BS Chemistry

(Session 2022-26)

Semester 1

CHM-301 Principles of Inorganic Chemistry 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 potentials. Electron affinities, electronegativities and redox potential.

Chemical Bonding in Main Block Elements

Nature and types of chemical bonding, lewis concepts, ionic, covalent, coordinate covalent bond; Valence bond theory (VBT), Molecular orbital theory (MOT). Interpretation of shapes of inorganic molecules on the basis of valence shell electron pair repulsion (VSEPR) theory and hybridization.

Acid and Bases

Concepts of acids and bases including soft and hard acid base concepts. Relative strengths of acids and bases, significance of pH, pKa, pKb and buffers solutions. Theories of indicators; (acid base, redox, adsorption). Solubility, solubility product, common ion effect and their industrial applications.

Chemistry of the p-block Elements

General characteristics of the following group of p-block elements with reference to the aspects given against each

Carbon and Silicon:

Group anomalies. Allotropic forms of carbon, fullerenes and their applications. Production of pure silicon for solar energy and silicon chips, silicates and silicones and industrial applications.

Nitrogen and Phosphorus

Group anomalies. Preparation, structures, properties and the environmental role of oxides of nitrogen. Industrial superphosphate fertilizers. Causes of fog and smog.

Oxygen and Sulfur

Group anomalies. Preparation, structure, properties and environmental role of oxides and oxyacids of sulphur, manufacturing of sulphric acid and its reactions. Thionic acids and use of hypo in industry.

The Halogens

Anomalous behavior of fluorine. Industrial preparation of chlorine. Preparation, structures, properties and uses of oxides, oxyacids of chlorine, interhalogens and pseudohalogens.

The Noble Gases

Preparation, properties, structures and uses of xenon fluorides; commercial uses of noble gases.

CHM-301 Practicals

1. Laboratory Ethics and Safety Measures:

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

2. Qualitative Analysis

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

3. Preparation and standardization of normal and molar solutions of HCl, NaOH and $KmnO_4$.

4. Quantitative analysis

- Determination of total hardness of water using EDTA.

- Estimation of magnesium using EDTA.
- Estimation of copper (iodometrically).
- Determinstion of ferricyanide using KI solution
- Determination of chloride by Volhard and Mohr methods.
- Estimation of chloride/bromide ions using adsorption (fluorescein) indicator.
- Percentage determination of ferric ions in ferric alum using $KMnO_4$ solution.
- Determination of purity of commercial potassium oxalate using $KMnO_4$ solution
- Estimation of ferrous / ferric ions using $K_2Cr_2O_7$ solution.
- Percentage determination of barium in barium nitrate by gravimetric method.
- Gravimetric determination of nickel.

Books Recommended:

1. F. A. Cotton, G. Wilkinson, C. A. Murillo, M. Bockhmann, "Basic Inorganic Chemistry" 2nd Ed, John Wiley & Sons, USA (1987).
2. B. Douglas, D. McDaniel, J. Alexander, "Concepts and Models of Inorganic Chemistry" 3rd Ed, John Wiley & Sons, Inc. (1994).
3. J. W. Hill, R. H. Petrucci, "General Chemistry" 8th Ed, Prentice-Hall, Inc. (1996).
4. J. E. Huheey, "Inorganic Chemistry Principles of Structure and Reactivity" 2nd Ed, Harper and Row Publishers (1978).
5. J. D. Lee, "Concise Inorganic Chemistry" 5th Ed, Chapman and Hall (1996).
6. G. L. Miessler, A. T. Donald, "Inorganic Chemistry" 2nd Ed., Prentice-Hall International, Inc. (1991).
7. B. Moody, "Comparative Inorganic Chemistry" 3rd Ed, Routledge, Chapman and Hall, Inc.(1991).
8. D. F. Shriver, P.W. Atkins, C. H. Langford, "Inorganic Chemistry" Oxford University Press USA (1994).

ENG-321	Functional English	3(3–0)

Government College University, Faisalabad
Department of English

1. Functional English 1st semester (ENG-321)

Part 1: Grammar in context

- Basics of Grammar
- Parts of speech and use of articles
- Sentence structure, active and passive voice
- Practice in unified sentence(synthesis)
- Analysis of phrase, clause and sentence structure
- Transformation, Inversion of sentences
- Analysis of Complex sentences
- Subject, Predicate, Complements, direct & indirect objects
- Direct and Indirect speech

Part 2: Functional English in use

1. Making introductions

- Making effective self and peer introductions
- Taking useful introductory notes

2. Expressing requests and enquiries

- Forming appropriate requests and enquiries
- Responding to enquiries
- Requests versus commands

3. Greetings

- Greeting friends and family on different occasions and for different reasons
- Responding to a positive event
- Using formal greeting expressions appropriately

4. Gratitude

- Using formal and informal expressions of gratitude appropriately

5. Invitations

- Demonstrating the use of formal and informal expressions of invitation
- Developing verbal and written skills for invitations
- Responding to invitation requests by accepting or declining

6. Regrets

- Expressing regrets orally and in writing appropriately
- Saying sorry and accepting apologies

7. Following and giving directions

- Following directions from a map
- Giving directions to a location in oral and narrative and imaginative texts by composing stories and sharing them in written and oral form.

8. Sharing narratives

- Reading short stories
- Reading excerpts, comic strips, interviews, and other common texts

9. Sharing unique experiences

- Summarizing and narrating true stories
- Solving word puzzles to develop language awareness
- Reading short stories and completing exercises to test comprehension
- Converting an event into a short story
- Using pictures as stimuli for narrative creation

Key Books:

- Eastwood, J. (2005). *Oxford Practice Grammar*. UK: Oxford.
- Wren & Martin. (2007). *High School. English Grammar & Composition*. New Delhi: S Chand & Company Limited.
- Thomson & Martinent. (1992). *A practical English Grammar*. UK: Oxford.
- Swan, M. (2005). *Practical English Usage*. UK: Oxford University Press.
- Shah, S. (2006). *Exploring the world of English*. Lahore: Ilmi Kitab Khana.

References:

- Hewings, M. (2008). *Advanced Grammar in Use*. New Delhi: CUP. (For classroom teaching and practice)
- Ur.P. (2008). *Grammar Practice Activities: A Practical Guide for Teachers*. Cambridge: CUP. (Topics for Assignments may be chosen from this Practice book)
- Quirk, R.et al. (1983). *Comprehensive Grammar of the English Language*. London: Longman.
- Leech, G., and Jan, S. (1998). A Communicative Grammar of English. London: Longman.
- Allama Iqbal Open University, *Compulsory English 1* (Code 1423) (Islamabad: AIOU Press).
- BBC. (2013) *Learning English.* http://www.bbc.co.uk/worldservice/learningenglish/
- British Council. *Learn English.* http://learnenglish.britishcouncil.org/en/
- British Council and BBC. *Learn English.* http://www.teachingenglish.org.uk/
- Grammar software free download: *3D Grammar English.* http://freesoftwarepc.biz/educational-software/ download-free-software-3d-grammar-English-portable

CSI-321 Introduction to Computing Applications 3(2-1)

Course objectives:

The main objective of this course is to provide a fundamental knowledge and basic understanding of computer applications in chemistry. The course helps to strengthen the students skills inliterature searching, data analysis, modelling and presentation.

Course contents:

Introduction to computer and its operating systems, Basics of different software's use for solving chemistry problems, Graphics and data handling tools, Introduction to software's used for bibliographic libraries, Data presentation, Computer applications to solve chemical problems and present scientific information, on-line journals and literature searches, Software to draw chemical structures and reaction schemes, Introduction to molecular modeling and simulations. Interfacing of computers, Data analysis, simulation, structural searching, modeling, drug design, Computational Chemistry, Chemometrics, Chemoinformatics, Molecular modeling and structural elucidations.

Lab:

Hand out practice on data processing, simulations, Optimization of experiments, handling of chemical structure, Molecular modeling, Structure elucidation and structure search, Bibliographic tools handling

Recommended books:

1. Computer Software Applications in Chemistry 2nd Edition by Peter C. Jurs, 1996.
2. Computer Applications In Chemistry, by G. Nageswara Rao, R. Sambasiva Rao, 2005
3. Software for teaching science by Roger Frost's, 2001.
4. Electronic structure calculations on graphics processing units, Wiley, Editors: RossC Wolkers, Andreas W. Goetz, 2016.
5. Computational techniques to real world problems by David C. Young, Wiley, 2001.
6. Computer and their applications to chemistry, by Ramesh Kumari, Alpha Science, 2002.
7. Computer-aided molecular design, theory and applications by Jean-Pierre Doucet and Jacques Weber, Academic press, 2007.

MTH-321 Algebra and Trigonometry 3(3-0)

Preliminaries: Real-number system, complex numbers, introduction to sets, set operations, functions, types of functions. Matrices: Introduction to matrices, types, matrix inverse, determinants, system of linear equations, Cramer's rule. Quadratic Equations: Solution of quadratic equations, nature of roots of a quadratic equations, equations reducible to quadratic equations, cube roots of unity, relation between roots and coefficients of quadratic equations. Sequences and Series: Arithmetic progression, geometric progression, harmonic progression. Binomial Theorem: Introduction to mathematical induction, binomial theorem with rational and irrational indices. Trigonometry: Fundamentals of trigonometry, trigonometric identities.

Recommended books:

1. Dolciani MP, Wooton W, Beckenback EF, Sharron S, Algebra 2 and Trigonometry, 1978, Houghton & Mifflin,
2. Boston (suggested text) Kaufmann JE, College Algebra and Trigonometry, 1987, PWSKent Company, Boston
3. Swokowski EW, Fundamentals of Algebra and Trigonometry (6th edition), 1986, PWS-Kent Company, Boston.
4. N. Khalid Mathematics-I Algebra and Trigonometry, Discover Mathematics Series, 3rd Edition, 2021.

BOT-303 Functional Biology-I 3(3-0)

(For Non-medical Students) Biological Methods; Principles of Cellular Life,Chemical Basis, Structure and Function, Principles of Metabolism, Energy Acquisition, Principles of Inheritance, Mitosis and Meiosis, Chromosomes, Observable Inheritance Patterns, DNA Structure and Function , RNA and Proteins, Genes Genetic Engineering and Biotechnology, Biodiversity, Fundamental Concept of Biodiversity, One or two examples of each of the following from commonly found organism , Prions, Viruses, Bacteria, Protistans, Algae, Fungi, Plants, Crops, Animals, Invertebrates, Vertebrates

Books Recommended

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

PHY-321 Fundamentals of Mechanics 3(2-1)

Vectors, one and two dimensional motion with constant acceleration, Motion in three dimensions with constant acceleration, Newton's laws in three dimensional vectors form, Projectile motion, Drag forces and the motion of projectiles, Momentum, Linear and angular momentum, Impulse and momentum, Conservation of momentum, Two body collision, Center of mass, Two particles system, Many particles system, Rotational motion and variables, Rotation with constant angular acceleration, relation between linear and angular variables, energy, Kinetic and potential energy, Work, Energy and work done by a constant force, Fluid flow, Streamlines and equation of continuity, Oscillator, Simple harmonic oscillator, Energy and applications, Damped harmonic oscillation, Mechanical waves and Types, Wave speed on stretched string, Energy in wave motion, Interference of waves, Standing waves and resonance, Properties of sound waves, Traveling sound waves, Power and intensity of sound waves, Beats, Doppler effect,

1. To Study the damping features of an oscillation system using simple pendulum of variable mass.
2. To determine the value of 'g' be compound pendulum.
3. To determine the modulus of rigidity of a flat spiral spring.

4. To determine the modulus of rigidity of a wire by solid cylindrical rod.

Recommended Books:

1. Halliday, Resnick and Walker, 2011, Fundamental Physics, 9th Ed. Ed, John Wiley and Sons Inc. New York.
2. Halliday, Resnick and Krane, 2002. Physics Vol. I & II, 5th Ed, John Wiley and Sons Inc. New York.
3. Sears, Zemansky and Young, 2000, University Physics, 8th Ed, Addison-Wesley. Reading (MA) USA.

ISL- Translation of The Holy Quran-I 1(1-0)

Semester 2

CHM-302 Principles of Organic Chemistry 4(3-1)

Basic concepts in chemical bonding

Localized and delocalized bonding. Concept of hybridization leading to bond angles, bond energies and geometry of simple organic molecules; dipole moment; inductive effect; resonance, resonance energy, rules of resonance, resonance effect, steric inhibition of resonance; hyperconjugation; tautomerism; hydrogen bonding.

Nomenclature of organic compounds

Common and trivial name of organic compounds; and introduction to the systematic nomenclature of mono and bi-bunfctional organic compounds by IUPAC rules.

Aromatic Hydrocarbons

Aromatic Compounds Structure of benzene, aromaticity, electrophilic substitution including orientation and reactivity, addition and oxidation reactions, preparation and reactivity of naphthalene.

Isomerism

Geometrical isomerism Determination of configuration of geometrical isomers, Z, E convention and cis- and trans- isomerism in compound containing two double bonds; Optical isomerismOptical activity, chirality and optical activity, racemisation and resolution of racemic mixture, R, S notation, diasteroisomers. Conformational isomerism A brief introduction to conformation of ethane, n-butane and cyclohexane.

Chemistry of the Hydroxyl Group and Ethers

Brief review of the physical properties, preparation and reactions of alcohols. Phenols acidity, preparation and reactions, Ethers preparation, properties and reactions.

Chemistry of Carboxylic Acids and Their Derivatives

Physical properties of carboxylic acids, effect of substitution and structure on the strengths of acidity of carboxylic acids. Preparation, properties and reactions of carboxylic acids and their derivatives i.e. ester, amides, acid halides and acid anhydrides.

CHM-302 Practicals

Sixteen experiments shall be conducted based on the following techniques:

a. Melting and boiling point determination, Distillation, solvent extraction, crystallization.

b. Qualitative Organic Analysis

Systematic identification of organic compound (1Compounds)

c. Preparation of Organic Compounds

Preparation of simple organic compound like iodoform, aspirin, acetanilide etc

Books Recommended:

1. R. K. Bansal, "A Text book of Organic Chemistry" 2nd Ed, Wiley Eastern Ltd; (1990).
2. I. L. Finar, "Fundamental Principles of Organic Chemistry" 3rd Ed, Vol.1, Longman, (1959).
3. J. March, "Advanced Organic Chemistry Reactions, Mechanisms and Structure" 6th Ed, John Wiley & Sons (2007).
4. J. McMurry, "Organic Chemistry" 5th Ed, Thomson Asia Ltd; Singapore (2000).
5. R. T. Morrison, R. N. Boyd, "Organic Chemistry" 6th Ed, Prentice-Hall, Inc; (1992).
6. S. H. Pine, J. B. Hendrickson, G. S. Hammond, "Organic Chemistry" 4th Ed, McGraw-Hill, Inc; (1992).

ENG-322	English Comprehension and Composition	3 (3 – 0)

Government College University, Faisalabad
Department of English

II. English Comprehension and Composition 2nd Semester (ENG-322)

A. **Reading Comprehension Skills**
- identifying main idea/topic sentences
- find specific information quickly
- distinguishing between relevant and irrelevant information according to purpose for reading
- recognizing and interpreting cohesive devices
- distinguishing between fact and opinion

B. **Reading techniques**- applying Skimming, Scanning, SQ3R, SPRE

C. **Vocabulary Building Skills**
- guessing the meanings of unfamiliar words using context clues
- using word formation rules for enhancing vocabulary
- using the dictionary for finding out meanings and use of unfamiliar words

D. **Pre-writing Techniques**- Brain Storming, making a list, Mind mapping.

E. **Writing Techniques**:
- Plan writing: identify audience, purpose and message
- Collect information in various forms such as mind maps, tables, charts, lists
- Order information such as:
  - Chronology for a narrative
  - Stages of a process
  - From general to specific and vice versa
  - From most important to least important
  - Advantages and disadvantages
  - Comparison and contrast
  - Problem solution pattern
- Write argumentative and descriptive forms of writing using different methods of developing ideas like listing, comparison, and contrast, cause and effect, for and against

F. **Paragraph Writing**:
- Structure & Development of Paragraph.
- Write and Identify good topic and supporting sentences and effective conclusions.
- Use appropriate cohesive devices such as reference words and signal markers

G. **Types of Writing**
- Narrative
- Descriptive: describing a place, character description

- Expository
- Argumentative

H. Essay writing techniques:

- Structure and outline of an essay.
- Writing Introductions and conclusions of an essay.
- Unity and coherence in an essay

I. Paraphrasing: What is Paraphrase? Paraphrasing Techniques and how to apply

J. Précis writing

- What is Précis?
- Uses of précis writing
- Essentials of a good précis
- Method of procedure
- How to find the title
- Précis of a phrase or clause
- Précis of a Sentence
- Précis of a Paragraph
- Summarizing an article
- Writing an assignment summary

K. Expansion: Expansion of a sentence into paragraph
Method of Expansion

Suggested Books:

- Exploring the World of English by Saadat Ali Shah
- College Writing: From paragraph to Essay: Zemach & Rumisek
- Reading. Upper Intermediate. Brain Tomlinson and Rod Ellis.
- Oxford Supplementary Skills. Third Impression 1992.
- Glencoe Writer's Choice: Grammar and Composition. McGraw Hill Glencoe
- College writing skills by John Langan. McGraw Hill Publishers, 2004
- Reading upper intermediate. Brain Tomlinson and Rod Ellis. Oxford supplementary skills. Third impression 1992

CSI-422 Computer Applications & Web-II 3(3-0)

Course Outline

- Some new advanced online computer applications
- Word Processing (Word)
- Presentation (PowerPoint)
- Spreadsheet (Excel)
- Desktop Publishing (Publisher)
- Microsoft Front page
- Introduction to Internet, Search engines, Web browsers
- Introduction to HTML and Web Page Design
- Introduction to Protocols, Http, TCP/IP, FTP
- Simple web page making using HTML
- Introduction to XML
- Database, Introduction to SQL as well as the use of emerging technologies.

ISL-321	Islamic Studies	2(2–0)

BA BSc (Complusory, Elective, Optional)

سلیبس اسلامیات (لازمی) بی اے دوسالہ پروگرام

نصاب مطالعہ اسلامیات (لازمی)

برائے بی اے، بی ایس سی اور بی کام

مطالعہ اسلامیات (لازمی) کے لیے 60 نمبر مختص ہوں گے۔

نصابی خاکہ

۱۔قرآن مجید	20نمبر
۲۔حدیث شریف	10نمبر
۳۔سیرت النبی ﷺ	10نمبر
۴۔اسلامی تہذیب وثقافت	10نمبر
۵۔معروضی سوالات	10نمبر

(معروضی سوالات پورے نصاب پر مشتمل ہوں گے)

اس مضمون کی تدریس وامتحانات کے لیے اردو، عربی اور انگریزی زبانوں کی اجازت ہے۔

نصابی تفصیلات

اہداف ومقاصد:

۱۔ طلبہ کو قرآن وحدیث سے استفادہ کے قابل بنانا۔

۲۔ طلبہ کے قلوب واذہان میں قرآن وسنت کی روح اور علم کو راسخ کرنا۔

۳۔ طلبہ میں اسوہ ختم المرسلین صلی اللہ علیہ وسلم کی اتباع اور حب رسول کا جذبہ پیدا کرنا۔

۴۔ اسلام کی بنیادی تعلیمات کا فہم آسان بنانا اور طلبہ کی اسلامی بنیادوں پر تربیت کرنا۔

۵۔ امت مسلمہ کو درپیش عصر جدید کے چیلنجوں سے طلبہ کو آگاہ کرنا۔

نصابی تفصیلات:

۱۔القرآن الکریم

(الف) قواعد لغۃ القرآن (قرآنی گرائمر)

الماضی والمضارع، الامر والنهی، الجملة الاسمیة والفعلیة المرکب الاضافی والتوصیفی، الضمائر و حروف الجر.

