Instructions

*Please follow the scheme of studies of relevant prospectus strictly.

*Course Code and Course Title should be carefully noted.

*Prospectus are available in soft form at university website.

*For any clash of scheme of studies in prospectus and outlines, please contact the Focal person (Department of Chemistry)

Dr. Tahir Maqbool (drtahirmaqbool@gcuf.edu.pk) 0332-7336562

Dr. Matloob Ahmad (Matloob.Ahmad@gcuf.edu.pk)
BS Chemistry

Session 2018-2022

Semester 1 (Session 2018-2022)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>CHM-301</td>
<td>Organic Chemistry – I</td>
<td>4(3-1)</td>
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<tr>
<td>ENG-321</td>
<td>Functional English</td>
<td>3(3-0)</td>
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<tr>
<td>PST-321</td>
<td>Pakistan Studies</td>
<td>2(2-0)</td>
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<tr>
<td>MTH-301</td>
<td>Calculus-I</td>
<td>4(4-0)</td>
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<tr>
<td>PHY-321</td>
<td>Fundamentals of Mechanics</td>
<td>4(3-1)</td>
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<tr>
<td>ZOL-301</td>
<td>Principle in Animal Life – I</td>
<td>4(3-1)</td>
</tr>
<tr>
<td>BOT-301</td>
<td>Diversity of Plants</td>
<td>4(3-1)</td>
</tr>
</tbody>
</table>

Optional (Any two subjects): Math & Physics or Botany & Zoology

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.
BS (Hons) Chemistry Session 2018-22

CHM-301 Practical
Sixteen experiments shall be conducted based on the following

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

b. Qualitative Organic Analysis
   Systematic identification of organic compound (1 Compounds)

c. Preparation of Organic Compounds
   Preparation of simple organic compound like iodoform, aspirin, acetanilide etc (1 preparations)

Books Recommended:

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 unifying 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

Prepared by: Noor ul Qamar Gausi, Head, Department of English
• 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:

References:
- Allama Iqbal Open University, Compulsory English I (Code 1423) (Islamabad: AIOU Press).
  http://www.bbc.co.uk/worldservice/learningenglish/
  http://learnenglish.britishcouncil.org/en/
- British Council and BBC. Learn English.
  http://www.teachingenglish.org.uk/
- Grammar software free download: 3D Grammar English.

Prepared by: Noor of Qamar Qasmi, Head, Department of English
PST-321 Pakistan Studies 2(2–0)

Class: B.A/B.S/B.Com

COURSE OUTLINE: PST-321

1. Regeneration of Muslim Society in sub-continent and causes of decline of Muslim Rule
2. War of Independence 1857 and its impacts upon the politics of South Asia.
3. Sir Syed Ahmed Khan and Aligarh Movement:
   i) Educational Services
   ii) Political Services
   iii) Rational Interpretation of Islam
4. All India Muslim League:
   i) Multiple approaches and causes of the formation of Muslim League.
   ii) Objectives of the party.
   iii) Comparison of the policies of All Indian National congress and All India Muslim League.
   iv) Politics of Muslim League after the creation of Pakistan
5. Lucknow Pact 1916, high water mark of Hindu-Muslim Unity.
6. Khilafat Movement:
   i) Khilafat as an institution.
   ii) Hindu-Muslim Unity.
   iii) Role of Gandhi
   iv) Emergence of Muslim Ulma in Indian politics.
   v) Causes of the failure and impacts of the movement.
7. Iqbal’s Address at Allahabad 1930 and political thoughts of Ch. Rehmat Ali.
8. Congress Ministries.
9. Pakistan Resolution 1940.
10. Muhammad Ali Jinnah:
    i) Jinnah’s role in Indian politician.
    ii) As a governor General
11. Initial problems and constitutional development in Pakistan.
13. Political culture of Pakistan.
14. Foreign Policy of Pakistan:
    i) Major determinants and objectives
    ii) Overview.

Recommended Books:


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<thead>
<tr>
<th>Course Number</th>
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<th>Credit Hours</th>
<th>Marks</th>
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<tbody>
<tr>
<td>MTH-301</td>
<td>Calculus I</td>
<td>4(4-0)</td>
<td>80</td>
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</tbody>
</table>

**Prerequisites:** Knowledge of Intermediate Calculus


**Applications of derivatives:** Increasing and decreasing functions. Relative extrema and optimization. First derivative test for relative extrema. Convexity and point of inflection. Second derivative test for extrema. Curve sketching. Mean value theorem (without proof). Indeterminate forms. L'Hospital’s rule (without proof) and its applications.

**Recommended Books:**

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.

Practicals

1. To determine the value of “g” by compound pendulum.
2. To determine the Modulus of rigidity of the material of a spiralspring.
3. To determine the Young’s Modulus of the material of a spiralspring.
4. To determine the Modulus of rigidity of a wire by solid cylindrical rod.
5. To determine the Modulus of rigidity of a wire by Static Method (Barton’s Apparatus).
6. To determine the Modulus of rigidity of a wire by Dynamic Method (Maxwell needle).
7. Surface tension of water by capillary tube method.
8. Projectile motion: (a) To determine the range as a function of the angle of inclination. (b) To determine the maximum height of projectile as a function of angle of inclination. (c) To determine the range / height as a function of initial velocity of projectile

Recommended Books:

3. Sears, Zemansky and Young, 2000, University Physics, 8th Ed, Addison-Wesley. Reading (MA) USA.
### Course Title
PRINCIPLES OF ANIMAL LIFE – I

### Course Code
ZOL-301

### Credit Hours
4(3-1)

### Theory
3

### Practical
1

### Aims and Objectives
The course aims to impart knowledge and understanding of:

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

### Learning Outcomes

### Syllabus in Brief

**Course Contents**

1. **Place of Zoology in Science**
   A one-world view: genetic unity, the fundamental unit of life, evolutionary oneness and the diversity of life, environment and world resources; what is Zoology? The classification of animals; the scientific method.

2. **The Chemical Basis of Animal Life**
   Atoms and elements: building blocks of all matter; compounds and molecules: aggregates of atoms; acids, bases, and buffers; the molecules of animals: fractional account of carbohydrates, lipids, proteins, nucleotides and nucleic acids based on their structural aspects.

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

4. **Energy and Enzymes: Life’s Driving and Controlling Forces**
   Energy and the laws of energy transformation; activation
energy; enzymes: structure, function and factors affecting their activity; cofactors and coenzymes; ATP: how cells convert energy? An overview.


7. Ecology II: Communities and Ecosystems Community structure and diversity; ecosystems; ecosystems of the earth; ecological problems; human population growth, pollution, resource depletion and biodiversity.

Practicals

1. Tests for different carbohydrates, proteins and lipids.
   Note: Emphasis on the concept that tests materials have been ultimately obtained from living organisms and constituted their body.

2. Study of the prepared slides of epithelial tissue (squamous, cuboidal, columnar), connective tissue (adipose, cartilage, bone, blood), nervous tissue and muscle tissue (skeletal, smooth and cardiac).
   Note: Prepared microscopic and/or projection slides and/or CD ROM computer projections must be used.

3. Plasmolysis and deplasmolysis in blood.

4. Protein digestion by pepsin.

5. Ecological notes on animals of a few model habitats.

6. Field observation and report writing on animals in their ecosystem (a terrestrial and an aquatic ecosystem study).

Books Recommended


6. Miller, S.A. GENERAL ZOOLOGY LABORATORY
|  |  |
---|---|
Title of the Course: Bot-301 Diversity of Plants
Credit Hours: 4 (3+1)

Specific Objectives of course:
To introduce the students to the diversity of plants and their structures and significance.

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

a) Viruses (RNA and DNA types) with special reference to TMV;
b) Bacteria and Cyanobacteria (Nostoc, Anabaena, Oscillatoria) with specific reference to biofertilizers, pathogenicity and industrial importance;
c) Algae (Chlamydomonas, Spirogyra, Chara, Vaucheria, Pinnularia, Ectocarpus, Polysiphonia)
d) Fungi (Mucor, Penicillium, Phylactinia, Ustilago, Puccinia, Agaricus), their implication on crop production and industrial applications.
e) Lichens (Physcia)
f) Bryophytes
   i. Riccia
   ii. Anthoceros
   iii. Funaria

g) Pteridophytes.
   i. Psilopsida (Psilotum)
   ii. Lycopsida (Selaginella)
   iii. Sphenopsida (Equisetum)
   iv. Pteropsida (Marsilea)

h) Gymnosperms
   i. Cycas
   ii. Pinus
   iii. Ephedra

i) Angiosperms
   i. Monocot (Poaceae)
   ii. Dicot (Solanaceae)

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

Journals / Periodicals:
BS (Hons) Chemistry Session 2018-22

Semester 2 (Session 2018-2022)

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<td>Inorganic Chemistry – I</td>
<td>4(3-1)</td>
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<tr>
<td>ENG-322</td>
<td>English Comprehensive and Composition</td>
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<tr>
<td>ISL-321</td>
<td>Islamic Studies/Ethics</td>
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<tr>
<td>MTH-302</td>
<td>Calculus-II</td>
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<tr>
<td>PHY-322</td>
<td>Fundamentals of Electricity and Magnetism</td>
<td>4(3-1)</td>
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<tr>
<td>ZOL-302</td>
<td>Principle in Animal Life – II</td>
<td>4(3-1)</td>
</tr>
<tr>
<td>BOT-302</td>
<td>Systematic, Anatomy and Development</td>
<td>4(3-1)</td>
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<tr>
<td></td>
<td>Optional (Any two subjects): Math &amp; Physics or Botany &amp; Zoology</td>
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</tbody>
</table>

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

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

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-302 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.


4. **Quantitative analysis**
   - Determination of total hardness of water using EDTA.
   - Estimation of magnesium using EDTA.
   - Estimation of copper (iodometrically).
   - Determination 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 KMnO₄ solution.
   - Determination of purity of commercial potassium oxalate using KMnO₄ solution
   - Estimation of ferrous / ferric ions using K₂Cr₂O₇ solution.
   - Percentage determination of barium in barium nitrate by gravimetric method.
   - Gravimetric determination of nickel.

**Books Recommended:**

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:
     o Chronology for a narrative
     o Stages of a process
     o From general to specific and vice versa
     o From most important to least important
     o Advantages and disadvantages
     o Comparison and contrast
     o 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

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II. 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
BA BSc (Compulsory, Elective, Optional)

Islamic Studies/Ethics

<table>
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<th>Module</th>
<th>Code</th>
<th>Credits</th>
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<tbody>
<tr>
<td></td>
<td>ISL-32</td>
<td>2(2-0)</td>
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</tbody>
</table>

Note: Details for the modules ISL-32 are yet to be finalized.

Instructions for students:

1. All students are expected to attend the classes regularly.
2. Online quizzes will be conducted on the learning management system.
3. Regular assignments and projects will be given to assess understanding.
4. Mid-term and final exams will be conducted as per the academic calendar.
5. Students are required to submit assignments and projects on time.

Faculty members:

[Signatures and dates]

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الحدثات الأصولية

(III) حديث: أي حديث كتابي
(IV) حديث: أي حديث كتابي
(V) حديث: أي حديث كتابي
(VI) حديث: أي حديث كتابي
(VII) حديث: أي حديث كتابي
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الحدثات النبوية

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الحدثات النبوية

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(VIII) حديث: أي حديث كتابي
لا تُنقَلِبَ قَلَبُهُ، فَلْيَقْدِحُ فيِّ للأُمَّةِ وَلَا تَعْصَمُهُ أَن يَحْفَظَ الْقُلُوبَ وَلَا يَتَبَيَّنَ لِلنَّاسِ أَنَّ الْأَقْرَأَ بْنَ الْفَزَّارَ بِأَنَّهُ كَانَ مِن نَّاسٍ مَّن لَّيْنَ فَيْنَ يَنْسَأُ يَدَهُ. 

هَلْ يُنَادِيُّ الْمَلَائِكَةَ مِنَ الْمَلَائِكَةِ بِمَلَائِكَةٍ أَن يَلْبَسَهُ، وَأَن يَقْدِحَ تِلْكَ قَلَبَتَا وَأَن يَذْهَبَ لِلْجَاهِلِيَّةِ بِعَضْوَةٍ؟ 

أنَّ الْأَرْضَ وَلَا الْجَهَنَّمَ، وَلَا أَبْنَيْنِي، فَلْيَقْدِحُ الْأُمَّةِ وَلَا تَعْصَمُهُ أَن يَحْفَظَ الْقُلُوبَ وَلَا يَتَبَيَّنَ لِلنَّاسِ أَنَّ الْأَقْرَأَ بْنَ الْفَزَّارَ بِأَنَّهُ كَانَ مِن نَّاسٍ مَّن لَّيْنَ فَيْنَ يَنْسَأُ يَدَهُ. 

هَلْ يُنَادِيُّ الْمَلَائِكَةَ مِنَ الْمَلَائِكَةِ بِمَلَائِكَةٍ أَن يَلْبَسَهُ، وَأَن يَقْدِحَ تِلْكَ قَلَبَتَا وَأَن يَذْهَبَ لِلْجَاهِلِيَّةِ بِعَضْوَةٍ؟
15. على أن ينص على زوجة لله علمنا صاحب في سبيل الله على مسالة. يلزم من أعمالهم ألا يكون فيها شيء في تنفيذها وتفتيح معجم مباني ومساكنه.

16. على أن يُنص على زوجة لله علمنا صاحب في سبيل الله على مسالة. يلزم من أعمالهم ألا يكون فيها شيء في تنفيذها وتفتيح معجم مباني ومساكنه.

17. على أن ينص على زوجة لله علمنا صاحب في سبيل الله على مسالة. يلزم من أعمالهم ألا يكون فيها شيء في تنفيذها وتفتيح معجم مباني ومساكنه.

18. على أن ينص على زوجة لله علمنا صاحب في سبيل الله على مسالة. يلزم من أعمالهم ألا يكون فيها شيء في تنفيذها وتفتيح معجم مباني ومساكنه.

19. على أن ينص على زوجة لله علمنا صاحب في سبيل الله على مسالة. يلزم من أعمالهم ألا يكون فيها شيء في تنفيذها وتفتيح معجم مباني ومساكنه.

20. على أن ينص على زوجة لله علمنا صاحب في سبيل الله على مسالة. يلزم من أعمالهم ألا يكون فيها شيء في تنفيذها وتفتيح معجم مباني ومساكنه.

21. على أن ينص على زوجة لله علمنا صاحب في سبيل الله على مسالة. يلزم من أعمالهم ألا يكون فيها شيء في تنفيذها وتفتيح معجم مباني ومساكنه.

22. على أن ينص على زوجة لله علمنا صاحب في سبيل الله على مسالة. يلزم من أعمالهم ألا يكون فيها شيء في تنفيذها وتفتيح معجم مباني ومساكنه.

23. على أن ينص على زوجة لله علمنا صاحب في سبيل الله على مسالة. يلزم من أعمالهم ألا يكون فيها شيء في تنفيذها وتفتيح معجم مباني ومساكنه.

24. على أن ينص على زوجة لله علمنا صاحب في سبيل الله على مسالة. يلزم من أعمالهم ألا يكون فيها شيء في تنفيذها وتفتيح معجم مباني ومساكنه.

25. على أن ينص على زوجة لله علمنا صاحب في سبيل الله على مسالة. يلزم من أعمالهم ألا يكون فيها شيء في تنفيذها وتفتيح معجم مباني ومساكنه.
86

(1) مسلم ہر کسی کا ہر صواب کہتے ہیں کہ

(2) اکرم ان کے وہاں نکل کر گا کہہا تھا کہ "اپنے والد修剪 کا تحریر کرو۔"

(3) لاہوری کا ہے ہو ہوئے کہہا تھا کہ "اپنے والد修剪 کا تحریر کرو۔"

(4) اکرم ان کے وہاں نکل کر گا کہہا تھا کہ "اپنے والد修剪 کا تحریر کرو۔"

(5) اکرم ان کے وہاں نکل کر گا کہہا تھا کہ "اپنے والد修剪 کا تحریر کرو۔"

(6) اکرم کا ہے ہوئے کہہا تھا کہ "اپنے والد修剪 کا تحریر کرو۔"

(7) اکرم ان کے وہاں نکل کر گا کہہا تھا کہ "اپنے والد修剪 کا تحریر کرو۔"

(8) اکرم ان کے وہاں نکل کر گا کہہا تھا کہ "اپنے والد修剪 کا تحریر کرو۔"


Conic section, parameterized curves and polar coordinates: Curves defined by parametric equations. Calculus with parametric curves: tangents, areas, arc length. Polar coordinates. Polar curves, tangents to polar curves. Areas and arc length in polar coordinates.

