polymerization (3+0)	3
ACHM 4119R/A/P	Research thesis/ Research Project/ Advance Practical/ Position Paper (0+3)	3
	Total	16
BS Semester – VIII		
SPECIALIZED COURSES (GENERAL APPLIED CHEMISTRY)		
ACHM 4045	Colour Chemistry (3+1)	4
ACHM 4046	Chemistry of Textiles Processing (3+0)	3
ACHM 4047	Glass, Ceramics and Cement Industries (3+0)	3
ACHM 4048	Biotechnology for Chemical Industries (3+0)	3
ACHM 4119R/A/P	Research thesis/ Research Project/ Advance Practical/ Position Paper (0+3)	3
	Total	16
OR		
BS Semester – VIII		
SPECIALIZED COURSES (POLYMER SCIENCES AND TECHNOLOGY GROUP)		

ACHM 4095	Characterization Techniques for Polymers (3+1)	4
ACHM 4096	Polymer Rheology and Processing (3+0)	3
ACHM 4097	Natural Polymers (3+0)	3
ACHM 4098	Physical Chemistry of Polymers (3+0)	3
ACHM 4119R/A/P	Research thesis/ Research Project/ Advance Practical/ Position Paper (0+3)	3
	Total	16
Total Credit Hours for BS Applied Chemistry		138

Sr. No.	Discipline specific foundation courses	Major courses including research project/internship	Elective courses other than the specialization
	9-10 Courses	14-16 Courses	2 Courses
	30-34 Credit hours	52-60 Credit hours	6 Credit hours
1	Fundamentals of Inorganic Chemistry-I (3+1)	Applied Inorganic Chemistry-I (3+1)	Research Thesis/ Research Project/ Advance Practical/ Position Paper (0+3)
2	Fundamentals of Organic Chemistry-I (3+1)	Applied Organic Chemistry-I (3+1)	Research Thesis/ Research Project/ Advance Practical/ Position Paper (0+3)
3	Fundamentals of Environmental Chemistry (3+0)	Applied Physical Chemistry-I (3+1)	
4	Fundamentals of Physical Chemistry-I (3+1)	Analytical Techniques and Quality Control (3+1)	
5	Fundamentals of Biochemistry (2+1)	Applied Inorganic Chemistry-II (3+1)	
6	Fundamentals of Analytical Techniques (2+1)	Applied Organic Chemistry-II (3+1)	
7	Fundamentals of Applied Chemistry (Industrial Chemistry) (3+1)	Applied Physical Chemistry-II (3+1)	
8	Statistics (3+0)	Chemical Process Industries (3+1)	
9	Chemometrics (3+0)	Specialized Course I (3+1)	
10		Specialized Course II (3+0)	
11		Specialized Course III (3+0)	
12		Specialized Course IV (3+0)	
13		Specialized Course V (3+1)	
14		Specialized Course VI (3+0)	
15		Specialized Course VII (3+0)	
16		Specialized Course VIII (3+0)	
Total	31 Cr. Hr.	58 Cr. Hr.	6 Cr. Hr.
Sr. No.	Compulsory Requirements		General Courses to Be Chosen

1	English I (3+0)	Botany I (2+1)/ Physics I (2+1)
2	English II (Functional) (3+0)	Zoology I (2+1)/ Mathematics I (3+0)
3	English III (Communication skill) (3+0)	Botany II (2+1)/ Physics II (2+1)
4	English IV (Report writing) (3+0)	Zoology II (2+1)/ Mathematics II (3+0)
5	Pak Studies (2+0)	Botany III (2+1)/ Physics III (2+1)
6	Islamic studies / Ethics (2+0)	Zoology III (2+1)/ Mathematics III (3+0)
7	Computer and Its Applications in Chemistry (2+1)	Botany IV (2+1)/ Physics IV (2+1)
8		Zoology IV (2+1)/ Mathematics IV (3+0)
Total	19 Cr. Hr.	24 Cr. Hr.

Note

- Specialized courses will be offered depending upon the expertise available.
- Outlines of the specialized courses / Position Paper/ Advanced Practical will be taken from the course contents depending upon the expertise available.
- In semester VII & VIII of BS Applied Chemistry there will be offered Position paper or Research Project or Advanced Practical depending upon the expertise available.

Semester I		
Course Code	Course Title	Credit Hours
ENG 2111	English I (3+0)	3
PHYS 2051/BOT 2011	Physics I/Botany I (2+1)	3
PST 2111	Pakistan Studies (2+0)	2
ZOOL 2015/MATH 3011	Zoology I (2+1)/Mathematics I (3+0)	3
COMP 2001	Computer and its Applications in Chemistry (2+1)	3
ACH 8071	Fundamentals of Inorganic Chemistry-I (3+1)	4
		18

BS Applied Chemistry 1st Year
SEMESTER-I

Course Title:

ENGLISH-I

Code: ENGL 2111

Credit Hours: 03 (3+0)

Objectives: Enhance language skills and develop critical thinking.

COURSE OUTLINE:

Grammar: Parts of speech and use of articles, Sentence structure, Subject-Verb agreement, Sentence fragments, Run-ons, Standard English verbs, Irregular verbs, Transitive and intransitive verbs, Phrases and clauses, Consistent verb tense, Misplaced modifiers, Dangling modifiers, Parallel structure, Faulty parallelism, Pronoun agreement, Reference and Point of View

Books Recommended:

- *English Skills with Readings* by John Langan, McGraw-Hill, New York, 1998
- *Reading and Study Skills* by John Langan
- *Practical English Grammar* by A.J. Thomson and A.V. Martinet, Oxford University Press, 1997
- *Writing: Intermediate* by Marie-Christine Boutin, Suzanne Brinand and Francoise Grellet, Oxford Supplementary Skills
- *Reading: Upper Intermediate* by Brain Tomlison and Rod Ellis, Oxford Supplementary Skills

BS Applied Chemistry 1st Year
Semester-I

Course Title:

PHYSICS -I

CODE: PHYS 2051

Credit Hours: 03 (2+1)

Mechanics I

Vector Derivatives and Operators, Gauss' Divergence Theorem, Stokes Theorem, Particle dynamics, Effect on frictional and drag forces on motion, Non-inertial frames and pseudo forces, Work energy theorem, Conservative and non-conservative forces, Particle systems, Center of mass of solid objects, Angular velocity and stability of spinning objects, Linear and angular momentums, Gravitational effect of spherical mass distribution, Kepler's laws

Books Recommended:

1. UNIVERSITY PHYSICS with Modern Physics, 12th edition, Hugh D. Young and Roger A. Freedman, Sears and Zemansky
2. Physics vol. I by Resnick, halliday, and Krane, 4th Edition, John Wiley & Sons

PHYS 2071 PHYSICS LAB-I (1 Cr.hr)

LIST OF EXPERIMENTS

1. The Harmonic Oscillation of Helical springs-parallel and series connection of spring
2. Measuring moments of inertia of different bodies disc-Hollow of Solid cylinder
3. Measurement of the speed of sound in air
4. Coherence & width of spectral lines
5. Diffraction intensity at slit of double slit system
6. Stephen-Boltzmann's law of Radiation
7. Characteristics curve of a solar cell
8. Magnetic field of paired coils in Helmholtz coils

BS Applied Chemistry 1st Year

Semester-I

Course Title:

Diversity of Plants

Course Code: BOTN 2011

Credit Hours: 3 (2+1)

Objectives of course: The Students will be able to:

- a. Get awareness between photosynthetic and non-photosynthetic plants.
- b. Know about beneficial and harmful aspects of microorganisms in everyday life.
- c. Know the role of Algae and Fungi in the improvements of environment.
- d. Know the phyletic lineage among plants.

Course Outline:

Comparative study of life form, structure, reproduction and economic significance of:

- a. Viruses (RNA and DNA types) with special reference to TMV;
- b. Bacteria and Cyanobacteria (Nostoc) with specific reference to biofertilizers, pathogenicity and industrial importance;
- c. Algae (Spirogyra, Chara, Vaucheria, Pinnularia, Ectocarpus, Polysiphonia)
- d. Fungi (Penicillium, Ustilago, Puccinia, Agaricus), their implication on crop production and industrial applications.
- e. Lichens (Physical)
- f. Bryophytes
 - i. Anthoceros Funaria
- g. Pteridophytes. (General characteristics and life cycles only)
 - i. Psilopsida (Psilotum)
 - ii. Lycopsida (Selaginella)
 - iii. Sphenopsida (Equisetum)
 - iv. Pteropsida (Marsilea)
- h. Gymnosperms
 - i. Cycas Ephedra
- i. Angiosperm
 - i. Monocot (Poaceae) ii. Dicot (Solanaceae)

Lab Outline:

Culturing, maintenance, preservation and staining of microorganisms. Study of morphology and reproductive structures of the types mentioned in theory. Identification of various types mentioned from prepared slides and fresh collections.

Recommended Books:

1. Lee, R.E. 1999. *Phycology*. Cambridge University Press, UK
2. Prescott, L.M., Harley, J.P. and Klein, A.D. 2004. *Microbiology*, 3rd ed. W.M. C. Brown Publishers.
3. Alexopoulos, C.J., Mims, C.W. and Blackwell, M. 1996. *Introductory Mycology*. 4th ed. John Wiley and Sons Publishers.
4. Agrios, G.N. 2004. *Plant Pathology*. 8th ed. Academic press London.
5. Vashishta, B.R. 1991. *Botany* for degree students (all volumes). S. Chand and Company. Ltd. New Delhi.
6. Andrew, H. N. 1961. *Studies in Paleobotany*. John Willey and Sons.

BS Applied Chemistry 1st Year Semester-I

Course Title:

CODE: PAKS 2111

Pakistan Studies

Credit Hours: 02

Introduction/Objectives

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

Course Outline

1. 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.

2. 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

3. 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

Books Recommended

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, .
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.

BS Applied Chemistry 1st Year

Semester-I

Course Title:

ZOOLOGY-I

CODE: ZOO 2015

Credit Hours: 03 (2+1)

PRINCIPLES OF ANIMAL LIFE- I-A + PRINCIPLES OF ANIMAL LIFE-II (Cr. 2+1)

PRINCIPLES OF ANIMAL LIFE- I-A

Aims and Objectives:

The course aims to impart knowledge and understanding of:

- a. The concept and status of Zoology in life sciences.
- b. The common processes of life through its chemistry, biochemical and molecular processes.
- c. The structure and function of cell organelles and how common animal cell diversified in various tissues, organs and organ systems.
- d. Biochemical mechanisms eventually generating energy for animal work.
- e. Animals and their relationship with their environment.

1. The Chemical Basis of Animal Life

Atoms and elements: building blocks of all matter; Structure of atoms; acids, bases, and buffers; Measuring of acidity and alkalinity, pH control by buffer; the molecules of animals: fractional account of carbohydrates, lipids, proteins, nucleotides and nucleic acids based on their structural aspects.

2. Cells, Tissues, Organs, and Organ System of Animals

Structure and functions of cell membranes; various movements across membranes; cytoplasm, organelles, and cellular components: functional account of ribosomes, endoplasmic reticulum, golgi apparatus, lysosomes, mitochondria, cytoskeleton, cilia and flagella, centrioles and microtubules, and vacuoles based on their structural aspects. The nucleus: nuclear envelope, chromosomes and nucleolus. Tissues: diversity in epithelial tissue, connective tissue, muscle tissue and nervous tissue to perform various functions. Structural integrations for functions in organs and organ systems.

PRINCIPLES OF ANIMAL LIFE-II

Aims and Objectives:

The course imparts knowledge and understanding of:

- a. cell division and its significance in cell cycle.
- b. concepts and mechanisms of inheritance pattern, chromosome and gene linkage and molecular basics of genetics.
- c. animal behaviour and communication.
- d. theories of evolution, gene flow and mechanism of evolution with reference to animals and diversity.

Course Contents

1. Cell Division

Mitosis, cytokinesis, and the cell cycle: an overview; meiosis: the basis of sexual reproduction.

2. Inheritance Patterns

Mendelian inheritance patterns; other inheritance patterns (multiple allele, Codominance, Incomplete dominance)

3. Chromosomes and Gene Linkage

Organization of DNA and protein; Sex chromosomes and autosomes; Number of chromosomes; Linkage relationships (only definition); changes in chromosome number and structure (Detecting number and structure changes).

4. Molecular Genetics: Ultimate Cellular Control

DNA: the genetic material; DNA replication in eukaryotes; genes in action; mutations; applications of genetic technologies; recombinant DNA.

5. Animal Behaviour

Learning (types); communication; social behavior.

6. Evolution: A Historical Perspective

Darwin's early years and His journey; the theory of evolution by natural selection; Adaptation, Alfred Wallace Russel.

7. Evolution and Gene Frequencies

The Hardy-Weinberg theorem; evolutionary mechanisms: population size, genetic drift, natural selection, gene flow, mutation; species and speciation.

Practical:

1. Tests for different carbohydrates, proteins and lipids.

Note: Emphasis on the concept that tests materials have been ultimately obtained from living organisms and constituted their body.

2. Study of the prepared slides of epithelial tissue (squamous, cuboidal, columnar), connective tissue (adipose, cartilage, bone, blood), nervous tissue and muscle tissue (skeletal, smooth and cardiac).

Note: Prepared microscopic and/or projection slides and/or CD ROM computer projections must be used.

3. Plasmolysis and deplasmolysis in blood.

4. Study of mitosis in onion root tip.

5. Study of meiosis in grasshopper testis (students should prepare the slide).

Note for 1-2: Prepared microscopic and/or projection slides and/or CD ROM computer projections must be used).

6. Problem based study of Mendelian ratio in animals.

7. Multiple alleles study in blood groups.

8. Survey study of a genetic factor in population and its frequency.

9. Study of karyotypes of *Drosophila*, mosquito.

10. Study of cytochemical detection of DNA in protozoa and avian blood cell.

11. Study to demonstrate nervous or endocrine basis of behaviour (conditioned reflex or aggression or parental behavior).

12. Study to demonstrate social behaviour (documentary film be shown, honey bee, monkey group in a zoo).
13. Study of representative groups of class Reptilia.
14. Study of representative groups of class Aves.
15. Study of representative groups of class Mammalia.
16. Field trips to study animal diversity in an ecosystem.

Books Recommended

1. Miller, S.A. GENERAL ZOOLOGY LABORATORY MANUAL. 5th Edition (International), 2002. Singapore: McGraw Hill.
2. Hickman, C.P. and Kats, H.L. LABORATORY STUDIES IN INTEGRATED PRINCIPLES OF ZOOLOGY. 2000. Singapore: McGraw Hill.

BS Applied Chemistry 1st Year

Semester-I

Course Title:

MATHEMATICS-I

CODE: MATHS 3011

Credit Hours: 03

Preliminaries: Intervals, Inequalities, Functions, Graphs of Functions, Lines, Circles, Parabolas, Shifting and Scaling of Graphs

Limits and Continuity: The Precise Definition of a Limit, Calculating Limits Using the Limit Laws, One-Sided Limits, Limits at Infinity, Infinite Limits and Vertical Asymptotes, Continuity

Differentiation: Secant and Tangent Lines, Rates of Change, The Derivative, Physical and Geometric Interpretation of a Derivative, Techniques of Differentiation, The Chain Rule, Implicit Differentiation, Linearization, Differentials

Applications of Derivatives: Extreme Values of Functions, Monotonic Functions and the First Derivative Test, Concavity, Rolle's Theorem, The Mean-Value Theorem, Curve Sketching: Graphs of Polynomials and Rational Functions, Applied Optimization Problems, Indeterminate Forms and L'Hôpital's Rule

Derivatives of Transcendental Functions: Logarithmic and Exponential Functions, Derivatives of Logarithmic and Exponential Functions, Graphs Involving Logarithmic and Exponential Functions, Inverse Functions, Derivatives of Hyperbolic and Inverse Hyperbolic Functions, Derivatives of Inverse Trigonometric Functions

Recommended Books:

1. CALCULUS by Howard Anton, 8th Edition, John Wiley & Sons
2. CALCULUS by George B. Thomas, 11th Edition, Pearson Education, India.