(ب) منتخب قرآنی آیات کا نحوی و بامحاورہ ترجمہ وتشریح

مطالعہ قرآن مجید کی ضرورت واہمیت

قرآن مجید سے متعلق موضوعات کے بارے میں آیت دی جائے گی اور آیت کی تشریح طلب کی جائے گی۔

<u>قرآن مجید کی مندرجہ ذیل آیات کا ترجمہ وتشریح کریں</u>

(i) (سورۃ البقرۃ(2) آیات 1 تا 5 و 284 تا 286) ایمانیات۔

(ii) (سورۃ الاحزاب(33) آیات: 6,21,32,33,40,56 تا 59)

(خصصات نبویہ: اسوہ حسنہ، ختم نبوت، مقام رسالت، ناموس رسالت، ازواج النبیؐ)۔

(iii) الفتح (48) آیت: (29). (رسالت محمدیہ اور خصائص اصحاب رسولؐ)

(iv) سورۃ الصف (61) آیات: 1 تا 14 (بعثت رسالت ختم المرسلین، ہجرت، جہاد، نصرت اور غلبہ دین)

(v) سورۃ الحجرات: (49) آیات: 1 تا 18. (ادب نبوی و معاشرتی احکام)

(vi) سورۃ الانعام: (06) آیات: 151 تا 153۔ (حقوق العباد)۔

(vi) سورۃ الفرقان: (25) آیات: 63 تا 77۔ (آداب معاشرت)۔

(vii) (سورۃ النحل: 16) آیات: 12 تا 14 ۔ (تفکر وتدبر)۔

<u>الاحادیث النبویة</u>

<u>منتخب احادیث نبویہ کا نحوی و بامحاورہ ترجمہ اور تشریح</u>

(نوٹ) اساتذہ کرام آیات واحادیث کی تعلیم وتدریس کے دوران نحوی اور بامحاورہ ترجمہ کے ضمن میں مندرجہ بالا قواعد عربیہ کی تطبیق کریں۔

۱. عَنْ عُمَرَ بْنِ الْخَطَّابِ رَضِیَ اللّٰہ عَنْہُ قَالَ سَمِعْتُ رَسُوْلَ اللّٰہِ صَلَّی اللّٰہُ عَلَیْہِ وَسَلَّمَ یَقُوْلُ: اِنَّمَا الاَعْمَالُ بِالنِّیَّاتِ، وَ اِنَّمَا لِامْرِیءٍ مَانَوٰی، فَمَنْ کَانَتْ ھِجْرَتُہٗ اِلٰی اللّٰہِ وَرَسُوْلِہٖ فَھِجْرَتُہٗ اِلَی اللّٰہِ وَرَسُوْلِہٖ. وَ مَنْ کَانَتْ ھِجْرَتُہٗ اِلٰی دُنْیَا یُصِیْبُھَا ، اَوِ امْرَاَۃٍ یَتَزَوَّجُھَا فَھِجْرَتُہٗ اِلٰی مَا ھَاجَرَ اِلَیْہِ (بخاری: ۱)

۲. عَنْ عُثْمَانَ بْنِ عَفَّان رَضِیَ اللّٰہ عَنْہُ عَنِ النَّبِیِّ صَلَّی اللّٰہُ عَلَیْہِ وَسَلَّمَ قَالَ: خَیْرُکُمْ مَنْ تَعَلَّمَ الْقُرْآنَ وَعَلَّمَہٗ (بخاری نمبر ۵۰۲۷)

۳. عَن مالِک بنِ اَنَسٍ رَضِیَ اللّٰہ عَنْہُ قَالَ : قَالَ رَسُوْلُ اللّٰہِ صَلَّی اللّٰہُ عَلَیْہِ وَسَلَّمَ: تَرَکْتُ فِیْکُمْ اَمْرَیْنِ لَنْ تَضِلُّوْا مَا تَمَسَّکْتُمْ بِھِمَا کِتَابُ اللّٰہِ وَسُنَّۃُ رَسُوْلِہٖ (رواہ مالک فی المؤطا مرسلا)

۴. عَنْ عَبْدِاللّٰہِ بْنِ عُمَرَرَضِیَ اللّٰہُ عَنْھُمَا قَالَ : قَالَ رَسُوْلُ اللّٰہِ صَلَّی اللّٰہُ عَلَیْہِ وَسَلَّمَ بُنِیَ الْاِسْلَامُ عَلٰی خَمْسٍ شَھَادَۃِ اَنْ لَّآاِلٰہَ اِلَّااللّٰہُ وَاَنَّ مُحَمَّدًا عَبْدُہٗ وَرَسُوْلُہٗ وَ اِقَامِ الصَّلٰوۃِ وَاِیْتَآءِ الزَّکٰوۃِ وَحَجِّ الْبَیْتِ وَصَوْمِ رَمَضَانَ (صحیح مسلم: ۱۱۳)

۵. عَنْ عُمَرَ بنِ الْخَطَّابِ رَضِیَ اللّٰہ عَنْہُ قَالَ بَیْنَمَا نَحْنُ عِنْدَ رَسُوْلِ اللّٰہِ صَلَّی اللّٰہُ عَلَیْہِ وَسَلَّمَ ذَاتَ یَوْمٍ اِذْ طَلَعَ عَلَیْنَا رَجُلٌ شَدِیْدُ بَیَاضِ الثِّیَابِ شَدِیْدُ سَوَادِ الشَّعْرِ لَایُرٰی عَلَیْہِ اَثَرُ السَّفَرِ وَمَا یَعْرِفُہٗ مِنَّا اَحَدٌ حَتّٰی جَلَسَ اِلَی النَّبِیِّ صَلَّی اللّٰہُ عَلَیْہِ وَسَلَّمَ فَاَسْنَدَ رُکْبَتَیْہِ اِلٰی رُکْبَتَیْہِ وَ وَضَعَ کَفَّیْہِ عَلٰی فَخِذَیْہِ وَقَالَ: یَا مُحَمَّدُ اَخْبِرْنِیْ عَنِ الْاِسْلَامِ؟ فَقَالَ رَسُوْلُ اللّٰہِ صَلَّی اللّٰہُ عَلَیْہِ وَسَلَّمَ: الْاِسْلَامُ

اَنْ تَشْهَدَ اَنْ لَا اِلٰهَ اِلَّا اللّٰهُ وَاَنَّ مُحَمَّداً رَّسُوْلُ اللّٰهِ صَلَّى اللّٰهُ عَلَيْهِ وَسَلَّمَ وَتُقِيْمَ الصَّلٰوةَ وَتُؤْتِيَ الزَّكٰوةَ وَتَصُوْمَ رَمَضَانَ وَتَحُجَّ الْبَيْتَ اِنِ اسْتَطَعْتَ اِلَيْهِ سَبِيْلاً ،قَالَ صَدَقْتَ، قَالَ فَعَجِبْنَا لَهُ يَسْأَلُهُ وَيُصَدِّقُهُ ،قَالَ: فَاَخْبِرْنِيْ عَنِ الْاِيْمَانِ؟ قَالَ اَنْ تُؤْمِنَ بِاللّٰهِ وَ مَلٰئِكَتِهٖ وَكُتُبِهٖ وَرُسُلِهٖ وَالْيَوْمِ الاٰخِرِ وَتُؤْمِنَ بِالْقَدْرِ خَيْرِهٖ وَشَرِّهٖ ، قَالَ صَدَقْتَ، قَالَ:فَاَخْبِرْنِيْ عَنِ الْاِحْسَانِ؟ قَالَ :اَنْ تَعْبُدَ اللّٰهَ كَاَنَّكَ تَرَاهُ فَاِنْ لَّمْ تَكُنْ تَرَاهُ فَاِنَّهٗ يَرَاكَ قَالَ:فَاَخْبِرْنِيْ عَنِ السَّاعَةِ؟ قَالَ: مَا الْمَسْئُوْلُ عَنْهَا بِاَعْلَمَ مِنَ السَّائِلِ، قَالَ:فَاَخْبِرْنِيْ عَنْ اَمَارَاتِهَا ؟ قَالَ: اَنْ تَلِدَ الاَمَةُ رَبَّتَهَا وَ اَنْ تَرَى الْحُفَاةَ الْعُرَاةَ الْعَالَةَ رِعَاءَ الشَّاءِ يَتَطَاوَلُوْنَ فِي الْبُنْيَانِ، قَالَ: ثُمَّ انْطَلَقَ، فَلَبِثْ مَلِيًّا ثُمَّ قَالَ لِيْ: يَا عُمَرُ أَ تَدْرِيْ مَنِ السَّائِلُ؟ قُلْتُ اَللّٰهُ وَرَسُوْلُهٗ اَعْلَمُ، قَالَ فَاِنَّهٗ جِبْرِيْلُ اَتَاكُمْ يُعَلِّمُكُمْ دِيْنَكُمْ (رواه مسلم : ٩٣)

٦. عَنْ شُبْرُمَةَ ابْنِ مَعْبَدٍ رَضِيَ اللّٰهُ عَنْهُ قَالَ: قَالَ رَسُوْلُ اللّٰهِ صَلَّى اللّٰهُ عَلَيْهِ وَسَلَّمَ مُرُوْا الصَّبِيَّ بِالصَّلٰوةِ اِذَا بَلَغَ سَبْعَ سِنِيْنَ وَ اِذَا بَلَغَ عَشْرَ سِنِيْنَ فَاضْرِبُوْا عَلَيْهَا اَخْرَجَه اَبُوْدَاوُدَ وَ التِّرْمِذِيُّ وَلَفْظُهٗ عَلِّمُوْا الصَّبِيَّ الصَّلٰوةَ اِبْنَ سَبْعِ سِنِيْنَ وَاضْرِبُوْا عَلَيْهَا ابْنَ عَشْرَةٍ (صحيح بخاری،ترمذی:٤٠٧)

٧. عَنْ مُعَاوِيَةَ رَضِيَ اللّٰهُ عَنْهُ قَالَ: قَالَ رَسُوْلُ اللّٰهِ صَلَّى اللّٰهُ عَلَيْهِ وَسَلَّمَ مَنْ يُّرِدِ اللّٰهُ بِهٖ خَيْراً يُّفَقِّهْهُ فِي الدِّيْنِ (رواه البخاری:٣١١٦)

٨. عَنْ اَبِيْ هُرَيْرَةَ رَضِيَ اللّٰهُ عَنْهُ قَالَ: قَالَ رَسُوْلُ اللّٰهِ صَلَّى اللّٰهُ عَلَيْهِ وَسَلَّمَ مَنْ سَلَكَ طَرِيْقاً يَلْتَمِسُ فِيْهِ عِلْمًا سَهَّلَ اللّٰهُ بِهٖ طَرِيْقًا اِلَى الْجَنَّةِ وَمَا اجْتَمَعَ قَوْمٌ فِيْ بَيْتٍ مِّنْ بُيُوْتِ اللّٰهِ يَتْلُوْنَ كِتَابَ اللّٰهِ وَيَتَدَارَسُوْنَ بَيْنَهُمْ اِلَّا نَزَلَتْ عَلَيْهِمُ السَّكِيْنَةُ وَغَشِيَتْهُمُ الرَّحْمَةُ وَحَفَّتْهُمُ الْمَلٰئِكَةُ وَذَكَرَهُمُ اللّٰهُ فِيْ مَنْ عِنْدَهٗ وَمَنْ بَطَّاَ بِهٖ عَمَلُهٗ لَمْ يُسْرِعْ بِهٖ نَسَبُهٗ (رواه مسلم)

٩. عَنْ اَبِيْ هُرَيْرَةَ رَضِيَ اللّٰهُ عَنْهُ قَالَ كَانَ رَسُوْلُ اللّٰهِ صَلَّى اللّٰهُ عَلَيْهِ وَسَلَّمَ يَقُوْلُ اَللّٰهُمَّ اِنِّيْ اَعُوْذُبِكَ مِنَ الْاَرْبَعِ مِنْ عِلْمٍ لَّا يَنْفَعُ وَ مِنْ دُعَاءٍ لَا يُسْمَعُ وَ مِنْ قَلْبٍ لَا يَخْشَعُ وَمِن نَّفْسٍ لَا تَشْبَعُ . (رواه مسلم و احمد ، ابو داؤد ، مشكوة المصابيح:٢٤٦٨ . سنن ابن ماجه :٢٥٠)

١٠. عَنِ ابْنِ مَسْعُوْدٍ رَضِيَ اللّٰهُ عَنْهُ عَنِ النَّبِيِّ صَلَّى اللّٰهُ عَلَيْهِ وَسَلَّمَ قَالَ:لَا تَزُوْلُ قَدَمَا ابْنِ اٰدَمَ يَوْمَ الْقِيٰمَةِ مِنْ عِنْدِ رَبِّهٖ حَتّٰى يُسْئَلَ عَنْ خَمْسٍ: عَنْ عُمُرِهٖ فِيْمَا اَفْنَاهُ وَعَنْ شَبَابِهٖ فِيْمَا اَبْلَاهُ وَ عَنْ مَالِهٖ مِنْ اَيْنَ اِكْتَسَبَهٗ وَ فِيْمَا اَنْفَقَهٗ وَمَاذَا عَمِلَ فِيْمَا عَلِمَ. (جامع الترمذی:٢٤١٦)

١١. عَنْ عَبْدِاللّٰهِ رَضِيَ اللّٰهُ عَنْهُ قَالَ: قَالَ رَسُوْلُ اللّٰهِ صَلَّى اللّٰهُ عَلَيْهِ وَسَلَّمَ طَلَبُ كَسْبِ الْحَلَالِ فَرِيْضَةٌ بَعْدَ الْفَرِيْضَةِ (شعب الایمان بیہقی)

١٢. عَنْ اَبِيْ سَعِيْدٍ رَضِيَ اللّٰهُ عَنْهُ عَنِ النَّبِيِّ صَلَّى اللّٰهُ عَلَيْهِ وَسَلَّمَ قَالَ اَلتَّاجِرُ الصَّدُوْقُ الْاَمِيْنُ مَعَ النَّبِيِّيْنَ وَ الصِّدِّيْقِيْنَ وَالشُّهَدَاءِ (جامع ترمذی: ١٢٠٩ ، سنن دارمی سنن دارقطنی)

١٣. عَنْ اَبِيْ هُرَيْرَةَ رَضِيَ اللّٰهُ عَنْهُ اَنَّ رَسُوْلَ اللّٰهِ صَلَّى اللّٰهُ عَلَيْهِ وَسَلَّمَ قَالَ: اَتَدْرُوْنَ مَا الْمُفْلِسُ؟ قَالُوْا اَلْمُفْلِسُ فِيْنَا مَنْ لَّا دِرْهَمَ لَهٗ وَلَا مَتَاعَ فَقَالَ:اِنَّ الْمُفْلِسَ مِنْ اُمَّتِيْ مَنْ يَّاْتِيْ يَوْمَ الْقِيٰمَةِ بِصَلَاةٍ وَصِيَامٍ وَزَكَاةٍ وَ يَاْتِيْ قَدْ شَتَمَ هٰذَا وَقَذَفَ هٰذَا وَاَكَلَ مَالَ هٰذَا وَسَفَكَ دَمَ هٰذَا وَضَرَبَ هٰذَا فَيُعْطٰى هٰذَا مِنْ حَسَنَاتِهٖ فَاِنْ فَنِيَتْ حَسَنَاتُهٗ قَبْلَ اَنْ يُّقْضٰى مَا عَلَيْهِ اُخِذَ مِنْ خَطَايَاهُمْ فَطُرِحَتْ عَلَيْهِ ثُمَّ طُرِحَ فِي النَّارِ.(رواه مسلم، كتاب البر:٦٥٧٩)

١٤. عَنْ اَبِي الدَّرْدَآءِ رَضِيَ اللّٰهُ عَنْهُ اَنَّ النَّبِيَّ صَلَّى اللّٰهُ عَلَيْهِ وَسَلَّمَ قَالَ : مَا شَيْءٌ اَثْقَلُ فِيْ مِيْزَانِ الْمُؤْمِنِ يَوْمَ الْقِيٰمَةِ مِنْ خُلُقٍ حَسَنٍ فَاِنَّ اللّٰهَ تَعَالٰى يُبْغِضُ الْفَاحِشَ الْبَذِيَّ (ترمذی:٢٠٠٢)

١٥.عَنِ ابْنِ عَبَّاسٍ رَضِيَ اللّٰهُ عَنْهُ اَنَّ النَّبِيَّ صَلَّى اللّٰهُ عَلَيْهِ وَسَلَّمَ قَالَ:اَرْبَعٌ مَنْ اُعْطِيَهُنَّ فَقَدْ اُعْطِيَ خَيْرَ الدُّنْيَا وَالْاٰخِرَةِ: قَلْبًا شَاكِرًا وَّلِسَانًا ذَاكِرًا وَّ بَدَنًا عَلَى الْبَلَاءِ صَابِرًا وَّزَوْجَةً لَا تَبْغِيْهِ حُوْبًا فِيْ نَفْسِهَا وَمَالِهٖ(معجم طبرانی ومشکوٰۃ :٣٢٧٣)

(سنن نسائی، کنز العمال :٤٣٣٠٩)

١٦.عَنْ اَبِيْ هُرَيْرَةَ رَضِيَ اللّٰهُ عَنْهُ قَالَ قَالَ:رَسُوْلُ صَلَّى اللّٰهُ عَلَيْهِ وَسَلَّم : اِجْتَنِبُوْا السَّبْعَ الْمُوْبِقَاتِ،قَالُوْا يَا رَسُوْلَ اللّٰهِ وَمَا هُنَّ قَالَ:اَلشِّرْكُ بِاللّٰهِ وَالسِّحْرُ وَقَتْلُ النَّفْسِ الَّتِيْ حَرَّمَ اللّٰهُ اِلَّا بِالْحَقِّ وَاَكْلُ الرِّبٰوا وَاَكْلُ مَالِ الْيَتِيْمِ وَالتَّوَلِّي يَوْمَ الزَّحْفِ وَ قَذْفُ الْمُحْصَنَاتِ الْمُؤْمِنَاتِ الْغَافِلَاتِ (متفق علیہ)

١٧.عَنْ اَبِيْ سَعِيْدِ الْخُدْرِي رَضِيَ اللّٰهُ عَنْهُ قَالَ سَمِعْتُ رَسُوْلَ اللّٰهِ صَلَّى اللّٰهُ عَلَيْهِ وَسَلَّم يَقُوْلُ مَنْ رَّاٰى مِنْكُمْ مُنْكَرًا فَلْيُغَيِّرْهُ بِيَدِهٖ فَاِنْ لَّمْ يَسْتَطِعْ فَبِلِسَانِهٖ فَاِنْ لَّمْ يَسْتَطِعْ فَبِقَلْبِهٖ وَذٰلِكَ اَضْعَفُ الْاِيْمَانِ (رواہ مسلم:١٧٧)

١٨.عَنْ اُسَامَةَ بْنِ زَيْدٍ رَضِيَ اللّٰهُ عَنْهُ قَالَ:قَالَ رَسُوْلُ اللّٰهِ صَلَّى اللّٰهُ عَلَيْهِ وَسَلَّم يُجَآءُ بِرَجُلٍ يَوْمَ الْقِيٰمَةِ فَيُلْقٰى فِي النَّارِ فَتَنْدَلِقُ اَقْتَابُهٗ فِيْ النَّارِ فَيَطْحَنُ فِيْهَا كَطَحْنِ الْحِمَارِ بِرَحَاهُ فَيَجْتَمِعُ اَهْلُ النَّارِ عَلَيْهِ فَيَقُوْلُوْنَ اَيْ فُلَانُ مَا شَانُكَ؟اَلَيْسَ كُنْتَ تَاْمُرُنَا بِالْمَعْرُوْفِ وَتَنْهٰنَا عَنِ الْمُنْكَرِ؟قَالَ كُنْتُ اٰمُرُكُمْ بِالْمَعْرُوْفِ وَلَا اٰتِيْهِ وَاَنْهَاكُمْ عَنِ الْمُنْكَرِوَاٰتِيْهِ (بخاری:٣٢٦٧ و مسلم)

١٩.عَنْ اَنَسٍ رَضِيَ اللّٰهُ عَنْهُ قَالَ رَسُوْلُ اللّٰهِ صَلَّى اللّٰهُ عَلَيْهِ وَسَلَّمَ وَالَّذِيْ نَفْسِيْ بِيَدِهٖ لَا يُؤْمِنُ عَبْدٌ حَتّٰى يُحِبَّ لِاَخِيْهِ مَا يُحِبُّ لِنَفْسِهٖ.(رواہ مسلم:١٧٠)

٢٠.وَعَنِ النُّعْمَانِ بْنِ بَشِيْرٍ رَضِيَ اللّٰهُ عَنْهُ قَالَ قَالَ رَسُوْلُ اللّٰهِ صَلَّى اللّٰهُ عَلَيْهِ وَسَلَّمَ تَرَى الْمُؤْمِنِيْنَ فِيْ تَرَاحُمِهِمْ وَتَوَادِّهِمْ وَتَعَاطُفِهِمْ كَمَثَلِ الْجَسَدِ اِذَا اشْتَكٰى عُضْوٌ تَدَاعٰى لَهٗ سَآئِرُ الْجَسَدِ بِالسَّهَرِ وَالْحُمّٰى(متفق علیہ بخاری: ٦٠١١)