Recommended Books:

PHY-322 Fundamentals of Electricity and Magnetism 4(3-1)

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

Practicals

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.
5. To determine the high resistance by Neon flash lamp and a capacitor.
6. To study the conversion of a pointer galvanometer into an ammeter reading upto 0.1 amperes.
7. To study the conversion of a pointer galvanometer into a voltmeter reading upto 3volts.
8. To measure the unknown resistance using neon flash bulb and capacitor.
9. To determine unknown small resistance by using Carey Fosterbridge.
10. To study the Acceptor circuit and determination of its resonance frequency.
11. To study the Rejecter circuit and determination of its resonance frequency.
12. Investigation of induced current and voltage in secondary coil of a transformer as a function of number of turns and current flowing in the primary coil.

Recommended Books:

4. Sears, Zemansky and Young, 2000, University Physics, 8th Ed, Addison-Wesley. Reading (MA) USA.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>ZOL-302</th>
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<tbody>
<tr>
<td>Course Title</td>
<td>PRINCIPLES OF ANIMAL LIFE – II</td>
</tr>
<tr>
<td>Credit Hours</td>
<td>4(3-1)</td>
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<tr>
<td>Theory</td>
<td>3</td>
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<tr>
<td>Practical</td>
<td>1</td>
</tr>
<tr>
<td>Follow up</td>
<td>BS</td>
</tr>
<tr>
<td>Aims and Objectives</td>
<td>The course imparts knowledge and understanding of: a. cell division and its significance in cell cycle. b. concepts and mechanisms of inheritance pattern, chromosome and gene linkage and molecular basics of genetics. c. animal behaviour and communication. d. theories of evolution, gene flow and mechanism of evolution with reference to animals and diversity.</td>
</tr>
<tr>
<td>Learning Outcomes</td>
<td>Course Contents 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 The birth of modern genetics; Mendelian inheritance patterns; other inheritance patterns; environmental effects and gene expression. 3. Chromosomes and Gene Linkage Eukaryotic chromosomes; linkage relationships; changes in chromosome number and structure. 4. Molecular Genetics: Ultimate Cellular Control DNA: the genetic material; DNA replication in eukaryotes; genes in action; control of gene expression in eukaryotes; mutations; applications of genetic technologies; recombinant DNA. 5. Animal Behaviour Four approaches to animal behaviour; proximate and ultimate causes; anthropomorphism; development of behavior; learning; control of behavior; communication; behavioral ecology; social behavior. 6. 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 evolution by natural selection;</td>
</tr>
</tbody>
</table>
evolutionary thought after Darwin; biogeography.

7. Evolution and Gene Frequencies
The modern synthesis: a closer look; 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.

Books Recommended


Practicals

1. Study of mitosis in onion root tip.

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

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

3. Problem based study of Mendelian ratio in animals.

4. Multiple alleles study in blood groups.

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


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

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

9. Study to demonstrate social behaviour (documentary film be shown, honey bee, monkey group in a zoo).

Books Recommended


Specific Objectives of course:
To understand: 1. various systems of classification, identification and nomenclature of Angiosperms, 2- Structures and functions of tissues and organs at embryonic level.

Course Outline:

a) Plant systematics
   1. Introduction to Plant Systematics: aims, objectives and importance.
   2. Classification: brief history of various systems of classification with emphasis on Takhtajan.
   4. Morphology: a detailed account of various morphological characters root, stem, leaf, inflorescence, flower, placentation and fruit types.
   5. Diagnostic characters, economic importance and distribution pattern of the following families:
      i. Ranunculaceae
ii. Brassicaceae (Cruciferae)
iii. Fabaceae (Leguminosae)
iv. Rosaceae
v. Euphorbiaceae
vi. Cucurbitaceae
vii. Lamiales (Labiateae)
viii. Aplacae (Umbelliferae)
ix. Asteraceae (Compositae)
x. Liliaceae (Sen. Lato)

b) Anatomy
1. Cell wall: structure and chemical composition
2. Concept, structure and function of various tissues like:
   i. Parenchyma
   ii. Collenchyma
   iii. Sclerenchyma
   iv. Phloem Epidermis (including stomata and trichomes)
   v. Xylem
3. Meristem: types, stem and root apices
4. Vascular cambium
5. Structure and development of root, stem and leaf. Primary and secondary
growth of dicot stem, periderm
6. Characteristics of wood: diffuse porous and ring porous, sap and heart
wood, soft and hard wood, annual rings.

c) Development/Embryology
1. Early development of plant body:
2. Capsella bursa-pastoris
3. Structure and development of Anther Microsporogenesis, Microgametophyte
4. Structure of Ovule Megasporogenesis Megagametophyte
5. Endosperm formation
6. Parthenocarpy
7. Polyembryony

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

Anatomy and Embryology
1. Study of stomata and epidermis.
2. Tissues of primary body of plant.
3. Study of xylem 3-dimensional plane of wood.
4. T. S of angiosperm stem and leaf.
5. Anatomy of germinating seeds
6. Study of pollens
Recommended Books:
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
### 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 comprehension
   - 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
- Hargie, O. (ed.) Hand book of Communications Skills
Course Outline

- Introduction to Computers
- Different Input and Output devices (Specially modern devices)
- Software and its different types
- Operating System Concepts
- Services and functions of operating system
- Network and its types
- Network Topologies and its types
- Introduction to Internet
- Different Web terminologies (Http, Web Browsers, Ftp, Search Engines, WWW)
- Introduction to common web devices specially modems.
- Introduction to protocols and use of protocols in Web.

RECOMMENDED BOOKS

**Semester-3**

**PHY-323 Concepts of Modern Physics 4(3-1)**

Thermal radiation and laws, quantization of energy, Photoelectric effect, the Compton effect, line spectra, wave behavior of particles. Testing de Broglie’s hypothesis, waves, wave packets and particles, Hersenberg’s uncertainty principle, wave function, Schrodinger equation, trapped particles and probability densities, the correspondence principle, dual nature of matter. The atomic structure of hydrogen. Bohar’s theory, angular momentum of electrons, electron spin, X-ray spectrum, LASERS. Discovering the nucleus, basic nuclear properties. Radioactive decay. Energy from the nucleus, nuclear fission. Nuclear fusion, Nuclear reactors. Electronics, the p-n junction, Bias the p-n junction diode, diode, characteristics of diode. Different models, and types of diodes (LED, Photo diode, Zener diode), half-wave and full-wave rectifier, full-wave bridge rectifier. Filter circuits. Bipolar junction transistor (BJT), BJT applications as a switch and amplifier.

**Practicals**

1. Variation of photo electric current with intensity of incident light.
2. Design a full-wave rectifier and study its output without and with a capacitor filter.
3. Design a Half-wave rectifier and study its output without and with a capacitor filter.
4. To study characteristics of NOT, AND, NOR, NOR, NAND and XOR and verify their truth table.
5. To determine the ionization potential of mercury.
6. To determine the charge to mass ratio (e/m) of an electron.
7. To determine the Planck's constant \((h)\) by using Photocell method.
8. To determine the Planck's constant \((h)\) by using spectrometer method.
9. To study the variation of photoelectric current with the intensity of light.
10. To study the Characteristic curves of a solar cell.
11. To study the effect of smoothing circuits on the ripple voltage.
12. To study the characteristics of a semiconductor diode (P N junction).
13. To study the characteristics of a transistor (NPN and PNP).

**Recommended Books:**

3. Sears, Zemansky, and Young, 2000, University Physics, 8th Ed, Addison-Wesley. Reading (MA) USA.

<table>
<thead>
<tr>
<th>Course Title</th>
<th>Animal Diversity: Invertebrates</th>
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<tbody>
<tr>
<td>Course Code</td>
<td>ZOL – 401</td>
</tr>
<tr>
<td>Credit Hours</td>
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<td>Theory</td>
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<td>Category</td>
<td>BS (Hons)</td>
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<tr>
<td>Aims and Objectives</td>
<td>The students will be able to make comparison from simple unicellular to complex multicellular organization along with phylogenetic relationship</td>
</tr>
<tr>
<td>Learning Outcomes</td>
<td>The students will be able to achieve the aims and objectives of the course</td>
</tr>
<tr>
<td>Syllabus in Brief</td>
<td>Theory</td>
</tr>
<tr>
<td></td>
<td>1. Introduction</td>
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<tr>
<td></td>
<td>fication of organisms; evolutionary relationships and tree diagrams; patterns of organization.</td>
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<tr>
<td></td>
<td>2. Animal-Like Protists: The Protozoa</td>
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<td></td>
<td>evolutionary perspective; life within a single plasma membrane; symbiotic life-styles. Protozoan taxonomy: (up to phyla, subphyla and super classes, wherever applicable). Pseudopodia and amoeboid locomotion; cilia and other pellicular structures; nutrition; genetic control and reproduction; symbiotic ciliates; further phylogenetic considerations.</td>
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<tr>
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<td>3. Multicellular and Tissue Levels of Organization</td>
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<td></td>
<td>evolutionary perspective: origins of multicellularity; animal origins. Phylum porifera: cell types, body wall, and skeletons; water currents and body forms; maintenance functions; reproduction. Phylum cnidaria (coelenterata) the body wall and nematocysts; alternation of generations; maintenance functions; reproduction and classification up to class. Phylum ctenophora; further phylogenetic considerations.</td>
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<tr>
<td></td>
<td>4. Triploblastics and Acoelomate Body Plan</td>
</tr>
<tr>
<td></td>
<td>evolutionary perspective; phylum platyhelminthes: classification up to class; the free-living flatworms and the tapeworms; phylum nemertea; phylum gastrotricha; further phylogenetic considerations.</td>
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<tr>
<td></td>
<td>5. Pseudocoelomate Body Plan: Aschelminths</td>
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<tr>
<td></td>
<td>evolutionary perspective; general characteristics; classification up to phyla with external features; feeding and the digestive system; other organ systems; reproduction and development of phylum</td>
</tr>
</tbody>
</table>
rotifera and phylum nematoda; phylum kinorhyncha. Some important nematode parasites of humans; further phylogenetic considerations.
6. Molluscan Success
Evolutionary perspective: relationships to other animals; origin of the coelom; molluscan characteristics; classification up to class.
The characteristics of shell and associated structures, feeding, digestion, gas exchange, locomotion, reproduction and development, other maintenance functions and diversity in gastropods, bivalves and cephalopods; further phylogenetic considerations.
7. Annelida: The Metameric Body Form
Evolutionary perspective: relationship to other animals, metamerism and tagmatization; classification up to class. External structure and locomotion, feeding and the digestive system, gas exchange and circulation, nervous and sensory functions, excretion, regeneration, reproduction and development, in polychaeta, oligochaeta and hirudinea; further phylogenetic considerations.
8. Arthropods: Blueprint for Success
Evolutionary perspective: classification and relationships to other animals; metamerism and tagmatization; the exoskeleton; metamorphosis; classification up to class; further phylogenetic considerations.
9. Hexapods and Myriapods: Terrestrial Triumphs
Evolutionary perspective; classification up to class. External structure and locomotion, nutrition and the digestive system, gas exchange, circulation and temperature regulation, nervous and sensory functions, excretion, chemical regulation, reproduction and development in hexapoda; insect behavior; insects and humans; further phylogenetic considerations.
Practicals
2. Study of sponges and their various body forms (prepared slides).
3. Study of principal representative classes of phylum Cnidaria.
4. Study of principal representative classes of phylum Platyhelminthes.
5. Study of representative of phylum Rotifera, phylum Nematoda.
7. Study of principal representative classes of phylum Annelida.
8. Study of principal representative classes of groups of phylum Arthropoda.
9. Brief notes on medical/economic importance of the
following:

10. Preparation of permanent stained slides of the following: *Obelia*, *Daphnia*, Cestode, Parapodia of *Nereis*.

Reference Books
Title of the course: Bot-401  Cell Biology, Genetics and Evolution  
Credit hours: 4 (3+1)

Specific objectives of course: To understand:
1. Structure and function of cell.
2. Nature of genetic material and hereditary process
3. Familiarization with evolutionary processes.

Course outline:

a) Cell Biology
1. Structure and Function of Bio-molecules
   i. Carbohydrates
   ii. Lipids
   iii. Proteins
   iv. Nucleic Acids
2. Cell: Cell theory, cell types (prokaryotes, eukaryotes), basic properties of cell.
3. Brief description of following cell organelles
   i. Cell wall
   ii. Cell membrane
   iii. Nucleus
   iv. Endoplasmic reticulum
   v. Plastids
   vi. Mitochondria
   vii. Ribosomes
   viii. Dictyosomes
   ix. Vacuoles
4. Reproduction in somatic and embryogenic cell, mitosis, meiosis and cell cycle

b) Genetics
1. Introduction, scope and brief history of genetics, Mendelian inheritance; Laws of segregation and independent assortment, back cross, test cross, dominance and incomplete dominance.
2. Molecular genetics; DNA replication. Nature of gene, genetic code, transcription, translation, protein synthesis, regulation of gene expression (e.g. lac operon).

c) Evolution: Introduction and theories.
Lab Outline:

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

Genetics
1. Genetical problems related to transmission and distribution of genetic material.
2. Identification of chromosomes in plant material. Carmine/orcein staining.
3. Determination of blood groups

Recommended Books:
Semester 4

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>CHM-402</td>
<td>Analytical Chemistry - I</td>
<td>4(3-1)</td>
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<tr>
<td>ENG-422</td>
<td>Technical Writing</td>
<td>3(3-0)</td>
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<tr>
<td>CSI-422</td>
<td>Computer Applications &amp; Web - II</td>
<td>3(3-0)</td>
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<tr>
<td>MTH-406</td>
<td>Differential Equations – II</td>
<td>4(4-0)</td>
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<tr>
<td>PHY-324</td>
<td>Introduction to Heat and Thermodynamics</td>
<td>4(3-1)</td>
</tr>
<tr>
<td>ZOL-402</td>
<td>Animal Form &amp; Function</td>
<td>4(3-1)</td>
</tr>
<tr>
<td>BOT-402</td>
<td>Plant Physiology and Ecology</td>
<td>4(3-1)</td>
</tr>
</tbody>
</table>

Optional (Any two subjects): Math & Physics or Botany & Zoology

CHM-402 Analytical Chemistry-I 4(3-1)

Introduction to analytical chemistry, Application of analytical chemistry in other disciplines of sciences, Qualitative and quantitative analysis, Classification of analytical techniques, Steps of a typical chemical analysis, Analytical concepts of errors, precision, accuracy (sources, control and applications), Measuring Apparatus, Expression of Quantities and Concentrations, Specifications of chemicals and reagents, their use and handling, Sample and sampling, Principals of Solvent extraction, Concept of electromagnetic radiations and basics of spectroscopic analysis (UV/Visible and IR spectroscopy and Atomic Emission and Atomic Absorption Spectroscopy) and chromatographic separations (Definition, Classification, Principals and overview of Applications).

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

Books Recommended
Technical English (422) 4th Semester (BS, honours)

Contents:
1. Basic factors of Technical Writing
2. Basic principles of technical writing style
3. Report Writing
   - What is Report Writing?
   - When we need to write reports.
   - Prior preparation and planning
   - Structure and sections of a report
   - Writing style and written language appropriate for report writing:
     - What is Report Writing?
     - When we need to write reports.
     - Prior preparation and planning
     - Structure and sections of a report
     - Writing style and written language appropriate for report writing:
     - social or university issue.
4. Proposal Writing:
   - 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
5. Plagiarism and Citation:
   - What is plagiarism
   - How to avoid plagiarism
   - How to cite:
     - Different styles to cite
6. How to do and write an academic research
   - Sources of research (primary, secondary and tertiary source)
   - Sections of an academic research paper

7. Academic writing

Compiled and prepared by: Ms. Fareeha Saleem
Approved and recommended by: Chairman of English Department Dr. Mazhar Hayat

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**Computer Applications and Web-II**

**BS (Chemistry) Course Code: CSI-422 Semester: 4th**

**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.
Higher Order Differential Equations:


RECOMMENDED BOOKS


**PHY-324  Introduction to Heat and Thermodynamics  4(3-1)**

Kinetic theory of the ideal gas; work done on an ideal gas, material energy of an ideal gas, intermolecular forces. Statistical mechanics, statistical distribution and mean values, distribution molecular speeds, distribution of energies, Brownian motion. Heat, different theories of heat, specific heat, gram molecular specific heat, laws of thermodynamics. Zeroth law, first law, second law, third law of thermodynamics, reversible and irreversible processes, indicator diagram, entropy, law of thermodynamics, reversible and irreversible processes, indicator diagram, entropy law of increase of entropy, temperature-entropy diagram. Maxwell’s thermodynamics relations, TDS equations, Clapeyron’s equation, entropy and second law of thermodynamics. Temperature scale, entropy, low temperature physics. Thermoelectricity, Seabeck effect, Peltier effect, thermocouple.