BS Applied Chemistry 1st Year
Semester-I

Course Title: **Computer and Its Applications in Chemistry**

CODE: COMP 2001

Credit Hours: (2+1)

Definition of Computer, Core Components of Computer, Brief history of Computers, Types/ Classification of Computer, **Software:** Definition, Types, Significance, Software Development Life Cycle, **Hardware:** Definition, Types, **Computer Architecture:** Modern Computer Architecture, Central Processing Unit, Main Memory, Bus Interconnection, IO Unit , CPU Registers, Instruction Set/ Instruction Format, **Programming Languages:** Definition, Types, Language Translators, **Introduction to Data Communication and Computer Networks:** Components of Data Communication, LAN, WAN and MAN, Internet, Viruses and Anti-Viruses, Use of office productivity tools, such as word processors, spreadsheets, presentation applications, database software, etc., Social, Ethical, Professional and Legal Issues

Use of MS Wors, Excel, Power Point, Use of Software e.g. Chems sketch/ Chemdraw

Recommended Books:

1. Discovering Computers 2012, Cashman
2. Introduction to Computers, Peter Norton
3. Discovering Computers Complete, 2013 Shelly Cashman series.
4. Exploring Computers Complete 2012 by Floyd Fuller, Brian Larson
5. Microsoft® Office Word 2007 Step by Step (Step By Step (Microsoft)) by Joyce Cox and Joan Preppernau (Paperback - Jan 31, 2007)
9. Steve Lambert and M Dow Lambert, Microsoft® Office Access(TM) 2007 Step by Step (Step By Step (Microsoft)), 2007.
10. Carl S. Chatfield, Timothy D. Johnson (2000), “*Microsoft Project 2000 Step by Step*”, Microsoft Press, ISBN: 0735609209.
6. Joyce Cox and Curtis Frye and Joan Preppernau, Microsoft® Office Home and Student 2007 Step by Step, 2007.
7. Joyce Cox and Joan Preppernau, Microsoft® Office Word 2007 Step by Step (Step By Step (Microsoft)), 2007.
8. Joyce Cox and Joan Preppernau, Microsoft® Office PowerPoint® 2007 Step by Step (Step By Step (Microsoft)), 2007.

Reference Book/s:

11. Peter Zorkoczy and Nicholas Heap, “*Information Technology: An Introduction*” 4th Edition, 1995 ISBN: 0-273-60591-7

BS Applied Chemistry 1st Year

Semester-I

Course Title:

Fundamentals of Inorganic Chemistry

CODE: ACH 8071

Credit Hours: 4 (3+1)

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 bond, covalent bond, coordinate covalent bond, bonding theory of metals and intermetallic compounds; conductors, insulators and semiconductors, hydrogen bonding. Prediction of shapes of molecules using VSEPR model and hybridization.

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 Element: General Chemistry 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.

Practical:

Laboratory Ethics and safety measures: Awareness about the toxic nature of chemicals and their handling, cleaning of glassware, safe laboratory operations

Qualitative analysis: Salt Analysis

Quantitative analysis: Laboratory work illustrating topics covered in the lectures

Books Recommended

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. and Selbin, J., "Theoretical Inorganic Chemistry", 2nd Ed., Van Nostrand 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.

SEMESTER II		
Course Code	Course Title	Credit Hours
ENG 2112	English II (Functional) (3+0)	3
ISL 2111	Islamic Studies/Ethics (2+0)	2
BOT 2021/PHYS 2052	Botany II /Physics II (2+1)	3
ZOOL 2016/MATH 3012	Zoology II (2+1)/ Mathematics II (3+0)	3
ACH 8081	Fundamentals of Organic Chemistry-I (3+1)	4
ACH 8101	Fundamentals of Environmental Chemistry (3+0)	3
		18

BS Applied Chemistry 1st Year Semester-II

Course Title:

English II (Functional)

Code: ENG 2112

Credit Hours: 03

Paragraph writing:

The first four steps in writing: 1) Making a Point, 2) Supporting the Point with Specific Evidence, 3) Organizing and connecting the Specific Evidence, 4) Writing clear Error-Free Sentences

The four bases for evaluating writing: 1) unity, 2) Support, 3) Coherence, Sentence Skills

Types of paragraph development: Introduction to paragraph development, Providing examples, Examining cause and effect, Explaining a process, Comparing and contrasting, defining a term, Dividing and classifying, Describing a scene or person, narrating an event, arguing a position

Essay Writing: The difference between a paragraph and an essay, Planing an essay, Making a thesis, developing paragraphs in an essay, Writing an essay

Books Recommended:

1. English Skills with Readings by John Langan, McGraw-Hill, New York, 1998
2. Reading and Study Skills by John Langan
3. Practical English Grammar by A.J. Thomson and A.V. Martinet, Oxford University Press, 1997
4. Writing: Intermediate by Marie-Christine Boutin, Suzanne Brinand and Francoise Grellet, Oxford Supplementary Skills
5. Reading: Upper Intermediate by Brain Tomlison and Rod Ellis, Oxford Supplementary Skills

BS Applied Chemistry 1st Year

Semester-II

Course Title:

Islamic studies

Code: ISL 2111

Credit Hours: 02

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.

Detail of Courses

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)

BS Applied Chemistry 1st Year

Semester-II

Course Title:

Botany II

Code: BOT 2021

Credit Hours: 3(2+1)

Plant Systematics, Anatomy and Development

Specific objectives of course: To understand

1. Various systems of classification, identification and nomenclature of higher plants,
2. Structures and functions of tissues and organs at embryonic level.

Course outline:

a) Plant systematic

1. Introduction to Plant Systematic: aims, objectives and importance.
2. Classification: brief history of various systems of classification with emphasis on Takhtajan.
3. Brief introduction to nomenclature, importance of Latin names and binomial system with an introduction to International Code of Botanical Nomenclature (ICBN).Vienna code.
4. Morphology: a detailed account of various, orphological characters
 - i. Stem
 - ii. Leaf
 - iii. Inflorescence
 - iv. Flower
 - v. Placentation .
5. Diagnostic characters, economic importance and distribution pattern of the following families:
 - i. Brassicaceae (Cruciferae)
 - ii. Fabaceae (Leguminosae)
 - iii. Rosaceae
 - iv. Euphorbiaceae
 - v. Cucurbitaceae
 - vi. Lamiaceae (Labiatae)
 - vii. Asteraceae (Compositae)

b) Anatomy

1. Cell wall: structure and chemical composition
2. Concept, structure and function of various tissues like:
 - i. Parenchyma
 - ii. Collenchyma
 - iii. Sclerenchyma
 - iv. Epidermis (including stomata and trichomes)
 - v. Xylem
 - vi. Phloem
3. Meristem: types, stem and root apices

4. Vascular cambium
5. Structure and development of root, stem and leaf. Primary and secondary growth of dicot stem, periderm
6. Characteristics of wood: diffuse porous and ring –porous, sap and heart wood, soft and hard wood, annual rings.

c) Development / Embryology

Early development of plant body:

1. Structure and development of Anther MicrosporogenesisMicrogametophyte
2. Structure of Ovule MegasporogenesisMegagametophyte
3. Endosperm formation
4. Parthenocarpy
5. Polyembryony

Lab Outline:

Anatomy

1. Study of stomata, epidermis,
2. Tissues of primary body of plant
3. Study of xylem 3-dimensional plane of wood.
4. T.S of angiosperm stem and leaf.
5. Anatomy of germinating seeds
6. Study of pollens

Taxonomy

1. Identification of families given in syllabus with the help of keys.
2. Technical description of common flowering plants belonging to families mentioned in theory syllabus.
3. Field trips shall be undertaken to study and collect local plants.
4. Students shall submit 40 fully identified herbarium specimens.

Recommended Books:

1. Mauseth, J.D. 1998. An Introduction to *Plant Biology*: Multimedia Enhanced. Jones and Bartlett Pub. UK
2. Moore, R.C., W.D. Clarke and Vodopich, D.S. 1998. *Botany*. McGraw Hill Company, U.S.A.
3. Raven, P.H., Evert, R.E. and Eichhorn, S.E. 1999. *Biology of Plants*. W.H. Freeman and Company Worth Publishers.
4. Stuessy, T.F. 1990. *Plant Taxonomy*. Columbia University Press, USA.
5. Lawrence, G.H.M. 1951 *Taxonomy of Vascular Plants*. MacMillan & Co. New York.
6. Panday, B.P. 2004. *A textbook of Botany (Angiosperms)*. S. Chand and Co. New Delhi.
7. Raymond E, S. E. Eichhorn. 2005. *Esau's Plant Anatomy*. Meristems cells and tissues of the plant body, 3 rd ed. John Wiley & Sons. Inc.
8. Fahn, A. 1990. *Plant Anatomy*. Pergamon Press, Oxford.
9. Esau, K. 1960. *Anatomy of Seed Plants*. John Wiley, New York.
10. Maheshwari, P.1971. *Embryology of Angiosperms*, McGraw Hill.New York.

BS Applied Chemistry 1st Year
Semester-II

Course Title:

Physics II

Code: PHYS 2052

Credit Hours: 3 (2+1)

Mechanics II

Relation between linear and angular variables, Kinetic energy of rotation, Rotational dynamics of rigid bodies, Equations of motion and effects of application of torques, Elastic properties of matter, physical basis of elasticity, tension, compression & shearing, Elastic modulus, Postulates of relativity, Galilean and Lorentz transformation, Length contraction and time dilation, Relativistic mass

Books Recommended:

1. University Physics with Modern Physics, 12th edition, Hugh D. Young and Roger A. Freedman, Sears and Zemansky
2. Physics vol. I by Resnick, halliday, and Krane, 4th Edition, John Wiley & Sons

PHYS 2072

PHYSICS LAB-II (1 Cr.hr)

LIST OF EXPERIMENTS:

1. Interference of light Fresnel Biprism
2. Measurement of wavelengths of sodium light, difference of wave lengths and thickness of thin film e.g. mica using Michelson interferometer.
3. The determination of Cauchy's constants using spectrometer.
4. Determining the modulus of elasticity.
5. Determining resistances using a Wheatstone bridge.

BS Applied Chemistry 1st Year

Semester-II

Course Title:
CODE: ZOO 2016

ZOOLOGY-II
Credit Hours: 3 (2+1)

Principles of Animal Life I-B Animal diversity-I (classification, phylogeny and organization) (cr. 2+1)

Principles of animal life I-B

1. Energy and Enzymes: Life's Driving and Controlling Forces

Energy; enzymes: structure, function and factors affecting their activity; cofactors and coenzymes; ATP: The cell's energy currency.

2. How Animals Harvest Energy Stored in Nutrients

Glycolysis: the first phase of nutrient metabolism; fermentation: "life without oxygen"; aerobic respiration: the major source of ATP; metabolism of fats and proteins.

ANIMAL DIVERSITY-I

Aims and Objectives:

The course is designed to provide students with:

- a. concepts of evolutionary relationship of animal kingdom.
- b. knowledge about animal kingdom, emphasizing their phylogenetic relationships and simple to complex mode of animal life.

Course Contents

1. Animal Classification, Phylogeny And Organization

Classification of organisms; A taxonomic hierarchy; Nomenclature; Animal systematics; patterns of organization.

2. Animal-Like Protists: The Protozoa

Life within a single plasma membrane; symbiotic life-styles. Protozoan taxonomy: (Table 17.1, up to phyla, subphyla and super classes, wherever applicable). Flagellar, Pseudopodia and amoeboid locomotion; cilia and other pellicular structures.

3. Multicellular and Tissue Levels of Organization

Phylum porifera: General characteristics; cell types, body wall, and skeletons; water currents and body forms; Phylum cnidaria (coelenterata): General characteristics; the body wall and nematocysts; alternation of generations; maintenance functions; reproduction and classification up to class (Table 18.2).

4 Triploblastics and Acoelomate Body Plan

phylum platyhelminthes: General characteristics classification up to class (Table 19.1); the free-living flatworms (Class Turbellaria in detail) and some important tapeworm parasites (*Taeniarhynchussaginatus*);

5. Pseudocoelomate Body Plan: Aschelminths

General characteristics; classification up to phyla with general features (six phyla); feeding and the digestive system; other organ systems; reproduction and development of phylum nematoda; Some important nematode parasites of humans (*Ascarislumbricoides*, *Wuchereriaspp.*: the Filarial worms).

6. Molluscan Success

Molluscan characteristics; classification up to class (Table 21.1). The characteristics of shell and associated structures, feeding, digestion, gas exchange, locomotion, reproduction and development, other maintenance functions and diversity in bivalves.

7. Annelida: The Metameric Body Form

Metamerism and tagmatization; classification up to class (Table 22.1). External structure and locomotion, feeding and the digestive system, gas exchange and circulation, nervous and sensory functions, excretion, regeneration, reproduction and development in polychaeta.

8. Arthropods: Blueprint for Success

Evolutionary perspective: classification upto class (Table 23.1); metamerism and tagmatization; the exoskeleton; metamorphosis.

9. Hexapods and Myriapods: Terrestrial Triumphs

External structure and locomotion, nutrition and the digestive system, gas exchange, circulation and temperature regulation, nervous and sensory functions, excretion, chemical regulation, reproduction and development in hexapoda; insect behavior; insects and humans.

Practical

1. Protein digestion by pepsin.
2. Study of *Euglena*, *Amoeba*, *Entamoeba*, *Plasmodium*, *Trypanosoma*, *Paramecium* as representative of animal like protists. (Prepared slides).
3. Study of sponges and their various body forms.
4. Study of principal representative classes of phylum Coelenterata.
5. Study of principal representative classes of phylum Platyhelminthes.
6. Study of representative of phylum Rotifera, phylum Nematoda.
7. Study of principal representative classes of phylum Mollusca.
8. Study of principal representative classes of phylum Annelida.
9. Study of principal representative classes of groups of phylum Arthropoda.
10. Brief notes on medical/economic importance of the following
Plasmodium, *Entamoeba histolytica*, *Leishmania*, Liverfluke, Tapeworm, Earthworm, Silkworm, Citrus butterfly.
10. Preparation of permanent stained slides of the following: *Obelia*, *Daphnia*, Cestode, Parapodia of *Nereis*.

Books Recommended

1. Hickman, C.P., Roberts, L.S. and Larson, A. INTEGRATED PRINCIPLES OF ZOOLOGY, 11th Edition (International), 2004. Singapore: McGraw Hill.
2. Miller, S.A. and Harley, J.B. ZOOLOGY, 5th Edition (International), 2002. Singapore: McGraw Hill.
3. Pechenik, J.A. BIOLOGY OF INVERTEBRATES, 4th Edition (International), 2000. Singapore: McGraw Hill.
4. Kent, G.C. and Miller, S. COMPARATIVE ANATOMY OF VERTEBRATES. 2001. New York: McGraw Hill.

BS Applied Chemistry 1st Year
Semester-II

Course Title:

Mathematics II

Code: MATH 3012

Credit Hours: 03

Integration: The Indefinite Integral, Estimating with Finite Sums, Sigma Notation and Limits of Finite Sums, Areas as Limits, The Definite Integral, The Fundamental Theorem of Calculus

Applications of Definite Integrals: Area between Two Curves, Volumes by Slicing; Discs and Washers, Volumes by cylindrical Shells, Length of a Plane Curve, Area of a Surface of Revolution

Techniques of Integration: Integration by Parts, Integration of Rational Functions by Partial Fractions, Integrating Powers of Sine and Cosine, , Integrating Powers of Secant and Cosecant, Trigonometric substitutions, Improper Integrals, Evaluating Integral

Infinite Sequences and Series: Sequences, Monotone Sequences, Infinite Series, The Integral Test, Comparison Tests, The Ratio Test, The Root Test, Alternating series, Absolute and Conditional Convergence, Power Series, Taylor and Maclaurin Series, Convergence of Taylor Series; Error Estimates, Applications of Power Series, Fourier Series

Recommended Books:

1. CALCULUS by Howard Anton, 8th Edition, John Wiley & Sons
2. CALCULUS by George B. Thomas, 11th Edition, Pearson Education, India

BS Applied Chemistry 1st Year

Semester-II

Course Title:

Fundamentals of Organic Chemistry-I

Code: ACH 8081

Credit Hours: 4(3-1)

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.