٢١.عَنْ عَبْدِاللّٰهِ ابْنِ عُمَرَرَضِيَ اللّٰهُ عَنْهُمَا قَالَ قَالَ رَسُوْلُ اللّٰهِ صَلَّى اللّٰهُ عَلَيْهِ وَسَلَّمَ اَلَا كُلُّكُمْ رَاعٍ وَّ كُلُّكُمْ مَسْئُوْلٌ عَنْ رَّعِيَّتِهٖ فَالْاِمَامُ الاعظم الَّذِيْ عَلَى النَّاسِ رَاعٍ وَهُوَمَسْئُوْل عَنْ رَّعِيَّتِهٖ وَالرَّجُلُ رَاعٍ عَلٰى اَهْلِ بَيْتِهٖ وَهُوَمَسْئُوْلٌ عَنْ رَّعِيَّتِهٖ وَالْمَرْاَةُ رَاعِيَةٌ عَلٰى بَيْتِ زَوْجِهَا وَوَلَدِهٖ وَهِيَ مَسْئُوْلَةٌ عَنْهُمْ وعَبْدُ الرَّجُلِ رَاعٍ عَلٰى مَالِ سَيِّدِهٖ وَهُوَمَسْئُوْلٌ عَنْهُ اَلَا فَكُلُّكُمْ رَاعٍ وَكُلُّكُمْ مَسْئُوْلٌ عَنْ رَعِيَّتِهٖ (بخاری:٧١٣٨ و ترمذی:١٧٠٥)

٢٢.عَنْ اَبِيْ هُرَيْرَةَ رَضِيَ اللّٰهُ عَنْهُ قَالَ، قَالَ رَسُوْلُ اللّٰهِ صَلَّى اللّٰهُ عَلَيْهِ وَسَلَّمَ: مَثَلِيْ وَمَثَلُ الْاَنْبِيَاءِ كَمَثَلِ قَصْرٍ اُحْسِنَ بُنْيَانُهٗ، تُرِكَ مِنْهُ مَوْضِعُ لَبِنَةٍ فَطَافَ بِهِ النُّظَّارُ يَتَعَجَّبُوْنَ مِنْ حُسْنِ بَنَائِهٖ اِلَّا مَوْضِعَ تِلْكَ اللَّبِنَةِ، فَكُنْتُ اَنَا سَدَدْتُ مَوْضِعَ اللَّبِنَةِ، خُتِمَ لِيَ الْبُنْيَانُ وَخُتِمَ بِيَ الرُّسُلُ وَ فِيْ رِوَايَةٍ: فَاَنَا اللَّبِنَةُ وَاَنَا خَاتَمُ النَّبِيِّيْنَ. (رواہ البخاری :٣٥٣٥)

٢٣.عَنْ اَنَسٍ رَضِيَ اللّٰهُ عَنْهُ عَنِ النَّبِيِّ صَلَّى اللّٰهُ عَلَيْهِ وَسَلَّمَ قَالَ: اَرْحَمُ اُمَّتِيْ بِاُمَّتِيْ اَبُوْ بَكْرٍ وَ اَشَدُّهُمْ عُمَرُ وَ اَصْدَقُهُمْ حَيَاءً عُثْمَانُ، وَاَقْضَاهُمْ عَلِيٌّ وَ اَفْرَضُهُمْ زَيْدُ بْنُ ثَابِتٍ، وَ اَقْرَءُهُمْ اُبَيُّ بْنُ كَعْبٍ وَ لِكُلِّ اُمَّةٍ اَمِيْنٌ وَ اَمِيْنُ هٰذِهِ الْاُمَّةِ اَبُوْ عُبَيْدَةَ بْنُ الْجَرَّاحِ.

(رواہ احمد والترمذی، مشکوۃ المصابیح، باب مناقب العشرۃ)

٢٤.عَنْ اَبِيْ بَكْرَةَ رَضِيَ اللّٰهُ عَنْهُ قَالَ: رَاَيْتُ رَسُوْلَ اللّٰهِ صَلَّى اللّٰهُ عَلَيْهِ وَسَلَّمَ عَلَى الْمِنْبَرِ وَالْحَسَنُ بْنُ عَلِيٍّ اِلٰى جَنْبِهٖ وَهُوَ يُقْبِلُ عَلَى النَّاسِ مَرَّةً وَعَلَيْهِ اُخْرٰى وَيَقُوْلُ: اِنَّ ابْنِيْ هٰذَا سَيِّدٌ وَ لَعَلَّ اللّٰهَ اَنْ يُّصْلِحَ بِهٖ بَيْنَ فِئَتَيْنِ عَظِيْمَتَيْنِ مِنَ الْمُسْلِمِيْنَ(بخاری: ٢٧٠٤)

٢٥.وَعَنْ عِمْرَانَ بْنِ حُصَيْنٍ رَضِيَ اللّٰهُ عَنْهُ قَالَ قَالَ: رَسُوْلُ اللّٰهِ صَلَّى اللّٰهُ عَلَيْهِ وَسَلَّمَ : خَيْرُ اُمَّتِيْ قَرْنِيْ ثُمَّ الَّذِيْنَ يَلُوْنَهُمْ،ثُمَّ الَّذِيْنَ يَلُوْنَهُمْ.....(متفق علیہ بخاری: ٣٦٥٠)

۲۶۔ عَنْ جَابِرِبْنِ عَبْدِاللّٰهِ رَضِیَ اللّٰهُ عَنْهُ قَالَ: خَطَبَنَا رَسُوْلُ صَلَّی اللّٰهُ عَلَیْهِ وَسَلَّمَ فِیْ وَسْطِ اَیَّامِ التَّشْرِیْقِ خُطْبَةَ الْوَدَاعِ فَقَالَ: یَاَیُّهَا النَّاسُ: اِنَّ رَبَّکُمْ وَاحِد ،وَاِنَّ اَبَاکُمْ وَاحِد اَلَا لَا فَضْلَ لِعَرَبِی عَلٰی عَجَمِی وَلَا لِعَجَمِی عَلٰی عَرَبِیّ، وَلَا لِاَ حْمَرَعَلٰی اَسْوَدَ وَلَا لِاَسْوَدَ عَلٰی اَحْمَرَ اِلَّا بِالتَّقْوٰی. اِنَّ اَکْرَمَکُمْ عِنْدَ اللّٰهِ اَتْقٰکُمْ، اَلَا هَلْ بَلَّغْتُ؟ قَالُوْا بَلٰی یَا رَسُوْ لَ اللّٰهِ، قَالَ: فَلْیُبَلِّغُ الشَّا هِدُ الْغَائِبَ فَلْیُبَلِّغُ الشَّا هِدُ الْغَائِبَ.(البیهقی، شعب الایمان، باب فی حفظ اللسان، فصل فی حفظ اللسان عن الفخر با لأباء)

3۔سیرت النبی ﷺ

(i) مطالعہ سیرت کی ضرورت واہمیت۔

(ii) نبی کریم صلی اللہ علیہ وسلم کی حکمت انقلاب۔(ہجرت، میثاق مدینہ، صلح حدیبیہ اور خطبہ حجۃ الوداع)

(iii) تزکیہ نفس اور تعمیر سیرت وشخصیت کا نبوی منہاج اور عملی نمونے۔

(عشرہ مبشرہؓ، امہات المومنین اور اولاد النبیؐ)

(iv) تشکیل اجتماعیت ومعاشرت اور اسوہ حسنہ۔

4۔ اسلامی تہذیب وثقافت

(الف) اسلامی تہذیب وثقافت کے خصائص۔

توحید، روحانیت، تصور مسؤلیت، انسانی عظمت ومساوات اور عالمگیر اخوت۔

عدل اجتماعی، اخلاقی اقدار، انسانی حقوق، رواداری، اعتدال وتوازن۔

(ب) اسلامی تہذیب وثقافت کے عالمی اثرات

(ج) مغربی تہذیب وثقافت اور اسلام

(i) مغربی تہذیب وثقافت کے خصائص واثرات

(ii) تہذیبوں کے تصادم کے نظریہ کا تنقیدی جائزہ

مجوزہ کتب عربی:

القرآن الکریم

۲۔	الخطیب التبریزی	مشکوۃ المصابیح
۳۔	ابن کثیر الدمشقی	تفسیر ابن کثیر
۴۔	شھاب الدین محمود آلوسی	تفسیر روح المعانی
۵۔	سید قطب	فی ظلال القرآن
۶۔	ابن ہشام	السیرۃ النبویۃ
۷۔	ابوالحسن علی ندوی	قصص النبین (جلد اول تا پنجم)
۸۔	مصطفیٰ امین وعلی الجارم	النحو الواضح فی قواعد اللغۃ العربیۃ (جلد اول تا ششم)
۹۔	ڈاکٹر فاء عبدالرحیم	دروس اللغۃ العربیۃ
۱۰۔	جماعۃ المؤلفین	دائرۃ المعارف الاسلامیۃ (عربی)

MTH--322 Introduction to Calculus 3(3-0)

Preliminaries: Real-number line, functions and their graphs, solution of equations involving absolute values, inequalities. Limits and Continuity: Limit of a function, left-hand and right-hand limits, continuity, continuous functions. Derivatives and their Applications: Differentiable functions, differentiation of polynomial, rational and transcendental functions, derivatives. Integration and Indefinite Integrals: Techniques of evaluating indefinite integrals, integration by substitution, integration by parts.

RECOMMENDED BOOKS

1. Anton H, Bevens I, Davis S, Calculus: A New Horizon (8th edition), 2005, John Wiley, New York
2. Stewart J, Calculus (3rd edition), 1995, Brooks/Cole (suggested text)
3. Swokowski EW, Calculus and Analytic Geometry, 1983, PWS-Kent Company,
4. Boston Thomas GB, Finney AR, Calculus (11th edition), 2005, Addison-Wesley, Reading, Ma, USA
5. N. Khalid, M.K. Iqbal, Mathematics-II Introduction to Calculus, Discover Mathematics Series, 2nd Edition, 2021

ZOL-306 Principles of Animal Life 3(2-1)

Aims and Objectives

Cell division and its significance in cell cycle. Concepts and mechanisms of inheritance pattern, chromosome and gene linkage and molecular basics of genetics. Animal behavior and communication. Theories of evolution, gene flow and mechanism of evolution with reference to animal diversity.

Course Content:

1. Cell Division

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

2. Inheritance Patterns and cellular control

The birth of modern genetics; Mendelian genetics; other inheritance patterns; environmental effects and gene expression.

Eukaryotic chromosomes; linkage relationships; changes in chromosome number and structure. DNA: the genetic material; DNA replication in eukaryotes; genes in action; control of gene expression in eukaryotes; mutations; recombinant DNA technology and its applications.

3. Animal Behavior

Four approaches to animal behavior; proximate and ultimate causes; anthropomorphism; development of behavior; types of behavior; control of behavior; communication; behavioral ecology; social behavior.

4. Evolution: A Historical Perspective

Pre-Darwinian theories of change; Lamarck: an early proponent of evolution; early development of Darwin's ideas of evolution and evidences. The theory of natural selection, adaptations, Alfred Russel Wallace.

5. Evolution and Gene Frequencies

The Hardy-Weinberg theorem; Evolutionary mechanisms: population size, genetic drift, natural selection, gene flow, mutation, and balanced polymorphism; species and speciation; rates of evolution; molecular evolution; mosaic evolution.

Practicals

1. Study of mitosis in onion root tip.

2. Study of meiosis in grasshopper testis
3. Problem based study of Mendelian ratio in animals.
4. Multiple alleles study in blood group.
6. Study of karyotypes of *Drosophila*, mosquito.

Books Recommended :1. Miller, S.A. and Harley, J.B. ZOOLOGY, 4th and 5th Edition (International), 2005. Singapore: McGraw Hill.
2. Hickman, C.P., Roberts, L.S. and Larson, A. INTEGRATED PRINCIPLES OF ZOOLOGY, 12th Edition (International), 2004. Singapore: McGraw Hill.
3. Campbell, N.A. 2002. Biology. 6th Ed. Menlo Park, California: Benjamin/Cummings Publishing Company, Inc.
4. Miller, S.A. 2002. General Zoology Laboratory Manual. 5th Ed. (International),Singapore: McGraw Hill.
5. Hickman, C.P. and Kats, H.L. 2000. Laboratory Studies in Integrated Principles of Zoology. Singapore: McGraw Hill.

PHY-322 Fundamentals of Electricity and Magnetism 3(2-1)

Electric charges, Conductor, Insulators, Coulomb's law, Electric field, Electric field intensity, Flux of electric field, Gauss's law and applications, Potential energy, Electric potential energy, Electric potential, Capacitor, Capacitance, Capacitors in series and parallel, Energy storage in an electric field, Electric current, Electromotive force, Motion of charge particles in electrical and magnetic fields, Analysis of circuits, Resistors in series and parallel, Energy transferred in an electric circuit, Magnetic force on a moving charge, Magnetic force on a current carrying wire, Ampere's law, Faraday law of induction, Lenz's law, Motional emf, Generator and motors, Induced electric fields, Visible light, Speed of light, Reflection and refraction of light waves, Double refraction, Polarization by scattering, Total internal reflection, Diffraction, Single slit diffraction, Diffraction grating, X-ray diffraction, Polarization, Types of polarization,

1. To study the behavior of RLC series circuit and determination of its resonance frequency.
2. To study the behavior of RLC Parallel circuit and determination of its resonance frequency.
3. Calibration of a voltmeter by a potentiometer.
4. Calibration of an ammeter by a potentiometer.
5. To determine the high resistance by Neon flash lamp and a capacitor.

Recommended Books:

1. Halliday, Resnick and Walker, 2011, Fundamental Physics, 9th Ed. Ed, John Wiley and Sons Inc. New York.
2. *Young and Freedman,* 2010 *University Physics* 12th edition.
3. Halliday, Resnick and Krane, 2002. Physics Vol. I & II, 5th Ed, John Wiley and Sons Inc. New York.
4. Sears, Zemansky and Young, 2000, University Physics, 8th Ed, Addison-Wesley. Reading (MA) USA.

Semester 3

CHM-401 Principles of Physical Chemistry 4(3-1)

Chemical Kinetics:
Introduction, rate, molecularity and order of reaction, zero, first and second with same and different initial concentrations, half-lives of reactions, experimental techniques and methods for determination of rate and order of reaction (integration, half-life, initial rate, and graphical methods), activation energy and Arrhenius equation. Collision theory, transition state theory.

Chemical Equilibrium:
General equilibrium expressions, reaction quotients, examples of equilibrium reactions in solid, liquid and gas phases, extent of reactions and equilibrium constants, effect of temperature and pressure on the equilibrium constants/compositions, von't Hoff equation, Le-Chatelier's principle.

Basic Quantum Chemistry
Limitations of classical mechanics, Wave and particle nature of matter, de Broglie equation, Heisenberg uncertainty principle. Schrodinger wave equation and its solution for particle in one dimensional box. Concept of quantization of energy

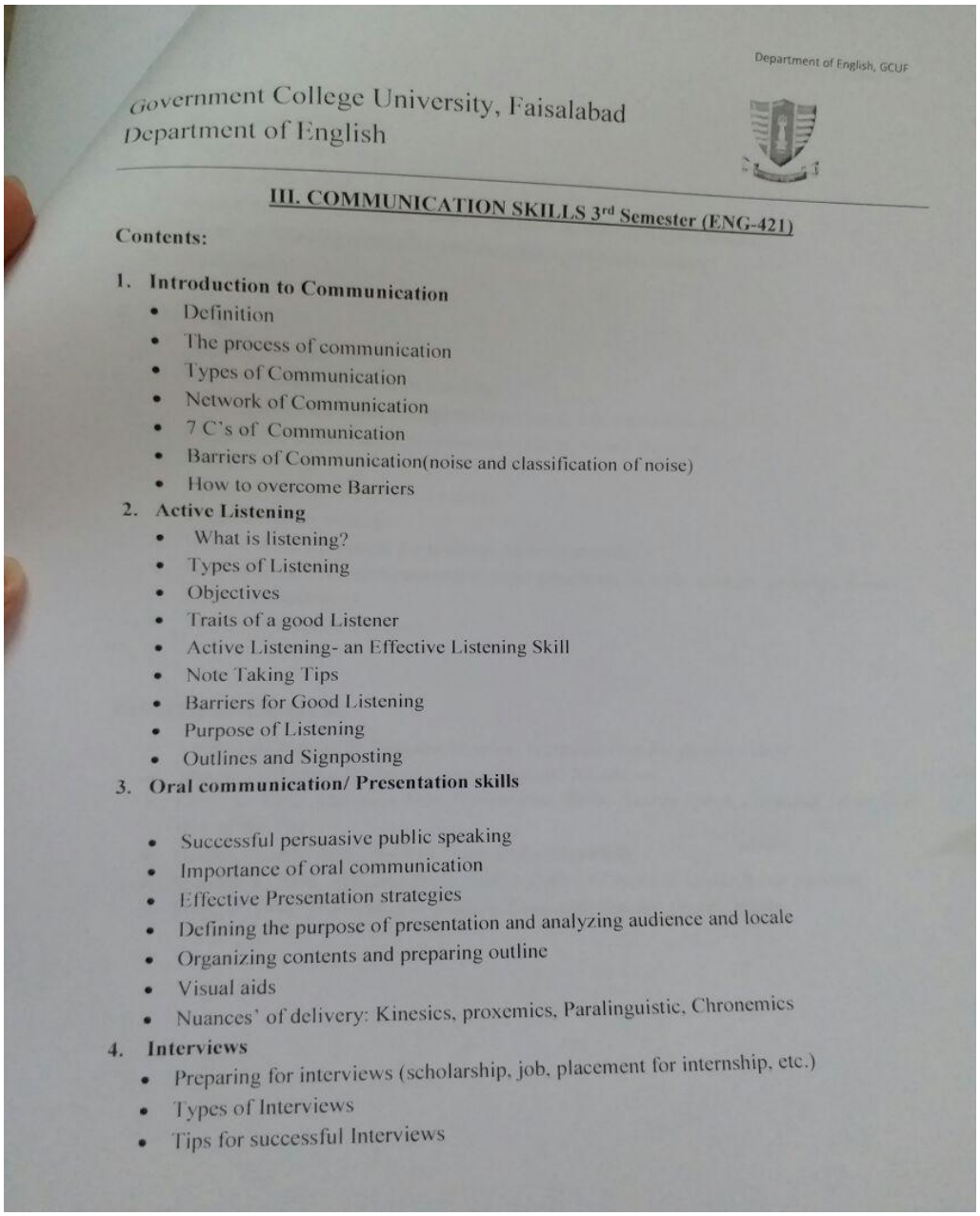
CHM-401 Practicals

- Determination of viscosity and parachor values of liquids.
- Determination of percent composition of liquid solutions by viscometer
- Determination of refractive index and molar refractivity.
- Determination of percent composition of liquid solutions by refractive index measurements.
- Determination of molecular weight of a compound by elevation of boiling point (ebullioscopic method).
- Determination of molecular weight of a compound by lowering of freezing point (cryoscopic method).
- Determination of heat of solution by solubility method.
- Determination of heat of neutralization of an acid with a base.

Books Recommended:

1. R. Albert, "Physical Chemistry" 17th Ed., John Wiley and Sons, USA (1987).
2. P. W. Atkins, "Physical Chemistry" 6th Ed, W. H. Freeman and co. New York, USA (1998).
3. K. J. Laidler, "The World of Physical Chemistry" 1st Ed., Oxford University Press USA (1993).
4. K. J. Laidler, H. M. John, C. S. Bryan, "Physical Chemistry" 4th Ed., Houghton Mifflin Publishing Company Inc. (2003).
5. P. A. Peter, "Chemical Thermodynamics", 4th Ed, Oxford University Press, USA (1983).
6. S. E. Brain, "Basic Chemical Thermodynamics" 4th Ed., E. L. B. S. Publishers, (1990).
7. M. G. Barrow, "Physical Chemistry" 5th Ed, Mc Graw Hill (1992).