**Practicals**

1. The determination of wavelength of light by Diffraction grating.
2. To determine the mechanical equivalent of heat, “J” by Electrical Method (Calendarand Barnes Method) with compensation for heat
3. To study the principle of thermocouple, thermal e.m.f. and temperature diagram.

4. To determine the temperature coefficient of resistor. (Resistance of Platinum wire)

5. To determine the Stefan’s Constant (σ).


**Recommended Books:**
3. Sears, Zemansky and Young, 2000, University Physics, 8th Ed, Addison-Wesley. Reading (MA) USA.

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**Course Title** ANIMAL FORM AND FUNCTION (A COMPARATIVE PERSPECTIVE)  **Course Code** ZOL-402  
**Credit Hours** 4(3-1)  
**Theory 3 Practical 1**  
**Follow up BS Category**

**Aims and Objectives** The course deals with the:  
- a. Basis of structure and functions of animal nutrition, digestion, homeostasis and temperature regulation.  
- b. It introduces the basic concepts in reproduction and development in animal kingdom.  
- c. Provides knowledge about the development of chordate body plan and fate of germinal layers.

**Learning Outcomes**

**Syllabus in Brief 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: gastrointestinal motility and its control, oral cavity, pharynx and esophagus, stomach, small intestine: main site of digestion; large intestine; role of the pancreas in digestion; and role of the liver and gallbladder in digestion.
2. Temperature and Body Fluid Regulation Homeostasis and Temperature Regulation; The Impact of Temperature on Animal Life; Heat Gains and Losses; Some Solutions to Temperature Fluctuations; Temperature Regulation in Invertebrates, Fishes, Amphibians, Reptiles, Birds and Mammals; Heat Production in Birds and Mammals; Control of Water and Solutes (Osmoregulation and Excretion); 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; the human male reproductive system: spermatogenesis, transport and hormonal control, reproductive function; the human female reproductive system: folliculogenesis, transport and hormonal control, reproductive function; hormonal regulation in gestation; prenatal development and birth: the placenta; milk production and lactation.

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, amphibian embryology, development in terrestrial environments, avian embryology, the fate of mesoderm.

Books Recommended

Practicals
1. Study of excretory system in an invertebrate and a vertebrate representative (Model).
2. Study of nutritive canal in an invertebrate and a vertebrate representative (Dissection).
3. Study of male reproductive system in an invertebrate and a vertebrate representative (Dissection).
4. Study of female reproductive system in an invertebrate and a vertebrate representative (Dissection).
5. Study of hormonal influence of a reproductive function (Model).
6. Study of preserved advanced stages of avian and mammalian development for amniotic membranes and placenta (Model).
7. Study of stages in the development of an Echinoderm.
8. Study of early stages in the development of a frog, chick and a mammal.

Note for 9-10: Prepared slides and preserved specimen and/or projection slides and/or CD ROM computer projections may be used.

Books Recommended
Title of the course: Bot-402 Plant Physiology and Ecology
Credit hours: 4 (3+1)

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

Course Outline:

a) Plant Physiology

b) Ecology
1. Introduction, aims and applications of ecology.
2. Soil: Physical and Chemical properties of soil (soil formation, texture, pH, EC, organism and organic matter etc) and their relationships to plants.
5. Wind: Wind as an ecological factor and its importance.
7. Community Ecology
   i. Ecological characteristics of plant community
   ii. Methods of sampling vegetation (Quadrat and line intercept)
   iii. Major vegetation types of the local area.

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,
      molar 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
   4. Field trips to ecologically diverse habitats.
   5. Measurements of wind velocity.
   7. Effect of light and temperature on seed germination.

Recommended Books:
BS (Hons) Chemistry Session 2018-22

Semester 5

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<td>CHM-503</td>
<td>Organic Chemistry – II</td>
<td>4(3–1)</td>
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<tr>
<td>CHM-505</td>
<td>Physical Chemistry - II</td>
<td>4(3–1)</td>
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<td>CHM-507</td>
<td>Analytical Chemistry – II</td>
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<tr>
<td>MTH-525</td>
<td>Mathematics for Chemists</td>
<td>2(2–0)</td>
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</table>

**CHM-501 Inorganic Chemistry-II 4(3–1)**

1. **BONDING MODELS FOR NON TRANSITION 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**

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\(^{+}\) )
2. Preparation And Characterisation 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\(^{3+}\)/Pb\(^{2+}\); Cd\(^{2+}\)/Zn\(^{2+}\); Ni\(^{2+}\)/Mg\(^{2+}\); Ca\(^{2+}\)/Zn\(^{2+}\)

**Books Recommended:**


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

Acids and Bases
Concepts of acids and bases; scale of acidity and basicity; pKa values; predicting acids/basic 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, dissubstituted cyclohexanes and decalin systems.

Oxidation Reduction Reactions:
a) Oxidation: Introduction. Oxidation of saturated, olefinic and aromatic compounds. System 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:

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

Kinetic Theory of Gases

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

CHM-505                Practicals
• Equilibrium constant of the KI + I₂ = KI₃ 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:

CHM-507 Analytical Chemistry-II

Analytical Chemistry-II 4(3-1)

Chemical Analysis and Data Handling: Accuracy of analytical processes such as sampling, weighing, volume measurements, precipitation, washing, filtration and ignition. Recent developments in the sampling techniques, Statistical analysis; random and systematic errors, rounding off the data, arithmetic mean, median, mode, standard deviation, relative standard deviation, student t-test, F-test etc., Quality control and quality assurance, The use of computer in data handling.


Separation Techniques: Solvent extraction Principle, factors affecting the extraction efficiency, Types and practical applications of solvent extraction in chemical analysis. Chromatographic methods General theory of chromatography, classification of chromatographic methods, column, paper, thin-layer, and ion-exchange chromatography and their applications.

Practicals
1. Laboratory materials, reagents and safety measures, Calibration of glassware used for volumetric analysis
2. Preparation and standardization of reagents and solutions.
3. Solvent extraction of organic compounds
4. Single step and multiple batch solvent extraction and comparison of efficiency
5. Analysis of iron sodium and potassium in tap water/food samples by spectrophotometry
6. Separation of mixture of organic and inorganic compounds by chromatography methods

Books Recommended:

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</table>

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**

Semester 6

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<td>Organic Chemistry II</td>
<td>4(3-1)</td>
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<tr>
<td>CHM-506</td>
<td>Physical Chemistry III</td>
<td>4(3-1)</td>
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<td>CHM-508</td>
<td>Analytical Chemistry III</td>
<td>4(3-1)</td>
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<tr>
<td>CHM-510</td>
<td>Environmental Chemistry</td>
<td>3(3-0)</td>
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</table>

CHM-502 Inorganic Chemistry-III 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 NH₃, HF, SO₂, BrF₃, CH₃COOH and HCN. Reactions in molten salt system.

2. Pi-Acceptor Ligands

3. Kinetics and mechanism of inorganic reactions

CHM-502 Practical

1. Estimation Of Anions (Any four)
   Chloride/Phospate; Chloride/Nitrate; Bromide/Nitrate; Iodide/Nitrate; Borate/Acetate; Oxalate/Chloride; Sulphate/Phosphate

2. KIO₃ Titrations (Any two)

3. Gravimetric Estimations:
   Estimations of Ba²⁺; Oxalate ions.

Books Recommended:

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

Aliphatic nucleophilic substitution and Elimination reactions
Aliphatic nucleophilic substitution reactions Mechanisms 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 and substitution reactions.

Aromatic Substitution reactions
Electrophilic substitution Aromatic; 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:


CHM 506 Physical Chemistry III 4(3-1)

Electrochemistry

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

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 KMnO₄ / K₂Cr₂O₇ 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:

<table>
<thead>
<tr>
<th>CHM-508</th>
<th>Analytical Chemistry-III</th>
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<td>4(3-1)</td>
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</table>

**CHM-508 Analytical Chemistry-III 4(3-1)**

Spectroscopy, Theory and principals of Spectroscopy, Lambert-Beer’s Law and its limitations, Single and double beam spectrophotometers, sources of light (lamp and lasers), monochromators, photomultiplier tubes, detectors, diode array and charged coupled devices, applications of UV-Vis spectrophotometer in natural product research, pharmaceutical industry, separation process, enzyme essay study, clinical studies, microbiology. Applications of IR, NMR and Mass spectrophotometer in research & development and quality control process.

**Practicals**

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

**Reference Books:**


**Recommended Books:**

English for Employment 7th Semester (BS), 3rd Semester (MSc.)

Contents:

8. Forms of Communication:
   - Verbal Communication
   - Non-Verbal Communication
   - Written Communication

9. Non-Verbal Communication
   - What is Non-Verbal
   - Characteristics of Non-Verbal Communication
   - Classification of Non-Verbal Communication
   - Advantages of learning Non-Verbal Communication
   - Guidelines to develop Non-Verbal Communication

10. Verbal Communication
   - Presentation Skills
     - What is presentation?
     - Qualities of a good presenter
     - Essential characteristics of a good presentation
   - Interview Skills
     - Preparation of an interview
     - How to handle difficult questions
     - Most common mistakes to avoid during an interview
     - Tips of a successful interview
   - Telephonic Conversations
     - How to enquire (job vacancy, scholarships, admissions)
How to respond to an enquiry

Effective use of Meta communication (Vocalization)

11.

- Written Communication
  - Principles of effective writing
  - Business writing - keys
  - E-mail Writing
  - Advantages of e-mail
  - The most common complaints about e-mail in practice
  - How to create electronic rapport
  - Sample e-mail messages
  - Writing subject lines
  - Writing negative messages
  - Writing positive messages
  - Writing an enquiry e-mail
  - Writing a response to an enquiry

- CV Writing
  - How to read a job advertisement
  - Responding to Job advertisement
  - To identify individual strengths and skills to write CV

- How to fill job application form
  - How to write a Cover letter
  - Report writing
  - How to write a Research Proposal

- Employability Skills
  - Strategies to identify employment opportunities
  - Business Etiquettes
  - Etiquette in the Workplace
Etiquette in the Social settings

Workplace Ethics

Cultural Awareness

Intercultural sensitivities

Communicating effectively

Interacting across cultures

Positive thinking

Role of positive thinking in successful career

How to be positive in crucial situation

Recommended Readings:

**Semester 7**

**Specialization in Analytical Chemistry**

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<tr>
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<td>ENG-611</td>
<td>English for Employment</td>
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<tr>
<td>CHM-601</td>
<td>Electroanalytical Techniques</td>
<td>3(3–0)</td>
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<tr>
<td>CHM-603</td>
<td>Advanced Separation Techniques</td>
<td>3(3–0)</td>
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<tr>
<td>CHM-605</td>
<td>Atomic Spectroscopy</td>
<td>3(3–0)</td>
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<tr>
<td>CHM-607</td>
<td>Advanced Analytical Chemistry Practicals – I</td>
<td>2(0 – 2)</td>
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**CHM-601 Electroanalytical Techniques 3(3-0)**

**Introduction**: Electrochemistry, Electrochemical cells, Standard cell potential, Indicator electrode, Reference electrodes, Classification of electro analytical methods, Bulk method, Interfacial methods, static methods, dynamic methods

**Potentiometric method of analysis**: Potentiometric measurements, Indicator electrodes, Metallic indicator electrode, Membrane indicator electrode, working of potentiometer and its application including pH measurements, ion selective electrode systems, ion exchange membrane electrode, solid state membrane electrodes and bio-membrane electrodes, potentiometric titrations.

**Coulometry and Electrogravimetry**: Basic electrochemistry, principle, instrumentation of coulometry, principle, instrumentation of electrogravimetry, consequences of electrogravimetry, Ohmic drop, activation over potential, concentration and gas polarization, basic difference and merits/demerits of coulometry and electrogravimetry.

**Reference Books:**


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

**Chromatography**:
Classification of chromatographic techniques, chromatographic processes, rate theory of chromatography, Van-Deemter equation and its significance in evaluating column efficiency.

**Gas Liquid Chromatography:**
General principle, sample preparation/derivatization, separation process and instrumental aspects and its applications.

**High Performance Liquid Chromatography:**
General principle, sample preparation, separation process (normal phase and reverse phase separation), instrumentation, method development and applications.

**Capillary Electrophoresis (CE):**
Introduction to Electrophoresis, Theory and principle of CE, mobility, electro-osmotic flow separation by CE, instrumentation, modes of operation, applications.

Reference Books:

CHM-605        Atomic Spectroscopy        3(3-0)

**Atomic Absorption Spectrophotometry:** principle of atomic absorption spectrophotometry, concentration dependence of absorption, quantitative methodology, instrumentation for atomic absorption spectrophotometry, radiation sources, atomizers, flames, graphite furnaces and electrochemical atomizers, wavelength selectors, detectors, handling background absorption, interferences in atomic absorption spectrophotometry, sample handling in atomic absorption spectrophotometry, preparation of the sample, use of organic solvents, microwave, digestion, sample introduction methods, applications of atomic absorption spectrophotometry.

**Atomic Emission Spectrophotometry:** Introduction, principle of atomic emission spectrometry, atomic emission spectrometry using plasma sources, plasma and its characteristics, inductively plasma, direct current plasma, microwave induced plasma, choice of argon as plasma gas, instrumentation for ICP-MS.

**Atomic Fluorescence Spectrometry:** Origin of atomic fluorescence, atomic fluorescence spectrum, types of atomic fluorescence transitions, principle of atomic fluorescence spectrometry, fluorescence intensity and analyte concentration, instrumentation for atomic fluorescence spectrometry, applications of atomic absorption spectrophotometry, interferences, merits and limitations.

Reference Books:
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 1 organic compounds.

Semester 7

Specialization in Inorganic Chemistry

<table>
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<tr>
<th>Semester 7 Specialization in Inorganic Chemistry</th>
<th>As per prospectus 2018 (available on GCUF web.)</th>
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<tbody>
<tr>
<td>ENG-611 English for Employment</td>
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<tr>
<td>CHM-611 Main Group Organometallic and Organic Reagents</td>
<td>3(3 – 0)</td>
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<tr>
<td>CHM-613 Spectroscopic Methods of Analysis</td>
<td>3(3 – 0)</td>
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<tr>
<td>CHM-615 Organo-Transition Metal Compounds</td>
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<tr>
<td>CHM-617 Advanced Inorganic Chemistry Practicals – I</td>
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CHM-611 Main Group Organometallic and Organic Reagents 3(3 - 0)

Main Group Organometallic Reagents
Introduction, Preparation, classes of nucleophilic organometallic reagents organo-Li, S, Sc, Si, B, Sn, Sb and Zn in organic synthesis, control side reaction (Enolization vs. nucleophilic 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:

BS (Hons) Chemistry Session 2018-22


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</table>

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**

CHM-617 Advanced Inorganic Chemistry Practicals-I

1. **Conductometry**
   - Titration of strong acid and weak acid with a strong base.
   - Precipitation titration involving AgNO₃ and KCl.

2. **Potentiometry**
   - Determination of K₁, K₂ and K₃ for H₃PO₄
   - Determination of chloride in the presence of iodide and evaluation of AgI and AgCl

3. **Spectrophotometry**
   - Micro determination of Cr(III) by Di-phenyllecabazide.
   - 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 Al (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.
Semester 7

Specialization in Organic chemistry

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<td>CHM-623</td>
<td>Rearrangements and Pericyclic Reactions</td>
<td>3(3 – 0)</td>
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<td>CHM-625</td>
<td>Pharmaceutical Chemistry</td>
<td>3(3 – 0)</td>
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<td>Advanced Organic Chemistry Practicals – I</td>
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CHM-623 Spectroscopic Organic Techniques 3(3 – 0)

(a) Introduction

(b) Ultraviolet/Visible 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:


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


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. Suprafacial 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:


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, Analgesics, Barbiturates, Antibiotics, their general synthesis and structure activity relationship.

Recommended Books:


CHM- 627 Advanced Organic Chemistry Practicals -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:


Semester 7
Specialization in Physical Chemistry

<table>
<thead>
<tr>
<th>Semester 7 Specialization in Physical Chemistry</th>
<th>As per prospectus 2018 (available on GCUF web.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENG-611 English for Employment</td>
<td>3(3-0)</td>
</tr>
<tr>
<td>CHM-631 Kinetics of Complex Reactions</td>
<td>3(3-0)</td>
</tr>
<tr>
<td>CHM-633 Advanced Spectroscopy</td>
<td>3(3-0)</td>
</tr>
<tr>
<td>CHM-635 Material Chemistry</td>
<td>3(3-0)</td>
</tr>
<tr>
<td>CHM-637 Advanced Physical Chemistry Practicals – I</td>
<td>2(0-2)</td>
</tr>
</tbody>
</table>

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:

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 magnetic 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:

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 rheology

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:
5. Joel R. Fried “Polymer Science and Technology” Prentice Hall PTR. 1995, USA.