Practical:

Qualitative analysis of compounds with different functional groups, synthesis of organic compounds using as a tool for understanding techniques like reflux, distillation, filtration, recrystallization and yield calculation, organic syntheses may include preparation of benzanilide from benzoyl chloride, succinic anhydride from succinic acid, phthalimide from phthalic anhydride, oximes and hydrazones from carbonyl compounds, and an ester from a carboxylic acid and alcohol etc.

Books Recommended

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.

BS Applied Chemistry 1st Year

Semester-II

Course Title:

Environmental Chemistry

Code: ACH 8071

Credit Hours: 3 (3+0)

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 greenhouse 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, Eutrophication, 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.

Air Pollution

Pollutants, Sources, Emission factors, Indoor air quality (IAQ), Health effects; Effects on cardiovascular health, Effects on cystic fibrosis, Effects on COPD and asthma, Links to cancer, Effects on children, Health effects in relatively "clean" areas, Reduction efforts, Control devices, Legal regulations

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.

Books Recommended

1. Colin Baird and Michael Cann. Environmental Chemistry. 4th edition (2008)
2. Stanley E. Manahan. Environmental Chemistry, CRC Press; 9 edition (2010)
3. James E. Girard. Principles of Environmental Chemistry Jones & Bartlett Publishers; 2 edition (2009)
4. Anil Kumar De, Environmental Chemistry, Wiley Eastern Ltd. New Delhi, (1989)

SEMESTER III		
Course Code	Course Title	Credit Hours
ENG 2113	English III (Communication skill) (3+0)	3
STAT 100	Statistics (3+0)	3
BOT 2031/PHYS-2053	Botany III /Physics III (2+1)	3
ZOOL 2023/MATH 3013	Zoology III (2+1)/Mathematics (3+0)	3
ACH 8091	Fundamentals of Physical Chemistry-I (3+1)	4
ACH 8021	Fundamentals of Biochemistry (2+1)	3
		19

BS Applied Chemistry 2nd Year
Semester-III

Course Title:

English III (Communication Skill)

Code: ENG 2113

Credit Hours: 03

Writing of CV and Job Application

Academic Writing: Letter/Memo writing, writing of minute of meetings, Use of Library and Internet

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

Books Recommended:

1. Practical English Grammar by A.J. Thomson and A.V. Martinet, Oxford University Press, 1986
2. Writing: Intermediate by Marie-Christine Boutin, Suzanne Brinand and Francoise Grellet, Oxford Supplementary Skills
3. Reading: Advanced by Brian Tomlison and Rod Ellis, Oxford Supplementary Skills

BS Applied Chemistry 2nd Year
Semester-III

Course Title:

Statistics

Code: STAT-100

Credit Hours: 03

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 R^2 . 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., Macmillan Publishing Co., Inc. New York.
- 2 Muhammad, F. 2005. "Statistical Methods and Data Analysis", Kitab Markaz, Bhawana Bazar Faisalabad.

BS Applied Chemistry 2nd Year

Semester-III

Course Title:

Botany III

Code: BOT 2031

Credit Hours: 3(2+1)

Cell Biology, Genetics and Evolution

Specific objectives of course: To understand

1. structure and functions of cell,
2. nature of genetic material and hereditary process
3. Familiarization with evolutionary processes.

Course outline:

a) Cell biology

1. Structures and Functions of Bio-molecules
 - i. Carbohydrates
 - ii. Lipids
 - iii. Proteins
 - iv. Nucleic Acids
2. Cell: Cell theory, Cell types (Prokaryotes and Eukaryotes), basic properties of cell
3. Ultrastructure of plant cell with a brief description and functions of the following organelles
 - i. Cell wall
 - ii. Cell membrane
 - iii. Nucleus
 - iv. Endoplasmic reticulum
 - v. Plastids
 - vi. Mitochondria
 - vii. Ribosomes
 - viii. Dictyosomes
 - ix. Vacuole
 - x. Microbodies (Glyoxysomes and Peroxisomes)
4. Reproduction in somatic and embryogenic cell, mitosis and meiosis, cell cycle

b) Genetics

1. Introduction, scope and brief history of genetics. Mendelian inheritance; Laws of segregation and independent assortment, back cross, test cross, dominance and incomplete dominance.
2. Molecular genetics; DNA replication. Nature of gene, genetic code, transcription, translation, protein synthesis, regulation of gene expression (e.g. *lac* operon).
3. Chromosomal aberrations; Changes in the number of chromosomes. Aneuploidy and euploidy. Changes in the structure of chromosomes, deficiency, duplication, inversion and translocation.

c) Evolution: Introduction and theories.

Lab Outline: Cell Biology

1. Study of cell structure using compound microscope and elucidation of ultrastructure from electron microphotographs
2. Measurement of cell size.
3. Study of mitosis and meiosis by smear/squash method and from prepared slides.
4. Study of chromosome morphology and variation in chromosome number.
5. Extraction and estimation of carbohydrate, protein, RNA and DNA from plant sources.

Genetics

1. Genetical problems related to transmission and distribution of genetic material.
2. Identification of DNA in plant material. Carmine/orcein staining.
3. Study of salivary gland chromosomes of *Drosophila*.

Recommended Books:

1. Hoelzel, A. R. 2001. *Conservation Genetics*. Kluwer Academic Publishers.
2. Dyonsager, V.R. (1986). *Cytology and Genetics*. Tata and McGraw Hill Publication Co. Ltd., New Delhi.
3. Lodish, H. 2001. *Molecular Cell Biology*. W. H. Freeman and Co.
4. Sinha, U. and Sinha, S. (1988). *Cytogenesis Plant Breeding and Evolution*, Vini Educational Books, New Delhi.
5. Strickberger, M.V. (1988), *Genetics*, MacMillan Press Ltd., London.
6. Carroll, S.B., Grenier, J.K. and Welnerbee, S.d. 2001. *From DNA to Diversity Molecular Genetics and the Evolution of Animal Design*. Blackwell Science.
7. Lewin, R, 1997. *Principles of Human Evolution*. Blackwell Science.
8. Strickberger, M. W. 2000 *Evolution*. Jones&Bartlet Publishers Canada
9. Ingrouille M. J. & B. Eddie. 2006. *Plant Diversity and Evolution*. Cambridge University Press.

Journals / Periodicals:

Theoretical & Applied Genetics, The Cell, Heredity.

BS Applied Chemistry 2nd Year
Semester-III

Course Title:

Physics III

Code: PHYS 2053

Credit Hours: 3 (2+1)

Electricity and Magnetism

Electric charge and electric field, Gauss's law, Electric potential, Capacitance and Dielectrics, Current, Resistance, Electromotive force, Dielectric-current circuits, Magnetic field and magnetic forces, Sources of magnetic field, Electromagnetic induction, Induction, Alternating current, Electromagnetic waves, Maxwell equations

Books Recommended:

1. University Physics with Modern Physics, 12th edition, Hugh D. Young and Roger A. Freedman, Sears and Zemansky
2. Physics vol. I by Resnick, halliday, and Krane, 4th Edition, John Wiley & Sons

PHYS 2073 PHYSICS LAB-III (1 Cr.hr)

LIST OF EXPERIMENTS:

1. Measurement of resistance using a Neon flash bulb and condenser
2. Conversion of a Galvanometer into Voltmeter and Ammeter.
3. To study the characteristics of Photoemission and determination of Plank's constant using a Photo cell.
4. Calibration of an ammeter and a voltmeter by potentiometer.
5. Charge sensitivity of a ballistic galvanometer.
6. Measurement of self/mutual inductance.
7. Study of electric circuit by black box.

BS Applied Chemistry 2nd Year
Semester-III

Course Title:

ZOOLOGY III

CODE: ZOO 2023

Credit Hours: 3 (2+1)

Principles of Animal Life I-C + ANIMAL DIVERSITY-II (Classification, Phylogeny and Organization) (2+1)

Aims and Objectives:

The course provides knowledge and understanding about the different animal groups, emphasizing their phylogenetic relationships.

Course Contents

PRINCIPLES OF ANIMAL LIFE- I-C

1. Ecology I: Individuals and Populations

Animals and their abiotic environment (Energy, Animal inactivity); populations; Population growth; interspecific interactions (only definitions of Herbivory, Predation, Competition, Symbiosis, Parasitism, Commensalism, Mutualism).

2. Ecology II: Communities and Ecosystems

Ecosystems (Trophic structure, Producers, Consumers, Decomposers); ecosystems of the earth (brief account); ecological problems; human population growth, pollution.

ANIMAL DIVERSITY-II (Classification, Phylogeny and Organization)

1. Echinoderms

Echinoderm characteristics; classification up to class (Table 25.1). Maintenance functions, regeneration, reproduction, and development in asteroidean.

2. Hemichordates and Invertebrate Chordates

Phylogenetic Relationships; Classification up to subphylum or class where applicable (Table 26.1); Class Enteropneusta in detail.

3. Fishes: Vertebrate Success in Water

Phylum Chordata, General characteristics and Classification (Table 26.1); Survey of super class agnatha and gnathostomata (Table 27.1); evolutionary pressures: adaptations in locomotion, nutrition and the digestive system, circulation, gas exchange, reproduction and development.

4. Amphibians: The First Terrestrial Vertebrates

Survey of order caudata, gymnophiona, and anura (Table 28.1). Evolutionary pressures: adaptations in external structure and locomotion, nutrition and the digestive system, circulation, gas exchange, temperature regulation, reproduction, development, and metamorphosis.

5. Reptiles: The First Amniotes

Survey of order testudines or chelonia, rhynchocephalia, squamata, and crocodilian (Table 29.1); evolutionary pressures: adaptations in external structure and locomotion, nutrition and the digestive system, circulation, gas exchange, and temperature regulation, reproduction and development.

6. Birds: Feathers, Flight, and Endothermy

Evolutionary pressures: adaptation in external structure and locomotion, nutrition and the digestive system, circulation, gas exchange, and temperature regulation, reproduction and development; migration and navigation.

7. Mammals: Specialized Teeth, Endothermy, Hair, and Viviparity

Evolutionary pressures: adaptations in external structure and locomotion, nutrition and the digestive system, circulation, gas exchange, and temperature regulation, excretion and osmoregulation.

Practical:

1. Ecological notes on animals of a few model habitats.
2. Field observation and report writing on animals in their ecosystem (a terrestrial and an aquatic ecosystem study).
3. Study of a representative of Hemichordate and Invertebrate Chordate.
4. Study of representative groups of class Fishes.
5. Study of representative groups of class Amphibia.
6. Study of representative groups of class Reptilia.
7. Study of representative groups of class Aves.
8. Study of representative groups of class Mammalia.
9. Field trips to study animal diversity in an ecosystem.

Note: Preserved specimen and/or colored projection slide and/or CD ROM projection of computer must be used.

Books Recommended

1. Hickman, C.P., Roberts, L.S. and Larson, A. INTEGRATED PRINCIPLES OF ZOOLOGY, 11th Edition (International), 2004. Singapore: McGraw Hill.
2. Miller, S.A. and Harley, J.B. ZOOLOGY, 5th Edition (International) 2002. Singapore: McGraw Hill.
3. Pechenik, J.A. BIOLOGY OF INVERTEBRATES, 4th Edition (International), 2000. Singapore: McGraw Hill.
4. Kent, G.C. and Miller, S. COMPARATIVE ANATOMY OF VERTEBRATES. 2001. New York: McGraw Hill.
5. Campbell, N.A. BIOLOGY, 6th Edition. 2002. Menlo Park, California: Benjamin/Cummings Publishing Company, Inc.

Books Recommended

1. Hickman, C.P. and Kats, H.L. LABORATORY STUDIES IN INTEGRATED PRINCIPLES OF ZOOLOGY. 2000. Singapore: McGraw Hill.
2. Miller, S.A. GENERAL ZOOLOGY LABORATORY MANUAL. 5th Edition (International), 2002. Singapore: McGraw Hill.

BS Applied Chemistry 2nd Year
Semester-III

Course Title:

Mathematics III

Code: MATH 3013

Credit Hours: 03

Partial Derivatives: Functions of Two or More Variables, Limits and Continuity, Partial Derivatives, Differentiability and Chain Rule for Two Variables, Differentiability of Three Variables, Directional Derivatives of Three Variables, Gradients for Functions of Three, Maxima and Minima of Functions of Two Variables

Multiple Integrals: Double Integrals, Double Integrals over Non Rectangular Regions, Double Integrals in Polar Coordinates, Surface Area, Triple Integrals, Centroid, Triple Integrals in Cylindrical and Spherical Coordinates, Change of Variables in Multiple Integrals

Integration in Vector Fields: Line Integrals, Vector Fields, Green's theorem, Parameterized surfaces, Stokes' Theorem, The Divergence Theorem

Recommended Books:

1. CALCULUS by Howard Anton, 8th Edition, John Wiley & Sons
2. CALCULUS by George B. Thomas, 11th Edition, Pearson Education, India

BS Applied Chemistry 2nd Year

Semester-III

Course Title:

Fundamentals of Physical Chemistry

Code: ACH 8091

Credit Hours: 4 (3+1)

Physical States of Matter

Equation of states, ideal and real gases, critical phenomenon and critical constants. Molecules in motion: collision diameter and mean free path. Physical properties of liquids: surface tension, viscosity, refractive index, dipole moment etc. and their applications. Brief account of interactions among the molecules in liquids. Packing of atoms in solids, unit cells and crystal systems. Bragg's diffraction law. Plasma state

Chemical Equilibrium

Equilibrium expressions, reaction quotient, examples of equilibrium reactions in solid, liquid and gas phases, extent of reactions and equilibrium constant, Gibbs energies of formation and equilibrium constants, effect of temperature and pressure on the equilibrium constants/ compositions, Van't Hoff equation, Le Chatelier's principle.

Chemical Thermodynamics

Four laws of thermodynamics and their applications. Reversible and non-reversible processes, spontaneous and non-spontaneous processes. Thermodynamic functions, Fundamental thermodynamic equations, Effect of temperature and pressure on the Gibbs free energy, chemical potential. Relations of entropy and Gibbs free energy with equilibrium constant. Gibbs Helmholtz equation, Heat capacities and their dependence on temperature, pressure and volume.

Chemical Kinetics

The rates of reactions, zero order, first order, and second order reactions with same and different initial concentration. Half-lives of reactions. Experimental techniques for rate determination and methods for determination of order of reaction (integration, half life, initial rate, and graphical methods). Arrhenius equation. Mechanisms of chemical reactions

Solution Chemistry

Ideal and non-ideal solutions. Concentration units and their inter-conversion. Raoult's law and its applications. Molecular interactions in solutions and ionic strength. Thermodynamic derivations of Colligative properties; lowering of vapour pressure, elevation of boiling point, depression of freezing point, osmotic pressure. Abnormal colligative properties; degree of association and dissociation of solutes. Osmotic pressure and its measurement. Fractional distillation and concept of azeotropic mixture.