ENG-421	Communications Skills	3(3–0)



Government College University, Faisalabad
Department of English

III. COMMUNICATION SKILLS 3rd Semester (ENG-421)

Contents:

1. **Introduction to Communication**
   - Definition
   - The process of communication
   - Types of Communication
   - Network of Communication
   - 7 C's of Communication
   - Barriers of Communication(noise and classification of noise)
   - How to overcome Barriers
2. **Active Listening**
   - What is listening?
   - Types of Listening
   - Objectives
   - Traits of a good Listener
   - Active Listening- an Effective Listening Skill
   - Note Taking Tips
   - Barriers for Good Listening
   - Purpose of Listening
   - Outlines and Signposting
3. **Oral communication/ Presentation skills**
   - Successful persuasive public speaking
   - Importance of oral communication
   - Effective Presentation strategies
   - Defining the purpose of presentation and analyzing audience and locale
   - Organizing contents and preparing outline
   - Visual aids
   - Nuances' of delivery: Kinesics, proxemics, Paralinguistic, Chronemics
4. **Interviews**
   - Preparing for interviews (scholarship, job, placement for internship, etc.)
   - Types of Interviews
   - Tips for successful Interviews

5. **Reading skills**
   - Importance of Reading
   - Definition of Reading
   - Levels of Reading
   - Requirements of Reading, improving reading rates and comprehnsion
   - Types of Reading (intensive and extensive, and speed reading)
   - Study skills

6. **Writing**
   - Writing formal letters
   - Memos writing, minutes of meetings,
   - Writing different kinds of applications (leave, job, complaint, etc.)
   - Preparing a Cover Letter, Curriculum Vitae (CV) and Resume
   - Writing reports
   - Types of reports, structure of reports
   - Progress report writing
   - How to write a proposal for research paper/term paper
   - How to write a research paper/term paper (emphasis on style, content, language, form, clarity, consistency)
   - Technical Proposals writing

Recommended Readings:

- Meenakshi Raman & Sangeeta Sharma: Technical Communication. OUP
- Murphy, Effective Business Communication, 7th edition
- Ellen, K. 2002. *Maximize Your Presentation Skills: How to Speak, Look and Act on Your Way to the Top*
- Hargie, O. (ed.) *Hand book of Communications Skills*
- Mandel, S. 2000. *Effective Presentation Skills: A Practical Guide Better Speaking*
- Mark, P. 1996. *Presenting in English*. Language Teaching Publications

PST-321 Pakistan Studies 2(2-0)

COURSE OUTLINE:

Regeneration of Muslim Society in sub-continent and causes of decline of Muslim Rule
War of Independence 1857 and its impacts upon the politics of South Asia.
Sir Syed Ahmed Khan and Aligarh Movement:

- Educational Services
- Political Services
- Rational Interpretation of Islam

All India Muslim League:

- Multiple approaches and causes of the formation of Muslim League.
- Objectives of the party.
- Comparison of the policies of All Indian National congress and All India Muslim League.
- Politics of Muslim League after the creation of Pakistan

Luckhnow Pact 1916, high water mark of Hindu-Muslim Unity.
Khilafat Movement:

- Khilafat as an institution.
- Hindu-Muslim Unity.
- Role of Gandhi
- Emergence of Muslim Ulma in Indian politics.
- Causes of the failure and impacts of the movement.

Iqbal's Address at Allahabad 1930 and political thoughts of Ch. Rehmat Ali.
Congress Ministries.
Pakistan Resolution 1940.
Muhammad Ali Jinnah:

- Jinnah's role in Indian politician.
- As a governor General

Initial problems and constitutional development in Pakistan.
The study of constitutions of Pakistan (1956-1962-1973)
Political culture of Pakistan.
Foreign Policy of Pakistan:

- Major determinants and objectives
- Overview.

Recommended Books:

- Ikram Rabbani, *Pakistan Studies*, Carvaan Publishers.
- M. R. Kazimi, *Pakistan Studies,* Oxfiord University Press.
- Khalid Bin Saeed, *Pakistan the Formative Phase*.
- I.H. Qureshi, *Struggle for Pakistan,* Karachi: Oxford, 1995
- Safdar Mahmood, *Pakistan: Political Roots and Development*, 1947-1999, Karachi, Oxford, 2000.

CHM-403 Environmental Chemistry 3(3-0)

Course Objectives: Students will be able to acquire knowledge and develop understanding about the fundamental principles of environmental chemistry and different types of pollutions. Such information will be useful in studying and solving pollution related issues and experiments in the laboratory.

Course Contents: Atmospheric Pollution: The atmosphere, composition, temperature and pressure profile, role of free radicals in the atmosphere, temperature inversion and photochemical smog, particulate matter in the atmosphere, Industrial pollutants, 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 source and their treatment, eutrophication, detergents and phosphates in water, water quality criteria, water purification: primary, secondary and advanced treatment. Heavy metals contamination of soilbio-accumulation of heavy metals, organic matter in soil, macro and micro-nutrients in soil, ion- exchange in soil, soil pH and nutrients availability. Green Chemistry and its modern practices.

Recommended Books:

1. Baird, C. and Cann, M., Environmental Chemistry, 5 th ed., W. H. Freeman & Company, (2012). 2. Dara, S. S. and Mihsra, D. D., A Text Book of Environmental Chemistry and Pollution Control, 9 th ed., S. Chand & Co. Ltd., (2004). 3. Singhi, R. and Singh, V., Green Chemistry for Environmental Remediation, John-Willey & Sons, Inc., (2011). 4. Holloway, A. M. and Wayne, R. P., Atmospheric Chemistry, 1 st ed., Royal Society of Chemistry, (2010). 5. Vaclavikova, M., Vitale, K., Gallios, G. P. and Ivanicova, L. Water Treatment Technologies for Removal of High Toxicity Pollutants, Springerlink, UK, (2010). 6. Manahan, S. E., Environmental Chemistry, 9 th ed., CRC press, Taylor & Francis group, USA, (2009). 7. Girard, J. E., Principles of Environmental Chemistry, 2 nd ed., Jones and Bartlett publishers, (2010). 8. Harrison, R. M., Monks, P., Farmer, J. G., Graham, M. C., Mora, S. J., Pulford, I. and Hulsal, C., Principles of Environmental Chemistry, 1 st ed., Royal Society of Chemistry, (2007). 9. Matalack, A., Introduction to Green Chemistry, 2 nd ed., CRC press, Taylor & Francis group, USA, (2010). 10. Wright, J., Environmental Chemistry, Routledge, (2003). 11. O'Neill, P., Environmental Chemistry, 3 rd ed., Blackie Academic &

ZOL-405 Diversity of Invertebrates and Vertebrate 3(2-1)

Course Objectives:

1. To provide the knowledge of evolutionary/phylogenetic relationship (from simple to the complex organisms).
2. To impart the basic taxonomic characteristics and classification of all the invertebrate phyla.
3. To provide understanding of body organization, Feeding and Digestive system; Other Organ System;
4. To provide the description of mode of Reproduction and Development
5. To provide the information of their economic and ecological importance

Course Learning Outcomes:

This course will be based on following outcomes:

1. Acquire the basic concepts of invertebrates with explanation of evolutionary origin and diversification.
2. Understand invertebrate organismal concepts in laboratory and field.
3. Demonstrate major evolutionary innovations for invertebrates with functional importance.

4. Understand how reproduction and development occured and able to breed animal in the laboratory/feild

5. Analyze economic and ecological importance of invertebrates.

Course Contents:

Note: The minimum details of the titles in the content must be of the principal book Zoology by Miller and Harley. This must be kept in view in teaching and assessments.

1. INTRODUCTION

a. Classification of Organisms:

b. Evolutionary Relationships and Tree Diagrams: Patterns of organization.

2. ANIMAL-LIKE PROTISTS: THE PROTOZOA

a. Evolutionary perspective; Life within a single plasma Membrane;

b. Symbiotic Life-styles.

c. Protozoon Taxonomy; (up to Phyla, subphyla and super Classes, wherever applicable).

d. Pseudopodia and Amoeboid Locomotion; Cilia and other pellicular structure;

e. Nutrition; Genetic Control and Reproduction; Symbiotic ciliates; Nutrition; Genetic Control and Reproduction; Symbiotic ciliates;

f. Further Phylogenetic Consideration.

3. MULTICELLULAR AND TISSUE LEVELS OF ORGANIZATION

a. Evolutionary Prespective:

b. Origins of Multicellularity; Animal Origins.

Phylum Porifera

a. Characteristics and classification. Cell Types, Body Wall, and Skeletons;

b. Water Current and Body Forms;

c. Maintenance Functions, Reproduction.

Phylum Cnidaria (Coelenterate)

a. Characteristics and classification. The body Wall and Nematocysts: Alteration of Generations;

b. Maintenance Functions; Reproduction and

c. Classification up to Class.

Phylum Ctenophore;

a. Characteristics, body organization

4. THE TRIPLOBLASTIC AND WITH ACOELOMATE BODY PLAN PHYLUM PLATYHELMINTHES

a. Evolutionary Perspective; Classification up to class;

b. The Free-Living Flatworms and the Tapeworms, adaptive modification for parasitic life style

Phylum Numerate; Characteristics, body organization

Phylum Gastrotrich; Characteristics, body organization

5. PSEUDOCOELOMATE BODY PLAN

PHYLUM ASCHELMINTHS

a. Evolutionary perspective; General Characteristics; Classification up to order with External Features;

b. Feeding and Digestive system; Other Organ System; Reproduction and Development including Phylum Rotifera, Phylum Nematoda and Phylum Kinorhyncha.

c. Some Important Nematode Parasites of Humans;

6. PHYLUM MOLLUSCA

a. Evolutionary perspective; Relationship to other animals; Origin of the Coelom;

b. Molluscan Characteristics, Classification up to class. The Characteristics of Shell and Associated Structures,

c. Feeding, Digestion, Gas Exchange, Locomotion,

d. Reproduction and Development, Other maintenance Functions and Diversity in Gastropods, Bivalves and Cephalopods:

7. PHYLUM ANNELIDA

a. The Metameric Body Form; Evolutionary perspective; Relationship to other animals,

b. Metamerism and Tag-matization, Classification up to Class. External Structure and Locomotion,

c. Feeding and the Digestive system, Gas Exchange and Circulation,

d. Nervous and Sensory Functions, Excretion, e. Regeneration, Reproduction and Development, in Polychaeta, Oligochaeta and Hirudinea, Further Phylogenetic Consideration.

8. PHYLUM ARTHROPODA:

a. Evolutionary Perspective: Classification and Relationship to other Animals;

b. Metamerism and Tagmatization;

c. The Exoskeleton; Metamorphosis;

d. Classification up to Class; Further Phylogenetic Consideration.

9. The Hexapods and Myriapods:

a. Evolutionary Perspective: Classification up to class. External Structure and Locomotion,

b. Nutrition and the Digestive system, Gas Exchange, Circulation and Temperature Regulation,

c. Nervous and Sensory Functions, Excretion, Chemical Regulation,

d. Reproduction and Development in Hexapoda, e. Insects Behavior, Insect and Human;

10. PHYLUMECHINODERMS

a. Evolutionary Perspective: Relationship to other Animals; Echinoderm Characteristics; Classification up to class.

b. Maintenance Functions, Regeneration,

c. Reproduction, and Development in Asteroida, Ophiuroidea, Echinoidea, Holothuridea and Crinoidea; SOME LESSER-KNOWN INVERTEBRATES;

a. The Lophophorates, Entoprocts, Cycliophores, and Cheatognaths.

Practical:

Note: Classification of each members of each phylum upto order with adaptions in relation to habitat of the specimen. Preserved Specimen and or colored projection slide and or CD ROM projection of computer must be used.

1. Study of Euglena, Amoeba, Endameba, Plasmodium, Trypanosome, Paramecium as representative of animal like Protists.
2. Study of prepared slides of sponges, spicules of songes, and their various body forms. Study of representatives of classes of Phylum Porifera.
3. Study of principal representatives of classes of Phylum Coelenterate.
4. Study of principal representatives of classes of Phylum Platyhelminthes.
5. Study of representatives of phylum Rotifer, Phylum Nematode.
6. Study of principal representatives of classes of Phylum Mollusca.
7. Study of principal representatives of classes of Phylum Annelida.
8. Study of principal representatives of classes of groups of Phylum Arthropoda
9. Study of representatives of classes of phylum Echinodermta.
10. Preparation of permanent mount of Leucosolenia, Obelia, Hydra, Proglottid of Tapeworm, Parapodia of Nereis and Daphnia. Drawing and labeling.
11. Preparation of permanent slide of mouthpart of insects (after dissection). Drawing and labeling.
12. How to make grade-wise series for preparation of temporary and permanent slides.

Recommended Book:

1. Miller, A.S. and Harley, J.B. ; 1999 , 2002., 2007, 2009, 2012 & 2016 Zoology, 4th , 5th, 6th, 7th, 8th , 9th& 10th Edition (International), Singapore : McGraw Hill. Additional Readings:

2. Hickman, C.P., Roberts, L.C/, AND Larson, A., 2018. INTEGRATED PRINCIPLES OF ZOOLOGY, 15th Edition (International), Singapore: McGRAW-Hill.
3. Hickman, C.P., Roberts, L.C/, AND Larson, A., 2007. INTEGRATED PRINCIPLES OF ZOOLOGy, 12th& 13th Edition (International). Singapore: McGraw-Hill.
4. Pechenik, J.A., 2015. BIOLOGY OF INVERTEBRATES, 7th Edition, (International), Singapore: McGraw-Hill.
5. Kent, G. C. and Miller, S., 2001. COMPARATIVE ANATOMY OF VERTEBRATES New York: McGraw-Hill.
6. Campbell, N.A., 2002; BIOLOGY 6 th Edition, Menlo Park, California; Benjamin Cummings Publishing Company, Inc. BOOKS FOR PRACTICAL
7. Miller, S.A., 2002. GENERAL ZOOLOGY LABORATORY MANUAL. 5th Edition (International), Singapore : McGraw-Hill. 8. Hickman, C.P. and Kats, H.L., 2000. Laboratory Studies in integrated principal of zoology. Singapore : McGraw-Hill.
8. Hickman, C.P. and Kats, H.L., 2000. Laboratory Studies in integrated principal of zoology. Singapore : McGraw-Hill.

BOT-403 Principles of Cell Biology, Genetics and Evolution 3(2-1)

Objectives of course: To understand: 1. Structure and function of cell 2.Nature of genetic material and hereditary process 3.Familiarization with evolutionary process
Course Outline: a) Cell Biology 1. Structure and Function of Bio-molecules i) Carbohydrates ii) Lipids iii) Proteins iv) Nucleic Acids 2. Brief description of the following cell organelles i) Cell wall ii) Cell membrane iii) Nucleus iv) Endoplasmic reticulum v) Plastids vi) Mitochondria vii) Ribosomes viii) Dictyosomes Genetics 1. Introduction and scope Mendelian inheritance; Laws of segregation and independent assortment, 2. Molecular genetics; DNA replication, transcription, translation, protein synthesis 3. Chromosomal aberrations; Changes in the number and structure of chromosomes. c) Evolution: Introduction and theories **Lab outline** 1. Study of cell structure using compound microscope and elucidation of ultrastructure from electron microphotographs. 2. Measurement of cell size. 3. Extraction and estimation of carbohydrate, protein, RNA and DNA from plant sources. 4. Genetical problems related to transmission and distribution of genetic material. 5. Identification of DNA in plant material.

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.

ISL- Translation of the Holy Quran-II 1(1-0)

Semester 4

CHM-402 Principles of Analytical Chemistry 4(3-1)

Introduction: Analytical chemistry and analysis, Application of analytical chemistry in other disciplines of sciences, Qualitative and quantitative analysis, Classification of analytical techniques, Steps of a typical chemical analysis. **Data handling:** Analytical concepts of errors, precision, accuracy (sources, control and applications), rounding off the data, significant figures, arithmetic mean, median, mode, absolute error, relative errors, relative accuracy, standard deviation, coefficient of variation and variance. **Laboratory Tools: S**pecification, applications and handling of various glassware used in analytical laboratory, Specifications and grades of chemicals and reagents, Expression of quantities and concentrations. S**ampling:** Samples and their types, sampling of solid, liquid and gases. **Solvent Extraction:** Principle, distribution coefficient (Kd) and distribution ratio (D), factors affecting the extraction efficiency, types, and practical applications of solvent extraction in chemical analysis. **Quality assurance and quality control:** Concept of quality assurance, quality control and quality assessment, elaboration with examples and application.

Practical

1. Laboratory materials, reagents, and safety measures,
2. Calibration of volumetric glassware,
3. Preparation and standardization of reagents and solutions,
4. Solvent extraction of organic compounds
5. Single step and multiple batch solvent extraction and comparison of efficiency

Books Recommended

1. Christian, G.D. 2014. Analytical Chemistry. 7th edition, John Wiley and Sons, New York
2. Skoog D.A., D.M. West and F.J. Holler, 2013. Fundamentals of Analytical Chemistry. 9th Ed. Harcout College Publishers.
3. Reilley, C. 1993. Laboratory Manual of Analytical Chemistry. Allyn & Bacon, London
   Harvey, D. Modern Analytical Chemistry, 1st Ed, McGraw-Hill, USA, (2000).

ENG-422	Technical Writing	3(3–0)

Contents: Basic factors of Technical Writing

Basic principles of technical writing style of Report Writing (Academic)

What is Report Writing?, When we need to writeReports, Prior preparation and planning, Structure and sections of a Report, Writing style and written language appropriate for report writing: Write a short report on any social or university issue**.**

Proposal Writing:

Types of proposals: Business proposal, Research proposal, Factors to consider while
preparing an academic research proposal, Structure and sections of an academic research proposal Writing style and written language appropriate for an academic research proposal: Analysis of a sample academic research proposal

Plagiarism and Citation:

What is plagiarism, How to avoid plagiarism, How to cite: Different styles to cite others' work.

How to do and write an academic research

Sources of research (primary, secondary and tertiary source), Sections of an academic research paper analysis and synthesis in academic writin

CHM-404 Chemistry of Biomolecules 3(3-0)

Course Objectives: Students will gain knowledge about fundamental concepts of biochemistry as well as be able to learn about the structures, properties and functions of amino acids, proteins, carbohydrates, lipids and nucleic acids,

Course Contents : Carbohydrates, Lipids and Proteins: 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. 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. 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 quatenary 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.

Recommended Books:

1. R. C. Alkire, D. M. Kolb, J. Lipkowski, Biselectro chemistry, volume 13, 13th ed., Publisher: Wiley-VCH Verlag GmbH & Co. ISSN: 0938-5193.
2. Nelson,D.L., Lehninger's Principles of Biochemistry, 6 th ed., Publisher: Macmillan Higher Education, (2008). ISBN: 149222638, 9781429222631.
3. Voet, D. and Voet, J.D., Biochemistry, 4 th ed., illustrated. Publisher: John- Wiley & Sons Canada, Limited, (2011). ISBN: 0470917458, 9780470917459.
4. Murray, R.M. and Harper, H.A., Harper's Biochemistry, 25th ed., Publisher:Appleton & Lange, (2000). ISBN: 0838536840, 9780838536841.
5. Zubay, G. L., Biochemistry, 4 th ed., illustrated, Publisher W. M. C. Brown Publishers, (1998), Digitized (2008). ISBN: 0697219003, 9780697219008.
6. Guyton, A. C. & Hall, J. E., Guyton & Hall Textbook of Medical Physiology, 12th ed., Publishers: Saunders Elsevier, (2011). ISBN: 978-1-4160-4574-8.
7. Harvey, R. A., Ferrier, DR, Karandish S., Lippincott's illustrated Reviews: Biochemistry, 5 th ed., and Biochemistry Map (Med maps) Bundle. Publisher: Lippincott Williams & Wilkins, (2010). ISBN: 1451116314, 9781451116311.

CHM-406 Industrial Chemistry 3(3-0)

Course Objectives: The objectives of the course are to educate the students about the fundamentals of chemical industry raw materials, manufacturing and industrial processes.

Course contents: Fundamentals of Chemical Industry: Basic principles and parameters for industrial plant unit operations and unit processes. Chemical Industries: Raw materials, flow sheet diagrams and unit operations and unit processes of sulphuric acid, nitric acid, hydrochloric acid, oxalic acid, formic acid, caustic soda and washing soda, cement industry, petroleum, textile, polymer and fuel industries, applications of these industries.

Recommended Books:

1. Kent, J. A., Riegel's Handbook of Industrial Chemistry, 10th ed., Kluwer Academic/ Plenum Publishers, (2003).
2. Vermani, O. P. and Narula, A. K., Applied Chemistry; Theory and Practice, New Age International Pvt. Ltd. Publishers, (2008).