CHM-637 Advanced Physical Chemistry Practicals-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
Course Title: Introduction to Statistical Theory
Credit Hours: 3(3-0)
Course Code: STA-595/321

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
2. Sher M. Chaudhry, Shahid Kamal, “Introduction to Statistical Theory I and II”.
Semester 8

Specialization in Analytical Chemistry

<table>
<thead>
<tr>
<th>Semester 8 Specialization in Analytical Chemistry</th>
<th>As per prospectus 2018 (available on GCUF web.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>STA-321 Introduction to Statistical Theory</td>
<td>3(3 – 0)</td>
</tr>
<tr>
<td>CHM-602 Thermal Methods of Analysis</td>
<td>3(3 – 0)</td>
</tr>
<tr>
<td>CHM-604 Nuclear Analytical Techniques</td>
<td>3(3 – 0)</td>
</tr>
<tr>
<td>CHM-606 Food and Drug Chemistry</td>
<td>3(3 – 0)</td>
</tr>
<tr>
<td>CHM-608 Standard Methods &amp; Quality Assurance</td>
<td>3(3 – 0)</td>
</tr>
<tr>
<td>CHM-610 Advanced Analytical Chemistry Practicals – II</td>
<td>2(0 – 2)</td>
</tr>
</tbody>
</table>

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

**Thermal Analysis:** Introduction, classification and principles of thermal analysis, thermograms, instrumentations, applications and limitations of thermal analysis.

**Thermogravimetric Analysis (TGA) and Derivative Thermal analysis (DTA):**
Introduction and principle of thermogravimetric analysis and derivative thermal analysis, its instrumentation, applications, data interpretations, limitations.

**Differential Thermal Analysis (DTA):** Introduction and principle of differential thermal analysis, its instrumentation, applications, data interpretations, limitations.

**Differential Scanning Calorimetry (DSC):**
Introduction and principle of differential scanning calorimetry, its instrumentation, applications, data interpretations, limitations.

**Differential Photo-Calorimetry (DPC):** Introduction and principle of evolved gas analysis, its instrumentation, data interpretations, applications.

**Evolved Gas Analysis (EGA):** Introduction and principle of evolved gas analysis, its instrumentation, data interpretations, applications.

**Thermo-mechanical Analysis (TMA):** Introduction and principle of thermo-mechanical analysis, its instrumentation, applications, data interpretations, limitations.

**Dynamic Mechanical Analysis (DMA):** Introduction and principle of dynamic mechanical analysis, its instrumentation, data interpretations, applications.

**Di-electric Thermal Analysis (DETA):** Introduction and principle of di-electric thermal analysis, its instrumentation, data interpretations, applications.

**Reference Books:**


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

Introduction to Nuclear sciences, Radioactive decay, Production of nuclear radiation, Interaction of radiation with matter, Radio-analytical techniques, Radiation detection and measurement instruments, Role of radiotracers in development of modern nuclear analytical techniques, Applications of radio-tracers in medical, environment, agriculture and industries.

**Reference Books:**


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

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

**Pharmaceuticals:** Classification of drugs, test for analysis of different pharmaceuticals, introduction to US and British pharmacopeia.
Forensics: History and scope of forensic Science, forensic ethics, forensic toxicology. Classification and analysis of narcotics & dangerous drugs, examination of crime scene evidences, fingerprinting, skeletal material to provide scientific opinion for legal.

Reference Books:

Method development and validation: Selection of analytical methods for problem solving, Optimizing the experimental procedures, 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: Introduction and concept of quality control and quality assurance, Development of quality standards in industries, Quality control chart, Quality control in some industries, General safety practices, Good laboratory practices


Automation in analytical methods: Automatic, automated and smart instruments and their applications with special emphasis on clinical, industrial and quality control aspects

Books Recommended:
CHM- 610 Advanced Analytical Chemistry Practicals-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 1 organic compounds.
Gas Chromatographic analysis of drugs and poison.
Analysis of milk, beverages and meat.

Reference Books:
1. Yolanda Picó, Chemical Analysis of Food: Techniques and Applications
2. Leo M. L. Nollet. Handbook of Food Analysis: Physical characterization and
BS (Hons) Chemistry Session 2018-22

Semester 8

Specialization in Organic Chemistry

<table>
<thead>
<tr>
<th>Course Code</th>
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<tbody>
<tr>
<td>STA-321</td>
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<tr>
<td>CHM-622</td>
<td>Organic Polymers</td>
<td>3(3 – 0)</td>
</tr>
<tr>
<td>CHM-624</td>
<td>Reactive Intermediates and Photochemistry</td>
<td>3(3 – 0)</td>
</tr>
<tr>
<td>CHM-626</td>
<td>Disconnection Approach</td>
<td>3(3 – 0)</td>
</tr>
<tr>
<td>CHM-628</td>
<td>Organic Catalyst and Protective Group</td>
<td>3(3 – 0)</td>
</tr>
<tr>
<td>CHM-630</td>
<td>Advanced Organic Chemistry Practicals – II</td>
<td>2(0 – 2)</td>
</tr>
</tbody>
</table>

**CHM–622 Organic Polymers 3(3 – 0)**


**Recommended Books:**


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


**Photochemistry:**


**Recommended Books:**
BS (Hons) Chemistry Session 2018-22


CHM – 626 Disconnection Approach 3(3 – 0)

The Disconnection Approach


Recommended Books:


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:

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:**

Semester 8
Specialization in Inorganic Chemistry

| Semester 8 Specialization in Inorganic Chemistry |
|-----------------|-----------------|------------------|
| STA-321         | Introduction to Statistical Theory | 3(3 – 0)         |
| CHM-612         | X-ray Spectroscopy            | 3(3 – 0)         |
| CHM-614         | Homogeneous Catalysis           | 3(3 – 0)         |
| CHM-616         | Radio Nuclear Chemistry       | 3(3 – 0)         |
| CHM-618         | Magneto Chemistry            | 3(3 – 0)         |
| CHM-620         | Advanced Inorganic Chemistry Practicals-- II | 2(0 – 2)         |

**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:**


**CHM-614 Homogenous Catalysis 3(3-0)**

Reaction of CO and hydrogen Hydroformylation, reductive carbonylation, reduction of CO by hydrogen, synthesis of water gas and shift reactions. Carbonylation reaction Synthesis of methanol and methyl acetate, adipic ester, other carbonylation and decarbonylation reactions. Catalytic addition of molecules to C-C multiple bonds Homogeneous hydrogenation, and hydrocylation and hydrocyanation.

**Recommended Books:**


**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:**


**CHM-618 Magneto Chemistry 3(3-0)**


**Recommended Books:**


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

CHM- 620 Advanced Inorganic 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:**


**Semester 8**
**Specialization in Physical Chemistry**

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<td>Applications of Symmetry &amp; Group Theory</td>
<td>3(3-0)</td>
</tr>
<tr>
<td>CHM-634</td>
<td>Quantum Mechanics</td>
<td>3(3-0)</td>
</tr>
<tr>
<td>CHM-636</td>
<td>Nuclear and Radiation Chemistry</td>
<td>3(3-0)</td>
</tr>
<tr>
<td>CHM-638</td>
<td>Electrochemical Aspects of Solutions</td>
<td>3(3-0)</td>
</tr>
<tr>
<td>CHM-640</td>
<td>Advanced Physical Chemistry Practicals – II</td>
<td>2(0-2)</td>
</tr>
</tbody>
</table>

**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:**


CHM-634 Quantum Mechanics 3(3-0)

Statistical Mechanics

Quantum Chemistry

Theoretical and Computational Chemistry

Recommended Books:

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

**Radiation Chemistry**

**Recommended Books:**

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**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, Butler Volmer equation, cyclic voltammetry 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:**

CHM-640 Advanced 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 Debye-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.
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:
BS (Hons) Chemistry Session 2017-21

**Instructions**

*Please follow the scheme of studies of relevant prospectus strictly.

*The Outlines of Allied courses (i.e. English, Physics, Mathematics, Computer Sciences, Zoology, Botany) are at the end of this file.

*Course Code and Course Title should be carefully noted.

*Prospectus are available in soft form at university website.

*For any clash of scheme of studies in prospectus and outlines, please contact the Focal person (Department of Chemistry)

Dr. Tahir Maqbool (drtahirmaqbool@gcuf.edu.pk) 0332-7336562

Dr. Matloob Ahmad (Matloob.Ahmad@gcuf.edu.pk)
BS Chemistry

Session 2017-2021

Semester 1 (Session 2017-2021)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
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<tbody>
<tr>
<td>CHM-301</td>
<td>Organic Chemistry – I</td>
<td>4(3-1)</td>
</tr>
<tr>
<td>ENG-321</td>
<td>Functional English</td>
<td>3(3–0)</td>
</tr>
<tr>
<td>PST-321</td>
<td>Pakistan Studies</td>
<td>2(2–0)</td>
</tr>
<tr>
<td>MTH-321</td>
<td>Mathematics –I</td>
<td>4(3-0)</td>
</tr>
<tr>
<td>PHY-323</td>
<td>Applied Physics –I</td>
<td>4(3-1)</td>
</tr>
<tr>
<td>ZOL-301</td>
<td>Zoology-I</td>
<td>4(3–1)</td>
</tr>
<tr>
<td>BOT-301</td>
<td>Diversity of Plants</td>
<td>4(3–1)</td>
</tr>
</tbody>
</table>

Optional (Any two subjects): Math & Physics or Botany & Zoology

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**CHM-301 Organic Chemistry – I 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-bunfuncional 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 isomerism Optical 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**

**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-301 Practicals**
Sixteen experiments shall be conducted based on the following

a. **Techniques**
   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 (1preparations)

**Books Recommended:**

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

Prepared by: Nour ul Qamar Gausmi, Head, Department of English
• 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:

References:
- Allama Iqbal Open University, Compulsory English I (Code 1423) (Islamabad: AIOU Press).
  http://www.bbc.co.uk/worldservice/learningenglish/
  http://learnenglish.britishcouncil.org/en/
- British Council and BBC. Learn English.
  http://www.teachingenglish.org.uk/
- Grammar software free download: 3D Grammar English.
4. Regeneration of Muslim Society in sub-continent and causes of decline of Muslim Rule

5. War of Independence 1857 and its impacts upon the politics of South Asia.

6. Sir Syed Ahmed Khan and Aligarh Movement:
   i) Educational Services
   ii) Political Services
   iii) Rational Interpretation of Islam

4. All India Muslim League:
   i) Multiple approaches and causes of the formation of Muslim League.
   ii) Objectives of the party.
   iii) Comparison of the policies of All Indian National congress and All India Muslim League.
   iv) Politics of Muslim League after the creation of Pakistan

5. Lucknow Pact 1916, high water mark of Hindu-Muslim Unity.

6. Khilafat Movement:
   i) Khilafat as an institution.
   ii) Hindu-Muslim Unity.
   vi) Role of Gandhi
   
   vii) Emergence of Muslim Ulma in Indian politics.

   viii) Causes of the failure and impacts of the movement.

15. Iqbal’s Address at Allahabad 1930 and political thoughts of Ch. Rehmat Ali.


17. Pakistan Resolution 1940.

18. Muhammad Ali Jinnah:
   i) Jinnah’s role in Indian politician.
   
   ii) As a governor General

19. Initial problems and constitutional development in Pakistan.

21. Political culture of Pakistan.

22. Foreign Policy of Pakistan:
   i) Major determinants and objectives
   ii) Overview.

**Recommended Books:**


**MTH-321  Mathematics –I  4(4-0)**


**RECOMMENDED BOOKS:**


**PHY-323  Applied Physics –I  4(3-1)**

**PHY-323  Applied Physics-I  4 (3-1)**

Vector, Properties of vectors, Position, Velocity and acceleration vectors, 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, Simple harmonic motion, 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:

6. Sears, Zemansky and Young, 2000, University Physics, 8th Ed, Addison-Wesley. Reading (MA) USA.
### Credit Hours
4(3-1)

### Theory
3

### Practical
1

### Aims and Objectives
The course aims to impart knowledge and understanding of:

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

### Learning Outcomes

### Syllabus in Brief

#### Course Contents

1. **Place of Zoology in Science**
   A one-world view: genetic unity, the fundamental unit of life, evolutionary oneness and the diversity of life, environment and world resources; what is Zoology? The classification of animals; the scientific method.

2. **The Chemical Basis of Animal Life**
   Atoms and elements: building blocks of all matter; compounds and molecules: aggregates of atoms; acids, bases, and buffers; the molecules of animals: fractional account of carbohydrates, lipids, proteins, nucleotides and nucleic acids based on their structural aspects.

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

4. **Energy and Enzymes: Life’s Driving and Controlling Forces**
   Energy and the laws of energy transformation; activation energy; enzymes: structure, function and factors affecting their activity; cofactors and coenzymes; ATP: how cells convert energy? An overview.

5. **How Animals Harvest Energy Stored in Nutrients**
   Glycolysis: the first phase of nutrient metabolism; fermentation:
“life without oxygen”; aerobic respiration: the major source of ATP; metabolism of fats and proteins; control of metabolism; the metabolic pool.


7. Ecology II: Communities and Ecosystems Community structure and diversity; ecosystems; ecosystems of the earth; ecological problems; human population growth, pollution, resource depletion and biodiversity.

Practicals

1. Tests for different carbohydrates, proteins and lipids.
   Note: Emphasis on the concept that tests materials have been ultimately obtained from living organisms and constituted their body.

2. Study of the prepared slides of epithelial tissue (squamous, cuboidal, columnar), connective tissue (adipose, cartilage, bone, blood), nervous tissue and muscle tissue (skeletal, smooth and cardiac).
   Note: Prepared microscopic and/or projection slides and/or CD ROM computer projections must be used.

3. Plasmolysis and deplasmolysis in blood.

4. Protein digestion by pepsin.

5. Ecological notes on animals of a few model habitats.

6. Field observation and report writing on animals in their ecosystem (a terrestrial and an aquatic ecosystem study).

Books Recommended


| BOT-301 | Diversity of Plants | 4(3–1) |
Title of the Course: Bot-301 Diversity of Plants
Credit Hours: 4 (3+1)

Specific Objectives of course:
To introduce the students to the diversity of plants and their structures and significance.

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

a) Viruses (RNA and DNA types) with special reference to TMV;
b) Bacteria and Cyanobacteria (Nostoc, Anabaena, Oscillatoria) with specific reference to biofertilizers, pathogenicity and industrial importance;
c) Algae (Chlamydomonas, Spirogyra, Chara, Vaucheria, Pinnularia, Ectocarpus, Polysiphonia)
d) Fungi (Mucor, Penicillium, Phyllactinia, Ustilago, Puccinia, Agaricus), their implication on crop production and industrial applications.
e) Lichens (Physcia)
f) Bryophytes
   i. Riccia
   ii. Anthoceros
   iii. Funaria

g) Pteridophytes.
   i. Psilopsida (Psilotum)
   ii. Lycopsida (Selaginella)
   iii. Sphenopsida (Equisetum)
   iv. Pteropsida (Marsilea)

h) Gymnosperms
   i. Cycas
   ii. Pinus
   iii. Ephedra

i) Angiosperms
   i. Monocot (Poaceae)
   ii. Dicot (Solanaceae)

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

**Journals / Periodicals:**

### Semester 2 (Session 2017-2021)

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<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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<td>CHM-302</td>
<td>Inorganic Chemistry - I</td>
<td>4(3-1)</td>
</tr>
<tr>
<td>ENG-322</td>
<td>English Comprehensive and Composition</td>
<td>3(3 – 0)</td>
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<tr>
<td>ISL-321</td>
<td>Islamic Studies/Ethics</td>
<td>2(2–0)</td>
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<td>MTH-322</td>
<td>Mathematics-II</td>
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<td>PHY-324</td>
<td>Applied Physics-II</td>
<td>4(3-1)</td>
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<td>ZOL-302</td>
<td>Zoology-II</td>
<td>4(3–1)</td>
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<tr>
<td>BOT-302</td>
<td>Systematic, Anatomy and Development</td>
<td>4(3–1)</td>
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<tr>
<td></td>
<td>Optional (Any two subjects): Math &amp; Physics or Botany &amp; Zoology</td>
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**CHM-302**  
**Inorganic Chemistry-I**  
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**

**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**

**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-302 Practical**

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 KmnO₄.**

4. **Quantitative analysis**
   - Determination of total hardness of water using EDTA.
   - Estimation of magnesium using EDTA.
   - Estimation of copper (iodometrically).
   - Determination of ferricyanide using KI solution
   - Determination of chloride by Volhard and Mohr methods.
   - Estimation of chloride/bromide ions using adsorption (fluorescein)
indication.
- Percentage determination of ferric ions in ferric alum using KMnO₄ solution.
- Determination of purity of commercial potassium oxalate using KMnO₄ solution
- Estimation of ferrous / ferric ions using K₂Cr₂O₇ solution.
- Percentage determination of barium in barium nitrate by gravimetric method.
- Gravimetric determination of nickel.