Practical:

1. Determination of viscosity and refractive index 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.

Books Recommended

1. Physical Chemistry by R. Silbey, R. Alberty and M. Bawendi. ISBN-13: 978-0471215042 (2004).
2. Physical Chemistry – A Molecular Approach, D. A. McQuarrie and J. D. Simon, (2008).
3. Alberty R. “Physical Chemistry” 17th ed., John Wiley and Sons (1987).
4. Atkins, P.W. “Physical Chemistry” 6th ed., W.H. Freeman and Co. New York (1998).
5. Laidler K.J. “The World of Physical Chemistry” 1st ed., Oxford University Press (1993).
6. Laidler K.J., John H.M. and Bryan C.S. “Physical Chemistry” 4th ed., Houghton Mifflin Publishing Company Inc. (2003).
7. Peter P.A. “Chemical Thermodynamics” Oxford University Press (1983).
8. Brain S.E. “Basic Chemical Thermodynamics” 4th ed., E.L.B.S. Publishers (1990).
9. Barrow G.M. “Physical Chemistry” 5th ed., McGraw Hill (1992).
10. Jaffar M. “Experimental Physical Chemistry” University Grants Commission (1989).
11. Levitt B.P. “Findlay’s Practical Physical Chemistry” 9th ed., Longman Group Limited (1978).
12. Shoemaker D. “Experiments in Physical Chemistry” 5th ed., McGraw Hill Publishing Company Limited (1989).

BS Applied Chemistry 2nd Year

Semester-III

Course Title:

Fundamentals of Biochemistry

Code: ACH 8021

Credit Hours: 3 (2+1)

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 lipids 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.

Practical:

Qualitative and quantitative analysis of carbohydrates, lipids and proteins.

Determination of pH, Preparation of buffers. Enzyme catalysis, Progress curve for enzyme catalyzed reactions, Determination of values. To study the effect of different factors on the rate of enzyme catalyzed reactions.

Books Recommended

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)

SEMESTER IV		
Course Code	Course Title	Credit Hours
ENG 2114	English IV (Report writing)/ University optional (3+0)	3
BOT 2041/PHYS-2054	Botany IV/Physics IV (2+1)	3
ZOOL 2033/MATH 3014	Zoology IV (2+1)/ Mathematics (2+1)	3
ACH 8048	Research Methods and Scientific Writing (3+0)	3
ACH 8001	Fundamentals of Analytical Techniques (2+1)	3
ACH 8042	Fundamentals of Applied Chemistry (Industrial Chemistry) (3+1)	4
		19

BS Applied Chemistry 2nd Year
Semester-IV

Course Title:

English IV (Report writing)

Code: ENG 2114

Credit Hours: 03

Academic Writing:

How to write a proposal for research paper,

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

Technical Writing

Progress Report Writing

Books Recommended:

1. College Writing Skills by John Langan, McGraw-Hill, New York, 2004
2. Patterns of College Writing by Laurie G. Kirsznar and Stephen R. Mandell, St. Martin's Press
3. Writing: Advanced by Ron White, Oxford Supplementary Skills

BS Applied Chemistry 2nd Year

Semester-IV

Course Title:

BOTANY IV

Course Code: BOTN 2041

Credit hours: 3 (2+1)

Plant Physiology and Ecology

Specific objectives of course:

1. To provide comprehensive knowledge of functioning of organs, organelles and biomolecules,
2. To enable the students to assess the effects of various environmental factors on plant growth and development.

Course outline:

a) Plant Physiology

1. Water relations (water potential, osmotic potential, pressure potential, matric potential). Absorption and translocation of water. Stomatal regulation.
2. Mineral nutrition: Soil as a source of minerals. Passive and active transport of nutrients. Essential mineral elements, role and deficiency symptoms of macronutrients.
3. Photosynthesis: Introduction, Oxygenic and non-oxygenic photosynthesis Mechanism: light reactions (electron transport and photophosphorylation) and dark reactions(Calvin cycle). Differences between C3 and C4 plants. Factors affecting this process, Products of photosynthesis.
4. Respiration: Definition and respiratory substrates. Mechanism-Glycolysis, Krebs cycle. Electron transport and oxidative phosphorylation. Anaerobic respiration. Energy balance in aerobic and anaerobic respiration, Respiratory quotients.

b) Ecology

1. Introduction, aims and applications of ecology.
2. Soil: Physical and Chemical properties of soil (soil formation, texture. pH, EC, organism and organic matter etc) and their relationships to plants.
3. Light and Temperature. Quality of light, diurnal and seasonal variations. Ecophysiological responses.
4. Water: Field capacity and soil water holding capacity. Characteristics of xerophytes and hydrophytes. Effect of precipitation on distribution of plants.
5. Wind: Wind as an ecological factor and its importance.
6. Population Ecology: Introduction. A brief description of seed dispersal, seed bank.
7. Community Ecology
 - i. Ecological characteristics of plant community
 - ii. Methods of sampling vegetation (Quadrat and line intercept)
8. Applied Ecology
 - i. Causes, effects and control of water logging and salinity with respect to Pakistan

Lab Outline:**a) Plant Physiology**

1. Preparation of solutions of specific normality of acids/bases, salts, sugars, molal and molar solutions and their standardization.
2. Determination of uptake of water by swelling seeds when placed in sodium chloride solution of different concentrations.
3. Measurement of leaf water potential by the dye method.
4. Determination of the temperature at which beet root cells lose their permeability.
5. Determination of the effects of environmental factors on the rate of transpiration of a leafy shoot by means of a potometer/by cobalt chloride paper method.
6. Extraction of chlorophyll from the leaves and separation of component pigments on a paper chromatogram. Study of absorption spectra using spectrophotometer.
7. Estimation of oxygen utilized by a respiring plant by Winkler's method.

b) Ecology

1. Determination of physical and Chemical characteristics of soil.
2. Measurements of various population variables
3. Measurement of vegetation by Quadrat and line intercept methods.
4. Field trips to ecologically diverse habitats.
5. Measurement of light and temperature.
6. Effect of light and temperature on seed germination.

Recommended Books:

1. IhsanIllahi 1995. *Plant Physiology*, Biochemical Processes in Plants, UGC Press.
2. Witham and Devlin. 1986 *Exercises in Plant Physiology*, AWS Publishers, Boston.
3. Taiz, L. and Zeiger, E. 2006. *Plant Physiology*. 4th Ed. Sinauers Publ. Co. Inc. Calif.
4. Salisbury F.B. and Ross C.B. 1992. *Plant Physiology*. 5th Edition. Wadsworth Publishing Co. Belmont CA.
5. Hopkins, W.B. 1999. *Introduction to Plant Physiology*. 2nd Ed. John Wiley and Sons. New York
6. Schultz, J.C. 2005. *Plant Ecology*. Springer-Verlag, Berlin.
7. Ricklefs, R.E. 2000. *Ecology*. W.H. Freeman and Co., UK.
8. Ricklefs, R.E. 2001. *The Economy of Nature*. W.H. Freeman and Co., UK.
9. Barbour, M. G., J. H. Burke and W.D. Pitts. 1999. *Terrestrial Plant Ecology*, The Benjamin, Cumming Publishing Co. Palo Alto, California, USA.
10. Chapman, J.L. and Reiss, M.J. 1995. *Ecology: Principles and Applications*. Cambridge University Press.
11. Hussain F. 1989. *Field and Laboratory Manual of Plan Ecology*. National Academy of Higher Education, Islamabad.
12. Hussain, S.S. 1989. *Pakistan Manual of Plant Ecology*; National Book Foundation, Islamabad.
13. Larcher, W. 2003 *Physiological Plant Ecology: Ecophysiology and Stress Physiology of Functions Groups* – Springer Verlag.
14. Krebs, C. J. 1997. *Ecology*. Harper and Row Publishers.

BS Applied Chemistry 2nd Year
Semester-IV

Course Title:

Physics IV

Code: PHYS 2054

Credit Hours: 3 (2+1)

Modern Physics

Photons, Electrons, Photoelectric effect, Atomic line spectra, Energy levels, Bohr model, Wave-particle duality, DeBroglie waves, Heisenberg uncertainty principle, Schrodinger equation, Structure of solids, Free-electron model of metals, Semiconductors, Semiconductor devices, Superconductivity, Radioactivity, Nuclear reactions

Books Recommended:

1. University Physics with Modern Physics, 12th edition, Hugh D. Young and Roger A. Freedman, Sears and Zemansky
2. Physics vol. I by Resnick, halliday, and Krane, 4th Edition, John Wiley & Sons

PHYS 3041 LAB-IV (1 Cr.h)

LIST OF EXPERIMENTS

Note:

- (i) The students must perform at least 4 experiments from the list given below.
 - (ii) 50% weight-age must be given to viva-voce about apparatus, theory of experiments and estimation of errors.
1. Measurement of wavelengths of sodium light, difference of wave lengths and thickness of thin film e.g. mica using Michelson interferometer.
 2. To measure Planck's constant by studying photoelectric effect.
 3. To study the characteristic curve of semi-conductor diodes.
 4. To study full-wave and half-wave rectification using oscilloscope.
 5. To determine the ionization of mercury.
 6. To study the characteristic of GM counter and study of fluctuation in random process.

BS Applied Chemistry 2nd Year Semester-IV

Course Title:
CODE: ZOO 2033

Zoology IV
Credit Hours: 3 (2+1)

Animal Form and Function (2+1) (A Comparative Perspective)

Aims and Objectives:

The course aims to teach the students about:

- a. Animals diversity adapted in different ways for their functions through modifications in body parts.
- b. The diversity in integumentary, skeletal, muscular, nervous and sensory, endocrine, circulatory, respiratory, nutritive, excretory, osmoregulatory and reproductive systems according to strategies to survive in their specific conditions.
- c. Organ systems, their specialization and coordination with each other and constantly changing internal and external environment, inside and outside the animal's body.
- d. The basic structure of each system that determines its particular function.

Course Contents

1. Protection, Support, and Movement

Protection: Integumentary systems

The integumentary system of invertebrates. The integumentary system of vertebrates (no need of details), the skin of mammals. Movement and support: skeletal systems. The skeletal system of invertebrates, Hydrostatic skeletons, Exoskeletons, Endoskeletons. Mineralized Tissues and the invertebrates. The skeletal system of vertebrates; Cartilage, Bone or Osseous Tissue. Movement: Nonmuscular Movement and Muscular Systems; Nonmuscular Movement. Amoeboid Movement, Ciliary and Flagellar Movement. An Introduction to Animal Muscles; The Muscular System of Invertebrates. The Muscular System of vertebrates. Skeletal Muscle Contraction. Control of Muscle Contraction.

2. Communication I: Nerves

Neurons: The Basic Functional Units of the Nervous System. Neuron Structure: The Key to Function. Invertebrate Nervous Systems. Invertebrate and Nervous Systems: The Spinal Cord, Spinal Nerves, The Brain; Hindbrain, Midbrain, Forebrain. Cranial Nerves. The Autonomic Nervous System.

3. Communication II: Senses

Sensory Reception. Hearing and Equilibrium in Air, Skin Sensors of Mechanical Stimuli, Smell, Taste and Vision.

4. Communication III: The Endocrine System and Chemical Messengers

Chemical Messengers: Hormones and Their Feedback Systems, Biochemistry of Hormones Feedback Control System of Hormone Secretion, Mechanisms of Hormone Action; Fixed-Membrane –Receptor Mechanism. Mobile-Receptor Mechanism. Endocrine System of Mammals; Pituitary Gland (Hypophysis), Hormones of the Neurohypophysis, Hormones of the Adenohypophysis, Thyroid Gland, Parathyroid Glands, Adrenal Glands, Adrenal Cortex, Adrenal Medulla. Pancreas, Gonads, Thymus, Other Sources of Hormones.

5. Circulation, Immunity, and Gas Exchange

Internal Transport and Circulatory Systems. Transport Systems in Invertebrates. Transport Systems in Vertebrates; Characteristics of Vertebrate Blood and Blood Cells, Plasma, Formed Elements, Red Blood Cells, White Blood Cells, Platelets, Vertebrate Blood Vessels. The Human Heart, Blood Pressure, The Lymphatic System. Immunity. Gas Exchange. Respiratory Surfaces. Human Respiratory System: Air-Conducting Portion, Gas-Exchange Portion, Ventilation, Gas Transport.

6. Nutrition and Digestion

Evolution of Nutrition; The Metabolic Fates of Nutrients in Heterotrophs; Calories and Energy. Macronutrients; Carbohydrates: Carbon and Energy from Sugars and Starches, Lipids: Highly Compact Energy-Storage Nutrients, Proteins: Basic to the Structure and Function of Cells. Micronutrients: Minerals, Vitamins. Digestion. Diversity in Digestive Structures: Invertebrates, Protozoa, Insects. The Mammalian Digestive System, Gastrointestinal Motility and Its Control, Oral Cavity. Pharynx and Esophagus, Stomach, Small Intestine: Main Site of Digestion, Large Intestine. Role of the Pancreas in Digestion, Role of the Liver and Gallbladder in Digestion.

7. Temperature and Body Fluid Regulation

Homeostasis and Temperature Regulation; The Impact of Temperature on Animal Life; Heat Gains and Losses; Some Solutions to Temperature Fluctuations;

Temperature Regulation in Birds and Mammals; Heat Production in Birds and Mammals. Control of Water and Solutes (Osmoregulation and Excretion). How the Metanephric Kidney Functions.

8. Reproduction and Development

Asexual reproduction in invertebrates; Fission, Budding, Fragmentation, Parthenogenesis.

Sexual Reproduction in Invertebrates; External Fertilization, Internal Fertilization.

Sexual Reproduction in Vertebrates; Some Basic Vertebrates Reproductive Strategies, Fishes,

Amphibians, Reptiles, Birds, Mammals.

Practical:

1. Study of insect chitin and mammalian skin.
2. Study and notes of skeleton of *Rana tigrina* and rabbit.
Note: Exercises of notes on the adaptations of skeletons to their function must be done.
3. Earthworm; cockroach, frog, pigeon and rabbits are representative animals for study in dissections.
4. Study of models or preserved brains of representative animals and notes on adaptations.
5. Study of nervous system of earthworm.
6. Study of endocrine system in an insect and a rabbit.
7. Study of different types of blood cells in blood smear of rabbit.
8. Study of heart, principal arteries and veins in a representative vertebrate (dissection of representative mammals).
9. Study of respiratory system in cockroach and a vertebrate representative (Model). 1. Study of excretory system in an invertebrate and a vertebrate representative (Model).
10. Study of nutritive canal in an invertebrate and a vertebrate representative (Dissection).
11. Study of male reproductive system in an invertebrate and a vertebrate representative (Dissection).
12. Study of female reproductive system in an invertebrate and a vertebrate representative (Dissection).
13. Study of hormonal influence of a reproductive function (Model).

Books recommended

1. Hickman, C.P., Roberts, L.S. and Larson, A. INTEGRATED PRINCIPLES OF ZOOLOGY, 11th Edition (International), 2004. Singapore: McGraw Hill.
2. Miller, S.A. and Harley, J.B. ZOOLOGY, 5th Edition (International), 2002. Singapore: McGraw Hill.
3. Pechenik, J.A. BIOLOGY OF INVERTEBRATES, 4th Edition (International), 2000. Singapore: McGraw Hill.
4. Kent, G.C. and Miller, S. COMPARATIVE ANATOMY OF VERTEBRATES. 2001. New York: McGraw Hill.
5. Campbell, N.A. BIOLOGY, 6th Edition. 2002. Menlo Park, California: Benjamin/Cummings Publishing Company, Inc.

Books Recommended

1. Hickman, C.P. and Kats, H.L. LABORATORY STUDIES IN INTEGRATED PRINCIPLES OF ZOOLOGY. 2000. Singapore: McGraw Hill.
2. Miller, S.A. GENERAL ZOOLOGY LABORATORY MANUAL. 5th Edition (International), 2002. Singapore: McGraw Hill.