3. Hede, P. D., Bier. S.P., Inorganic and Applied Chemistry, Ventus publishing app., (2007).
4. Sharma, J., Ndi., Applied Industrial Chemistry, Arise publishers & Distributors, (2012).
5. Heaton, A., An introduction to Industrial Chemistry, 3 rd ed., Chapman &

BOT-406 Plant Physiology and Ecology 3(2-1)

Plant Physiology 1. Absorption and translocation of water. Stomatal regulation. 2. Mineral nutrition: Soil as a source of minerals. Passive and active transport of nutrients. Essential and non- essential mineral 3. Photosynthesis: Introduction,light reactions (electron transport and photophosphorylation) and dark reactions (Calvin cycle). Differences between C3 /C4 and CAM plants. 4. Respiration: Definition Mechanism-Glycolysis, Krebs cycle. Electron transport and oxidative phosphorylation. b) Ecology 1. Introduction, aims and applications of ecology. 2. Soil: Physical and Chemical properties organism and organic matter etc) and their relationships to plants. 3. Light and Temperature. Quality of light, diurnal and seasonal variations. 4. Water: Field capacity and soil water holding capacity. Characteristics of xerophytes and hydrophytes. 5. Wind: Wind as an ecological factor and its importance. 6. Population Ecology: Introduction. A brief description of seed dispersal and seed bank. 7. Community Ecology i. Ecological characteristics of plant community ii. Methods of sampling vegetation (Quadrat and line intercept) 8. Ecosystem Ecology i. Definition, types and components of ecosystem. ii. Food chain and Food web. 9. Applied Ecology: 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 porometer/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. Measurements of wind velocity. 8. Measurement of light and temperature. Effect of light and temperature on seed germination

ZOL-406 Animal Form and Function 3(2-1)

Course Learning Outcomes:

1. **Acquire** the concept that for the performance of a function for example exchange of respiratory gases the different forms are adapted in t environments e.g. gills in aquatic and lungs in terrestrial environment.
2. **Understand** that diverse forms adapted to perform the same functions are because of the different past and present conditions.
3. **Solve** of emergence of diversity of forms for the performance of similar function.
4. **Analyze** the requirements of diverse forms for the performance of similar function in their past and present needs.
5. **Evaluate** the adaptations in forms for its efficiency in managing the function in differing situations in the past and present times.

Course Contents

1. Nutrition and Digestion

Evolution of nutrition; the metabolic fates of nutrients in heterotrophs; digestion; animal strategies for getting and using food, diversity in digestive structures of invertebrates and vertebrates; the mammalian digestive system:

2. Temperature and Body Fluid Regulation

Homeostasis and Temperature Regulation; The Impact of Temperature on Animal Life; Heat Gains and Losses; Temperature Regulation in Invertebrates, Invertebrate and Vertebrate Excretory Systems; How Vertebrates Achieve Osmoregulation; Vertebrate Kidney Variations; Mechanism in Metanephric Kidney Functions.

3. Reproduction and Development

Asexual reproduction in invertebrates; advantages and disadvantages of asexual reproduction; sexual reproduction in invertebrates; advantages and disadvantages of sexual reproduction; sexual reproduction in vertebrates; reproductive strategies; examples of reproduction among various vertebrate classes..

4. Descriptive Embryology

Fertilization; embryonic development: cleavage, and egg types; the primary germ layers and their derivatives; echinoderm embryology; vertebrate embryology: the chordate body plan.

5. Protection, Support, and Movement

Protection: the integumentary system of invertebrates and vertebrates; movement and support: the skeletal system of invertebrates and vertebrates; movement: non-muscular movement; an introduction to animal muscles; the muscular system of invertebrates and vertebrates.

6. Communication

Neurons: structure and function; neuron communication: introductory accounts of resting membrane potential, action potential (nerve impulse) and transmission of the action potential between cells. Sensory reception of invertebrates and vertebrates. Chemical messengers: hormones chemistry; and their feedback systems; mechanisms of hormone action; Hormones with principal function of invertebrates and vertebrates.

7. Circulation, Immunity and Gas Exchange

Internal transport and circulatory systems in invertebrates and transport systems in vertebrates; Immunity: nonspecific defenses, the immune response; gas exchange: respiratory surfaces; invertebrate and vertebrate respiratory systems: cutaneous exchange, gills, lungs, and lung ventilation; human respiratory system: gas transport.

Practicals

1. Study of excretory system in an invertebrate and a vertebrate representative (Model).
2. Study of male reproductive system in an invertebrate and a vertebrate representative (Dissection and Model).
3. Study of female reproductive system in an invertebrate and a vertebrate representative (Dissection).
4. Study of preserved advanced stages of avian and mammalian development for amniotic membranes and placenta (performance/Model).
5. Model study of insect chitin, fish scale, amphibian skin, reptilian scales,feathers and mammalian skin.
6. Study and notes of skeleton of Labeo, Rana tigrina, Varanus, fowl and rabbit alongwith models.
7. Study of nervous system of earthworm and a fish.
8. Study of endocrine system in an insect and a rabbit.
9. Study of heart, principal arteries and veins in a representative vertebrate (dissection of representative fish/mammals).

Books Recommended

1. Miller, S.A. and Harley, J.B. ZOOLOGY, 10th Edition (International), 2016. Singapore: McGraw Hill.

2. Hickman, C.P., Roberts, L.S. and Larson, A. INTEGRATED PRINCIPLES OF ZOOLOGY, 17th Edition (International), 2017. 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.

Semester 5

CHM-501 Inorganic Chemistry-I 4(3-1)

1. BONDING MODELS FOR NON TRANSITIION ELEMENTS

(a) Covalent bond. VSEPR model followed by VBT for prediction of geometries of molecules and ions containing sigma bonds as well as pi bonds. MOT for homonuclear and heteronuclear diatomic molecules.

(b) Metallic bond. Band theory to describe conductors, insulators and semiconductors.

(c) 3 center 4 electrons bond, 3 center 2 electrons bond, bent bond, H bonding.

2. CHEMISTRY OF COORDINATION COMPOUNDS

Nomenclature, theories of bonding (Werners theory, Sigwick theory, Chain theory, VBT, CFT, LFT). Stereochemistry of coordination compounds, Coordination geometries (CN 2 6). Preparation of coordination compounds Stability of coordination compounds. Spectrochemical series. Application of coordination compounds in Chemistry, life and industry.

3. LANTHANIDES AND ACTINIDES

Historical survey, occurrence, separation and preparation. Oxidation states, magnetic properties of Lanthanides and Actinides. Lanthanides contraction. Applications and uses of elements and their compounds.

CHM-501 Practicals

1. Separation of cations by paper chromatography: (Pb^{2+},Cd^{2+},Cu^{2+},Co^{2+},Ni^{2+},Ag^{1+})
2. Preparation And Characteristation Of Complex Compounds:

(i) Sodium Cobaltinitrate (ii)Potassium trioxalato aluminate (iii) Ammonium Nicke II Sulphate (iv) Hexa aqua Chromium III chloride).

3. Complexometric Titration (Any four) Cu^{2+} / Ni^{2+};Ca^{2+} /Ba^{2+};Au^{2+} /Pb^{2+};Cd^{2+} /Zn^{2+};Ni^{2+} /Mg^{2+};Ca^{2+} /Zn^{2+}

Books Recommended:

1. P. Atkins, L. Jones, "Chemical Principles" 2nd Ed, Freeman and Company (2002).
2. F. Basolo, R. C. Johnson, "Coordination Chemistry: The Chemistry of Metal Complexes" W. A. Benjamin, Inc. (1964).
3. J. E. Brady, J. R. Holum, "Chemistry-The Study of Matter and Its Changes" 3rd Ed, John Wiley and Sons, Inc. (2000).
4. B. Douglas, D. McDaniel, J. Alexander, "Concepts and Models of Inorganic Chemistry" 3rd Ed John Wiley & Sons, Inc. (1994).
5. S. F. A. Kettle, "Coordination Compounds" 1st Ed, Thomas Nelson & Sons Ltd. (1969).
6. G. L. Miessler, A. T. Donald, "Inorganic Chemistry" 2nd Ed, Prentice-Hall International, Inc. Prentice-Hall, (1991).
7. D. F. Shriver, P.W. Atkins, C. H. Langford, "Inorganic Chemistry". 2nd Ed, Oxford University Press. USA (1994).

CHM-503 Organic Chemistry-I 4(3-1)

Acids and Bases

Concepts of acids and bases; scale of acidity and basicity; pka values; predicting acids/basis reactions from pKa values; the effect of structure on the strengths of acids and bases, field effects, resonance effects, steric effects, hydrogen bonding effects and hybridization effects, the effect of the medium on the strengths of acids and bases; the Hammett and Tafts equations, applications and limitations.

Stereochemistry

Introduction; optical isomerism; optical activity, chirality, symmetry elements and optical inactivity, relative and absolute configuration, R, S notation, methods of determining configuration. Racemic mixtures and their resolution, asymmetric synthesis, optical activity in biphenyls, alkenes and spiro compounds, stereospecific and stereoselective reactions; Geometrical isomerism. Determination of configuration of geometrical isomers, Z, E, conventions cis-and trans- isomerism in cyclic systems; Conformational isomerism conformational analysis of monosubstituted cyclohexanes, disubstituted cyclohexanes and decalin systems.

Oxidation Reduction Reactions:

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

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

CHM-503 Practicals

Purification Techniques: Fractional distillation, fractional distillation under reduced pressure and fractional crystallization

Mixture Analysis: Analysis of two component mixture.

Books Recommended:

1. B. S. Fumiss, A. J. IIannaford, P.W.G. Smith, A. R. Tatchell "Vogel's Practical Organic Chemistry", 5th Ed, Addition Wesley Longman, Harlow, England(1989).
2. J. Leonard, B. Lygo, G. Proctro, "Advanced Practical Organic Chemistry" 2nd Ed, Chapman, & Hall, London (1995).
3. H. L. Clarke, D. Hynes, "A Hand Book of Organic Analysis", Edward Arnold, London, (1995).
4. F. A Carey, R. J Sunderg, "Advanced Organic Chemistry". 3rd Ed, Part A & B, Pleman Press, New York, USA (1990).
5. K. Mislow "Stereochemistry", 2nd Ed, W. A. Benjamin Inc. New York, USA (1965).
6. E. L Eleil, S. H Wilen, L. N Mander, "Stereochemistry of Organic Compounds", 4th Ed, John Wiley & Sons, USA (1994).
7. S. H. Pine, "Organic Chemistry", 5th Ed, McGraw Hill, New York, USA (1987).
8. G. M. London, "Organic Chemistry", Addison Wesley, London, UK (1998).

CHM-505 Physical Chemistry I 4 (3-1)

Kinetic Theory of Gases

Virial equations. Maxwells law of molecular velocities. Calculation of molecular velocities and binary collisions. Maxwell-Boltzmanns law of energy distribution.

Chemical Thermodynamics

Relation of entropy and energy with equilibrium constant and their dependence on temperature. Clausius-Clapeyron equation. Chemical potential. Partial molar quantities.

Chemical Kinetics

Integrated rate laws second and third order reactions with same and different initial concentrations of reactants. Elementary and complex reactions opposing, parallel and consecutive reactions. Steady state approximation, Lindemann theory of unimolecular reactions. Chain reactions, kinetics of interfacial reactions.

CHM-505 Practicals

- Equilibrium constant of the KI + I_2 = Kl_3 reaction
- Kinetics of saponification of ethyl acetate
- Acid catalyzed hydrolysis of sucrose
- Study of the adsorption isotherms of acetic acid charcoal system
- Study of the charge transfer complex formation between iodine and benzene
- Determination of activation energy for the acid catalyzed hydrolysis of ethyl acetate
- Determination of partial molar volumes
- Determination of partition coefficient of a substance in two immiscible liquids.

Books Recommended:

1. R. A. Alberty, J. S. Robert, G. B. Moungi, "Physical Chemistry". 4th Ed, John Wiley and Sons (2004).
2. D. W. Ball, "Physical Chemistry" 1st Ed, Brooks/Cole Co. Inc. (2003).
3. Engel, Thomas, P. Reid, "Thermodynamics, Statistical Thermodynamics, and Kinetics" 1st Ed, Benjamin Cummings (2006).
4. K. James, P. Wothers, "Why Chemical Reactions Happen". 5th Ed, Oxford University Press, USA (2003).
5. Smith, E. Brian, "Basic Chemical Thermodynamics" 5th Ed, Imperial College Press, (2004).
6. B. R. Stephen, S. A. Rice, J. Ross, "Physical Chemistry" 2nd Ed., Oxford University Press, USA (2000).
7. I. Chorkendorff, J. W. Niemantsverdriet, "Concepts of Modern Catalysis and Kinetics" 1st Ed, John Wiley and Sons, USA (2003).
9. J. H. Espenson, "Chemical Kinetics and Reaction Mechanism" 2nd Ed, McGraw Hill (2002).

CHM-507 Analytical Chemistry-I 4(3-1)

Analytical processes: Accuracy of analytical processes such as weighing, volume measurements, precipitation, washing, filtration, and ignition. **Data handling/Statistical analysis**: confidence limits, confidence interval, student t-test, F-test etc. and their applications. **Ionic Equilibria in Solutions:** Activity and activity coefficients, Hydrogen ion activity and pH for weak acids and bases, Determination of pKa and pKb value, common ion effect and its industrial applications. Buffer its composition and mechanism and buffer capacity. Stability and formation constants of complexes, methods for their determination. **Separation Techniques:** Introduction and principle of chromatographic separations, classification and nomenclature of chromatographic techniques, Principle, theory and applications of Column chromatography and Planer chromatography (paper, thin-layer, and ion-exchange chromatography).

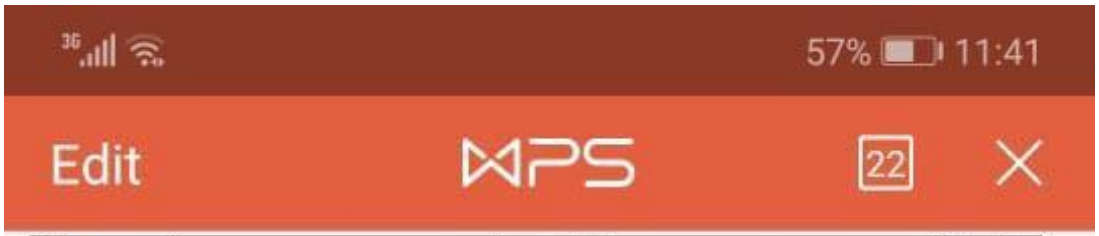
Practical

1. Practical elaboration of weighing, precipitation, washing, filtration, and ignition though experiments
2. Separation and identification of metal ions and biomolecules by paper chromatography, thin layer chromatography (TLC) and instant TLC etc.
3. Separation of mixture of organic and inorganic compounds by chromatography methods

Books Recommended:

1. Blackburn, R. Thomas, "Equilibrium- A Chemistry of Solutions", 2nd Ed, Holt, Rinehart and Winston, Inc., (1969).

2. G. D. Christian, "Analytical Chemistry" 7th Ed, John Wiley & Sons, New York, USA (2014).
3. D. C. Harris, "Quantitative Chemical Analysis" 4th Ed, Freeman (1995).
4. D. A. Skoog, D. D. West, F. J. Holler, "Fundamentals of Analytical Chemistry" 9th Ed., Saunders College Publishing (2013).



Course Code	Course Title	Credit Hour
MTH-525	Mathematics for Chemists	2(2-0)

Simple Cartesian Curves, Functions and Graphs, Symmetrical Properties, Curve Tracing, Composition of functions, Limit and Continuity, Differentiation of Functions. Derivative as Slope of Tangent to a Curve and as Rate of Change, Application to Tangent and Normal. Integral as Anti-derivative, Indefinite Integration of Simple Functions. Methods of Integration: Integration by Substitution, by Parts, and by Partial Fractions, Definite Integral as Limit of a Sum.

RECOMMENDED BOOKS

1. Swokowski, Olinick and Pence, *Calculus and Analytical Geometry*, 6th edition, 1994, Brooks/Cole Publishers.
2. Howard Anton, *Calculus*, 7th edition. 2002, John Wiley and Sons (WIE).
3. William E. Boyce Richard C. Diprima, *Calculus*, John Wiley & Sons, ISBN: 0471093335.
4. Thomas Finny, Calculus and Analytical Geometry, 10th edition, John Wiley and Sons.
5. Erwin Kreyzig, Advanced Engineering Mathematics, 7th edition, 1993, John Wiley & Sons Inc.

ISL- Translation of the Holy Quran-III 1(1-0)

Semester 6

CHM-502 Inorganic Chemistry-II 4(3-1)

1. 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 liquid NH_3, HF, SO_2, BrF_3, CH_3COOH and HCN. Reactions in molten salt system.

2. Pi-Acceptor Ligands

Class of ligands. 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). Metal nitrosyls and their derivatives. Applications of metal carbonyls and their derivatives to catalysis and organic synthesis.

3. Kinetics and mechanism of inorganic reactions

Rate law, Stationary state approximation, 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. Half life.

CHM- 502 Practicals

1. Estimation Of Anions (Any four)

Chloride/Phospate; Chloride/Nitrate; Bromide/Nitrate; Iodide/Nitrate; Borate/ Acetate; Oxalate/ Chloride; Sulphate/Phosphate

2. KIO_3 Titrations (Any two)

3. Gravimetric Estimations:

Estimations of Ba^{2+} ; Oxalate ions.

Books Recommended:

1. J. E. Huheey, "Inorganic Chemistry Principles of Structure and Reactivity" 2nd Ed. Harper and Row Publishers (1978).
2. J. D. Lee, "Concise Inorganic Chemistry" 5th Ed. Chapman and Hall (1996).
3. K. M. Mackay, R. A. Mackay, W. Henderson, "Introduction to Modern Inorganic Chemistry" 5th Ed. Stanley Thornes (Publishers) Ltd. (1996).
4. G. L. Miessler, A. T. Donald, "Inorganic Chemistry". 2nd Ed, Prentice-Hall Prentice-Hall International, Inc. (1991).
5. F. A. Cotton, G. Wilkinson, "Advance Inorganic Chemistry", 5th Ed, John Wiley & Sons, Inc. (1988).
6. F. A. Cotton, G. Wilkinson, C. A. Murillo, M. Bockhmann, "Advanced Inorganic Chemistry" 6th Ed, John Wiley & Sons, Inc. USA (1999).
7. A. K. Holliday, A. G. Massey, "Inorganic Chemistry in Non-Aqueous Solvents", 6th Ed., Pergamon Press. (1985).

CHM-504 Organic Chemistry-II 4(3-1)

Aliphatic nucleophilic substitution and Elimination reactions

Aliphatic nucleophilic substitution reactions Meachanisms and study of SN1, SN2, SN1, SN2, mechanism; neighbouring group participationintra molecular displacement by neighbouring oxygen,

nitrogen, sulphur and halogen; The effects of the substrate structure, entering group, leaving group and reaction medium on the mechanisms and rates of substitution reactions.
Elimination ReactionsMechanisms study of E1, E1cB and E2 mechanisms; attacking base, leaving group and the reaction medium on the rates and mechanisms of elimination reactions; competition between elimination andsubstitution reactions.

Aromatic Substitution reactions

Electrophilic substitution Aromaticity; mechanisms of substitution; orientation sulfonation, Friedel-Crafts reactions, diazo-coupling, formylation and carboxylation.
Nucleophilic substitutionMechanisms-Study of SNAr, SN1 and benzyne mechanisms; The effects of substrate structure, leaving group and the attacking nucleophile on the rates of substitution reactions.

Named Organic Reactions

Cannizzaro reaction, Perkin reaction, Michael reaction, Claisen-Schmidt reaction, Darzens Glycidic Ester reaction, Stobbe reaction, Mannich reaction, Wittig reaction, Ene reaction and Reformatsky reaction, Diels-Alder reaction.

CHM-504 Practicals

Organic Synthesis at least four experiments involving two step synthesis
Estimation of Amide and Carboxyl groups, Phenol and other functional groups.
Determination of Saponification value and acid value in oil.

Books Recommended:

1. F. A. Carey, R. J. Sundberg, "Advanced Organic Chemistry (Part B: Reactions and Synthesis)", 3rd Ed, Plenum Press, New York, USA (1990).
2. B. K. Carpenter, "Determination of Organic Reaction Mechanisms, "John Wiley & Sons, Inc. (1984).
3. G. R. Chatwal, "Reaction Mechanism and Reagents in Organic Chemistry", 1st Ed., Himalaya Publishing House (1987).
4. J. Fuhrhop, G. Penzlin, "Organic Synthesis Concepts, Methods, Starting Materials", 2nd Ed., Weinheim Germany (1983).
5. R. K. Mackie, D. M. Smith, "Guide book to Organic Synthesis", Longman Group Ltd. (1982).
6. J. March, "Advanced Organic Chemistry Reactions, Mechanisms and Structure", 4th Ed, John Wiley & Sons, Inc; USA (1992).
7. A. Streitwieser, C. H.H. Cock, "Introduction to Organic Chemistry", 3rd Ed, Macmillan Publishing Company (1989).
8. P. Sykes, "A Guide Book to Mechanism in Organic Chemistry", 6th Ed, Longman Group Ltd. (1986).
9. A. L. Vogel, "Elementary Practical Organic Chemistry Part III: Quantitative Organic Analysis", 1st Ed., Longman Group Ltd (1958).