**Books Recommended:**

| ENG-322 | English Comprehensive and Composition | 3 ( 3 – 0 ) |
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

Prepared by: Noor ul Qamar Qasmi, Head, Department of English
• Expository
• Argumentative

II. 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
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<th>ISL-321</th>
<th>Islamic Studies</th>
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**BA BSc (Compulsory, Elective, Optional)**

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(For details, please refer to the course syllabus.)

**Notes:**

1. 
2. 
3. 
4. 
5. 

(For further details, please refer to the course syllabus.)
لا يمكنني قراءة النص العربي من الصورة المقدمة. يرجى تقديم النص باللغة العربية المكتوبة بشكل طبيعي، أو النص باللغة الإنجليزية إذا كان ذلك ممكناً.
لا يمكنني قراءة النص العربي في الصورة المقدمة.
15. عن أبي بكر...
16. عن أبي سعيد...
17. عن أبي...
18. عن...
19. عن...
20. وحكى...
21. عن...
22. عن...
23. عن...
24. رواه...
25. وعن...

(الجواب: المتضمن في الرسالة السابقة)
21. And those who believe in Our Lord and in the Last Day, and perform regular prayer and give zakah, they will have their reward with their Lord, and They will have no fear in the life of this world and in the Hereafter; and theirs will be the Garden of Eden which they will enter. 

3. The answer to the question is:

(i) 

(ii) The verse is from the Book of Surat al-Ikhlas (The纯真) and verse number 4.

(iii) The verse is about the Zakah (Alms).
MTH-322 Mathematics-II  3(3-0)

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<td>MTH-322</td>
<td>Mathematics-II</td>
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RECOMMENDED BOOKS

PHY-324 Applied Physics-II  4(3-1)

PHY-324  Applied Physics-II  4(3-1)
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, Photon, Photoelectric effect, Compton effect

13. To study the behavior of RLC series circuit and determination of its resonance frequency.
14. To study the behavior of RLC Parallel circuit and determination of its resonance frequency.
15. Calibration of a voltmeter by a potentiometer.
17. To determine the high resistance by Neon flash lamp and a capacitor.
Recommended Books:

   Sears, Zemansky and Young, 2000, University Physics, 8th Ed, Addison-Wesley. Reading (MA) USA.

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<td>ZOL-302</td>
<td>PRINCIPLES OF ANIMAL LIFE – II</td>
<td>4(3-1)</td>
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Aims and Objectives

The course imparts knowledge and understanding of:

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

Learning Outcomes

Course Contents

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
   The birth of modern genetics; Mendelian inheritance patterns; other inheritance patterns; environmental effects and gene expression.
3. Chromosomes and Gene Linkage
   Eukaryotic chromosomes; linkage relationships; changes in chromosome number and structure.
4. Molecular Genetics: Ultimate Cellular Control
   DNA: the genetic material; DNA replication in eukaryotes; genes in action; control of gene expression in eukaryotes; mutations; applications of genetic technologies; recombinant DNA.
5. Animal Behaviour
Four approaches to animal behaviour; proximate and ultimate causes; anthropomorphism; development of behavior; learning; control of behavior; communication; behavioral ecology; social behavior.

6. 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 evolution by natural selection; evolutionary thought after Darwin; biogeography.

7. Evolution and Gene Frequencies
The modern synthesis: a closer look; 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.

Books Recommended

Practicals
1. Study of mitosis in onion root tip.
2. Study of meiosis in grasshopper testis (students should prepare the slide).

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

3. Problem based study of Mendelian ratio in animals.
4. Multiple alleles study in blood groups.
5. Survey study of a genetic factor in population and its frequency.
7. Study of cytochemical detection of DNA in protozoa and avian blood cell.
8. Study to demonstrate nervous or endocrine basis of behaviour (conditioned reflex or aggression or parental behavior).
9. Study to demonstrate social behaviour (documentary film be shown, honey bee, monkey group in a zoo).
Books Recommended

| BOT-302 | Systematic, Anatomy and Development | 4(3-1) |

1st Year
2nd Semester

Title of the Course: Bot-302 Plant Systematics, Anatomy and Development/Embryology

Credit Hours: 4 (3+1)

Specific Objectives of course:
To understand: 1. various systems of classification, identification and nomenclature of Angiosperms, 2- Structures and functions of tissues and organs at embryonic level.

Course Outline:

a) Plant systematics
1. Introduction to Plant Systematics: aims, objectives and importance.
2. Classification: brief history of various systems of classification with emphasis on Takhtajan.
4. Morphology: a detailed account of various morphological characters root, stem, leaf, inflorescence, flower, placentation and fruit types.
5. Diagnostic characters, economic importance and distribution pattern of the following families:
   i. Ranunculaceae
ii. Brassicaceae (Cruciferae)
iii. Fabaceae (Leguminosae)
iv. Rosaceae
v. Euphorbiaceae
vi. Cucurbitaceae
vii. Lamiaceae (Labiatae)
viii. Apliaceae (Umbelliferae)
ix. Asteraceae (Compositae)
x. Liliaceae (Sen. Lato)

b) Anatomy
1. Cell wall: structure and chemical composition
2. Concept, structure and function of various tissues like:
   i. Parenchyma
   ii. Collenchyma
   iii. Sclerenchyma
   iv. Phloem Epidermis (including stomata and trichomes)
   v. Xylem
3. Meristem: types, stem and root apices
4. Vascular cambium
5. Structure and development of root, stem and leaf. Primary and secondary growth of dicot stem, periderm
6. Characteristics of wood: diffuse porous and ring porous, sap and heart wood, soft and hard wood, annual rings.

c) Development/Embryology
1. Early development of plant body:
2. Capsella bursa-pastoris
3. Structure and development of Anther Microsporogenesis, Microgametophyte
4. Structure of Ovule Megasporogenesis Megagametophyte
5. Endosperm formation
6. Parthenocarpy
7. Polyembryony

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

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

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 Practical**
- 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:**

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 comprehension
- 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
- Hargie, O. (ed.) *Hand book of Communications Skills*
Course Outline

- Introduction to Computers
- Different Input and Output devices (Specially modern devices)
- Software and its different types
- Operating System Concepts
- Services and functions of operating system
- Network and its types
- Network Topologies and its types
- Introduction to Internet
- Different Web terminologies (Http, Web Browsers, Ftp, Search Engines, WWW)
- Introduction to common web devices specially modems.
- Introduction to protocols and use of protocols in Web.


**The Laplace transform:** Laplace transforms and their properties. Initial-value problems. Delta or impulse function and Heaviside or step function.

**RECOMMENDED BOOKS**


**PHY-423**  
**Applied Physics – III**  
4(3-1)

**PHY-423**  
**Applied Physics – III**  
4(3-1)

Thermal radiation and laws, quantization of energy, Photoelectric effect, the Compton effect, line spectra, wave behavior of particles. Testing de Broglie’s hypothesis, waves, wave packets and particles, Heisenberg’s uncertainty principle, wave function, Schrodinger equation, trapped particles and probability densities, the correspondence principle, dual nature of matter. The atomic structure of hydrogen. Bohar’s theory, angular momentum of electrons, electron spin, X-ray spectrum, LASERS. Discovering the nucleus, basic nuclear properties. Radioactive decay. Energy from the nucleus, nuclear fission. Nuclear fusion, Nuclear reactors. Electronics, the p-n junction, Bias the p-n junction diode, diode, characteristics of diode. Different models, and types of diodes, half-wave and full-wave rectifier, full-wave bridge rectifier. Filter circuits. Bipolar...
junction transistor (BJT), base bias, emitter bias, voltage-divider bias. Amplifier classification, common emitter amplifier common collector, the common base amplifier.

14. Variation of photo electric current with intensity of incident light.
15. Design a full-wave rectifier and study its output without and with a capacitor filter.
16. Design a Half-wave rectifier and study its output without and with a capacitor filter.
17. To study characteristics of NOT, AND, NOR, NOR, NAND and XOR and verify their truth table.

Recommended Books:

6. Sears, Zemansky and Young, 2000, University Physics, 8th Ed, Addison-Wesley. Reading (MA) USA.

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<th>Zoology-III</th>
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<tr>
<td>Follow up</td>
<td>Animal Diversity -1 (Vertebrates)</td>
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<td>BS (Hons)</td>
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<tr>
<td>Aims and Objectives</td>
<td>The students will be able to make comparison from simple unicellular to complex multicellular organization along with phylogenetic relationship</td>
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<tr>
<td>Learning Outcomes</td>
<td>The students will be able to achieve the aims and objectives of the course</td>
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<tr>
<td>Syllabus in Brief</td>
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<tr>
<td></td>
<td>1. Introduction</td>
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<td>Evolutionary classification of organisms; evolutionary relationships and tree diagrams; patterns of organization.</td>
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<td>2. Animal-Like Protists: The Protozoa</td>
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<td>Evolutionary perspective; life within a single plasma membrane; symbiotic life-styles. Protozoan taxonomy: (up to phyla, subphyla and super classes, wherever applicable). Pseudopodia and amoeoboid locomotion; cilia and other pellicular structures; nutrition; genetic control and reproduction; symbiotic ciliates; further phylogenetic considerations.</td>
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<td>3. Multicellular and Tissue Levels of Organization</td>
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Evolutionary perspective: origins of multicellularity; animal origins. Phylum porifera: cell types, body wall, and skeletons; water currents and body forms; maintenance functions; reproduction. Phylum cnidaria (coelenterata) the body wall and nematocysts; alternation of generations; maintenance functions; reproduction and classification up to class. Phylum ctenophora; further phylogenetic considerations.

4. Triploblastics and Acoelomate Body Plan
Evolutionary perspective; phylum platyhelminthes: classification up to class; the free-living flatworms and the tapeworms; phylum nemertea; phylum gastrotricha; further phylogenetic considerations.

5. Pseudocoelomate Body Plan: Aschelminths
Evolutionary perspective; general characteristics; classification up to phyla with external features; feeding and the digestive system; other organ systems; reproduction and development of phylum rotifera and phylum nematoda; phylum kinorhyncha. Some important nematode parasites of humans; further phylogenetic considerations.

6. Molluscan Success
Evolutionary perspective: relationships to other animals; origin of the coelom; molluscan characteristics; classification up to class. The characteristics of shell and associated structures, feeding, digestion, gas exchange, locomotion, reproduction and development, other maintenance functions and diversity in gastropods, bivalves and cephalopods; further phylogenetic considerations.

7. Annelida: The Metameric Body Form
Evolutionary perspective: relationship to other animals, metamerism and tagmatization; classification up to class. External structure and locomotion, feeding and the digestive system, gas exchange and circulation, nervous and sensory functions, excretion, regeneration, reproduction and development, in polychaeta, oligochaeta and hirudinea; further phylogenetic considerations.

8. Arthropods: Blueprint for Success
Evolutionary perspective: classification and relationships to other animals; metamerism and tagmatization; the exoskeleton; metamorphosis; classification up to class; further phylogenetic considerations.

9. Hexapods and Myriapods: Terrestrial Triumphs
Evolutionary perspective; classification up to class. External structure and locomotion, nutrition and the digestive system, gas exchange, circulation and temperature regulation, nervous and sensory functions, excretion, chemical regulation, reproduction and development in hexapoda; insect behavior; insects and humans; further phylogenetic considerations.
Practicals
1. Study of *Euglena, Amoeba, Entamoeba, Plasmodium, Trypanosoma, Paramecium* as representative of animal like protists. (Prepared slides and from fresh water).
2. Study of sponges and their various body forms (prepared slides).
3. Study of principal representative classes of phylum Cnidaria.
4. Study of principal representative classes of phylum Platyhelminthes.
5. Study of representative of phylum Rotifera, phylum Nematoda.
7. Study of principal representative classes of phylum Annelida.
8. Study of principal representative classes of groups of phylum Arthropoda.
10. Preparation of permanent stained slides of the following: *Obelia, Daphnia*, Cestode, Parapodia of *Nereis*.

Reference Books
Title of the course: Bot-401 Cell Biology, Genetics and Evolution
Credit hours: 4 (3+1)

Specific objectives of course: To understand:
1. Structure and function of cell.
2. Nature of genetic material and hereditary process
3. Familiarization with evolutionary processes.

Course outline:

a) Cell Biology
1. Structure and Function of Bio-molecules
   i. Carbohydrates
   ii. Lipids
   iii. Proteins
   iv. Nucleic Acids
2. Cell: Cell theory, cell types (prokaryotes, eukaryotes), basic properties of cell.
3. Brief description of following cell organelles
   i. Cell wall
   ii. Cell membrane
   iii. Nucleus
   iv. Endoplasmic reticulum
   v. Plastids
   vi. Mitochondria
   vii. Ribosomes
   viii. Dictyosomes
   ix. Vacuoles
4. Reproduction in somatic and embryogenic cell, mitosis, meiosis and cell cycle

b) Genetics
1. Introduction, scope and brief history of genetics. Mendelian inheritance; Laws of segregation and independent assortment, back cross, test cross, dominance and incomplete dominance.
2. Molecular genetics; DNA replication. Nature of gene, genetic code, transcription, translation, protein synthesis, regulation of gene expression (e.g. lac operon).

c) Evolution: Introduction and theories.
Lab Outline:

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

Genetics
1. Genetical problems related to transmission and distribution of genetic material.
2. Identification of chromosomes in plant material. Carminic/orcein staining.
3. Determination of blood groups

Recommended Books:
Semester 4 (Session 2017-2021)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>CHM-402</td>
<td>Chemistry (Special Topics)</td>
<td>4(3-1)</td>
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<tr>
<td>ENG-422</td>
<td>Technical writing</td>
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<td>CSI-422</td>
<td>Computer Applications &amp; Web– II</td>
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<td>PHY-424</td>
<td>Applied Physics-IV</td>
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<td>ZOL-402</td>
<td>Zoology-IV</td>
<td>4(3-1)</td>
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<tr>
<td>BOT-402</td>
<td>Plant Physiology and Ecology</td>
<td>4(3–1)</td>
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<td>Optional (Any two subjects): Math &amp; Physics or Botany &amp; Zoology</td>
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*Optional (Any two subjects): Math & Physics or Botany & Zoology

Semester 4

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<tr>
<td>CHM-402</td>
<td>Chemistry (Special Topics)</td>
<td>4(3-1)</td>
</tr>
</tbody>
</table>

Surface Chemistry

Chemistry of Solutions
Ideal and non-ideal solutions, Raoult’s law and its applications, lowering of vapor pressure, elevation of boiling point, depression of freezing point, osmotic pressure, vapor pressure of non-ideal solutions and Henry’s law, abnormal colligative properties, degrees of association and dissociation of solutes, osmotic pressure and its measurement, fractional distillation and concept of azeotropic mixtures

Nanomaterials
Introduction to nanochemistry, Synthesis of nanoparticels, characterization and applications,

Introduction to Nuclear Chemistry
Natural and artificial radioactivity, Atomic nucleus, nuclides, nuclear stability, nuclear energetics, Nuclear models (shell + liquid drop model), fusion and fission, modes of decay, kinetics of nuclear reactions, nonspontaneous nuclear processes, nuclear reactors, beta decay systematic. Uses of radioisotopes in various fields. Nuclear hazards and safety measures.

Biomolecules
A brief introduction to the chemical nature of carbohydrates, proteins, lipids, nucleic acids and their importance in living systems.

CHM-402  
Practicals
More experiments should be included according to the facilities available to the facilities
available to the teaching institution.
Eight experiments in chromatography (TLC, column and paper) using cations, mixture of inks and organic compounds.
Determination of dipole moment of organic compounds.
Determination of specific and molar conductivities of strong weak electrolytes.

**Books Recommended:**


**Technical English(422) 4th Semeter (BS, honours)**

**Contents:**

13. Writing
14. technical writing style
15. (Academic)
   • reports.
   • planning
   • report

Basic factors of Technical Writing
Basic principles of
Report Writing
What is Report Writing?
When we need to write
Prior preparation and
Structure and sections of a
• Writing style and written language appropriate for report writing:
• Write a short report on any social or university issue.