BS Applied Chemistry 2nd Year
Semester-IV

Course Title:

Mathematics IV

Code: MATH 3014

Credit Hours: 03

Ordinary Differential Equations

Introduction to Differential Equations: Differential Equation (DE), Classification of DEs by Type, Order, and Linearity; Solutions of DEs: Trivial, Explicit, Implicit, Particular, Singular, and General; Introduction to Initial-Value and Boundary-Value Problems, Existence of a Unique Solution; Introduction to Mathematical Modeling with DEs

First-Order Differential Equations: Solutions of Separable, Homogeneous, Exact, and Linear DEs; Solutions of Bernoulli's, Ricatti's, and Clairaut's DEs

Linear Differential Equations of Higher Order: nth Order Homogeneous Linear DEs: Superposition Principle, Linear Dependence, Linear Independence, Wronskian, Fundamental Set of Solutions, General Solution; nth Order Nonhomogeneous Linear DEs: Superposition Principle, General Solution; Constructing a Second Solution from a Known Solution; Homogeneous Linear DEs with Constant Coefficients; Undetermined Coefficients; Applications of Second-Order DEs; Solving DEs with *Maple, Mathematica or Matlab*

Differential Equations with Variable Coefficients: Cauchy-Euler Equation, Power Series Solutions, Solutions About Ordinary and Singular Points, Solutions of Bessel and Legendre Equations; Finding Power Series Solutions of DEs with *Maple, Mathematica or Matlab*

Laplace Transform: Laplace Transform, Inverse Laplace Transform, Transforms of Derivatives and Integrals, Solving DEs Using Laplace Transforms; Evaluating Laplace Transforms with *Maple, Mathematica or Matlab*

Systems of Linear Differential Equations: Operator Method, Laplace Method, Matrices and Systems of Linear First-Order DEs, Homogeneous Linear Systems; Solving systems of DEs with *Maple, Mathematica or Matlab*

Recommended Books:

1. Differential Equations with Boundary-Value Problems by Dennis G. Zill & Michael R. Cullen, 3rd Edition, PWS Publishing Company

BS Applied Chemistry 2nd Year
Semester-IV

Course Title:

Research Methods and Scientific Writing

Code: ACH 8048

Credit Hours: 3(3+0)

1. Introduction

Meaning of research, scientific method and research steps, and scientific ethics.

2. Various research methods

Research category based on objectives, Research category based on research variables, Research category based on research subjects, Research category based on location, Research category based on approaches.

3. Identification and formulation of research problems

Methods to identify research problems and problems formulation, Technique to determine scope of research, Formulation of research problems.

4. Scientific writing

Meaning and criteria of a scientific writing, Types of scientific writing: thesis, paper and scientific articles, difference between research paper, review paper, short communication.

5. Literature reviews

Significance of references in a research, Criteria of good and recommended references, Technique and rules in citing reference, Technique in writing references.

6. Hypothesis, variables and Research data

Meaning of hypothesis and research variables, Types of hypothesis and research hypothesis statement, Types of research variables and determination of research variables.

7. Data processing and methods of analysis

Data processing and analysis, Hypothesis testing

8. Results presentation of data and illustration writing

Introduction to various types or forms of data, presentation: Tables, figures, graphs; Methods in writing a good and correct illustration.

9. Formulation of research proposal

Objective of proposal writing and technical requirements for organizing research proposal, Content of a research proposal, Research timeline and budget.

10. Abstract writing and summary of research results

Meaning of abstract, summary, content of abstract and summary, writing technique for abstract and summary

11. Writing research results: thesis

Structure of thesis – general format and sequence, thesis writing technique , establishment of topic and title, technical requirements in writing chapters and sub-chapters, presentation of data (tables and figures), results and discussion writing, references, conclusions and recommendation.

Books Recommended:

1. Angelika H. Hofmann, Scientific Writing and Communication: Papers, Proposals, and Presentations, Oxford University Press, USA (December 16, 2009), Paperback: 704 pages, ISBN-10: 0195390059, ISBN-13: 978-0195390056.
2. Klaus Hinkelmann, Oscar Kempthorne, Design and Analysis of Experiments, 2nd Edition, Wiley-Interscience, A John Wiley & Sons, Inc., Publication, 2007.
3. Prof. Dr. Asif Mian, Principles of Writing Research Papers and Research Methodology, Caravan Book House, Kachehri Road, New Anarkali, Lahore.

BS Applied Chemistry 2nd Year
Semester-IV

Course Title:

Fundamentals of Analytical Techniques

Code: ACH 8001

Credit Hours: 3 (2+1)

Introduction to analytical chemistry, Application of analytical chemistry in other disciplines of sciences, Qualitative and quantitative analysis, Classification of analytical techniques, Steps of a typical chemical analysis. Measuring Apparatus, Expression of Quantities and Concentrations, Chemicals and reagents, their use and handling, Sampling, Errors, Precision, Accuracy, Solvent extraction, Concept of electromagnetic radiations and basics of spectroscopic analysis (UV/Visible and IR spectroscopy and Atomic Emission and Atomic Absorption Spectroscopy) and chromatographic separations (Paper Chromatography and TLC)

Practical:

Laboratory materials, reagents and safety measures, Separation and identification of metal ions and biomolecules by paper chromatography and TLC, Verification of Beer Lambert Law, qualitative and quantitative analysis by UV/Visible spectroscopy

Books Recommended

1. Christian, G.D. 2003. Analytical Chemistry. Sixth edition, John Wiley and Sons, New York
2. Hargis, L.G. 1988. "Analytical Chemistry: Printice Hall Publishers, London
3. Skoog, D.A. and J.J. Leary. 1992. "Principles of Instrumental Analysis. Saunders College Publishing Co., London
4. Bender, G.T. 1987. "Principles of Chemical Instrumentation" W.B. Saunders Co., London.
5. Skoog D.A., D.M. West and F.J. Holler, 1997. Fundamentals of Analytical Chemistry. 7th Ed. Harcourt College Publishers.
6. Reilly, C. 1993. Laboratory Manual of Analytical Chemistry. Allyn& Bacon, London

BS Applied Chemistry 2nd Year

Semester-IV

Course Title:

Fundamentals of Applied Chemistry

Code: ACH 8042

Credit Hours: 4 (3+1)

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 glasses; 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.

Introduction to Polymers: History of polymers, classification of polymers, most commonly synthesized polymers and their applications.

Books Recommended

1. Ali, M.F., Ali, B. M. E. and Speight, J. G. 2005, Handbook of Industrial Chemistry, McGraw Hill Co. New York.
2. Austin, G. T., 2005. Shreve's Chemical Process Industries Handbook, McGraw Hill, New York.
3. Tebbutt, T.H. 1998. Principles of Water Quality Control, 4TH Edition, Butterworth-Heinemann, Oxford.
4. Leo M., L. Nollet, 2007. Handbook of Water Analysis, 2nd Edition, CRC Press, Taylor & Francis, Inc., Shackelford, J.F., and Doremus, R. H., 2008. Ceramics and glass material, Springer, Inc.,

5. Doremus, R.H. 1994. Glass Science, 2ND Ed. A Wiley-interscience, John Wiley & Sons Inc. New York.
6. Boch, P.,Niepce, J-C., 2007. Ceramics material; Processes, properties and application, Antony Rowe Ltd, Chippenham, Wiltshire.
7. Hewlett P. 2004, Lea's Chemistry of Cement and Concrete, Fourth Edition, Elsevier
8. Hermann, H.F., 2005. Encyclopedia of Polymer Sciences, John Wiley & Sons, Inc.
9. Brydson, J.A., 1999. Plastics Materials, 7th Edition, Butterworth-Heinemann, Oxford
10. Carraher, E., Carraher, J., Carraher's Polymer Chemistry, 9th Edition, CRC Press, Taylor & Francis, New York.

SEMESTER V		
Course Code	Course Title	Credit Hours
ACH 8072	Applied Inorganic Chemistry-I (3+1)	4
ACH 8082	Applied Organic Chemistry-I (3+1)	4
ACH 8092	Applied Physical Chemistry-I (3+1)	4
ACH 8002	Analytical Techniques and Quality Control (3+1)	4
ACH 8121	Chemometrics (3+0)	3
		19

BS Applied Chemistry 3rd Year
Semester-V

Course Title:

Applied Inorganic Chemistry-I

Code: ACH 8072

Credit Hours: 4(3+1)

Introduction to Bonding Theories for Non Transition Elements

Introduction to Chemical Bonding and Bonding Theories, Valence Bond Theory, Explanation of sigma bonds as well as pi bonds, Molecular orbital theory for homonuclear and heteronuclear diatomic and polyatomic molecules, 3 center 4 electrons bond, 3 center 2 electrons bond, bent bond.

Chemistry of Coordination Compounds

Introduction to coordination compounds, some concepts in coordination compounds, geometry of complexes having coordination number 2 to 9, Nomenclature, theories of bonding (Werner's theory, Sigwick theory, Valence Bond Theory, Crystal Field Theory, Ligand Field Theory), Isomerism and stereochemistry of coordination compounds, Jahn-Teller theorem; magnetic properties; Spectrochemical series, Application of coordination compounds in Chemistry, life and industry

Chemistry of Non-Aqueous Solvents

Classification of solvents, Type of reactions in non-aqueous solvents. Physical and chemical properties of solvents. Study of reactions in liq NH₃, liq HF and liq SO₂. Reactions in molten salt system.

Practicals

1. Preparation and Characterization of Complex Compounds:
(i) Sodium Cobaltinitrate (ii) Potassium tri oxalato aluminate (iii) Ammonium Nickel II Sulphate (iv) Copper Amine Complex
2. Complexometric Titrations
Ni²⁺, Ca²⁺, Mg²⁺, Mn²⁺

Books Recommended

1. Cotton, F.A. and G. Wilkinson. 1999. Advanced Inorganic Chemistry. John Wiloy and Sons, New York
2. Gilreath, E.S. 1993. Fundamental Concepts of Inorganic Chemistry. McGraw Hill Book Company, London
3. Gray, H.B., J.D. Simon and W.C. Troglor. 1994. Chemical Bonds. University Science Books. London
4. Huheey, J.E. 1991. Inorganic Chemistry. Harper and Row, London
5. Iqbal, Z.M. 1984. Pi-Acceptor Ligands. University Grants Commission, Islamabad
6. Whitten, K.W. and K.D. Gailey. 1993. General Chemistry. Saunders College Publishing, London
7. Basallo, B.A. and R. Johnson. 1987. Coordination Chemistry. W.A. Benhamen, London

8. Canham, G.R.1999. Second Edition. Descriptive Inorganic Chemistry. W.H. Freeman co. New York
9. Das A.K. 2000. Fundamentals Concepts of Inorganic Chemistry. CBS Publishers and distributors ,India
10. Harris, D.C. 2001. Quantitative Chemical Analysis, W.H. Freeman, London
11. Vogel, A.I. 2006. A Text Book of Qualitative Inorganic Analysis, Longmans Green and Co. London.

BS Applied Chemistry 3rd Year Semester-V

Course Title:

Applied Organic Chemistry-I

Code: ACH 8082

Credit Hours: 4(3+1)

Structure and Reactivity

The effect of structure, medium and the steric effect on the strength of acids and bases and on acid- base equilibria. Resonance and inductive effect on acidity and basicity. Hybridizations and hydrogen bonding effect. Predicting acid/base reactions from pKa/pKb values. Linear free energy relationships like the Bronsted Catalysis Laws. The Hammett equation and Tafts equation, their applications and limitations.

Introduction to Stereochemistry

- a. Configurational and Conformational Isomerism
- b. Geometrical Isomerism Z, E conventions, determination of configuration. Geometrical Isomerism in acyclic and cyclic compounds
- c. Optical Isomerism; Chirality and symmetry, Elements and centers of Chirality, Prochiral and prochiral stereoisomeric relationships. Isomerism in compounds containing upto three chiral carbon atoms. R S nomenclature, Racemization, epimerization. Walden inversion. Resolution of a racemic mixture. Asymmetric and stereoselective synthesis.

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: inter- and intra-molecular carbon migration from oxygen to carbon.

Practical:

- I. Specific rotation of optically active substances in solution by polarimetric method
- II Identification of organic compounds by dry and wet tests (Glucose, Oxalic acid, benzoic acid, Resorcinol, Benzamide, Thiourea)
- III. **Techniques**
Fractional Distillation, Fractional Distillation under reduced pressure, Steam Distillation,
Fractional, Crystallization, Recrystallization and Sublimation

Books Recommended

1. Smith, M.B. and March, J. 2007. March Advanced Organic Chemistry, Wiley Interscience John Wiley & Sons, Inc.,
2. Clarke, M.T. 1984. A Hand Book of Organic Analysis. Edward Arnold and Co. London
3. Morrison, T.R. 2005. Organic chemistry. Prentice Hall of India Private, Limited. New Dehli
4. Solomon, T.W.G. 2005. Organic chemistry. John waley and sons .INC. Singapore

5. Sykes, P. 1986. A Guide Book to Mechanism in Organic Chemistry. Longman Group Limited England
6. Vogel, A.I. 2000. Elementary Practical Organic Chemistry. CBS Publishers and Distributors Delhi, India
7. Morris, D.G. 2001. Stereochemistry. The Royal Society of chemistry. U K
8. Hallas, G. 1984. Organic Stereochemistry. McGraw Hill Company, U.S.A.
9. Clayden, J., Greeves, N., Warren, S. and Wothers, P., "Organic Chemistry", Oxford University Press, New York.
10. Carey, F. A., "Organic Chemistry", McGraw-Hill, New York.

BS Applied Chemistry 3rd Year
Semester-V

Course Title:

Applied Physical Chemistry-I

Code: ACH 8093

Credit Hours: 4 (3+1)

Quantum Chemistry

Classical and quantum mechanics, wave and particle nature of matter, de Broglie's equation, Heisenberg's uncertainty principle. Wavefunction and Born interpretation of wavefunction, probability density, eigenfunctions and eigenvalues, Hamiltonian operator, Schrodinger wave equation and its solution for particle in 1-dimensional, 2-dimensional and 3-dimensional boxes, quantum mechanical tunneling with examples. Postulates of quantum mechanics, normalization and orthogonality, wavefunctions for hydrogen-like atomic orbitals, radial distribution functions, shielding and penetration, effective nuclear charge, orbital energies.

Kinetic Theory of Gases

Maxwell's law of molecular velocities. Calculation of molecular velocities and binary collisions, pressure of an ideal gas, mean free path. Maxwell-Boltzmann's law of energy distribution. Method for the determination of the Avogadro number (N_A). Statistical probability and entropy.

Phase Equilibrium

Phase diagrams of one-component systems, Gibbs phase rule, Gibbs energy and the phase diagram of a substance, location of phase boundaries, Clausius-Clapeyron equation, vapor-liquid equilibrium of binary liquid mixtures, binary phase diagrams and lever rule.

Solid state chemistry

Unit cell, crystal system, x-ray diffraction techniques, application of crystallography.

Practical:

1. Equilibrium constant of $KI + I_2 \longrightarrow I_3$ reactions
2. Kinetics of saponification of ethyl acetate
3. Acid catalyzed hydrolysis of sucrose
4. Study of the charge transfer complex formation between iodine and benzene
5. Determination of activation energy for the acid catalyzed hydrolysis of ethyl acetate
6. Determination of partial molar volumes
7. Characterization of the given compound by UV-Vis spectroscopy
8. Evaluation of pK_a value of an indicator by spectrometric method.