CHM 506 Physical Chemistry II 4(3-1)

Electrochemistry

Theory of metallic conduction, electrode potential, electrochemical cell, electrolysis and related issues, liquid junction potential electron transfer reactions, rate of charge transfer reaction, cell potential and thermodynamics, and Nernst equation, Voltammetry, fuel cells. Corrosion and its prevention. Ion in aqueous solution, ionic activity and Debye Huckel Theory.

Quantum Chemistry and Spectroscopy

Eigen functions and eigenvalues, Schrödinger wave equation and its applications, Hamiltonian operator, Simple harmonic oscillator. Rigid rator, vibrator, Quantum numbers.

Symmetry Elements
Introduction, Coordinate System, Symmetry operations and symmetry Elements, The Symmetry Point Groups.

CHM-506 Practicals

- Determination of molecular weight of a polymer by viscosity method
- Precipitation value of electrolytes
- Measurement of IR spectra of simple compound and their interpretation
- Measurement of cyclic voltammogram of an organic compound and its interpretation
- Determination of dipole moment of an organic liquid
- Determination of percentage composition of $KMnO_4$ / $K_2Cr_2O_7$ in a given solution by spectroscopy.
- Stoichiometry of a complex in solution by jobs method
- Evaluation of pKa value of indicator by spectrometric method

Books Recommended:

1. F. Cotton, Albert "Chemical Applications of Groups Theory", 1st Ed, Interscience Publishers (1963).
2. G. W. King, "Spectroscopy and Molecular Structure", 1st Ed, Rinehart and Winston (1964).
3. J. Albery, "Electrode Kinetics", 2nd Ed, Clarendon, Oxford, (1975).
4. O. M. J. Bockris, A. K. N. Reddy, "Modern Electrochemistry" 2nd Ed, Vol. I and 2, Plenum Press, New York, USA (1970).
5. D. F. Micheal, "Elements of Quantum Mechanics" 2nd Ed., Oxford University Press, USA (2005).
6. H. H. Lowell, "Group Theory and Symmetry in Chemistry" 1st Ed, McGraw Hill Book Company (1969).
7. D. H. Whiffen, "Spectroscopy" 1st Ed, Longmans Green and Co.: London, (1966).

CHM-508 Analytical Chemistry-II 4(3-1)

Spectroscopy: Electromagnetic radiations, their characteristics (Energy, frequency, wavelength, and wave number) and interaction with matter **UV/Vis Spectroscopy:** Theory and principals of Spectroscopy, Lambert-Beer's Law and its limitations, Molecular energy levels and transitions, Characteristics of absorption (position and intensity of absorption) and effects of solvent and conjugation, auxochrome, chromophore along with the nomenclature of spectral shifts. **Instrumentation:** Sources of light (lamp and lasers), monochromators, photomultiplier tubes, diode array detectors, signal processor (charged coupled devices) and readout devices and Single and double beam spectrophotometers, Principles, brief instrumental overview and applications of **IR & NMR Spectroscopy and Mass Spectrometry.** A brief overview of applications of molecular spectroscopy in research & development and quality control process.

Practical

Qualitative and quantitative analysis by UV/Visible Spectroscopy
Identification of functional groups of organic compounds by IR spectroscopy
Identification of organic compounds using available and accessible spectroscopic techniques.
Sample preparation for various molecular spectroscopic techniques; IR, FTIR, MS
Visit of Hi-Tech Lab and practical demonstration of molecular spectroscopic techniques; IR, FTIR, MS

Reference Books:

Christian, G.D. Analytical Chemistry, 7th Eds., John-Wiley & Sons, New York, (2014).
Harris, D.C. Quantitative Chemical Analysis, 8th ed., W. H. Freeman and Company, New York, (2011).
Skoog, D. A., West, P.M., Holler, F.J. and Crouch, S. R., Fundamentals of Analytical Chemistry, 9th ed., Cengage Learning, (2013).
Braun, R.D. Introduction to instrumental Analysis, International student Edition, (1985).

CHM-510 Fuel Chemistry 3(3-0)

Course Objective: Able the students about the chemistry of fossil fuels like coal, petroleum and natural gas and their conversion processes to get useful chemical products. Improve tier understanding about alternative fuels to be used in case of non- availability of petroleum based oils

Couse Contents: Classification of fossil fuels. Origin of coal, petroleum and natural gas. Preliminary treatment of crude oil. Fractionation of crude oil. Properties of petroleum products i.e. CNG, LPG, gasoline, kerosene, diesel fuels and lubricating oils. Coal storage and cleaning. Carbonization of coal: Low temperature and high temperature carbonization, Coking and non-coking coals, Separation of tar from coke oven gas, Hydrogen sulfide removal from coke oven gas Introduction to alternate sources of energy: Biomass as energy resources: Bio gas technology. Alcohols: Alcohols and its uses as alternative fuel. Hydrogen: Hydrogen production, storage, handling and its uses as alternative fuel. Fuel Cells and its application, Solar Energy: Solar energy collectors. Nuclear fuels: fission and fusion, nuclear reactors and introduction to Hydel energy.

Recommended Books:

1. Gyngell, E.S. Applied Chemistry for Engineers, Edward Arnold Publisher, Ltd. London. (1989).
2. Harker, J.H. and Backurst, J.R. Fuel and Energy, Academic Press, London and New York (1988).
3. Wilson, P.J. and Wells, J.H. Coal Coke and Coal Chemicals, McGraw-Hill Book Company, London, (1980). 4. Hobson, G.D. Modren Petroleum Technology, part-I. John Wily & Sons, Toronto, (1984). 5. Goodger E.M. Alternative Fuels (chemical energy resources), The Macmillan

press Ltd, London, (1980). 6. Twidell, J. and Weir, T. Renewable Energy Resources, Sopn London, New York, (1986). 7. Matar, S. and Hatch, L.W. Chemistry of Petrochemical Processes, 2 nd Ed. Gulf Publishing Company. Houston, Texas, USA (2002)

Semester 7

Specialization in Analytical Chemistry

STA-321 Introduction to Statistical Theory 3(3 - 0)

Introduction and scope of statistics, Basic concepts of statistics, Different types of variables, types of data and methods of data collection, Scales of measurement, Data arrangement and presentation, formation of tables and charts, Measures of central tendency: mean, median and mode and quantiles from grouped and ungrouped data. Measures of dispersion: computation of range, variance, standard deviation, and coefficients of variation, Skewness and Kurtosis, Definition of probability, Different terminology used in probability, Different laws of probability, Discrete distributions (Binomial distribution, Poisson distribution, Negative Binomial distribution, geometric distribution, hyper geometric distribution with their properties and applications), Continuous distribution (Normal distribution with their properties and applications), Correlation and Regression, Survey sampling, Types of Sampling (probability and non probability sampling), Sampling Distribution of mean, Hypothesis testing: Z-test for single and difference between mean, Student's 't' test for single and difference between mean. Chi-square test of independence and goodness of fit, Analysis of variance and LSD.

Recommended Books

- Ronald Walpole, Myers, Myers, Ye, "Probability & Statistics for Engineers & Scientists", 8th edition, 2008, Prentice Hall Publisher.
- Sher M. Chaudhry, Shahid Kamal, "Introduction to Statistical Theory I and II".
- Steel, R.G.D. and Torrie,J. H.,1980. Principles and procedures of statistics. McGraw Hill International Editions. Zar, 1998. Biostatistics Analysis

CHM-601 Electroanalytical Techniques 3(3-0)

Introduction: Electrochemistry, Classification of electro analytical methods, Electrochemical cells

Potentiometry: Redox potentials, potentiometric measurements, Indicator electrodes (Metallic & Membrane indicator electrode), Ion selective electrodes (glass membrane electrode, Solid state ion exchange membrane electrode, solid state crystal electrode, liquid membrane electrode), gas sensing electrode, bio-membrane electrodes, electrochemical biosensors and chemosensors, Potentiometric titrations

Coulometry and Electrogravimetry: working principle, instrumentation of coulometry, types of coulometry, working principle, instrumentation of electro gravimetry, electro gravimetric analysis, polarization, types of electro gravimetry

Voltammetry: Working principle, Instrumentation, method of analysis, voltammogram, polarizable and non-polarizable electrodes, solid electrodes, their scope and limitations, Types of voltammetry Linear sweep voltammetry (cyclic voltammetry, anodic stripping voltammetry). voltammetry equation,

Polarography: Instrumentation, analysis, polarograms, measurement of decomposition potential, diffusion and limiting currents, derivation of Ilkovic equation, logarithmic analysis of polarographic wave, advantages and limitation of dropping mercury electrode.

Reference Books:

Christian, G.D. Analytical Chemistry, 6th ed., John-Wiley & Sons, New York, (2004).

Harris, D.C. Quantitative Chemical Analysis, 8th ed., W. H. Freeman and Company, New York, (2011).

Skoog, D. A., West, P.M., Holler, F.J. and Crouch, S. R., Fundamentals of Analytical Chemistry, 9th ed., Cengage Learning, (2013).

Braun, R.D. Introduction to instrumental Analysis, International student Edition, (1985).

CHM-603 Advanced Separation Techniques 3(3-0)

Theoretical consideration: Distribution ratio and separation, retention and equilibrium, efficiency of separation, band broadening, Van-Deemter equation and its significance in evaluating column efficiency.

Gas Chromatography (GC): Principle, instrumentation (sample injection modes, columns, choices of stationary phases, detectors), sample preparations, separation process, temperature programming, identification and quantification (normalization of peak areas) and its applications.

Liquid Chromatography (LC): Principle and theory of LC, modes of LC, High performance LC (HPLC), instrumentation, solvent delivery systems, injectors (sample loading procedures), columns with choice of stationary phases, detectors) sample preparation, method development, applications with emphasis on pharmaceutical and petrochemical industry.

Supercritical Fluid Chromatography (SFC): Principle, supercritical fluids, instrumentation, separation process, applications in industrial Sectors.

Electrophoresis: Theory and principle of Electrophoresis, Types of Electrophoresis (Paper & Gel Electrophoresis), Capillary Electrophoresis (CE), Separation Procedure (mobility, electro-osmotic flow separation), Instrumentation and applications.

Reference Books:

Christian, G.D. Analytical Chemistry, 7th Ed., John-Wiley & Sons, New York, (2014).
Harvey, D. Modern Analytical Chemistry, 1st Ed, McGraw-Hill, USA, (2000).
Skoog, D. A., West, P.M., Holler, F.J. and Crouch, S. R., Fundamentals of Analytical Chemistry, 9th ed., Cengage Learning, (2014).
Patnaik, P. Dean's Analytical Chemistry Handbook, 2nd Ed. McGraw-Hill, USA.
Mikkelsen, S. R. and Corton, E. Bioanalytical Chemistry, John Wiley & Sons, Inc., Hoboken, New Jersey

CHM-605 Analytical Atomic Spectroscopy 3(3-0)

Introduction, classification of atomic spectroscopy (atomic absorption and atomic emission spectroscopy), sample preparation, qualitative and quantitative analysis, interferences in atomic spectroscopy

Atomic emission spectroscopy: Principle, types, atomic spectra, atomic spectral line widths, instrumentation (flame, arc, spark and plasma based emission spectroscopies), arrangements of the instruments for each type of emission spectroscopy with dedicated applications

Atomic absorption spectroscopy:

Principle, instrumentation (radiation sources, hollow cathode lamps, electrodeless discharge lamps, atomizers (flames and furnaces), burners and their types, wavelength selectors, detectors), wavelength choices, applications of atomic spectroscopy for qualitative and quantitative analyses

Recommended Books

1. Introduction to Chemical Analysis, International Edition by Robert D. Braun, McGRAW-HILL BOOK COMPANY
2. Analytical Chemistry, 7th Edition by Christian, G.D. John-Wiley & Sons, New York, (2004).
3. Quantitative Chemical Analysis, 8th Edition by Harris, D.C., W. H. Freeman and Company, New York, (2011).
4. Fundamentals of Analytical Chemistry, 9th Edition by Skoog, D. A., West, P.M., Holler, F.J. and Crouch, S. R., Cengage Learning, (2013)

CHM-607 Analytical Chemistry Lab-I 2(0 - 2)

The experiments may be set making use of the following instruments depending upon their availability. The instructor should consult the "Journal of Chemical Education" for the innovative designing of experiments. Special experiments may also be designed for which a specimen list of instruments/techniques is given below.
Conductometry, Potentiometry, Coulometry, Electrogravimetry, Column Chromatography
Gas Chromatography, HPLC, Capillary Electrophoresis. Atomic Absorption Spectroscopy and Atomic Emission Spectroscopy.

Experiments
Determination of iron in soil by spectrophotometry.
Spectrophotometric determination of molybdate ion.
Separation of dyes using column/paper/thin layer chromatography.
Separation of sugars using paper chromatography.
Separation of amino acids using paper/thin layer chromatography.
Separation of hydrocarbons using GC/HPLC.
Determination of iron in foods products spectrophotometrically.
Determination of phosphate content in commercial fertilizers by spectrophotometry.
Determination of nickel in vegetable ghee by spectrophotometry involving solvent extraction.
Identification and spectrophotometric determination of aspirin, phenacetine and caffeine in pharmaceutical samples.
IR analysis and identification of human body stones
Mass spectrometry of mineral oil samples.
To determine pKa values for the given samples of weak acids by potentiometric method.
To determine the quality parameters i.e. pH, conductance and concentration of anions cations.
To determine Ni (II) in steel using DMG reagent by spectrophotometric method.
To determine vitamin-C concentration in the given samples.
To determine calcium and zinc in milk by atomic absorption spectrophotometer.
To determine lead in sewage sludge by atomic absorption spectrophotometer.
To determine Mn and Cr in stainless steel spectrophotometrically.
To record and characterization of IR spectra of at least one organic compounds.

CHM-XXX One optional Course from other than Specialization 3(3 - 0)

ISL- Translation of the Holy Quran-IV 1(1 - 0)

Semester 7
Specialization in Inorganic chemistry

STA-321 Introduction to Statistical Theory 3(3 - 0)

Introduction and scope of statistics, Basic concepts of statistics, Different types of variables, types of data and methods of data collection, Scales of measurement, Data arrangement and presentation, formation of tables and charts, Measures of central tendency: mean, median and mode and quantiles from grouped and ungrouped data. Measures of dispersion: computation of range, variance, standard deviation, and coefficients of variation, Skewness and Kurtosis, Definition of probability, Different terminology used in probability, Different laws of probability, Discrete distributions (Binomial distribution, Poisson distribution, Negative Binomial distribution, geometric distribution, hyper geometric distribution with their properties and applications), Continuous distribution (Normal distribution with their properties and applications), Correlation and Regression, Survey sampling, Types of Sampling (probability and non probability sampling), Sampling Distribution of mean, Hypothesis testing: Z-test for single and difference between mean, Student's 't' test for single and difference between mean. Chi-square test of independence and goodness of fit, Analysis of variance and LSD.

Recommended Books

1. Ronald Walpole, Myers, Myers, Ye, "Probability & Statistics for Engineers & Scientists", 8th edition, 2008, Prentice Hall Publisher.
2. Sher M. Chaudhry, Shahid Kamal, "Introduction to Statistical Theory I and II".
3. Steel, R.G.D. and Torrie,J. H.,1980. Principles and procedures of statistics. McGraw Hill International Editions. Zar, 1998. Biostatistics Analysis

CHM-611 Main Group Organometallic and Organic Reagents 3(3 - 0)

Main Group Organometallic Reagents

Introduction, Preparation, classes of necleophilic organometallic reagents organo-Li**, S,** Sc, Si, B, Sn, Sb and Zn in organic synthesis, control side reaction (Enolization vs. nuelecophilic addition, substitution vs. elimination, selectively among functional griops via organometallic reagents

Organic reagents in inorganic Analysis

Type of reagents, their specific nature and methods of applications with specific examples, Complexometric and gravimetric methods involving various reagents, chelates and chelate effect.

Recommended Books:

1. C. R. Dillard, D. E. Goldberg, "Chemistry, Reactions, Structure and Properties" Colliers-Macmillan Limited, London, UK (1971).
2. E. S. Gould, "Inorganic Reactions and Structures" Holt, Rinehart and Winston, Inc. Revised Edition (1962).
3. A. K. Holliday,A. G. Massey, "Inorganic Chemistry in Non-Aqueous Solvents", 6th Ed., Pergamon Press. (1985).
4. J. E. Huheey, "Inorganic Chemistry Principles of Structure and Reactivity" 2nd Ed., Harper and Row Publishers (1978).

CHM- 613 Spectroscopic Methods of Analysis 3(3-0)

Physical methods of analysis in Inorganic Chemistry, NMR, IR, UV Spectroscopy, Mass Spectrometry, Basic Principles, Instrumentation and Applications.

Recommended Books:

1. D. L. Pavia, G. M. Lampman, G. S. Kriz, Jr., "Introduction to Spectroscopy," 2nd Ed., W.B. Saunders, (1979).
2. D. W. Mathieson, "Nuclear Magnetic Resonance for organic Chemistry," Academic Press, London, UK (1967).
3. A. Douglas, F. Skoog, J. Holler, A. T. Neuman "Principles of Instrumental Analysis", 5th Ed, Saunders College Publishing, New York, USA (1997).
4. E. A. V. Ebsworth, D. W. H. Rankin, S. Cradock, "Structural Methods in Inorganic Chemistry," 2nd Ed., Blackwell, (1987).
5. E. D. Hoffmann, "Mass Spectrometry: Principles and Applications" 2nd Ed., V. Stroobant (Ed.,) John Wiley & Sons, USA (2001).
6. H. Budzikiewitz, C. Djerassi, D. H. Williams, J. R. Chapman, "Practical Organic Mass Spectrometry," John Wiley and Sons, USA (1985).

CHM-615 Organo-Transition Metal Compounds 3(3-0)

Introduction, Cluster Compounds: Nomenclature and Structural Patterns, Metal Carbonyl Type Clusters, Anionic, Hydrido, Larger and Superlarge Carbonyl Clusters, Non-Carbonyl Clusters, Heteroatom in Clusters, Electron Counting Rules (TEC, Wades, Capping). Metal to Carbon Single, Double and Triple bonds; Acyls, Alkylidene and Alkalidyne Complexes, Bonding to Olefins, Polyolefins, Allyl, Alkyne and Arene Complexes.

Recommended Books

F. A. Cotton, G. Wilkinson, C. A. Murillo, M. Bochmann, "Advanced Inorganic Chemistry", 6th

Edition, John Wiley and Sons (2003).
G. L. Miessler and D.A. Tarr, Inorganic Chemistry", 3rd Edition, Pearson Education, Inc., (2004).
W. W. Porterfield, Inorganic Chemistry, A Unified Approach, 2nd Edition, Elsevier (1993).
B. Douglas, D. McDaniel, J. Alexander, Concepts and Models of Inorganic Chemistry, 3rd Edition, Johan Wiley and Sons (2006).

CHM-617 Inorganic Chemistry Lab-I 2(0-2)

1. **Conductometry**

- Titration of strong acid and weak acid with a strong base.
- Precipitation titration involving $AgNO_3$ and KCI.

2. **Potentiometry**

- Determination of K1, K2 and K3 for H_3PO_4
- Determination of chloride in the presence of iodide and evaluation of AgI and AgCl

3. **Spectrophotometry**

- Micro determination of Cr(III) by Di-phenyllecarbazide.
- Determination of Fe (II) by 1-10Phenanthroline.
- Determination of nitrites. Determination of Fe (III) by 8-hydroxyquinoline.

4. **Use of some Organic Reagents for the estimation of various elements by gravimetric estimation.**

- 8-Hydroxyquinoline AI (III) and Fe (III)
- Salicylaldoxime: Ni (II) in the presence of Cu (II)
- Anthranilic acid: Co (II) and Zn (II)

5. **Inorganic Synthesis:**
   Preparation of at least six inorganic compounds/complexes in a pure state and determination of their state of purity.