16. 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

17. Plagiarism and Citation:
• What is plagiarism
• How to avoid plagiarism
• How to cite:
  Different styles to cite

18. How to do and write an academic research
Sources of research
(primary, secondary and tertiary source)
Sections of an academic research paper

19. Academic writing
Analysis and synthesis in academic writing

Compiled and prepared by: Ms. Fareeha Saleem
Approved and recommended by: Chairman of English Department
Dr. Mazhar Hayat
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.
Kinetic theory of the ideal gas; work done on an ideal gas, material energy of an ideal gas, intermolecular forces. Statistical mechanics, statistical distribution and mean values, distribution molecular speeds, distribution of energies, Brownian motion. Heat, different theories of heat, specific heat, gram molecular specific heat, laws of thermodynamics. Zeroth law, first law, second law, third law of thermodynamics, reversible and irreversible processes, indicator diagram, entropy, law of thermodynamics, reversible and irreversible processes, indicator diagram, entropy law of increase of entropy, temperature-entropy diagram. Maxwell’s thermodynamics relations, TDS equations, Clapeyron’s equation, entropy and second law of thermodynamics. Temperature scale, entropy, low temperature physics. Thermoelectricity, Seabeck effect, Peltier effect, thermocouple.

7. The determination of wavelength of light by Diffraction grating.
8. Design a full-wave rectifier and study its output without and with a capacitor filter.
9. Design a Half-wave rectifier and study its output without and with a capacitor filter.
10. To study characteristics of NOT, AND, NOR, NOR, NAND and XOR and verify their truth table.

Recommended Books:
ZOL-402 Zoology-IV

Course Title: Zoology-IV Course Code ZOL-402
Credit Hours 4(3-1)
Theory 3 Practical 1
Follow up BS Category

Aims and Objectives
The course deals with the: a. Basis of structure and functions of animal nutrition, digestion, homeostasis and temperature regulation. b. It introduces the basic concepts in reproduction and development in animal kingdom. c. Provides knowledge about the development of chordate body plan and fate of germinal layers.

Learning Outcomes

Syllabus in Brief 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: gastrointestinal motility and its control, oral cavity, pharynx and esophagus, stomach, small intestine: main site of digestion; large intestine; role of the pancreas in digestion; and role of the liver and gallbladder in digestion.

2. Temperature and Body Fluid Regulation Homeostasis and Temperature Regulation; The Impact of Temperature on Animal Life; Heat Gains and Losses; Some Solutions to Temperature Fluctuations; Temperature Regulation in Invertebrates, Fishes, Amphibians, Reptiles, Birds and Mammals; Heat Production in Birds and Mammals; Control of Water and Solutes (Osmoregulation and Excretion); 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; the human male reproductive system: spermatogenesis, transport and hormonal control, reproductive function; the human female reproductive system: folliculogenesis, transport and hormonal control, reproductive function; hormonal regulation in gestation; prenatal development and birth: the placenta; milk production and lactation.

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, amphibian embryology, development in terrestrial environments, avian embryology, the fate of mesoderm.

Books Recommended

Practicals
1. Study of excretory system in an invertebrate and a vertebrate representative (Model).
2. Study of nutritive canal in an invertebrate and a vertebrate representative (Dissection).
3. Study of male reproductive system in an invertebrate and a vertebrate representative (Dissection).
4. Study of female reproductive system in an invertebrate and a vertebrate representative (Dissection).
5. Study of hormonal influence of a reproductive function (Model).
6. Study of preserved advanced stages of avian and mammalian development for amniotic membranes and placenta (Model).
7. Study of stages in the development of an Echinoderm.
8. Study of early stages in the development of a frog, chick and a mammal. Note for 9-10: Prepared slides and preserved specimen and/or projection slides and/or CD ROM computer projections may be used.

**Books Recommended**


| BOT-402 | Plant Physiology and Ecology | 4(3–1) |
Title of the course: Bot-402  Plant Physiology and Ecology
Credit hours:  4 (3+1)

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

Course Outline:

a)  Plant Physiology

b)  Ecology
   1. Introduction, aims and applications of ecology.
   2. Soil: Physical and Chemical properties of soil (soil formation, texture, pH, EC, organism and organic matter etc) and their relationships to plants.
   5. Wind: Wind as an ecological factor and its importance.
7. Community Ecology
   i. Ecological characteristics of plant community
   ii. Methods of sampling vegetation (Quadrat and line intercept)
   iii. Major vegetation types of the local area.

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, molar 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
   4. Field trips to ecologically diverse habitats.
   5. Measurements of wind velocity.
   7. Effect of light and temperature on seed germination.

Recommended Books:
Semester 5 (Session 2017-2021)

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<th>Credits</th>
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<td>Inorganic Chemistry-II</td>
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<td>CHM-503</td>
<td>Organic Chemistry-II</td>
<td>4(3-1)</td>
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<td>CHM-505</td>
<td>Physical Chemistry-II</td>
<td>4(3-1)</td>
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<td>CHM-507</td>
<td>Analytical Chemistry-I</td>
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<tr>
<td>BCH-509</td>
<td>Biochemistry-I</td>
<td>3(3-0)</td>
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<tr>
<td>MTH-525</td>
<td>Mathematics for Chemists</td>
<td>2(2-0)</td>
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Optional (Any one subject): Analytical Chemistry-I or Biochemistry-I

Semester 5

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

1. BONDING MODELS FOR NON TRANSITION 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

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\(^{+}\))
2. Preparation and Characterization of Complex Compounds:
   (i) Sodium Cobaltinitrate  (ii) Potassium trioxalato aluminate  (iii) Ammonium Nickel II Sulphate  (iv) Hexa aqua Chromium III chloride.
3. Complexometric Titration (Any four) Cu\(^{2+}\)/Ni\(^{2+}\), Ca\(^{2+}\)/Ba\(^{2+}\), Au\(^{3+}\)/Pb\(^{2+}\), Cd\(^{2+}\)/Zn\(^{2+}\), Ni\(^{2+}\)/Mg\(^{2+}\), Ca\(^{2+}\)/Zn\(^{2+}\)

Books Recommended:

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

Acids and Bases
Concepts of acids and bases; scale of acidity and basicity; pK\(_a\) values; predicting acids/basis reactions from pK\(_a\) 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 Taft's 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.


CHM-503 Practical
Purification Techniques: Fractional distillation, fractional distillation under reduced pressure and fractional crystallization
Mixture Analysis: Analysis of two component mixture.

Books Recommended:


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

Kinetic Theory of Gases

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

CHM-505 Practical
- Equilibrium constant of the KI + I₂ = KI₃ reaction
BS (Hons) Chemistry Session 2017-21

- 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:**


| CHM-507 | Analytical Chemistry-I | 3(3-0) |

**CHM-507 Analytical Chemistry-I 3(3-0)**

**Chemical Analysis and Data Handling**

Accuracy of analytical processes such as sampling, weighing, volume measurements, precipitation, washing, filtration and ignition. Recent developments in the sampling techniques, statistical analysis; random and systematic errors, rounding off the data, arithmetic mean, median, mode, standard deviation, relative standard deviation, student t-test, F-test etc., quality control and quality assurance constructing and interpreting quality control plots. The use of computer in data handling.

**Ionic Equilibria in Solutions**


**Separation Techniques**
Solvent extraction Principle, factors affecting the extraction systems, Distribution la, coefficient and ratio, multiple batch extraction, practical applications in chemical analysis.
Chromatographic methods General theory of chromatography, classification of chromatographic methods, column, paper, thin-layer, and ion-exchange chromatography and their applications.

**Books Recommended:**


**BCH-509**  **Biochemistry-I**  **3(3-0)**

**CHM-509**  **Biochemistry-I**  **3(3-0)**

Introduction to biochemistry, scope of biochemistry, living systems, evolution and rise of living systems, important elements of living systems including carbon, nitrogen, phosphorus, hydrogen etc. foundations of biochemistry, the physical, cellular, chemical, genetic and evolutionary foundations of life, nature of organic matter, isomerism, general reactions of different functional groups, biologically important organic compounds, carbohydrates, proteins, lipids and nucleic acids

**Books Recommended:**

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 NH₃, HF, SO₂, BrF₃, CH₃COOH 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 (Wade's rule), spectroscopic evidence of bonding situation. Chemical properties of metal-carbonyls (carbonylate anions, carbonyl hydrides

3. **Kinetics and mechanism of inorganic reactions**

**CHM-502 Practicals**

1. **Estimation Of Anions (Any four)**
   - Chloride/Phosphate; Chloride/Nitrate; Bromide/Nitrate; Iodide/Nitrate; Borate/Acetate; Oxalate/Chloride; Sulphate/Phosphate

2. **KIO₃ Titrations (Any two)**

3. **Gravimetric Estimations:**
   - Estimations of Ba²⁺; Oxalate ions.

**Books Recommended:**


**CHM-504 Organic Chemistry-III**

**4(3-1)**

**CHM-504 Organic Chemistry-III**

**4(3-1)**

**Aliphatic nucleophilic substitution and Elimination reactions**

Aliphatic nucleophilic substitution reactions Mechanisms and study of SN1, SN2, SN1, SN2, mechanism; neighbouring group participation intra 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 Reactions Mechanisms 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 and substitution reactions.

**Aromatic Substitution reactions**
Electrophilic substitution: Aromaticity; mechanisms of substitution; orientation sulfonation, Friedel-Crafts reactions, diazo-coupling, formylation and carboxylation.
Nucleophilic substitution: Mechanisms: Study of SNAr, SN1 and benzylene 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 Practical**
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:**

<table>
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<th>CHM-506</th>
<th>Physical Chemistry-III</th>
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**CHM 506 Physical Chemistry III 4(3-1)**

**Electrochemistry**

**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**

**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$_2$Cr$_2$O$_7$ 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:**

CHM-508  Analytical Chemistry II  3(3-0)

Properties of Light and its interaction with matter, relation between frequency, velocity and wave number, Lambert-Beer’s Law and its limitations, Single and double beam spectrophotometers, sources of light (lamp and lasers), monochromators, photomultiplier tubes, detectors, diode array and charged coupled devices, applications of UV-Vis spectrophotometer in natural product research, pharmaceutical industry, separation process, enzyme essay study, clinical studies, microbiology. Applications of IR, NMR and Mass spectrophotometer in research & development and quality control process.

**Reference Books:**


BCH-510  Biochemistry-II  3(3-0)

CHM-510  Biochemistry-II  3(3-0)

**Physical aspects of Biochemistry**


**Digestion Absorption and Utilization:**

Carbohydrates, Lipids proteins nucleic acids, vitamins, minerals.

**Enzymes**


**Books Recommended:**


CHM-512  Introductory Spectroscopy  2(2-0)
CHM-512  Introductory Spectroscopy  2(2-0)

Spectroscopy:
Introduction to principle, instrumentation and application of Electronic (UV / Visible) Atomic (Emission /Absorption), Molecular (Infrared) and Nuclear Magnetic Spectroscopy.

Recommended Books:

English for Employment 7th Semester (BS), 3rd Semester (MSc.)

Contents:

20. Forms of Communication:
   - Verbal Communication
   - Non-Verbal Communication
   - Written Communication

21. Non-Verbal Communication
   - What is Non-Verbal Communication
   - Characteristics of Non-Verbal Communication
   - Classification of Non-Verbal Communication
   - Advantages of learning Non-Verbal Communication
   - Guidelines to develop Non-Verbal Communication

22. Verbal Communication
   - Presentation Skills
     - What is presentation?
     - Qualities of a good presenter
     - Essential characteristics of a good presentation
     - Elements of a presentation
     - Designing of your presentation
   - Interview Skills
     - Preparation of an interview
     - How to handle difficult questions
     - Most common mistakes to avoid during an interview
     - Tips of a successful interview
   - Telephonic Conversations
How to inquire (job vacancy, scholarships, admissions)

How to respond to an enquiry

Effective use of Meta communication (Vocalization)

**Written Communication**

- Principles of effective writing
- Business writing- keys

- E-mail Writing
  - Advantages of e-mail
  - The most common complaints about e-mail in practice
  - How to create electronic rapport
  - Sample e-mail messages
  - Writing subject lines
  - Writing negative messages
  - Writing positive messages
  - Writing an enquiry e-mail
  - Writing a response to an enquiry

- CV Writing
  - How to read a job advertisement
  - Responding to Job advertisement
  - To identify individual strengths and skills to write CV
  - Writing an effective CV
  - How to fill job application form
  - How to write a Cover letter
  - Report writing
  - How to write a Research Proposal

**Employability Skills**

- Strategies to identify employment opportunities
- Business Etiquettes
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<tbody>
<tr>
<td>Workplace Ethics</td>
<td>Courtland Bovee &amp; John Thill, Business Communication Essentials. Pearson</td>
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<tr>
<td>Cultural Awareness</td>
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<td>Intercultural sensitivities</td>
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<td>Communicating effectively across cultures</td>
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<tr>
<td>Positive thinking</td>
<td></td>
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<td>Role of positive thinking in successful career</td>
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<tr>
<td>How to be positive in crucial situation</td>
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Recommended Readings:

Compiled by: Ms. Fareeha Saleem
Approved and recommended by: Chairman of English Department
Dr. Mazhar Hayat
### Semester 7

**Specialization in Analytical Chemistry**

**Semester 7 (Session 2017-2021)**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<td>EFE (English for Employment)</td>
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<tr>
<td>CHM-601</td>
<td>Electroanalytical Techniques</td>
<td>3(3-0)</td>
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<tr>
<td>CHM-603</td>
<td>Advanced Separation techniques</td>
<td>3(3-0)</td>
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<tr>
<td>CHM-605</td>
<td>Atomic Spectroscopy</td>
<td>3(3-0)</td>
</tr>
<tr>
<td>CHM-607</td>
<td>Advanced Analytical Chemistry Practicals -I</td>
<td>2(2-0)</td>
</tr>
</tbody>
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**CHM-601 Electroanalytical Techniques 3(3-0)**

**Introduction:** Electrochemistry, Electrochemical cells, Standard cell potential, Indicator electrode, Reference electrodes, Classification of electro analytical methods, Bulk method, Interfacial methods, static methods, dynamic methods

**Potentiometric method of analysis:** Potentiometric measurements, Indicator electrodes, Metallic indicator electrode, Membrane indicator electrode, working of potentiometer and its application including pH measurements, ion selective electrode systems, ion exchange membrane electrode, solid state membrane electrodes and bio-membrane electrodes, potentiometric titrations.

**Coulometry and Electrogravimetry:** Basic electrochemistry, principle, instrumentation of coulometry, principle, instrumentation of electrogravimetry, consequences of electrogravimetry, Ohmic drop, activation over potential, concentration and gas polarization, basic difference and merits/demerits of coulometry and electrogravimetry.

**Reference Books:**


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**CHM-603 Advanced Separation techniques 3(3-0)**

**CHM-603 Advanced Separation techniques 3(3-0)**

**Chromatography:**
Classification of chromatographic techniques, chromatographic processes, rate theory of chromatography, Van-Deemter equation and its significance in evaluating column efficiency.

**Gas Liquid Chromatography:**
General principle, sample preparation/derivatization, separation process and instrumental aspects and its applications.

**High Performance Liquid Chromatography:**
General principle, sample preparation, separation process (normal phase and reverse phase separation), instrumentation, method development and applications.

**Capillary Electrophoresis (CE):**
Introduction to Electrophoresis, Theory and principle of CE, mobility, electro-osmotic flow separation by CE, instrumentation, modes of operation, applications.

Reference Books:

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

**Atomic Absorption Spectrophotometry:**
principle of atomic absorption spectrophotometry, concentration dependence of absorption, quantitative methodology, instrumentation for atomic absorption spectrophotometry, radiation sources, atomizers, flames, graphite furnaces and electrochemical atomizers, wavelength selectors, detectors, handling background absorption, interferences in atomic absorption spectrophotometry, sample handling in atomic absorption spectrophotometry, preparation of the sample, use of organic solvents, microwave, digestion, sample introduction methods, applications of atomic absorption spectrophotometry.

**Atomic Emission Spectrophotometry:**
introduction, principle of atomic emission spectrometry, atomic emission spectrometry using plasma sources, plasma and its characteristics, inductively plasma, direct current plasma, microwave induced plasma, choice of argon as plasma gas, instrumentation for ICP-MS.