Books Recommended

1. Alberty, R. A., Robert J.S. and Mounji G. B. "Physical Chemistry". 4th ed, John Wiley and Sons (2004).
2. Physical Chemistry by R. Silbey, R. Alberty and M. Bawendi. ISBN-13: 978-0471215042 (2004).
3. Ball, D W., "Physical Chemistry" 1st ed., Brooks/Cole Co. Inc. (2003).
4. Engel, Thomas and Reid p., "Thermodynamics, Statistical Thermodynamics, and Kinetics" 1st ed., Benjamin Cummings (2006).
5. James K. and Wothers, P., "Why Chemical Reactions Happen". Oxford University Press (2003).
6. Smith, E. Brain, "Basic Chemical Thermodynamics" 5th ed., Imperial College Press (2004).
7. Stephen B. R., Rice S. A. and Roses J., "Physical Chemistry" 2nd ed., Oxford University Press (2000).
8. Jurg W., "Basic Chemical Thermodynamics" W. A. Benjamin (1969).
9. Chorkendorff, I. and Niemantsverdriet, J.W. "Concept of Modern Catalysis and Kinetics" 1st ed., John Wiley and Sons (2003).
10. Espenson, J. H. "Chemical Kinetics and Reaction Mechanism" 2nd ed., McGraw Hill (2002).
11. Berry R. S., Stuart A.R., and Roses J. "Physical and Chemical Kinetics" 2nd ed., Oxford University Press (2000).
12. Helpers Arthur M., "Experimental Physical Chemistry: A Laboratory Textbook" 2nd ed., Prentice Hall (1997).
13. 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)

BS Applied Chemistry 3rd Year
Semester-V

Course Title:

Analytical Techniques and Quality Control

Code: ACH 8002

Credit Hours: 4(3+1)

Data handling: Statistical Evaluation of Data, Selection of analytical methods for problem solving, Sensitivity of instruments, Limits of detection and Signal-to-noise ratio.

Separation Techniques: Applications of solvent extraction in chemical analysis, General theory, principles and types of chromatography with their applications (GC, HPLC).

Electro-analytical Techniques: Introduction, classification; Principles and applications in brief

Atomic Spectroscopy; Basic principle, classification, brief instrumentation of AAS, ICP-Emission Spectroscopy and their applied applications

Automation in analytical methods; Automatic, automated and smart instruments and their applications with special emphasis on clinical, industrial and quality control aspects
Introduction and concept of quality control and quality assurance

Practical:

1. Laboratory materials, reagents and safety measures, Calibration of glassware used for volumetric analysis
2. Determination of iron sodium and potassium in tap water/food samples by spectrophotometry
3. Separation of mixture of organic and inorganic compounds by chromatography methods
4. Determination of heavy metal by atomic absorption
5. Hands on HPLC and GLC

Books Recommended

1. Christian, G.D. 2003. Analytical Chemistry. Sixth edition, John Wiley and Sons, New York
2. Kealey, D. and P.J.Haines, 2002. Analytical Chemistry, Bios Scientific Publishers Limited, Oxford, UK
3. Bender, G.T. 1987. "Principles of Chemical Instrumentation" W.B. Saunders Co., London
4. Hargis, L.G. 1988. "Analytical Chemistry: Printice Hall Publishers, London
5. Skoog, D.A. and J.J. Leary. 1992. "Principles of Instrumental Analysis. Saunders College Publishing Co., London
6. Sharma, B.K. 2005. Instrumental Methods of Chemical Analysis, Goel Publishing House, Meerut, India
7. Bender, G.T. 1987. "Principles of Chemical Instrumentation" W.B. Saunders Co., London.
8. Reilley, C. 1993. Laboratory Manual of Analytical Chemistry. Allyn& Bacon, London.

BS Applied Chemistry 3rd Year Semester-V

Course Title:

Chemometrics

Code: ACH 8121

Credit Hours: 3 (3+0)

Numbers and Algebra: Real Numbers, Algebra

Functions and Equation: Their form and use: Defining Function, Representation of Functions, Some Special Mathematical Functions, Equations

Limits: Mathematical and Chemical Examples, Defining the Limiting Process

Differentiation: The Average Rate of Change, The Instantaneous Rate of Change, Higher Order Derivatives, Maxima, Minima and Points of Inflection, The Differentiation of Functions of Two or More Variables.

Differentials: The Effects of Incremental Change, The differential of a Function of Two or More Variables, The Propagation of Errors,

Integration: Reversing the Effects of Differentiation, The Definite Integral, The Indefinite Integral, General Strategies for Solving More Complicated Integrals, The Connection between the Definite and Indefinite Integral.

Differential Equations: Using the Derivative of a Function to Create a Differential Equation, Some Examples of Differential Equations, Arising in Classical and Chemical Contexts, First-order Differential Equations, Second-order Differential Equations

Statistics

Statistics and its importance in chemical sciences; brief concept of sampling, observations, variables, data collections, data presentation (tabulation and graphs), mean, mode and median; brief concept of regression and correlation; basics of experimental design and data analysis (ANOVA, t-test, Z-test and Duncan Multiple Range (DMR) test).

Books Recommended

1. Cockett, M., and Doggett, G., 1999, Maths for Chemist, Vol. 1, Royal Society of Chemistry, UK.
2. Scott, S., 1995. Beginning Mathematics for Chemistry, Oxford University Press New York.
3. Stephan, K. S., 2005. Beginning Mathematics for Chemistry, Oxford University Press New York.
4. Chaudhary, S.M., 2000. Introduction to Statistical Theory: Part-I Ilmi Kitab Khana Lahore.
5. Chaudhary, S.M., 2000. Introduction to Statistical Theory: Part-II Ilmi Kitab Khana Lahore.

SEMESTER VI		
Course Code	Course Title	Credit Hours
ACH 8073	Applied Inorganic Chemistry-II (3+1)	4
ACH 8083	Applied Organic Chemistry-II (3+1)	4
ACH 8093	Applied Physical Chemistry-II (3+1)	4
ACH 8043	Chemical Process Industries (3+1)	4
		16

BS Applied Chemistry 3rd Year Semester-VI

Course Title:

Applied Inorganic Chemistry-II

Code: ACH 8073

Credit Hours: 4(3+1)

Kinetics and Mechanism of Inorganic Reactions

Labile and inert complexes. Mechanism of substitution reactions in octahedral complexes (hydrolysis reactions, anation reactions, reactions of substituted ligand and redox reactions), Thermodynamic and kinetic stability,

Pi- Acceptor Ligands

Class of ligands, Metal carbonyls, Mononuclear and polynuclear metal carbonyls, molecular structure, localized bonding (EAN rule, 18 electron rule), Delocalized bonding (Wades rule), spectroscopic evidence of bonding situation, Chemical properties of metal-carbonyls (carbonylate anions, carbonyl hydrides and carbonyl halides), Applications of metal carbonyls and their derivatives to catalysis and organic synthesis

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.

Practical:

- 1. Redox Titrations
- 2. Estimation of at least two halides by adsorption indicator.
- 3. Gravimetric estimation of Ba^{2+} and $\text{C}_2\text{O}_4^{2-}$ ions.

Books Recommended

- 1. Cotton, F.A. and G. Wilkinson. 1999. Advanced Inorganic Chemistry. John Wiley and Sons, New York.
- 2. Gilreath, E.S. 1993. Fundamental Concepts of Inorganic Chemistry. McGraw Hill Book Company, London.
- 3. Gray, H.B., J.D. Simon and W.C. Troglor. 1994. Chemical Bonds. University Science Books. London.
- 4. Huheey, J.E. 1991. Inorganic Chemistry. Harper and Row, London.
- 5. Iqbal, Z.M. 1984. Pi-Acceptor Ligands. University Grants Commission, Islamabad.
- 6. Whitten, K.W. and K.D. Gailey. 1993. General Chemistry. Saunders College Publishing, London.

BS Applied Chemistry 3rd Year
Semester-VI

Course Title:

Applied Organic Chemistry-II

Code: ACH 8073

Credit Hours: 4 (3+1)

Aliphatic Nucleophilic Substitution Reactions

Mechanism Study of SN1, SN2, SN1 and Ion-pair mechanism. Structure and Reactivity. Effects of substrate, attacking nucleophile, leaving group and reaction medium on the mechanism and rates of nucleophilic substitution reactions.

Elimination Reactions

Mechanism Study of E1, E2, E1cB mechanisms. Structure and Reactivity Saytzeff and Hofmanns Rules. The effects of substrate, structure, attacking base, leaving group and reaction medium on the rates and mechanism of elimination reactions.

Oxidation and Reduction Reactions

Oxidation: Introduction. Oxidation of saturated, olefinic and aromatic compounds. System containing oxygen and nitrogen compounds

Reduction: Introduction. Reduction of cycloalkanes, olefins, alkynes and aromatic rings. Hydrogenolysis. Reduction of systems containing oxygen and nitrogen compounds

Aromatic Substitutions Reactions

a. Nucleophilic substitution Reactions: Mechanism Study of SN Ar, SN1, SNAr and SN2, intermediate complex mechanism and Benzyne mechanism. Structure and Reactivity The effects of substrate, leaving group and the attacking nucleophile on the rate of substitutions.

b. Electrophilic Substitution Reactions: The Arenium ion mechanism, Orientation and Reactivity in mono substituted benzene and with more than one substituents and orientations in other ring systems. Quantitative treatment of reactivity in the electrophiles and substrate. Nitration, Alkylation, Sulfonation, Halogenation and Formylation

Practical:

I. Qualitative Analysis

Structure elucidation of organic compounds by spectroscopic methods (UV, IR, NMR and MS)

II. Organic Preparations

- a. Synthesis of different dyestuff intermediates and Dyes/Pigments.
- b. Synthesis of some pharmaceutical precursors.

Books Recommended

1. Smith, M.B. and March, J. 2007. March Advanced Organic Chemistry, Wiley-Interscience John Wiley & Sons, Inc.,
2. Vogel, A.I. 2000. Elementary Practical Organic Chemistry. CBS Publishers and Distributors Delhi, India
3. Morrison, T.R. 2005. Organic chemistry. Prentice Hall of India Private, Limited. New Dehli
4. Pine, S.H. 1987. Organic Chemistry. McGraw Hill Inc., New York
5. Solomon, T.W.G. 2005.Organic chemistry. John waley and sons .INC. Singapore
6. Steitwieser, A., C. Heathcock and E.M. Kosower. 1989. Introduction to Organic Chemistry.
Maxwell Macmillan International, New York
7. Sykes, P. 1986. A Guide Book to Mechanism in Organic Chemistry. Longman Group Limited, England.
8. Kalsi, P.S. "Spectroscopy of Organic Compounds", Wiley Eastern Ltd., New Delhi.
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. Solomon, T.W.G. 2005.Organic chemistry. John wiley and sons .INC. Singapore

BS Applied Chemistry 3rd Year
Semester-VI

Course Title:

Applied Physical Chemistry-II

Code: ACH 8093

Credit Hours: 4 (3+1)

Conductometry

Ions in solution. Measurement of conductance and Kohlrausch's law. Mobility of ions and transport number. Conductometric titrations. Debye-Hückel theory and activity coefficient. Determination of activities. Application of conductance measurement.

Electrochemistry

Redox reactions, spontaneous reactions, electrochemical cells, standard electrode potentials, liquid junction potential, electrochemical series, Nernst's equation, thermodynamic of redox reactions, measurement of pH and pK. Dynamic electrochemistry, Latimer Diagram, Frost Diagram, electrolytic cells, Potentiometry, reference and indicator electrodes, voltammetry, fuel cells. Corrosion and its prevention. Fuel cell and hydrogen economy

Surface Chemistry

Surface tension, curved surfaces, capillary action, interfaces, adsorption and adsorption isotherms: Freundlich and Langmuir adsorption isotherms. Catalysis, colloids emulsion and their industrial applications.

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..

Practical:

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. Conductometric determination of hydrolysis constant (K_h) of conjugate base of a weak acid.
7. Study of the adsorption isotherms of acetic acid-charcoal system

Books Recommended

1. Alberty, R.A. Robert J.S. and Mounji G.B. 2004. Physical Chemistry. 4th Ed. John Wiley and Sons, New York
2. Atkins, P.W.H. 2006. Physical Chemistry. Freeman and Company, New York
3. Ball, D.W., 2003. Physical Chemistry. 1st Ed. Brooks/Cole Co. Inc.
4. Castellan, G.W. 2005. Physical Chemistry. Narosa Publishing House, New Dehli.
5. Engel, Thomas and Reid, P. 2006. Thermodynamics, Statistical Thermodynamics and Kinetics. 1st Ed. Benjamin Cummings
6. Fried, V., U. Bluiks and H.F. Hamka. 2001. Physical Chemistry. MacMillan Publishing Company, Inc., New York
7. Moore, W.J. 2003, Physical Chemistry. Longman Scientific and Technical, Essex, UK.

BS Applied Chemistry 3rd Year Semester-VI

Course Title:

Chemical Process Industries

Code: ACH 8043

Credit Hours: 4(3+1)

Industrial Chemistry; Brief introduction and history of chemical industry,

Unit Operations: Elementary treatment of general unit operations commonly used in industries such as size reduction, screening, enrichment, filtration, distillation and crystallization.

Unit Process: Chemical unit process like nitration, halogenation, sulfonation, oxidation and hydrolysis with appropriate technical examples.

Green chemistry: Green chemistry, Health hazards and safety considerations in process industries, Industrial pollution, prevention and working safety health, OSHA.,

Water for industrial use, its resources, properties, contaminants with reference to their industrial use and methods of treatment. Types of industrial effluents and their treatment methods

Corrosion and scaling; types of corrosion, Tendency of different metals for corrosion, Scaling, causes and methods of protection against corrosion and scaling. Langelier saturation index.

Polymer Structure: Morphology of Polymer, Stereochemistry of Polymers, Chain Length, Pendant Groups and Branching, Tacticity, Molecular Interactions, Glass Transition and Melt Transition, Secondary Structure, Polymer Crystals, Amorphous Bulk State, Polymer Structure–Property Relationships, Cross-Linking, Crystalline and Amorphous Combinations.

Practical:

1. Determination of pH, electrical conductivity, total soluble salts, and total suspended salt of different water samples used for drinking, agriculture and industrial proposes.
2. Determination of cations and anions in the water samples such as Na^+ , K^+ , Ca^{+2} , Mg^{+2} , Cl^{-1} , CO_3^{-2} , HCO_3^{-1} , SO_4^{-2} etc.
3. Testing of raw water, treated water, cooling tower water and boiler water samples to check its suitability for industrial use
4. Determination of scaling and corrosive nature of treated water through saturation index evaluation

Books Recommended

1. Tebbutt, T.H. 1998. Principles of Water Quality Control, 4TH Edition, Butterworth Heinemann, Oxford
2. Leo M., L. Nollet, 2007. Handbook of Water Analysis, 2nd Edition, CRC Press, Taylor & Francis, Inc.,
3. Wang, L. K., Hung, Y-T., Lo, H.H., Yapijakis, C. 2006. Waste Treatment in the Process Industries CRC Press, Taylor & Francis, Inc.,
4. Ali, M.F., Ali, B. M. E. and Speight, J. G. 2005, Handbook of Industrial Chemistry, McGraw Hill Co. New York.
5. Austin, G. T., 2005. Shreve's Chemical Process Industries Handbook, McGraw Hill, New York.
6. Wachter, Kirk-Ottomer Encyclopedia of Chemical technology, Volume 19, Fourth Edition.
11. Hermann, H.F., 2005. Encyclopedia of Polymer Sciences, John Wiley & Sons, Inc.
12. Brydson, J.A., 1999. Plastics Materials, 7th Edition, Butterworth-Heinemann, Oxford
13. Carraher, E., Carraher, J., Carraher's Polymer Chemistry, 9th Edition, CRC Press, Taylor & Francis, New York.