CHM-XXX One optional Course from other than Specialization 3(3-0)

ISL- Translation of the Holy Quran-IV 1(1 - 0)

Semester 7
Specialization in Organic chemistry

STA-321 Introduction to Statistical Theory 3(3 - 0)

Introduction and scope of statistics, Basic concepts of statistics, Different types of variables, types of data and methods of data collection, Scales of measurement, Data arrangement and presentation, formation of tables and charts, Measures of central tendency: mean, median and mode and quantiles from grouped and ungrouped data. Measures of dispersion: computation of range, variance, standard deviation, and coefficients of variation, Skewness and Kurtosis, Definition of probability, Different terminology used in probability, Different laws of probability, Discrete distributions (Binomial distribution, Poisson distribution, Negative Binomial distribution, geometric distribution, hyper geometric distribution with their properties and applications), Continuous distribution (Normal distribution with their properties and applications), Correlation and Regression, Survey sampling, Types of Sampling (probability and non probability sampling), Sampling Distribution of mean, Hypothesis testing: Z-test for single and difference between mean, Student's 't' test for single and difference between mean. Chi-square test of independence and goodness of fit, Analysis of variance and LSD.

Recommended Books

4. Ronald Walpole, Myers, Myers, Ye, "Probability & Statistics for Engineers & Scientists", 8th edition, 2008, Prentice Hall Publisher.
5. Sher M. Chaudhry, Shahid Kamal, "Introduction to Statistical Theory I and II".
6. Steel, R.G.D. and Torrie,J. H.,1980. Principles and procedures of statistics. McGraw Hill International Editions. Zar, 1998. Biostatistics Analysis

CHM-621 Spectroscopic Organic Techniques 3(3 – 0)

(a) Introduction

Electromagnetic radiations. Wavelength, frequency, wave number and energy of electromagnetic radiations and their interconversion. Electromagnetic spectrum. Interaction transitions and spectral regions. Relaxation of the excited molecules.

(b) Ultraviolet/Visible Spectroscopy:

Introduction, Electronic transitions and absorption of electromagnetic radiations, Intensities of absorption, Beer-Lambert Law and its applications, Instrumentation and sample handling, The chromophore, Absorption by conjugated systems, Woodward fieser rules for conjugated dienes and unsaturated carbonyl systems, Absorption by aromatic compounds, Application of UV/Vis spectroscopy.

(c) Infrared Spectroscopy:

Introduction, Vibrational modes and absorption frequencies, Hooks Law, Instrumentation and sample handling, Interpretation of Infrared spectra, Characteristic absorptions frequencies of some common functional groups, Applications of Infrared spectroscopy.

(d) Nuclear Magnetic Resonance:

Introduction, Spin flipping Nuclear Precession and absorption of electromagnetic radiation, Spin relaxation, The Chemical shift and integration curve, Molecular structure and chemical shifts, Instrumentation and Sample handling, Spin splitting and coupling constants. Interpretation of NMR spectra.

(e) Mass spectrometry:

Introduction, Basic Principle, Instrumentation (theory and operation) The mass spectrum, Modes of Fragmentation of various organic molecules. Applications of mass spectrometry determination of molecular weight, molecular formula and molecular structure. Interpretation of mass spectra.

Recommended Books:

1. H. E Duckworth, R. C Barber, V.S Barber, V.S Venkatasubramanian "Mass Spectroscopy", 2nd Ed., Cambridge University Press, London, UK (1996).
2. E. D. Hoffmann, J. Charette, V. Stroobant, "Mass Spectrometry, Principes & Applications", John Wiley & Sons, USA (1996).
3. A. Frigerio "Essential Aspects of Mass Spectrometry", Spectrum Publication, Ine New York, USA (1974).
4. H. Friebolin "Basic one and two dimensional NMR Spectroscopy", 2nd Ed, VCH (1988).
5. G. E Martin, A. S Zektzer, "Two Dimensional NMR Methods for Establishing Molecular Connectivity" VCH (1988).
6. W. Voelter "Carbon-13 NMR Spectroscopy", 3rd Ed., VCH (1990).
7. Atta-ur-Rahman "Nuclear Manetic Resonsance Spectroscopy",UGC, Islamabad (1989).
8. H. Gunther, "NMR Spectroscopy", 3rd Ed., John Wiley and Sons, New York, USA (1972).
9. R. M. Silverstein, G. G. Bassler, "Spectrometric Identification of Organic Compounds" 5th Ed., John Wiley & Sons, New York, USA (1998).
10. W. Kemp, "Organic Spectroscopy", 3rd Ed., Macmillan, London, USA (1991).

CHM-623 Rearrangements and Pericyclic Reactions 3(3 – 0)

Classification of rearrangement, Pinacol Pinacolon rearrangement, Benzil benzilic acid rearrangement, R.A involving Diazomethane, Favorski R.A, Hofman R.A. Schmidt R.A, Lossen R.A, Bayer Villiger, R.A, benzidine R.A, Fries R.A. Sigma tropic R.A.

Migration of carbon, cope rearrangement, claisen rearrangement benzidine rearrangement. [1,3] H, [1,5], [1,7] H, [1,9] H migration.

Pericyclic Reactions

Conrotatory and Disrotatory motion of orbital, electrocyclic reactions, thermal cyclization, Photochemical cyclization, Hofman rule, Fukui Theory of Frontier orbitals.
Introduction to cycloaddition reactions. Supraficial and Antanafacial addition woodmard Hofman Rule. Frontier theory and mobius huckle theory for (2 + 2) and (2 + 4) thermal and photochemical cycloaddition reaction.

Recommended Books:

1. R. O .C. Norman "Principles of Organic Synthesis", Blackie Academic & Professional, 3rd Ed. (1993).
2. F. L. Ansari, R. Qureshi and M. L. Qureshi "Electrocyclic Reactions – from Fundamentals to Research", 1st Ed., John Wiley and Sons, (1999).
3. J. Clayden, N. Greeve, S. Warren, P. Wothers, "Organic Chemistry", 1st Ed., Oxford University Press, USA (2001).

CHM-625 Pharmaceutical Chemistry 3(3 – 0)

Alkolids

Introduction, occurrence, function of Alkolids in plants, Classification, Nomenclature, Pharmaceutical Applications, Isolation, Qualitative Test and General Properties, General Method of Structure Determination. Morphines, Nicotine, Quinine.

Drugs

Introduction, Sources, Route of administration, Metabolites and mechanism of drug action. Sulfonamide, Antipyretics, Analagasic, Barbiturates, Antibiotics, their general synthesis and structure activity relationship.

Recommended Books:

1. Koji Nakanishi et "Natural Products Chemistry", 1st Ed., Vol. I. (1974).
2. Mann, "Secondary Metabolism", Oxford Science Publication, 2nd Ed. (1987).
3. J. D. Bu Lock "The Biosynthesis of Natural Products", 1st Ed., McGraw-Hill, London, UK (1965).
4. S. V. Bhat, B. A. Nagasampagi, M. Sivakumar "Chemistry of Natural Product" 1st Ed., Narosa Publishing House (2005).

CHM- 627 Organic Chemistry Lab -I 2(0-2)

Synthesis of Organic Compounds:

Students must be informed of MSDS of all compounds used in experiments.

The experiments may be arranged as per choice/requirement of instructor but should be designed from following categories;
Various experiments involving the development of amide, ester and ether linkages.
Experiments involving oxidation and reduction of organic compounds.
Synthesis of various dyes.

Recommended Books:

1- J. Fuhrhop, G. Penzlin, "Organic Synthesis Concepts, Methods, Starting Materials", 2nd Ed., Weinheim Germany (1983).

2- A. L. Vogel, “Elementary Practical Organic Chemistry Part III: Quantitative Organic Analysis”, 1st Ed., Longman Group Ltd (1958).
3- F. A. Carey, R. J. Sundberg, “Advanced Organic Chemistry (Part B: Reactions and Synthesis)”, 3rd Ed, Plenum Press, New York, USA (1990).
4- B. S. Fumiss, A. J. IIannaford, P.W.G. Smith, A. R. Tatchell “Vogel’s Practical Organic Chemistry”, 5th Ed, Addition Wesley Longman, Harlow, England(1989).

CHM-XXX One optional Course from other than Specialization 3(3-0)

ISL- Translation of the Holy Quran-IV 1(1 - 0)

Semester 7
Specialization in Physical Chemistry

STA-321 Introduction to Statistical Theory 3(3 - 0)

Introduction and scope of statistics, Basic concepts of statistics, Different types of variables, types of data and methods of data collection, Scales of measurement, Data arrangement and presentation, formation of tables and charts, Measures of central tendency: mean, median and mode and quantiles from grouped and ungrouped data. Measures of dispersion: computation of range, variance, standard deviation, and coefficients of variation, Skewness and Kurtosis, Definition of probability, Different terminology used in probability, Different laws of probability, Discrete distributions (Binomial distribution, Poisson distribution, Negative Binomial distribution, geometric distribution, hyper geometric distribution with their properties and applications), Continuous distribution (Normal distribution with their properties and applications), Correlation and Regression, Survey sampling, Types of Sampling (probability and non probability sampling), Sampling Distribution of mean, Hypothesis testing: Z-test for single and difference between mean, Student's 't' test for single and difference between mean. Chi-square test of independence and goodness of fit, Analysis of variance and LSD.

Recommended Books

7. Ronald Walpole, Myers, Myers, Ye, "Probability & Statistics for Engineers & Scientists", 8th edition, 2008, Prentice Hall Publisher.
8. Sher M. Chaudhry, Shahid Kamal, "Introduction to Statistical Theory I and II".
9. Steel, R.G.D. and Torrie,J. H.,1980. Principles and procedures of statistics. McGraw Hill International Editions. Zar, 1998. Biostatistics Analysis

CHM-631 Kinetics of Complex Reactions 3(3-0)

Chemical Reactions
Advanced theories of unimolecular reactions, Chain and non chain complex reactions, Fast reactions, Experimental techniques for measurement of fast reaction kinetics, Kinetics of catalyzed reactions

Photochemical Reactions
Introduction, Photochemical reactions, photochemical reactions in gas phase and in solutions, quantum yields, flash photolysis, photochemical reaction kinetics

Interfacial Phenomena
Solid surfaces, Gas solid interfaces, thermodynamics of adsorption, adsorption at liquid surfaces, organized molecular assemblies, colloids and surfactants, liquid interfaces, surface tension and adsorption from solutions,

Recommended Books:

1. S. Asperger, "Chemical Kinetics and Inorganic Reaction Mechanisms" 2nd Ed., Springer Verlag (2003).
2. J. H. Espenson, "Chemical Kinetics and Reaction Mechanism "2nd Ed., McGraw Hill London, UK (2002).
3. D. C. Neckers, G. von, B. Unau, W. S. Jenks, "Advances in Photochemistry", Vol. 27, John Wiley & Sons, Inc. USA (2002).
4. P. W. Atkins, "Physical Chemistry" 6th Ed, W. H. Freeman and co. New York, (1998).
5. K. J. Laidler, "The World of Physical Chemistry*"* 1st Ed., Oxford University Press, pp. 488 (1993).

CHM-633 Advanced Spectroscopy 3(3-0)

Molecular Spectroscopy
Electromagnetic radiations, interactions of electromagnetic radiations with matter, microwave, infrared and Raman spectroscopy of polyatomic molecules, vibrational-rotational spectra,

Nuclear Magnetic Resonance
Principles of megnatic resonance. Nuclear magnetic resonance (NMR) spectroscopy. Coupling phenomenon in simple (AXn) and complex systems. Relaxation mechanisms and their applications. Dynamic NMR. Applications in structure elucidation.

Electron Spin Resonance
Electron spin resonance spectroscopy (ESR). Principles and applications to solids and solutions.

Recommended Books:

1. J. D. Graybal, "Molecular Spectroscopy," McGraw-Hill, New York, USA (1988).
2. G. M. Barrow, "Introduction to Molecular Spectroscopy," 2nd Ed, McGraw-Hill, New York, USA (1962).
3. C.N. Banwell, " Molecular Spectroscopy" 3rd edition Tata-Mc Grahill Publishing Company , New Delhi, India, 1983.

CHM-635 Material Chemistry 3(3-0)

Physical Chemistry of Macromolecules
Introduction, molecular forces and chemical bonding in macromolecules, configurations and conformation of polymer chains, theories of polymer solutions, spectroscopic analysis, thermal analysis, polymer reheology

Solid State
Introduction, attractive forces, properties of solids, crystal structure, crystal defects, crystallography, theories of bonding, packing of atoms in metals.

Modern Materials
Composite materials, superconductors, conducting polymers, biopolymers, Bullet proof polymers, edible plastics, smart materials, nano particles.

Recommended Books:

1. S. F. Sun, "Physical Chemistry of Macromolecules" 2nd Ed, John Wiley and Sons, INC. New York, USA (2004).
2. G. C. Bond, "Heterogeneous Catalysis" 2nd Ed., Clarendon Press. Oxford, USA (1987).
3. Anthony West "Basic Solid State Chemistry" John Wiley and sons, 1988, USA.
4. Robert J. Young, " Introduction to polymers" Capmann and Hall, 1981, USA.
5. Joel R. Fried " Polymer Science and Technology " Prentice Hall PTR. 1995. USA.
6. Fred W. Billmeyer "Text of Polymer Science" Wiley Interscience Publications, John Wiley and sons , 1984, USA.

CHM-637 Physical Chemistry Lab-I 2(0 –2)

Note: Any ten Experiments will be Conducted according to the Availability of Apparatus & Chemicals

1. Sugar analysis and inversion studies by polarimetry
2. Verify Beer's Lambert's Law for the given solution.
3. Investigate the kinetics of hydrolysis of ethyl acetate in the presence of hydrochloric acid at room temperature and determination of order of reaction.
4. Interpretation of IR and NMR spectra
5. Determination of molecular weight of given sample of polymer viscometrically
6. Thermal analysis of given polymer sample with the help of available established literature
7. Surface characteristics of given polymer sample with the help of available established literature
8. Waste water treatment using chemicals
9. Waste water treatment using advanced oxidation process
10. Study of isotherms and experiments of surface chemistry
11. Preparation of colloidal solution and determination of precipitation value of colloidal solution by using monovalent, bivalent and trivalent cations
12. Determination of apparent molar volume of different sample solutions
13. Calculation of partial molar volume by graphical method

14. Kinetic study of enzyme catalyzed reactions

CHM-XXX One optional Course from other than Specialization 3(3-0)

ISL- Translation of the Holy Quran-IV 1(1 - 0)

Semester 8

Specialization in Analytical Chemistry

CHM-650 Research /review report 3(0-3)

Note: The students will be allocated among faculty members. The Research/review report will be evaluated by the following committee.

i) Chairman (convener)
ii) Advisor (member)
iii) Faculty member (member)

CHM-602 Thermal Methods of Analysis 3(3-0)

Introduction, historical developments, classifications of thermal methods, simultaneous and complementary techniques, Factors affecting thermal analysis (samples, crucibles, heating rate, atmosphere and sample mass)

Thermogravimetric analysis (TGA): Introduction and principles, instrumentation (thermobalance, furnaces, sample holders, temperature control and data processing) combined thermal instruments i.e. TGA/MS and TGA/FTIR, High-Resolution TGA, applications of TGA

Differential Thermal Analysis (DTA): Introduction, general principles, instrumentation, applications of DTA

Differential Scanning Calorimetry (DSC): Introduction and principles, instrumentation (Power-Compensated DSC, Heat-Flux DSC, and Modulated DSC), DSC Accessories, DSC Experiment, DSC Calibration, DSC Data Analysis and applications of DSC.

Differential Photocalorimetry (DPC): Introduction, principles, instrumentation and applications (Photocure rates, Degree of Cure determination)

Evolved gas analysis (EGA): Basic principles, Evolved gas detection (EGD), instrumentation and applications, EGA coupled with MS/ GC/ IR.

Thermomechanical Methods: Introduction and principles, types of Thermomechanical methods (Thermodilatometry (TD), thermomechanical analysis (TMA) and dynamic mechanical analysis (DMA)), instrumentation and applications

Recommended Books:

1. Thermal Methods of Analysis, Principles, Applications and Problems by P.]. Haines, Springer-Science Business Media
2. Principles of Instrumental Analysis, 7th Edition by Douglas A. Skoog, F. James Holler, Stanley R. Crouch, Cengage Learning 20 Channel Center Street Boston, MA 02210 USA
3. Introduction to Thermal Analysis Techniques and applications, by Michael E. Brown, Chapman and Hall, 29 West 35th Street, New York NY 10001
4. Polymer Reference Book by T.R. Crompton, Rapra Technology Limited, Shawbury, Shrewsbury, Shropshire, SY4 4NR, United Kingdom

CHM-604 Nuclear Analytical Techniques 3(3-0)

Introduction to Nuclear sciences, Stability of Nucleus, Binding Energy, Mode of Radionuclide decay, Production of nuclear radiation and its characteristics, Radiation Detection and Measurement Instruments, Nuclear Radiation Survey Meters, Radiochemical Method of Analysis (RMA), Isotope Dilution Methods of Analysis (IDMA), Role of Radiotracers in the Development of Modern Nuclear Analytical Techniques, Radiation Safety, Applications of Radioisotope Detecting Instruments in Medical, Environment, Agriculture and Industries.

Reference Books:

1. Patnaik, P. Dean's Analytical Chemistry Handbook, 2nd Ed. McGraw-Hill, USA.
2. V.S. Ramachandran, J.J. Beaudoin Handbook of Analytical Techniques in Concrete Science and Technology, Principle, Technique and Applications. William Andrew Publishing. Norwich, New Yourk, USA, 2001.
3. Saha, G. B. Fundamentals of Nuclear Pharmacy, 6th Ed. Springer New York Heidelberg Dordrecht London, (2010).
4. Brune, D.; Forkman, B.; Persson, B. Nuclear analytical chemistry, Chartwell-BrattLtd.,Bromley, England, United States, 1984.
5. Harvey, D. Modern Analytical Chemistry, 1st Ed, McGraw-Hill, USA, (2000).
6. R Cornelis, J Caruso, H Crews, K Heumann Handbook of elemental speciation II: species in the environment, food, medicine and occupational Health. Wiley Online Library, England, 2005

CHM-606 Food and Drug Chemistry 3(3-0)

Introduction to food analysis, food gradients and nutritional values, food adulterations, sampling of food, general methods of analysis. Analysis of milk, butter, wheat flour, meat, beverages, tea, coca, honey and soft drinks, Food and drug authority legislations.

Pharmaceuticals: Classification of drugs, test for analysis of different pharmaceuticals, introduction to US and British pharmacopeia, Testing for Blood Alcohol Concentration, Testing for Drugs, Testing for Poisons, Confirmatory Tests,

Forensics:

History and scope of forensic Science, Finger Print analysis, Chemical test for detection of finger prints, Forensic toxicology. Classification of narcotics, Forensic pathology, Forensic Serology, Examination of crime scene evidences.

Reference Books:

Yolanda Picó, Chemical Analysis of Food: Techniques and Applications Academic Press, ELSEVIER, Spain, 2012.

Leo M. L. Nollet. Handbook of Food Analysis: Physical characterization and nutrient analysis.CRC Press, Technology & Engineering, New Yourk USA, 2004.

David E. Newton, Forensic Chemistry, United States of America, (2007).

CHM- 608 Quality Control and Assurance 3(3– 0)

Method development and validation: Selection of analytical methods for problem solving, verify the method, Single operator characteristics, Blind analysis of standard samples, Ruggedness testing, Equivalency testing, , Sensitivity of instruments, Limits of detection and Signal-to-noise ratio.

Quality Control & Assurance: Introduction and concept of quality control and quality assurance, Introduction to ISO (International Standards Organization) Process Standards, ISO Certification Procedures, Quality control tools, flow chart, check sheet, scatter diagram, pareto analysis, histogram Ishakawa analysis, Methods for Measuring Quality within Processes, , Internal & External Methods of Quality Assessments, Evaluation of quality assurance data, Prescriptive approach, Performance-based approach. Components of a Quality Assurance Program like Goals, Benchmarks, Leadership and Motivation, Quality Assurance And Quality Control Relation to Specialties in Manufacturing, Food, Service or Pharmaceuticals or within some other Business Organization. **Automation in analytical methods;** Automatic, automated and smart instruments and their applications with special emphasis on clinical, industrial and quality control aspects

Recommended Books

ristian, G.D. 2003. Analytical Chemistry. Sixth edition, John Wiley and Sons, New York
rvey, D. 2008. Modern Analytical Chemistry. The McGraw Hill Companies, Inc. USA.
rgis, L.G. 1988. "Analytical Chemistry: Printice Hall Publishers, London
nciples of Instrumental Analysis, 7th Edition by Douglas A. Skoog, F. James Holler, Stanley R. Crouch, Cengage Learning 20 Channel Center Street Boston, MA 02210 USA, Publishing Co., London
6. FAO and WHO (2000). Codex Alimentarius General Requirement Vol. 14

CHM- 610 Analytical Chemistry Lab -II 2(0 - 2)

The experiments may be set making use of the following instruments depending upon their availability. The instructor should consult the "Journal of Chemical Education" for the innovative designing of experiments. Special experiments may also be designed for which a specimen list of instruments/techniques is given below.