**Atomic Fluorescence Spectrometry:**
Origin of atomic fluorescence, atomic fluorescence spectrum, types of atomic fluorescence transitions, principle of atomic fluorescence spectrometry, fluorescence intensity and analyte concentration, instrumentation for atomic fluorescence spectrometry, applications of atomic absorption spectrophotometry, interferences, merits and limitations.
**Reference Books:**


### CHM-607 Advanced Analytical Chemistry Practicals -I 2(2-0)

### CHM-607 Analytical Chemistry Practicals-I 2(0 - 2)

**Practicals**

The experiments may be set making use of the following instruments depending upon their. Availability, special experiments may also be designed for which a specimen list of instruments is given below. For the innovative designing of experiments the Journal of Chemical Education may be consulted.

**INSTRUMENTS**

- UV/Visible spectrophotometers
- Flame photometers
- pH-meters
- Conductivity bridge
- Gas chromatography
- HPLC chromatography
- Electro gravimetric apparatus
- Atomic absorption spectrophotometer
- Infrared spectrophotometers

**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 1 organic compounds.
**Specialization in Inorganic chemistry**

**Semester 7 (Session 2017-2021)**

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<tr>
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<tr>
<td>CHM-617</td>
<td>Main Group Organometallic and Organic Reagents</td>
<td>3(3-0)</td>
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<tr>
<td>CHM-619</td>
<td>Spectroscopic Methods of Analysis</td>
<td>3(3-0)</td>
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<tr>
<td>CHM-621</td>
<td>Metal Cluster Compounds</td>
<td>3(3-0)</td>
</tr>
<tr>
<td>CHM-623</td>
<td>Advanced Inorganic Chemistry Practicals-I</td>
<td>2(2-0)</td>
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</table>

**CHM-617** Main Group Organometallic and Organic Reagents 3(3-0)

**Main Group Organometallic Reagents**
Introduction, Preparation, classes of nucleophilic organometallic reagents organo-Li, S, Sc, Si, B, Sn, Sb and Zn in organic synthesis, control side reaction (Enolization vs. nucleophilic addition, substitution vs. elimination, selectively among functional groups 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:**


**CHM-619** Spectroscopic Methods of Analysis 3(3-0)

**CHM-619** Spectroscopic Methods of Analysis 3(3-0)

**Recommended Books:**


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**CHM-621**  
Metal Cluster 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**


<table>
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<th>CHM-623</th>
<th>Advanced Inorganic Chemistry Practicals-I</th>
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</table>

**CHM-623**  
Inorganic Chemistry Practicals -I  
2(0-2)

6. **Conductometry**

- Titration of strong acid and weak acid with a strong base.
- Precipitation titration involving AgNO₃ and KCl.

7. **Potentiometry**
- Determination of K₁, K₂ and K₃ for H₃PO₄
- Determination of chloride in the presence of iodide and evaluation of AgI and AgCl

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

9. **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)

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

semester 7 (session 2017-2021)

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<td>Spectroscopic Organic Techniques</td>
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<tr>
<td>CHM-627</td>
<td>Rearrangements and Pericyclic Reactions</td>
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<tr>
<td>CHM-633</td>
<td>Pharmaceutical Chemistry</td>
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<tr>
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<td>Advanced Organic Chemistry Practicals-I</td>
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CHM-625 Spectroscopic Organic Techniques 3(3 – 0)

(a) **Introduction**

(b) **Ultraviolet/Visible 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:**


**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:**

CHM-633  
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:


CHM-635  
Advanced Organic Chemistry Practicals-I  
2(2-0)

CHM- 635  
Advanced Organic Chemistry Practicals -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:

Specialization in Physical Chemistry

Semester 7 (Session 2017-2021)

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<td>Kinetics of Complex Reactions</td>
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<td>CHM-639</td>
<td>Thermodynamics and Spectroscopy</td>
<td>3(3-0)</td>
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<td>Material Chemistry</td>
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CHM-637 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:

CHM-639 Thermodynamics and Spectroscopy 3(3-0)

**Molecular Spectroscopy**
Electromagnetic radiations, interactions of electromagnetic radiations with matter, microwave, infrared and Raman spectroscopy, Nuclear magnetic resonance spectroscopy

**Nuclear chemistry I**
Introduction to Nuclear chemistry, Nuclear systematic, sources of nuclear instability, nuclear energetic, nuclear fission and fusion

**Energy Balance and Thermodynamics**
Thermodynamics terminology, material balance, energy balance, correlation of energy balances and thermodynamics, energy balances in open and closed system.

**Recommended Books:**

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 rehology

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:


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

15. Sugar analysis and inversion studies by polarimetry
17. Investigate the kinetics of hydrolysis of ethyl acetate in the presence of hydrochloric acid at room temperature and determination of order of reaction.
18. Interpretation of IR and NMR spectra
19. Determination of molecular weight of given sample of polymer viscometrically
20. Thermal analysis of given polymer sample with the help of available established literature
21. Surface characteristics of given polymer sample with the help of available established literature
22. Waste water treatment using chemicals
23. Waste water treatment using advanced oxidation process
24. Study of isotherms and experiments of surface chemistry
25. Preparation of colloidal solution and determination of precipitation value of colloidal solution by using monovalent, bivalent and trivalent cations
26. Determination of apparent molar volume of different sample solutions
27. Calculation of partial molar volume by graphical method
28. Kinetic study of enzyme catalyzed reactions
Course Title: Introduction to Statistical Theory
Credit Hours: 3(3-0)
Course Code: STA-595/321
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
6. Sher M. Chaudhry, Shahid Kamal, “Introduction to Statistical Theory I and II”.
**Specialization in Analytical Chemistry**

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<th>Semester 8</th>
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<td>Nuclear Analytical Techniques</td>
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<td>CHM-608</td>
<td>Food and Drug Chemistry</td>
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<tr>
<td>CHM-648</td>
<td>Standard Methods &amp; Quality Assurance</td>
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<tr>
<td>CHM-628</td>
<td>Advanced Analytical Chemistry Practicals II</td>
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</table>

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

**Thermal Analysis:**
Introduction, classification and principles of thermal analysis, thermograms, instrumentations, applications and limitations of thermal analysis.

**Thermogravimetric Analysis (TGA) and Derivative Thermal analysis (DTA):**
Introduction and principle of thermogravimetric analysis and derivative thermal analysis, its instrumentation, applications, data interpretations, limitations.

**Differential Thermal Analysis (DTA):**
Introduction and principle of differential thermal analysis, its instrumentation, applications, data interpretations, limitations.

**Differential Scanning Calorimetry (DSC):**
Introduction and principle of differential scanning calorimetry, its instrumentation, applications, data interpretations, limitations.

**Differential Photo-Calorimetry (DPC):**
Introduction and principle of evolved gas analysis, its instrumentation, data interpretations, applications.

**Evolved Gas Analysis (EGA):**
Introduction and principle of evolved gas analysis, its instrumentation, data interpretations, applications.

**Thermo-mechanical Analysis (TMA):**
Introduction and principle of thermo-mechanical analysis, its instrumentation, applications, data interpretations, limitations.

**Dynamic Mechanical Analysis (DMA):**
Introduction and principle of dynamic mechanical analysis, its instrumentation, data interpretations, applications.

**Di-electric Thermal Analysis (DETA):**
Introduction and principle of di-electric thermal analysis, its instrumentation, data interpretations, applications.

**Reference Books:**


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

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

Introduction to Nuclear sciences, Radioactive decay, Production of nuclear radiation, Interaction of radiation with matter, Radio-analytical techniques, Radiation detection and measurement instruments, Role of radiotracers in development of modern nuclear analytical techniques, Applications of radio-tracers in medical, environment, agriculture and industrial.

Reference Books:


**CHM-608 Food and Drug Chemistry** 3(3-0)

**CHM-608 Food and Drug Analysis** 3(3-0)

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

**Pharmaceuticals:**
Classification of drugs, test for analysis of different pharmaceuticals, introduction to US and British pharmacopeia.

**Forensics:**
History and scope of forensic Science, forensic ethics, forensic toxicology. Classification and analysis of narcotics & dangerous drugs, examination of crime scene evidences, fingerprinting, skeletal material to provide scientific opinion for legal.

**Reference Books:**

**CHM-648 Standard Methods & Quality Assurance** 3(3-0)

**CHM- 648 Standard Methods and Quality Assurance** 3(3– 0)

**COURSE OBJECTIVES**
The objectives of this course are to:
- Introduce students to the concept and benefits of quality assurance/quality control in the manufacturing industries
- Expose students to the process of conducting quality control of products in chemical and allied industries
- Expose students to the causes and effects of industrial and laboratory hazards and accidents
- Educate them on prevention and control of industrial and laboratory accidents

**CONTENTS**

**Method development and validation:** Selection of analytical methods for problem solving, Optimizing the experimental procedures, 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:** Introduction and concept of quality control and quality assurance, Development of quality standards in industries, Quality control chart, Quality control in some industries, General safety practices, Good laboratory practices


**Automation in analytical methods:** Automatic, automated and smart instruments and their applications with special emphasis on clinical, industrial and quality control aspects

**Books Recommended:**


**CHM-628 Advanced Analytical Chemistry Practicals II 2(0 – 2)**

**Practicals**

The experiments may be set making use of the following instruments depending upon their. Availability, special experiments may also be designed for which a specimen list of instruments is Given below. For the innovative designing of experiments the Journal of Chemical Education may be consulted.

**INSTRUMENTS**

Atomic absorption spectrophotometer
Infrared spectrophotometers
GCMS
HPLC
UX/Visible spectrophotometers
Flame photometers
pH-meters
Conductivity bridge
Thin Layer Chromatography
Electro gravimetric apparatus

**Experiments**

Potentiometric determination of Fluoride in drinking water.
Spectrophotometric determination of Iron in soil.
Determination of pH of Hair Shampoo.
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 1 organic compounds.
Gas Chromatographic analysis of drugs and poison.
Analysis of milk, beverages and meat.

**Reference Books:**

7. Yolanda Picó, Chemical Analysis of Food: Techniques and Applications
**Semester 8 (Session 2017-2021)**

**Specialization in Organic Chemistry**

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<td>CHM-612</td>
<td>Reactive Intermediates and Photochemistry</td>
<td>3(3-0)</td>
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<td>CHM-614</td>
<td>Disconnection Approach</td>
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<td>CHM-616</td>
<td>Organic Catalyst and Protective Group</td>
<td>3(3-0)</td>
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<tr>
<td>CHM-620</td>
<td>Advanced Organic Chemistry Practicals II</td>
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**CHM–610 Organic Polymers 3(3 – 0)**


**Recommended Books:**


**CHM–612 Reactive Intermediates and Photochemistry 3(3 – 0)**


**Photochemistry:**


**Recommended Books:**

**CHM-614** Disconnection Approach 3(3-0)

**CHM – 614** Disconnection Approach 3(3 – 0)

**The Disconnection Approach**


**Recommended Books:**


**CHM-616** Organic Catalyst and Protective Group 3(3-0)

**CHM – 616** 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:

CHM-620  Advanced Organic Chemistry Practicals II  2(0 – 2)

CHM-620  Advanced 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:
Semester 8 (Session 2017-2021)
Specialization in Inorganic Chemistry

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<td>Radio Nuclear Chemistry</td>
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**CHM-618**  
**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 diffractometer, identification and applications.

**Recommended Books:**


**CHM-620**  
**Homogeneous Catalysis**  
3(3-0)


**Recommended Books:**


CHM-622 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:


CHM-624 Magneto Chemistry 3(3-0)
Theory of magnetism, diamagnetism, paramagnetism, ferro-, ferri- and antiferromagnetism, magnetic susceptibility, magnetic moments, Faraday’s & Gouy’s methods, orbital contribution to magnetic moment, Russell-Sanders coupling scheme, derivation of term symbols of for \(p_1, p_6\) and \(d_1, d_{10}\) systems, pigeon holes diagram, effect of temperature on magnetic properties of complexes. Magnetic moment of lengthanise.

Recommended Books:


CHM-626 | Advanced Inorganic Chemistry Practicals II | 2(0 – 2)

CHM- 626 | Advanced Inorganic Practicals | 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:

Semester 8 (Session 2017-2021)

Specialization in Physical Chemistry

| Semester 8 | As per prospectus 2017 (available on GCUF website) |  
| STA-321 | Introduction to Statistical Theory | 3(3-0)  
| CHM-638 | Applications of Symmetry & Group Theory | 3(3-0)  
| CHM-640 | Quantum Mechanics | 3(3-0)  
| CHM-642 | Nuclear and Radiation Chemistry | 3(3-0)  
| CHM-644 | Electrochemical Aspects of Solutions | 3(3-0)  
| CHM-632 | Advanced Physical Chemistry Practicals II | 2(0 – 2)  

CHM-638 | Applications of Symmetry & Group Theory | 3(3-0)
Applications of Symmetry & Group Theory

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:


Quantum Mechanics

Statistical Mechanics

Quantum Chemistry
Applications to quantum mechanical systems.

**Theoretical and Computational Chemistry**

**Recommended Books:**

**CHM-642 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**

**Radiation Chemistry**

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

15. Determination of partial molar volumes and excess molar volumes for binary and ternary systems.
16. Purification of the given commercial solvent using pertinent methods of separation (distillation, fractional distillation, reflux).
17. Verification of Ostwald’s Dilution law.
19. Determination of heat of solutions of selected compounds by solubility methods in aqueous and non-aqueous media.
20. Determination of critical micelle concentration of selected surfactants in aqueous and non-aqueous media by surface tension and conductivity.
21. Determination of free energy of micellization of selected surfactants in aqueous and non-aqueous media by surface tension and conductivity.
22. Determination of equivalence point of acid-base titration by electrical conductivity.
23. Determination of degree of dissociation of weak electrolytes.
24. Determination of pKa values of acids.
25. Determination of pKa values of indicators.
26. Preparation of buffers of required pH values.

Books recommended:

students will study four courses with compulsory Introduction to Statistical Theory’ and ‘Seminar’
Chemistry Courses Outlines 2016-20

Instructions

*Please follow the scheme of studies of relevant prospectus strictly.

*The Outlines of Allied courses (i.e. English, Physics, Mathematics, Computer Sciences, Zoology, Botany) are at the end of this file.

*Course Code and Course Title should be carefully noted.

*Prospectus are available in soft form at university website.

*For any clash of scheme of studies in prospectus and outlines, please contact the Focal person (Department of Chemistry)

Dr. Matloob Ahmad

Matloob.Ahmad@gcuf.edu.pk
BS Chemistry

Semester 1 (Session 2016-2020)

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHM-301</td>
<td>Organic Chemistry – I</td>
<td>4(3-1)</td>
</tr>
<tr>
<td>ENG-321</td>
<td>Functional English</td>
<td>3(3-0)</td>
</tr>
<tr>
<td>PST-321</td>
<td>Pakistan Studies</td>
<td>2(2-0)</td>
</tr>
<tr>
<td>MTH-321</td>
<td>Mathematics – I</td>
<td>3(3-0)</td>
</tr>
<tr>
<td>PHY-323</td>
<td>Applied Physics –I</td>
<td>4(3-1)</td>
</tr>
<tr>
<td>ZOL-301</td>
<td>Zoology-I</td>
<td>4(3-1)</td>
</tr>
<tr>
<td>BOT-301</td>
<td>Diversity of Plants</td>
<td>4(3-1)</td>
</tr>
</tbody>
</table>

Optional (Any two subjects): Math & Physics or Botany & Zoology

**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-301 Practical
Sixteen experiments shall be conducted based on the following
a. Techniques
   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 (1preparations)

Books Recommended:

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 sentences (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

Prepared by: Noor ul Qamar Qasmi, Head, Department of English
• 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:

References:
- Allama Iqbal Open University, Compulsory English I (Code 1423) (Islamabad: AIOU Press).
  http://www.bbc.co.uk/worldservice/learningenglish/
  http://learnenglish.britishcouncil.org/en/
- British Council and BBC. Learn English.
  http://www.teachingenglish.org.uk/
- Grammar software free download: 3D Grammar English.

Prepared by: Noor ul Qamar Qasmi, Head, Department of English
7. Regeneration of Muslim Society in sub-continent and causes of decline of Muslim Rule
8. War of Independence 1857 and its impacts upon the politics of South Asia.
9. Sir Syed Ahmed Khan and Aligarh Movement:
   i) Educational Services
   ii) Political Services
   iii) Rational Interpretation of Islam
4. All India Muslim League:
   i) Multiple approaches and causes of the formation of Muslim League.
   ii) Objectives of the party.
   iii) Comparison of the policies of All Indian National congress and All India Muslim League.
   iv) Politics of Muslim League after the creation of Pakistan
5. Lucknow Pact 1916, high water mark of Hindu-Muslim Unity.
6. Khilafat Movement:
   i) Khilafat as an institution.
   ii) Hindu-Muslim Unity.
   ix) Role of Gandhi
   x) Emergence of Muslim Ulma in Indian politics.
   xi) Causes of the failure and impacts of the movement.
23. Iqbal’s Address at Allahabad 1930 and political thoughts of Ch. Rehmat Ali.
25. Pakistan Resolution 1940.
26. Muhammad Ali Jinnah:
   i) Jinnah’s role in Indian politician.
   ii) As a governor General
27. Initial problems and constitutional development in Pakistan.
29. Political culture of Pakistan.