SEMESTER VII		
SPECIALIZED COURSES (GENERAL APPLIED CHEMISTRY)		
Course Code	Course Title	Credit Hours
ACH 8044	Oils, Fats and Waxes (3+1)	4
ACH 8045	Inorganic Chemical Industries (3+0)	3
ACH 8046	Food and Allied Industries (3+0)	3
ACH 8047	Paper and Leather Industries (3+0)	3
ACHEM 8119R/A/P	Research Thesis/ Research Project/ Advance Practical/ Position Paper (0+3)	3
		16
OR		
BS Semester – VII		
SPECIALIZED COURSES (POLYMER SCIENCES AND TECHNOLOGY GROUP)		
Course Code	Course Title	Credit Hours
ACH 8049	Synthetic Polymers (3+1)	4
ACH 8050	Introduction to Composite Materials (3+0)	3
ACH 8051	Synthetic Fibers (3+0)	3
ACH 8052	Mechanism and Kinetics of Polymerization (3+0)	3
ACH 8119R/A/P	Research Thesis/ Research Project/ Advance Practical/ Position Paper (0+3)	3
	Total	16

BS Applied Chemistry 4th Year Semester-VII

Course Title:

Oil, Fats and Waxes

Code: ACH 8044

Credit Hours: 4(3+1)

Oils and Fats; Chemistry of oils, fats and waxes, their properties and applications, edible oil and ghee industry.

Soap and Detergents; Raw materials, manufacturing and different formulation of soaps. Classification of surfactants, Synthesis and properties of different types of surfactants and their industrial uses

Flavors and Fragrances/Perfumes; Chemistry and Classification of fragrances and flavors.

Practical:

1. Determination of FFA value of given sample of oil.
2. Saponification value determinations, Iodine value, Peroxide value and ester value of given sample of oil.
3. Fatty acid composition determination
4. Unsaponifiable matter determinations
5. Determination of flash point
6. Free alkali determination in given sample of soap
7. Manufacturing of liquid and solid soap
8. Preparation of cold and vanishing cream

Books Recommended

1. Ali, M.F., Ali, B. M. E. and Speight, J. G. 2005, Handbook of Industrial Chemistry, McGraw Hill Co. New York
2. Kent, J.A. 2007, Kent and Riegel's Handbook of Industrial Chemistry and Biochemistry, Eleventh Edition, Springer New York
3. Berger, R.G., 2007, Flavours and Fragrances, Springer-Verlag, Berlin
4. Zeigler H, 2007, Flavourings, Wiley-VCH Verlag, Weinheim
5. Calkin, R.R. and Jellinek, S. J, 1994, Perfumery: Practice and Principles, John Wiley, New York
6. Barel, A. O., Paye, M. and Maibach H.I., 2001, Handbook of Cosmetic Science and Technology, Marcel Dekker Inc. New York
7. Butler H., 2000, Poucher's Perfumes, Cosmetics and Soaps, Tenth Edition, Kluwer Academic Publishers, Dordrecht
8. Austin, G. T., 2005. Shreve's Chemical Process Industries Handbook, McGraw Hill, New York.
9. Wachter, Kirk-Ottomer Encyclopedia of Chemical technology, Volume 19, Fourth Edition

BS Applied Chemistry 4th Year
Semester-VII

Course Title:

Inorganic Chemical Industries

Code: ACH 8045

Credit Hours: 3 (3+0)

Chemical Industry; Preparation, properties and industrial applications of Ammonia and Ammonium products, Sulfur and Sulfuric Acid, HCl, Nitric Acid

Fertilizers; Chemistry, properties and synthesis of different nitrogenous and phosphatic fertilizers

Chloro Alkali and Hydrogen Peroxide: chemistry, properties, synthesis and their application in different industries,

Books Recommended

1. Patnaik. P., 2002. Handbook of Inorganic Chemicals, McGraw-Hill, New York
2. UNIDO & IFDC (Editors), 1998. The Fertilizer Manual, Kluwer Academic, Publishers, Inc.
3. Douglass, W.C. 2003. Hydrogen Peroxide, Rhino Publishing, S.A.
4. Craig W. Jones, 1999. Application of Hydrogen Peroxide and derivatives, Royal Society of Chemistry, USA.
5. Schmittinger, P., 2002. Chlorine-Principle and Industrial Practice, Wiley-VCH, Weinheim
6. Agarwal, O.P. and A. Agarwal. 2001. Engineering Chemistry. Khanna Publishers. India
7. Das, R. K. 2001. Industrial Chemistry. Part. 2. Kalyani Publishers. India
8. Gopalan, G., D. Venkappayya and Nagaragan, S. 2000. Engineering Chemistry. Vikas Publishing House. Pvt. Ltd. India
9. Smith, R. 1995. Chemical Process Design. McGraw Hill Book Company, New York
10. Austin, G. T., 2005. Shreve's Chemical Process Industries Handbook, McGraw Hill, New York
11. Wachter, Kirk-Ottomer Encyclopedia of Chemical technology, Volume 19, Fourth Edition

BS Applied Chemistry 4th Year
Semester-VII

Course Title:

Food and Allied Industries

Code: ACH 8046

Credit Hours: 3 (3+0)

Sugar and Sweeteners Industry; Chemistry of sugar industry including the chemistry of different additives utilized in preparation of sugar. Synthesis and properties of different low calorie artificial sweeteners

Dairy Chemistry: Composition of milk (lactose, salts, lipids, proteins, enzymes etc.), General aspects of milk processing; heating, centrifugation, homogenization, concentration, Milk coagulation and protein denaturation

Books Recommended

1. Stanbury, T. F., Whifker, A., Hall, S. J. 2002, Principles of Fermentation Technology, 2nd Edition, Elsevier Ltd.
2. Allen, P. W. 1926. Industrial Fermentation, The Chemical Technology Catalog Company, Inc.,
3. Aehle, W., 2007. Enzymes in industry, Production and Application, Wiley-VCH, Verlag, GmbH, & Co. KGaA.
4. Shahidi F., 2005, Bailey's Industrial Oil and Fat Products, Vol. 1, Sixth Edition, Wiley- Interscience Inc. New Jersey
5. Wachter, Kirk-Ottomer Encyclopedia of Chemical technology, Fourth Edition
6. Ali, M.F., Ali, B. M. E. and Speight, J. G. 2005, Handbook of Industrial Chemistry, McGraw-Hill Co. New York
7. Kent, J.A. 2007, Kent and Riegel's Handbook of Industrial Chemistry and Biochemistry, Eleventh Edition, Springer New York
8. Austin, G. T., 2005, Shreve's Chemical Process Industries Handbook, McGraw Hill, New York
9. N. P. Wong, 1999. Fundamentals of dairy chemistry. Aspen Publishers, Inc
10. P. Walstra, J. T.M. Wouters, T.J. Geurts. 2006. Dairy Science and Technology, 2nd Ed., Taylor & Francis Group, LLC.

BS Applied Chemistry 4th Year
Semester-VII

Course Title:
Code: ACH 8047

Paper and Leather Industries
Credit Hours: 3 (3+0)

Pulp and Paper; Chemistry of raw materials (woody and non woody, Chemistry involved in the preparation of paper, Chemistry of lignin as byproducts of paper industry,

Leather Industry; Chemistry of natural and synthetic tanning agents, chemistry of all the steps involved in conversion of skin/hide in to finished leather and all the post-tanning finishing operations,

Books Recommended

1. NIIR Board of Consultants and Engineers, 2003, The Complete Technology Book on Pulp & Paper Industries, NIIR, Delhi
2. Smook, G. A., 1992, Handbook for Pulp and Paper Technologists, Third Edition
3. Biermann, C. J., 1998, Handbook of Pulping and Paper making, Second Edition, Academic Press, San Diego
4. Austin, G. T., 2005. Shreve's Chemical Process Industries Handbook, McGraw Hill, New York
5. Wachter, Kirk-Ottomer Encyclopedia of Chemical technology, Volume 19, Fourth Edition
6. Ali, M.F., Ali, B. M. E. and Speight, J. G. 2005, Handbook of Industrial Chemistry, McGraw-Hill Co. New York.
7. Kent, J.A. 2007, Kent and Riegel's Handbook of Industrial Chemistry and Biochemistry, Eleventh Edition, Springer New York

BS Applied Chemistry 4th Year Semester-VII

Course Title:

Synthetic Polymers

Code: ACH 8049

Credit Hours: 4 (3+1)

Polymers; History and Classification of polymers, determination of molecular weight, polymer synthesis.

Industrial Polymers: Industrial polymer synthesis, properties and applications, Polyethylene (PE), Polypropylene (PP), Polystyrene (PS), Poly vinyl Chloride (PVC), Polyurethanes (PUs), Amino resins; Urea-formaldehyde, melamine-formaldehyde, phenolics and other thermosetting resins of similar behavior

Rubbers and Elastomers; Types, chemistry, properties, processing and applications

Fibers: Types of fibers, origin and chemical basis of natural and synthetic fiber and their applications.

Practical:

1. Synthesis of some common polymers such as PE, Nylon, alkyds, PUs, emulsions PVAc, etc.
2. Testing of the synthesized material as per facility available in the department
3. Interpretation of Spectral data analysis of the synthesized polymer with the help of the literature

Books Recommended

1. Ciesielki A., 1999, An Introduction to Rubber Technology, Rapra Technology Limited, Shropshire, UK
2. Hermann, H.F., 2005. Encyclopedia of Polymer Sciences, John Wiley & Sons, Inc.
3. Brydson, J.A., 1999. Plastics Materials, 7th Edition, Butterworth-Heinemann, Oxford
4. Bhowmick, A. K and Stephens H. L, 2001, Handbook of Elastomers, Second Edition, Marcel Dekker, Inc. New York.
5. Austin, G. T., 2005. Shreve's Chemical Process Industries Handbook, McGraw Hill, New York
6. Wachter, Kirk-Ottomer Encyclopedia of Chemical technology, Volume 19, Fourth Edition

BS Applied Chemistry 4th Year Semester-VII

Course Title:

Introduction to Composite Materials

Code: ACH 8050

Credit Hours: 3 (3+0)

Definitions and classification, natural composites. Property enhancement by reinforcement and orientation, matrix interface, synthetic fibers, properties and processing of composites with metallic, ceramic and polymeric matrices, interface reactions, mechanical and thermal properties of composite materials, stress relaxation and creep studies, dynamical mechanical properties, toughening mechanism and mechanical failure in polymeric composites

Books Recommended

1. Composite Materials: Engineering and Science, F. L. Matthews and R. D. Rawlings, Chapman & Hall Publishers
2. Sadowski, T., BORST, R.d. 2008. Lecture Notes on Composite, Materials, Current Topics and Achievements, Springer Science and Business Media B.V.
3. Delhaès, P. 2003. Fibers and Composites, Taylor & Francis Group Inc.,
4. Mallick, P.K. 2008. Fiber-Reinforced Composites Materials, Manufacturing, and Design, 3rd Ed, Taylor & Francis Group, LLC
5. Mazumdar, S.K. 2002. Composites Manufacturing, Materials, Product, and Process Engineering, CRC Press, LLC.

BS Applied Chemistry 4th Year Semester-VII

Course Title:

Synthetic Fibers

Code: ACH 8051

Credit Hours: 3(3+0)

Introduction: History, Classification of fibers;, Definitions related to fibers(Yarn, Fiber spinning, weave, knitting, braiding, Non-wovens, carding, rope etc), Some important attributes of fibers(Tensile strength, Tenacity, moth resistance, resilience, acid alkali resistance, solubility, staple length, fiber length, fiber surface area, fiber crimp, fiber flexibility, skin core structure, stretching and orientation, cross-sectional shape and roughness), Important fiber types, General applications, Health hazards.

Polymeric fibers: Introduction, Classification of polymeric fibers, Natural polymeric fibers, Animal Kingdom fibers i.e. silk fibers, wool, related mammalian fibers, Vegetable fibers(Cotton, jute, sisal, ramie, rayon, coir etc), Modified natural fibers (cellulose acetate), Regenerated natural fibers (viscose rayon), Applications of natural polymeric fibers. Brief history of synthetic fibers, Processing, Environmental effects on polymeric fibers, Chemistry of Some important synthetic polymeric fibers: Polyester Fibers, Polyamide Fibers, Polypropylene Fiber, Vinyl Fibers, Acrylic Fibers, elastomeric fibers, Applications of synthetic polymeric fibers. Polymer nanofibers.

Metallic fibers: General characteristics of metals, Processing of metallic filaments, Microstructure and properties of metallic fibers, Applications

Ceramic fibers: Some important ceramics, Creep in ceramics, Natural ceramic fibers, Synthetic ceramic fibers, Ceramic whiskers, Applications.

Glass fibers: Basic concept of optical communication, Fabrication, Chemical composition, Structure, Properties, Applications.

Carbon fibers: Structure and properties of graphite, Processing of carbon fibers, Structure of carbon fibers ,Properties of carbon fibers, High thermal conductivity carbon fibers, Hollow carbon fibers, Hazards of carbon fibers, Applications of carbon fibers.

Books Recommended

1. J.W.S. Hearly, 2001, High-performance fibres, Woodhead Publishing Ltd.
2. Menachem Lewin, 2007, A Hand Book of Fiber Chemistry, Taylor & Francis Group, LLC.
3. Krishan Kumar Chawla, 2005, Fibrous material, Cambridge University Press.
4. George Odian, 2004, Principles of polymerization, John Wiley & Sons, Inc.
5. Ciesielki A., 1999, An Introduction to Rubber Technology, Rapra Technology Limited, Shropshire, UK
6. Hermann, H.F., 2005. Encyclopedia of Polymer Sciences, John Wiley & Sons, Inc.
7. Brydson, J.A., 1999. Plastics Materials, 7th Edition, Butterworth-Heinemann, Oxford
8. Bhowmick, A. K and Stephens H. L, 2001, Handbook of Elastomers, Second Edition, Marcel Dekker, Inc. New York.
9. Austin, G. T., 2005. Shreve's Chemical Process Industries Handbook, McGraw Hill, New York
10. Wachter, Kirk-Ottomer Encyclopedia of Chemical technology, Volume 19, Fourth Edition
11. Terje A. Skotheim, 2007, Handbook of Conducting Polymers, Taylor & Francis Group, LLC.

BS Applied Chemistry 4th Year
Semester-VII

Course Title:

Mechanism and Kinetics of Polymerization

Code: ACH 8052

Credit Hours: 3 (3+0)

Introduction to polymer chemistry. Mechanism of Free Radical polymerization, free radical addition polymerization, ionic polymerization; Kinetics of free radical chain polymerization, Equation for kinetics chain length. Degree of polymerization, Mechanism of Chain transfer reactions, Kinetics of chain transfer reactions, The Mayo Equation, Ceiling temperature, Mechanism of cationic polymerization, Kinetics of cationic polymerization, Mechanism of ionic polymerization, Kinetics of polymerization, Poly-condensation, Non catalyzed polycondensation, acid catalyzed poly condensation, Molecular weight distribution, ratio of weight average to number average molecular weight, Extend of reaction and degree of polymerization, Stoichiometry of reactants and degree of polymerization, salient feature of polymerization reactions, Mono-functional reactants and degree of polymerization. Step polymerization: Experimental Observations, Kinetics, Accessibility of Functional Groups, Equilibrium Considerations, Molecular Weight Control in Linear Polymerization, Crosslinking Technology, Inorganic and Organometallic Polymers, Initiation, Molecular Weight, Inhibition and Retardation, Determination of Absolute Rate Constants, Energetic Characteristics,

Books Recommended

1. Ciesielki A., 1999, An Introduction to Rubber Technology, Rapra Technology Limited, Shropshire, UK
2. Herman, F.M. 2005. Encyclopedia of Polymer Sciences, John Wiley & Sons, Inc.
3. Brydson, J.A., 1999. Plastics Materials, 7th Edition, Butterworth-Heinemann, Oxford.
4. Bhowmick, A. K and Stephens H. L, 2001, Handbook of Elastomers, Second Edition, Marcel Dekker, Inc. New York.
5. Gowariker, V.R., Viswanathan N.V., AND Jajadev Sreedhar, Polymer Science, Wiley Estern Limited, Bombay.

BS Applied Chemistry 4th Year
Semester-VII

Title of the Course:

Research Thesis/ Research Project/ Advanced Practical/ Position Paper Cr. Hr. 3

RESEARCH THESIS/ RESEARCH PROJECT

Code ACH 8119R

Will be offered on the basis of availability of faculty, lab facilities, and research interest of the available faculty and their skills.