Thermogravimetry, Differential Thermal Analyzer, Differential Scanning Calorimetry, Differential Photo-Calorimetry, Evolved Gas Analyzer, Thermo-mechanical Analyzer.

Experiments

Potentiometric determination of Fluoride in drinking water.
Spectrophotometric determination of Iron in soil.
Determination of pH of Hair Shampoos.
IR analysis and identification of human body stones
Ultraviolet Spectrophotometric determination of Aspirin and Caffeine in pharmaceutical samples.
Determination of iron in foods products spectrophotometrically.
Determination of Calcium by Atomic Absorption Spectrophotometry.
Determination of Mercury in Laboratory Air using Atomic Absorption Spectrophotometry.
Flame Emission Spectrometric determination of Sodium.
Qualitative and Quantitative Analysis of Fruit juices for Vitamin C using HPLC.
Enzymatic determination of Glucose in Blood.
Separation of dyes using column/paper/thin layer chromatography.
Separation of sugars using paper chromatography.

Separation of amino acids using paper/thin layer chromatography.
Identification of fingerprints by chemical test.
Analysis of Analgesics using HPLC.
Determination of phosphate content in commercial fertilizers by spectrophotometry.
Determination of nickel in vegetable ghee by spectrophotometry involving solvent extraction.
Mass spectrometry of mineral oil samples.
To determine calcium and zinc in milk by atomic absorption spectrophotometer.
Test for analysis of drugs.
To determine lead in sewage sludge by atomic absorption spectrophotometer.
Identification of fingerprints by powder test.
To record and characterization of IR spectra of at least 1organic compounds.
Gas Chromatographic analysis of drugs and poison.
Analysis of milk, beverages, and meat.

Reference Books:

3. Yolanda Picó, Chemical Analysis of Food: Techniques and Applications Academic Press, ELSEVIER, Spain, 2012.
4. Leo M. L. Nollet. Handbook of Food Analysis: Physical characterization and nutrient analysis. CRC Press, Technology & Engineering, New York USA, 2004.
5. David E. Newton, Forensic Chemistry, United States of America, (2007)

Specialization in Inorganic Chemistry

CHM-650 Research /review report 3(0-3)

Note: The students will be allocated among faculty members. The Research/review report will be evaluated by the following committee.

i) Chairman (convener)
ii) Advisor (member)
iii) Faculty member (member)

CHM-612 X-ray Spectroscopy 3(3-0)

Introduction, Lattice and unit cell , geometry of crystals, crystal systems, primitive and non primitive cells, Lattice direction and planes crystal shapes Dimensional relationship, Braggs equation, reciprocal lattice, experimental methods of single & multicrystal (power) analysis, diffraction and diffractrometer, identification and applications.

Recommended Books:

1. B. D. Cullity "Elements of X-ray diffraction" 2nd Ed, Addison-Wesley publishing company, California, (1977).
2. E. P. Bertin, "Principles and Practice of X-ray Spectrometric Analysis", Plenum Press (1975).
3. S. Prakash, G. D. Tuli, S. K. Basu, R. D. Madan, "Advanced Inorganic Chemistry" Vol.I (1997).

CHM-614 Homogenous Catalysis 3(3-0)

Reaction of CO and hydrogenHydroformylation, reductive carbonylation, reduction of CO by

hydrogen, synthesis of water gas and shift reactions. Carbonylation reactionSynthesis of methanol and methyl acetate, adipic ester, other carbonylation and decarbonylation reactions. Catalytic addition of molecules to C-C multiple bondsHomogeneous hydrogenation, and hydrocylation and hydrocynation.

Recommended Books:

1. P. Powell, "Principles of Organometallics Chemistry", 2nd Ed, London, Chapman and Hall, New York, USA (1988).
2. A. Yamamoto "Organotransition metal chemistry" John Wiley and Sons: New York, USA (1986).
3. M. Bochmann "Orgaometallics 2, complexes with transition metal carbon π-bonds" Oxford University Press, UK (1993).
4. G. L. Miessler, D. A. Tarr, "Inorganic chemistry" 2nd Ed., Prentice Hall International, USA (1998).
5. F. A. Cary, "Organic Chemistry" 7th Ed, The McGraw-Hill Company, USA (2008).

CHM-616 Radio Nuclear Chemistry 3(3-0)

Fundamentals and applied aspects of Radio activity and nuclear chemistry. Trans-Uranium elements; Natural and artificial radioactivity, methods for isotope production, nuclear reactions; mass spectrograph, Astam mass spectrograph, The structure of the nucleus; nuclear stability and radioactive decay; Types, characteristics and detection of radio active Particles; laws of radioactive decay; the interaction of radiation with matter including radiological health hazards; Processing of the nuclear materials. Accelerators of charged particles Applications of radioisotopes.

Recommended Books:

1. F. Landler, Kennedy, Miller, "Nuclear and Radiochemistry", 2nd Ed, John Wiley and Sons, Inc. (1964).
2. G. R. Choppin, J. Rydber, "Theory and Applications", 1st Ed., Pergamon (1980).
3. H. J. Arnikan, "Essentials of Nuclear Chemistry", 4th Ed, (1990).
4. B. G. Harvey, "Nuclear Physics and Chemistry", Prentice-Hall Inc., (1990).
5. I. I. Naqvi, "Radiochemistry", McGraw Hill, USA (1990).

CHM-618 Magneto Chemistry 3(3-0)

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

Recommended Books:

1. B. Douglas, D. McDaniel, J. Alexander, "Concepts of Models of Inorganic Chemistry", 3rd Ed, John Wiley & Sons Inc., (.1994).
2. J. E. Huheey, E. A. Keiter, R. L. Keiter, "Inorganic Chemistry: Principles of Structure and Reactivity", 4th Ed., Harper & Row, New York, USA (2001).

3. K. M. Mackay, R. A. Mackay, W. Henderson, "Introduction to Modern Inorganic Chemistry", 5th Ed, Stanley Thomas Publisher Ltd. (1996).
4. G. L. Miessler, A. T. Donald, "Inorganic Chemistry", 2nd Ed., Prentice Hall International, 1991.

CHM- 620 Inorganic Chemistry Practicals-II 2(0-2)

Preparation of at least six compounds/organometallic compounds and characterization by IR and UV spectrophotometer to the subject of availability of facilities, Spectroscopic determination of some metal ions, Estimation of different metals in food, tap water and brass etc. By atomic absorption spectrometer/flame photometer/UV/Visible spectrophotometer, subject to the availability of facilities.

Recommended books:

1. Bassette, J., Denney, G.H. and Mendham, J., Vogel's Textbook of Quantitative Inorganic Analysis Including Elementary Instrumental Analysis '' English Language Book Society, 4th Edition .1981.
2. Vogel, A. I., ''A Textbook of Micro and Semi-micro Qualitative Inorganic Analysis '' Longman Green & Co. 1995.
3. Fritz, J . S. and Schenk, G. H., ''Quantitative Analytical Chemistry'', Allyn and Bacon Inc., 4th Edition, 1979.
4. Pass. G and Sutcliffe .H., ''Practical Inorganic Chemistry ''. Van Nostrand Reinhold Company. 1972.

Specialization in Organic Chemistry

CHM-650 Research /review report 3(0-3)

Note: The students will be allocated among faculty members. The Research/review report will be evaluated by the following committee.

i) Chairman (convener)
ii) Advisor (member)
iii) Faculty member (member)

CHM–622 Organic Polymers 3(3 – 0)

Introduction to polymer chemistry. Step-growth polymerization, free radical addition polymerization, ionic polymerization; stereochemistry polymers; polymerization using Ziegler-Ziegler-Niegler-Natta catalyst. Stereo-regulation and conformation of polymers. Moleculars weight determination. Structure property relation. Reactions of synthetic polymers; polymers degradation and stability with special emphasis on thermal and photo-degradation.

Recommended Books:

1. W. Fred, B. Meyer " Text Book of Polymer Science", 3rd Ed,. Johan Wiley & Sons, (1992).
2. Joel R. Fried "Polymer Science & Technology", Prentice Hall, Inc. (1995).
2. L.H Sperling "Introduction to Physical Polymer Sciences", 2nd Ed., John Wiley & Sons, USA (1990).

3. J. R. Fried "Polymer Science & Technology", Prentice Hall, Inc. (1995).

CHM–624 Reactive Intermediates and Photochemistry 3(3 –0)

Nomerclature, Preparation, Reaction of Carbene. Nintrene: Nomenclature, Preparation, Reactions, Preparation, Reaction. Arynes: Preparation, Reactions.

Photochemistry:

Introduction, Principles, Difference between thermal and photochemical reaction, laws of photochemistry, quantum yield, inter system crossing, jablonski diagram, Photofregmentation, Norish type I and II reaction. Photoreduction, Pateno Buchi Reaction. Reactivity of keton, photochemistry of olefins. Pinerization reaction.

Recommended Books:

1. N.S Isaacs "Reactive Intermediates in Organic Chemistry", John Wiley & Sons USA (1974).
2. H. Okabe "Photochemistry of small Molecules", John Wiley & Sons, New York, USA (1978).
3. C. W Rees, T.I. Gilehrist, "Carbenes, Nitrenes Arynes," Nelson, London, UK (1973).

CHM – 626 Disconnection Approach 3(3 – 0)

The Disconnection Approach

Basic Principles: Synthesis of Aromatic Compounds, One Group: C – X Disconnections, Strategy II: Chemoselectivity, Two Group C – X Disconnections, Strategy V: Stereoselectivity A, One Group C – C Disconnections II: Carbonyl Compounds, Strategy VI: Regioselectivity, Two Group Disconnections II: 1,3-Difunctionalized Compounds and α,β-unsaturated Carbonyl Compounds, Two Group Disconnections III: 1,5-Difunctionalized Compounds, Michael Addition and Robinson Annelation, Two Group Disconnections IV: 1,2-Difunctionalized Compounds, Strategy XIII: Introduction to Ring Synthesis. Saturated Heterocycles, Three Membered Rings, Strategy XV: Use of Ketenes in Synthesis, Six-membered Rings

Recommended Books:

1. T. H. Lowry, K. S. Richardson, "Mechanism and Theory in Organic Chemistry", 3rd Ed, Harper and Row Publisher (1987).
2. G. M. Loudon "Organic Chemistry", 3rd Ed. Addison Wesley London Company (1995).
3. S. H. Pine, "Organic Chemistry", 5th Ed., McGraw Hill, New York, USA (1987).
4. G. M. Loudon, " Organic Chemistry", 2nd Ed., Addison Wesley, London (1998).
5. H.O. House "Modern Synthetic Reactions", 2nd Ed, Benjamin, California, USA (1972).

CHM – 628 Organic Catalyst and Protective Group 3(3–0)

Homogeneous and heterogeneous catalysis, Acid Catalysis, Base Catalysis, Metal ion catalysis, Hydrogenation, Asymmetric hydrogenation, Hydroboration and Hydrocyanation of olefins, Transformation of alkenes and alkynes i.e. polymerization, metathesis, dimerization and oligomerization and olefin isomerization, oxidation of olefins using catalysts, Metal complexes and Quaternary ammonium compounds in organic synthesis. Protecting Groups for alcohols, aldehydes, carboxylic acid and amines

Recommended Books:

1. T. H. Lowry, K. S. Richardson "Mechanism and Theory in Organic Chemistry", 3rd Ed, Harper and Row Publisher (1987).
2. S. H. Pine, "Organic Chemistry", 5th Ed., McGraw Hill, New York, USA (1987).
3. G. M. Loudon, "Organic Chemistry", 2nd Ed., Addison Wesley, London (1998).

CHM-630 Organic Chemistry Practicals -II 2(0-2)

The experiments may be arranged as per choice/requirement of instructor but should be designed from following categories;

Synthesis of the organic compounds involving multi step synthesis using various synthetic methods. Synthesis of five or six membered heterocyclic compounds. Synthesis of targeted molecules; Anthranilic Acid. Benzilic acid, p-nitro aniline, Phenacetin and Acridon.

Recommended Books:

1- J. Fuhrhop, G. Penzlin, "Organic Synthesis Concepts, Methods, Starting Materials", 2nd Ed., Weinheim Germany (1983).

2- A. L. Vogel, "Elementary Practical Organic Chemistry Part III: Quantitative Organic Analysis", 1st Ed., Longman Group Ltd (1958).

3- F. A. Carey, R. J. Sundberg, "Advanced Organic Chemistry (Part B: Reactions and Synthesis)", 3rd Ed, Plenum Press, New York, USA (1990).

4- B. S. Fumiss, A. J. IIannaford, P.W.G. Smith, A. R. Tatchell "Vogel's Practical Organic Chemistry", 5th Ed, Addition Wesley Longman, Harlow, England(1989).

Specialization in Physical Chemistry

CHM-650 Research /review report 3(0-3)

Note: The students will be allocated among faculty members. The Research/review report will be evaluated by the following committee.

i) Chairman (convener)
ii) Advisor (member)
iii) Faculty member (member)

CHM-632 Applications of Symmetry Group Theory 3(3-0)

Advanced Group Theory

Group Algebra. Point groups. Classes Symmetry, The character table and representation, Group theory application in chemistry

Solution Chemistry

Physicochemical characteristics of solvents. Solute-solvent interaction, salvation of ions, preferential salvation. Thermodynamic methods for study of solutions

Biophysical Chemistry

Principles of biophysical chemistry; thermodynamic aspect of simple molecules, macro molecules, lipids and biological membranes; nucleic acids and proteins; enzyme kinetics and catalysis; experimental techniques

Recommended Books:

1. F. A. Cotton, "Chemical Applications of Groups Theory", Interscience Publishers (1963).
2. A. Mohammad, "Application of Symmetry and Group Theory in Chemistry" University Grants Commission, Islamabad, (1984).
3. Alan Vincent "Molecular Symmetry and Group Theory" John Wiley & sons , 1976, USA.
4. Alberty, R. A., Robert J. S. and Moungi G. B. "Physical Chemistry". 4th Edition , John Wiley and Sons, (2004
5. Smith, E. Brian, "Basic Chemical Thermodynamics" 5 College Press,. (2004).Edition. Imperial
6. Stephen B. R., Rice S. A., and Ross J., "Physical Chemistry" 2nd Ed., Oxford University Press, (2000).
7. Jurg, W., "Basic Chemical Thermodynamics" W. A. Benjamin (1969).
8. Robert G. Mortimer. "Physical Chemistry" 3rd Edition, Elsevier Academic Press, UK (2008).

CHM-634 Quantum Mechanics 3(3-0)

Statistical Mechanics

Average values, fluctuations. Partition functions of diatomic and polyatomic gases. Statistical mechanical treatment of chemical processes and equilibria. Imperfect gases, liquid state , dilute solutions and perfect crystals.

Quantum Chemistry

Operators and their properties, angular momentum. Central field problem. Variation and perturbation methods. Approximate methods in molecular quantum chemistry. Applications to quantum mechanical systems.

Theoretical and Computational Chemistry

Molecular orbital calculations. Essential concepts, semiempirical and Ab-initio methods. Reactivity. Configuration interaction method. Potential energy surfaces. Quantitative structura-activity relationship (QSAR). Computer programming and three dimensional graphics using standard packages.

Recommended Books:

1. D. J. Griffiths, "Introduction to Quantum Mechanics" 2nd Ed, Prentic Hall (2004).
2. M. G. Barrow, "Physical Chemistry" 5th Ed., Mc Graw Hill (1992).
3. R. Alberty, "Physical Chemistry" 17th Ed., John Wiley and Sons, USA (1987).
4. P. W. Atkins, "Physical Chemistry" 6th Ed, W. H. Freeman and co. New York,
5. USA (1998).
6. K. J. Laidler, "The World of Physical Chemistry" 1st Ed., Oxford University Press, USA (1993).
7. K. J. Laidler, H. M. John, C. S. Bryan, "Physical Chemistry" 4th Ed., Houghton Mifflin Publishing Company Inc. (2003).
1. E. Thomas, P. Reid, "Thermodynamics, Statistical Thermodynamics", and Kinetics 1st Ed., Benjamin Cummings, (2006).

CHM-636 Nuclear and Radiation Chemistry 3(3-0)

Nuclear Chemistry

Introduction to Nuclear chemistry, Nuclear systematic, sources of nuclear instability, nuclear energetics , nuclear fission and fusion

Nuclear Techniques

Principles, sources of nuclear radiation. Nuclear track detectors. Etchings. Kinetics and mechanism of track etching. Nuclear materials. Nuclear techniques.

Radiation Chemistry

Tracers. Radiation Chemistry, theoretical aspects. Various models. Kinetic studies of radiolytic processes. Dosimetry (physical and chemical). Radiation chemical yields. Dose and dose rate effects on primary and secondary products. Steady atate and pulse radiolysis techniques. Radiolytic studies of gaseous, water, aqueous and organic systems. Radiology.

Recommended Books:

1. G. Friedlander, J. W. Kennedy, "Nuclear and Radiochemistry", 3rd Ed. John Wiley & Sons, New York, USA (1981).
2. G. R. Choppin, J. Rayberg "Nuclear Chemistry Theory and Applications", 1st Ed., Pergaman Press, Oxford, USA (1998).
3. F. Aziz, M. A. J. Rodgers, "Radiation Chemistry Principles and Application" Ed., VCH Publishers, Inc, (1987).
4. R. Gregory, Choppin, J. Rayberg "Nuclear Chemistry Theory and Applications", 1st Ed., Pergaman Press, Oxford, USA (1998).

CHM-638 Electrochemical Aspects of Solutions 3(3-0)

Electrochemistry of Solution

Introduction to solution and its units, Conductance and resistance, Fugacity, activity, activity coefficient, colligative properties of electrolytes, ionic mobility, cell constant, ionic strength

Kinetics of Electrode Process

Theories of electrolytes, interfacial phenomena, electrode kinetics, mechanism of electrode reactions, Butlar Volmer equation, cyclic voltametry and its applications

Electrochemistry of Colloidal Solution

Colloids, classification, preparation of colloidal solution, peptisation, coagulation, flocculation, peptisation, Dialysis, Electrophoresis, Zeta potential, Solutions of Surfactants.

Recommended Books:

1. J. Albert, "Electrode Kinetics" Clarendon, Oxford, USA (1975).
2. B. R. Stephen, S. A. Rice, J. Ross, *"*Physical Chemistry*"* 2nd Ed., Oxford University Press, USA (2000).
3. W. Jurg, "Basic Chemical Thermodynamics" W. A. Benjamin (1969).
4. Smith, E. Brian, "Basic Chemical Thermodynamics" 5th Ed, Imperial College

Press. (2004).
5. R. A. Alberty, J. S. Robert, G. B. Moungi, "Physical Chemistry". 4th Ed, John Wiley and Sons, (2004).
6. D. W. Ball, "Physical Chemistry" 1st Ed., Brooks/Cole Co. Inc., (2003).

CHM-640 Physical Chemistry Practicals-II 2(0-2)

NB: ***At least eight experiments should be performed from following list subjected to availability of apparatus and chemicals.***

1. Determination of Equivalent and molar conductance of aqueous and non-aqueous solutions of different electrolytes.
2. Determination of partial molar volumes and excess molar volumes for binary and ternary systems.
3. Purification of the given commercial solvent using pertinent methods of separation (distillation, fractional distillation, reflux).
4. Verification of Ostwald's Dilution law.
5. Verification of Debyle-Huckel Limiting law.
6. Determination of heat of solutions of selected compounds by solubility methods in aqueous and non-aqueous media.
7. Determination of critical micelle concentration of selected surfactants in aqueous and non-aqueous media by surface tension and conductivity.
8. Determination of free energy of micellization of selected surfactants in aqueous and non-aqueous media by surface tension and conductivity.
9. Determination of equivalence point of acid-base titration by electrical conductivity.
10. Determination of degree of dissociation of weak electrolytes.
11. Determination of pKa values of acids.
12. Determination of pKa values of indicators.
13. Preparation of buffers of required pH values.

Books recommended:

1. C.W. Garland, J.W. Nibler and DP Shoemaker, Experiments in Physiacl Chemistry, Mc Grawhill, 7th edition (1996).
2. James, A. M., Prichard, F. E., *Practical Physical Chemistry,* 3rd ed., Longman Group Limited, New York, (1974).
3. A. Findly's Practical Physical Chemistry, Longmann, London(1972).
4. LP Gold, L. Gold, Physical Chemistry Laboratory, Primis Publishers (1997) ISB: 0072902698.