OR

ADVANCED PRACTICAL

Code ACH 8119A

Will be offered on the basis of availability of faculty and their skills, and also availability of lab facilities. Advance level practical will be carried out to give the students know-how about using the advance and latest instruments and to develop their interest toward the latest research in the field of chemistry.

OR

POSITION PAPER

Code ACH 8119P

Will be offered on the basis of availability of faculty, and research interest of the available faculty and their skills. Topic will be awarded to the students to test their knowledge and to give know-how about research work and literature survey to develop their interest toward the latest research in the field of chemistry.

SEMESTER VIII SPECIALIZED COURSES (GENERAL APPLIED CHEMISTRY)		
Course Code	Course Title	Credit Hours
ACH 8053	Colour Chemistry (3+1)	4
ACH 8054	Chemistry of Textiles Processing (3+0)	3
ACH 8055	Glass, Ceramics and Cement Industries (3+0)	3
ACH 8056	Biotechnology for Chemical Industries (3+0)	3
ACH 8119R/A/P	Research Thesis/ Research Project/ Advanced Practical/ Position Paper (0+3)	3
	Total	16
OR		
SEMESTER VIII SPECIALIZED COURSES (POLYMER SCIENCES AND TECHNOLOGY GROUP)		
Course Code	Course Title	Credit Hours
ACH 8057	Characterization Techniques for Polymers (3+1)	4
ACH 8058	Polymer Rheology and Processing (3+0)	3
ACH 8059	Natural Polymers (3+0)	3
ACH 8060	Physical Chemistry of Polymers (3+0)	3
ACH 8119R/A/P	Research Thesis/ Research Project/ Advanced Practical/ Position Paper (0+3)	3
	Total	16

BS Applied Chemistry 4th Year Semester-VIII

Course Title:

Colour Chemistry

Code: ACH 8053

Credit Hours: 4 (3+1)

Dyes and pigments; Chemistry and Classification of dyes, pigments, optical brighteners, and dyestuff Intermediates, Synthesis of industrial dyes and optical brighteners and pigments. Chemistry, formulation and applications of inorganic pigments

Printing Inks; chemistry and formulation of both water based and oil based printing inks

Practical:

1. Aromatic substitution, nitration, sulfonation,
2. Preparation of some common dyes based on Di-chloro triazine (DCT), Vinyl sulfone (VS), Bi-functional and pigment substrate
3. Application of the synthesized dyes on to the specific fabric
4. Colorfastness testing of the dyed fabric

Books Recommended

1. Zolinger, H. 1995. Diazo-Chemistry-II, Aliphatic, Inorganic and Organometallic Compounds, Wiley-VCH, Weinheim, Germany
2. Hunger K., 2002, Industrial Dyes, Wiley-VCH, Weinheim.
3. Buxbaum, G. and Pfaff, G., 2005, Industrial Inorganic Pigments, Wiley-VCH, Weinheim.
4. Herbst, W. and Hunger K., 2004, Industrial Organic Pigments, Wiley-VCH, Weinheim.
5. Zolinger H., 2003, Color Chemistry, Wiley-VCH, Weinheim.
6. Freeman, H. S. and Peters, A. T. 2000, Colorants for Non-Textile Applications, Elsevier, Amsterdam.
7. Austin, G. T. 2005. Shreve's Chemical Process Industries Handbook, McGraw Hill, New York
8. Wachter, Kirk-Ottomer Encyclopedia of Chemical technology, Volume 19, Fourth Edition

BS Applied Chemistry 4th Year
Semester-VII

Course Title:

Chemistry of Textiles Processing

Code: ACH 8054

Credit Hours: 3 (3+0)

Textile Industry: Brief introduction and flow sheet diagram of textile industries, raw material used for textile and its specifications,

Preparation of Fabrics: Pretreatment processes in the textile industry, Quality check of grey fabrics, Chemistry of Sizing material, Chemical treatment of the fabrics with special reference to singeing, desizing, scouring, bleaching, mercerizing and batching.

Chemical Processing of the Fabrics: Textile auxiliaries for dyeing, printing and finishing, Applications of reactive, disperse & vat dyes and pigments. Processing of dyeing of cotton and synthetic / manmade fibers. Technology of Printing of fabrics using reactive, vat dyes and pigments, Finishing of the dyed and printed fabrics.

1. Shore, J., 1995. Cellulose dyeing, Society of Dyers and Colourists, Hobbs the Printers, Hampshire, UK
2. Heywood, D., 2003. Textile Finishing, Society of Dyers and Colourists, Hobbs the Printers, Hampshire, UK
3. Karmakar, S. R. 1999. Chemical Technology in the Pre-Treatment Processes of Textiles, Elsevier, Ltd.
4. Fan, Q. 2005. Chemical Testing of Textiles, Woodhead Publishing Ltd,

BS Applied Chemistry 4th Year
Semester-VIII

Course Title:

Glass, Ceramics and Cement Industries

Code: ACH 8055

Credit Hours: 3 (3+0)

Cement Industry; Different types of cements. Raw material and technology of cement manufacturing (Wet and Dry process).

Ceramics and Porcelain; Types of clays used and their effect on the physico-chemical properties of the products

Glass Industry; Types and applications of glass, Chemistry of manufacturing process of the glass.

Books Recommended

1. Rao, K. J., 2002. Structural Chemistry of Glass, Elsevier Science & Technology Books
2. Lee, B. and Komarneni, S. 2005. Chemical Processes of Ceramics 2nd Edition, Taylor and Francis, Boca Raton
3. Shackelford, J.F., and Doremus, R. H., 2008. Ceramics and glass material, Springer, Inc.,
4. Doremus, R.H. 1994. Glass Science, 2ND Ed. A Wiley-interscience, John Wiley & Sons Inc. New York
5. Boch, P., Niepce, J-C., 2007. Ceramics material; Processes, properties and application, Antony Rowe Ltd, Chippenham, Wiltshire.
6. Hewlett P. 2004, Lea's Chemistry of Cement and Concrete, Fourth Edition, Elsevier
7. Wachter, Kirk-Ottomer Encyclopedia of Chemical technology, Fourth Edition
8. Hlavac J, 1983, The Technology of Glass and Ceramics, Elsevier, Amsterdam
9. Austin, G. T., 2005. Shreve's Chemical Process Industries Handbook, McGraw Hill, New York
10. Ali, M.F., Ali, B. M. E. and Speight, J. G. 2005, Handbook of Industrial Chemistry, McGraw-Hill Co. New York
11. Meyers. R. A., 2001, Encyclopedia of Physical Science and Technology 3rd ed Inorganic Chemistry, Academic Press, San Diego.

BS Applied Chemistry 4th Year
Semester-VIII

Course Title:

Biotechnology for Chemical Industries

Code: ACH 8056

Credit Hours: 3 (3+0)

Introduction to industrial biotechnology, the scope and impact of industrial biotechnology, socio-economic challenges, history of industrial biotechnology, types of biotechnology with main focus on white, green, red and blue biotechnology, industrial biotechnology in the chemical and pharmaceutical industries, in the food and feed sector, in the paper and pulp sector, in the textile industry, enzymes used in textile in bioprocessing, dyeing, desizing etc. biotechnology in the detergents industry, in the starch industry. Introduction to biofuels, genetically modified plant technology, transgenic plants and animals, bio warfare and bioterrorism on a country.

Books Recommended

- 1- Biotechnology by John E. Smith, Fifth edition, published by Cambridge University Press, New York. 2009,
- 2- Industrial Biotechnology, Sustainable Growth and Economic Success by Wim Soetaert & Erick J. Vandamme, Published by Wiley VCH. April 2010, ISBN: 978-3-527-31442.
- 3- Industrial Biotechnology and Biomass Utilization, Prospects and Challenges for the Developing Countries. A report written by Francis X. Johnson (SEI); Claudia Linke-Heep (UNIDO) provided overall guidance and supervised the compilation of the various components of the report and convened at UNIDO's headquarters, Vienna, Austria in December 2005.

BS Applied Chemistry 4th Year Semester-VIII

Course Title:
Code: ACH 8057

Characterization Techniques for Polymers
Credit Hours: 4 (3+1)

Chromatographic techniques: Gas chromatography, HPLC, GPC

Spectroscopic Techniques: Atomic absorption spectroscopy, inductively coupled plasma (ICP) atomic emission spectroscopy, mass spectrometry (MS and GC/MS), Nuclear magnetic resonance (NMR) spectrometer, UV-Vis and infrared spectrometry, (UV,-Vis, IR), Fourier transform infrared (FT-IR), X-ray diffraction analysis, fluorescence spectrometry, potentiometric titrations, neutron activation analysis,

Thermal analysis: Differential scanning calorimetry (DSC), thermo-gravimetric analysis (TGA), thermo-mechanical analysis (TMA), dynamic mechanical thermal analysis (DMTA),

Microscopy for polymer characterization: SEM, TEM

Chemical analysis of polymers: comminution, separation, and identification, stabilizer identification, polymer identification

Practical:

1. Interpretation of functional groups peak in IR spectra of various polymer samples
2. Interpretation of various peaks in the ¹HNMR and ¹³CNMR spectra
3. Interpretation of various DSC scans in order to check their thermal transitions
4. Interpretation of various TGA thermo-grams in order to check their thermal stability
5. Determination of hydrophilicity and hydrophobicity of various polymers using contact angle measuring system
6. Determination of water absorption (%) of various polymer samples
7. Determination of equilibrium degree of swelling of various polymer samples

Books Recommended:

1. Cheremisinoff, Nicholas P. (1996). Polymer characterization: Laboratory techniques and analysis, Noyes Publications, USA.
2. ASTM 2004, American standard test methods,
3. Chartoff, Richard."Polymer Characterization Laboratory". University of Oregon CAMCOR. 2013.
4. Campbell, D.; Pethrick, R. A.; White, J. R. *Polymer Characterization Physical Techniques*. Chapman and Hall, 1989

BS Applied Chemistry 4th Year
Semester-VIII

Course Title:

Polymer Rheology and Processing

Code: ACH 8058

Credit Hours: 3 (3+0)

Definition and measurement of the material functions of complex fluids, continuum mechanics of stress and deformation, constitutive equations derived from continuum and molecular theories, interrelation of material function for shear and elongational flow, linear and nonlinear elasticity and visco-elasticity, material function of important class of polymeric fluids, the role of rheological properties in material characterization and polymer processing. Application of engineering principles to the analysis of polymers processes such as extrusion, roll coating, mixing, etc. Applied fluid dynamics, with attention to heat and mass transfer processes.

Basic techniques for the rheological characterization of thermoplastics and thermosets resins; “hand-on” experience with the equipment used in polymer processing methods such as extrusion, injection molding, compression molding; techniques for material characterization and basic principles of statistical quality control.

Books Recommended

1. Gupta, B R, Polymer processing technology, Asian Books, 2008
2. Han, C. D. Polymer processing, Oxford University Press, 2007
3. White, J L. Principles of Polymer Engineering Rheology, Wiley 1990.
4. Bart CJ, Plastics additives: advanced industrial analysis. IOS Press, 2006.
5. Furukawa, J. Physical Chemistry of Polymer Rheology, Springer, 2003.
6. Thomas, S., Yang, W., Advances in Polymer processing, CRC Press, 2009.

BS Applied Chemistry 4th Year Semester-VIII

Course Title:

Natural Polymers

Code: ACH 8059

Credit Hours: 3(3+0)

Introduction to Natural polymers, Types of natural polymers and brief account about their biochemistry e.g. Starch, Glycogen, Cellulose, Chitin, Protein and Natural rubber. Determination of molar masses of macromolecules. Derivatives of these polymers such as derivative of starch and its uses e.g. dextrin, paper making, food additives and International numbering system (INS). Carboxymethyle cellulose (CMC), Cellulose derivatives such as organic cellulose esters, inorganic cellulose esters and cellulose ethers, their uses e.g. Cellulose acetate, cellulose nitrate, cellulose sulphate, cellulose sulphonates, Cellophane, rayon. Mixed ether derivatives. Chitin and its derivative e.g. chitosan. Protein types such as globular proteins e.g. insulin, hemoglobin and fibrous protein .e.g. Silk, Wool, Nail and Hair. Natural rubber and its chemical modification e.g. vulcanization and epoxidation.

Books Recommended

1. Biopolymers By Assoc. Prof. Dr. Magdy M. Elnashar (2010) Published by Sciyo. Janeza Trdine 9, 51000 Rijeka, Croatia.
2. Encyclopedia of Polymer Science and Technology 4th edition (2012). John Wiley & Sons, Inc.America.
3. Biodegradable and sustainable fibres By RS Blackburn (2005). Woodhead Publishing Limited Cambridge England.

BS Applied Chemistry 4th Year
Semester-VIII

Course Title:

Physical Chemistry of Polymers

Code: ACH 8060

Credit Hours: 3(3+0)

Physical Chemistry of Polymers

Introduction to macromolecules and their synthesis, Molecular Weights of Polymers: Distributions, averages, and methods of determination. Structure of Polymer Chain: Introduction to chain conformation, configurations, isomerism and stereochemistry. Conformation of Polymer Chain, Chain Statistics: Various models of chain, Gaussian chain. Polymer Solutions and Blends: Thermodynamics, phase separation, mechanisms, kinetics. Crystalline State of Polymers: Crystallization and kinetics, crystalline structures, experimental methods. Polymer Viscoelasticity: Stress relaxation, mechanical models of polymer behavior, time temperature superposition, and rheology. Relaxation and Transitions in Polymers: Polymer relaxation mechanisms, the glass transition, and experimental methods. Rubber Elasticity: Thermodynamics and Statistical Mechanics of polymer elasticity. Polymer interface, surface and wetting, contact angle measurement, surface free energy, Modern Topics in Polymer Science

Books Recommended

1. M.Rubinstein and R.H.Colby, 2003, "Polymer Physics" Oxford University Press USA.
2. A.Y.Grosberg & A.R.Khoklov, 2002, "Statistical Physics of Macromolecules" American Institute of Physics
3. P.-G. deGennes, 1979, "Scaling Concepts in Polymer Physics" Cornell University Press, USA.
4. G.Strobl, 2007, "The Physics of Polymers" 3rd Edition, Sringer Berlin Heidelberg NewYork.
5. A.Y.Grosberg & A.R.Khoklov, 2011 "Giant Molecules" World Scientific Publishing Co. Pte. Ltd.
6. U.W.Gedde, 2008 "Polymer Physics" 1st Edition, Springer.
7. M.DoI and S.F.Edwards, 1988 "The Theory of Polymer Dynamics" Oxford University Press USA.
8. P.J.Flory, 1989 "Statistical Mechanics of Chain Molecules" Hanser Gardner Pubns.
9. P.C. Hiemenz, 1984 "Polymer Chemistry-The Basic Concepts" CRC Press.
10. A. Ravve, 2012 "Principles of Polymer Chemistry" Springer; 3rd Edition.

BS Applied Chemistry 4th Year
Semester-VIII

Title of the Course:

Research Thesis/ Research Project/ Advanced Practical/ Position Paper Cr. Hr. 3

RESEARCH THESIS/ RESEARCH PROJECT

Code ACH 8119R

Will be offered on the basis of availability of faculty, lab facilities, and research interest of the available faculty and their skills.

OR

ADVANCED PRACTICAL

Code ACH 8119A

Will be offered on the basis of availability of faculty and their skills, and also availability of lab facilities. Advance level practical will be carried out to give the students know-how about using the advance and latest instruments and to develop their interest toward the latest research in the field of chemistry.

OR

POSITION PAPER

Code ACH 8119P

Will be offered on the basis of availability of faculty, and research interest of the available faculty and their skills. Topic will be awarded to the students to test their knowledge and to give know-how about research work and literature survey to develop their interest toward the latest research in the field of chemistry.