30. Foreign Policy of Pakistan:
   i) Major determinants and objectives
   ii) Overview.

**Recommended Books:**


<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>MTH-321</td>
<td>Mathematics-I</td>
<td>3(3-0)</td>
</tr>
</tbody>
</table>


**RECOMMENDED BOOKS:**

**PHY-323** Applied Physics – I 4(3-1)

| Vector, Properties of vectors, Position, Velocity and acceleration vectors, 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, Simple harmonic motion, 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 |
|---|---|
| 5. To Study the damping features of an oscillation system using simple pendulum of variable mass. |
| 6. To determine the value of ‘g’ be compound pendulum. |
| 7. To determine the modulus of rigidity of a flat spiral spring. |
| 8. To determine the modulus of rigidity of a wire by solid cylindrical rod. |

**Recommended Books:**

9. Sears, Zemansky and Young, 2000, University Physics, 8th Ed, Addison-Wesley. Reading (MA) USA.
<table>
<thead>
<tr>
<th>Course Title</th>
<th>Zoology-I</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Code</td>
<td>ZOL-301</td>
</tr>
<tr>
<td>Credit Hours</td>
<td>4(3–1)</td>
</tr>
<tr>
<td>Theory</td>
<td>3</td>
</tr>
<tr>
<td>Practical</td>
<td>1</td>
</tr>
<tr>
<td>Follow up</td>
<td>BS</td>
</tr>
<tr>
<td>Aims and Objectives</td>
<td>The course aims to impart knowledge and understanding of:</td>
</tr>
<tr>
<td></td>
<td>a. The concept and status of Zoology in life sciences.</td>
</tr>
<tr>
<td></td>
<td>b. The common processes of life through its chemistry, biochemical and molecular processes.</td>
</tr>
<tr>
<td></td>
<td>c. The structure and function of cell organellae and how common animal cell diversified in various tissues, organs and organ systems.</td>
</tr>
<tr>
<td></td>
<td>d. Biochemical mechanisms eventually generating energy for animal work.</td>
</tr>
<tr>
<td></td>
<td>e. Animals and their relationship with their environment.</td>
</tr>
</tbody>
</table>

**Learning Outcomes**

**Syllabus in Brief**

<table>
<thead>
<tr>
<th>Course Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Place of Zoology in Science</td>
</tr>
<tr>
<td>A one-world view: genetic unity, the fundamental unit of life, evolutionary oneness and the diversity of life, environment and world resources; what is Zoology? The classification of animals; the scientific method.</td>
</tr>
<tr>
<td>2. The Chemical Basis of Animal Life</td>
</tr>
<tr>
<td>Atoms and elements: building blocks of all matter; compounds and molecules: aggregates of atoms; acids, bases, and buffers; the molecules of animals: fractional account of carbohydrates, lipids, proteins, nucleotides and nucleic acids based on their structural aspects.</td>
</tr>
<tr>
<td>3. Cells, Tissues, Organs, and Organ System of Animals</td>
</tr>
<tr>
<td>Structure and functions of cell membranes; various movements across membranes; cytoplasm, organelles, and cellular components: functional account of ribosomes, endoplasmic reticulum, golgi apparatus, lysosomes, mitochondria, cytoskeleton, cilia and flagella, centrioles and microtubules, and vacuoles based on their structural aspects. The nucleus: nuclear envelope, chromosomes and nucleolus. Tissues: diversity in epithelial tissue, connective tissue, muscle tissue and nervous tissue to perform various functions. Structural integrations for functions in organs and organ systems.</td>
</tr>
<tr>
<td>4. Energy and Enzymes: Life’s Driving and Controlling Forces</td>
</tr>
</tbody>
</table>
| Energy and the laws of energy transformation; activation energy; enzymes: structure, function and factors affecting their
activity; cofactors and coenzymes; ATP: how cells convert energy? An overview.


7. Ecology II: Communities and Ecosystems Community structure and diversity; ecosystems; ecosystems of the earth; ecological problems; human population growth, pollution, resource depletion and biodiversity.

Practicals
1. Tests for different carbohydrates, proteins and lipids.
   Note: Emphasis on the concept that tests materials have been ultimately obtained from living organisms and constituted their body.

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

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

3. Plasmolysis and deplasmolysis in blood.

4. Protein digestion by pepsin.

5. Ecological notes on animals of a few model habitats.

6. Field observation and report writing on animals in their ecosystem (a terrestrial and an aquatic ecosystem study).

Books Recommended


<table>
<thead>
<tr>
<th>Mcgraw Hill.</th>
</tr>
</thead>
</table>

| BOT-301 | Diversity of Plants | 4(3-1) |
Title of the Course: Bot-301 Diversity of Plants
Credit Hours: 4 (3+1)

Specific Objectives of course:
To introduce the students to the diversity of plants and their structures and significance.

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

a) Viruses (RNA and DNA types) with special reference to TMV;
b) Bacteria and Cyanobacteria (Nostoc, Anabaena, Oscillatoria) with specific reference to biofertilizers, pathogenicity and industrial importance;
c) Algae (Chlamydomonas, Spirogyra, Chara, Vaucheria, Pinnularia, Ectocarpus, Polysiphonia)
d) Fungi (Mucor, Penicillium, Phylactinia, Ustilago, Puccinia, Agaricus), their implication on crop production and industrial applications.
e) Lichens (Physcia)
f) Bryophytes
   i. Riccia
   ii. Anthoceros
   iii. Funaria

g) Pteridophytes.
   i. Psilopsida (Psilotum)
   ii. Lycopsida (Selaginella)
   iii. Sphenopsida (Equisetum)
   iv. Pteropsida (Marsilea)

h) Gymnosperms
   i. Cycas
   ii. Pinus
   iii. Ephedra

i) Angiosperms
   i. Monocot (Poaceae)
   ii. Dicot (Solanaceae)

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

Journals / Periodicals:

Semester 2 (Session 2016-2020)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHM-302</td>
<td>Inorganic Chemistry - I</td>
<td>4(3-1)</td>
</tr>
<tr>
<td>ENG-322</td>
<td>English Comprehensive and Composition</td>
<td>3 (3 – 0)</td>
</tr>
<tr>
<td>ISL-321</td>
<td>Islamic Studies</td>
<td>2(2–0)</td>
</tr>
<tr>
<td>ISL-322</td>
<td>Ethics (For Non-Muslim only)</td>
<td>2(2–0)</td>
</tr>
<tr>
<td>MTH-322</td>
<td>Mathematics-II</td>
<td>3(3-0)</td>
</tr>
<tr>
<td>PHY-324</td>
<td>Applied Physics-II</td>
<td>4(3-1)</td>
</tr>
<tr>
<td>ZOL-302</td>
<td>Zoology-II</td>
<td>4(3–1)</td>
</tr>
<tr>
<td>BOT-302</td>
<td>Systematic, Anatomy and Development</td>
<td>4(3–1)</td>
</tr>
</tbody>
</table>

Optional (Any two subjects): Math & Physics or Botany & Zoology

CHM-302  Inorganic Chemistry-I  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**

**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**

**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-302 Practical**

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 KmnO₄.**

4. **Quantitative analysis**
   - Determination of total hardness of water using EDTA.
   - Estimation of magnesium using EDTA.
   - Estimation of copper (iodometrically).
   - Determination 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 KMnO₄ solution.
• Determination of purity of commercial potassium oxalate using KMnO₄ solution
• Estimation of ferrous / ferric ions using K₂Cr₂O₇ solution.
• Percentage determination of barium in barium nitrate by gravimetric method.
• Gravimetric determination of nickel.

**Books Recommended:**
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:
     o Chronology for a narrative
     o Stages of a process
     o From general to specific and vice versa
     o From most important to least important
     o Advantages and disadvantages
     o Comparison and contrast
     o 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

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Chemistry Courses Outlines 2016-20

- Expository
- Argumentative

II. 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 by Zemach & Rumisek
<table>
<thead>
<tr>
<th>ISL-321</th>
<th>Islamic Studies</th>
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**مضامین وصولات اسلامیہ**

1. طالب علم کے ذریعہ کتب اور جذبہ کی سیرت میں گزارش ہے۔
2. طالب علم کے ذریعہ کتب اور جذبہ کی سیرت میں گزارش ہے۔
3. اسلام کی تاریخی وقائعوں میں کتابیات کا انتہائی محققہ ہے۔
4. اسلام کی تاریخی وقائعوں میں کتابیات کا انتہائی محققہ ہے۔
5. اسلام کی تاریخی وقائعوں میں کتابیات کا انتہائی محققہ ہے۔

**فہمیات**

1. انوار علمی ہیں۔

(انفر) قاہرہ دُلیل خان (یاقوت میری)
المصطلحات والدلالات

الحالة الجوية: 

الطقس:،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،،，
15: في الأسرى العشيرة، وعندما تشاء الله، فقد صلى الله عليه وسلم قال: "أرخى من أخيلهم فقد أخيلهم. فقد صلى الله عليه وسلم. فلا تأتيوا قال: "أرخى من أخيلهم فقد أخيلهم. فقد صلى الله عليه وسلم. فلا تأتيوا على الله، فإن لا بأس به". وضحى م Österreich (6)

16: عذب أبي قرينه: "بوب الله، فإن لا بأس به". وضحى م Österreich (6)

17: وضحى م Österreich (6)

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78: وضحى م奥地利 (6)

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**MTH-322 Mathematics-II**

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<th>Course Title</th>
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<td>MTH-322</td>
<td>Mathematics-II</td>
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</table>


**RECOMMENDED BOOKS**

**PHY-324 Applied Physics-II**

**PHY-324 Applied Physics-II**

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, Photon, Photoelectric effect, Compton effect

18. To study the behavior of RLC series circuit and determination of its resonance frequency.
19. To study the behavior of RLC Parallel circuit and determination of its resonance frequency.
20. Calibration of a voltmeter by a potentiometer.
22. To determine the high resistance by Neon flash lamp and a capacitor.
Recommended Books:

Sears, Zemansky and Young, 2000, University Physics, 8th Ed, Addison-Wesley. Reading (MA) USA.

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<th>Course Title</th>
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<td>Practical</td>
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<tr>
<td>Follow up</td>
<td>BS</td>
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Aims and Objectives
The course imparts knowledge and understanding of:

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

Learning Outcomes

Course Contents
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
   The birth of modern genetics; Mendelian inheritance patterns;
   other inheritance patterns; environmental effects and gene
   expression.
3. Chromosomes and Gene Linkage
   Eukaryotic chromosomes; linkage relationships; changes in
   chromosome number and structure.
4. Molecular Genetics: Ultimate Cellular Control
   DNA: the genetic material; DNA replication in eukaryotes;
   genes in action; control of gene expression in eukaryotes;
   mutations; applications of genetic technologies; recombinant
5. Animal Behaviour
Four approaches to animal behaviour; proximate and ultimate causes; anthropomorphism; development of behavior; learning; control of behavior; communication; behavioral ecology; social behavior.

6. 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 evolution by natural selection; evolutionary thought after Darwin; biogeography.

7. Evolution and Gene Frequencies
The modern synthesis: a closer look; 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.

Books Recommended

Practicals
1. Study of mitosis in onion root tip.
2. Study of meiosis in grasshopper testis (students should prepare the slide).

Note for 1-2: Prepared microscopic and/or projection slides and/or CD ROM computer projections must be used.
3. Problem based study of Mendelian ratio in animals.
4. Multiple alleles study in blood groups.
5. Survey study of a genetic factor in population and its frequency.
7. Study of cytochemical detection of DNA in protozoa and avian blood cell.
8. Study to demonstrate nervous or endocrine basis of behaviour (conditioned reflex or aggression or parental behavior).
9. Study to demonstrate social behaviour (documentary film be
shown, honey bee, monkey group in a zoo).

Books Recommended

**BOT-302**  **Systematic, Anatomy and Development**  

1st Year  
2nd Semester  

**Title of the Course:** Bot-302 Plant Systematics, Anatomy and Development/Embryology  
**Credit Hours:** 4 (3+1)

**Specific Objectives of course:**  
To understand: 1. various systems of classification, identification and nomenclature of Angiosperms, 2- Structures and functions of tissues and organs at embryonic level.

**Course Outline:**  

**a) Plant systematics**  
1. Introduction to Plant Systematics: aims, objectives and importance.  
2. Classification: brief history of various systems of classification with emphasis on Takhtajan.  
5. Diagnostic characters, economic importance and distribution pattern of the following families:  
   i. Ranunculaceae
ii. Brassicaceae (Cruciferae)
iii. Fabaceae (Leguminosae)
iv. Rosaceae
v. Euphorbiaceae
vi. Cucurbitaceae
vii. Lamiaceae (Labiatae)
viii. Apliaceae (Umbelliferae)
ix. Asteraceae (Compositae)
x. Liliaceae (Sen. Lato)

b) Anatomy
1. Cell wall: structure and chemical composition
2. Concept, structure and function of various tissues like:
   i. Parenchyma
   ii. Collenchyma
   iii. Sclerenchyma
   iv. Phloem Epidermis (including stomata and trichomes)
   v. Xylem
3. Meristem: types, stem and root apices
4. Vascular cambium
5. Structure and development of root, stem and leaf. Primary and secondary growth of dicot stem, periderm
6. Characteristics of wood: diffuse porous and ring porous, sap and heartwood, soft and hard wood, annual rings.

c) Development/Embryology
1. Early development of plant body:
2. Capsella bursa-pastoris
3. Structure and development of Anther Microsporogenesis, Microgametophyte
4. Structure of Ovule Megasporogenesis Megagametophyte
5. Endosperm formation
6. Parthenocarp
7. Polyembryony

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

Anatomy and Embryology
1. Study of stomata and epidermis.
2. Tissues of primary body of plant.
3. Study of xylem 3-dimensional plane of wood.
4. T. S of angiosperm stem and leaf.
5. Anatomy of germinating seeds
6. Study of pollens
Recommended Books:
Chemistry Courses Outlines 2016-20

Semester 3 Session 2016-2020

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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<tr>
<td>CHM-401</td>
<td>Physical Chemistry – I</td>
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<tr>
<td>ENG-421</td>
<td>Communications Skills</td>
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<td>CSI-401</td>
<td>Computer Applications &amp; Web-I</td>
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<td>MTH-423</td>
<td>Mathematics –III</td>
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<td>Applied Physics-III</td>
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<td>ZOL-401</td>
<td>Zoology-III</td>
<td>4(3–1)</td>
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<tr>
<td>BOT-401</td>
<td>Cell Biology, Genetics and Evolution</td>
<td>4(3–1)</td>
</tr>
</tbody>
</table>

Optional (Any two subjects): Math & Physics or Botany & Zoology

CHM-401 Physical Chemistry - I 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
Chemistry Courses Outlines 2016-20

- Determination of heat of solution by solubility method.
- Determination of heat of neutralization of an acid with a base.

Books Recommended:
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 comprehension
   • 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
- Hargie, O. (ed.) Hand book of Communications Skills
BS (Chemistry)  Course Code: CSI-401  Semester: 3rd

Course Outline

- Introduction to Computers
- Different Input and Output devices (Specially modern devices)
- Software and its different types
- Operating System Concepts
- Services and functions of operating system
- Network and its types
- Network Topologies and its types
- Introduction to Internet
- Different Web terminologies (Http, Web Browsers, Ftp, Search Engines, WWW)
- Introduction to common web devices specially modems.
- Introduction to protocols and use of protocols in Web.


The Laplace transform: Laplace transforms and their properties. Initial-value problems. Delta or impulse function and Heaviside step function.

RECOMMENDED BOOKS

PHY-423 Applied Physics – III 4(3-1)
Thermal radiation and laws, quantization of energy, Photoelectric effect, the Compton effect, line spectra, wave behavior of particles. Testing de Broglie’s hypothesis, waves, wave packets and particles, Hersenberg’s uncertainty principle, wave function, Schrodinger equation, trapped particles and probability densities, the correspondence principle, dual nature of matter. The atomic structure of hydrogen. Bohr’s theory, angular momentum of electrons, electron spin, X-ray spectrum, LASERS. Discovering the nucleus, basic nuclear properties. Radioactive decay. Energy from the nucleus, nuclear fission. Nuclear fusion, Nuclear reactors. Electronics, the p-n junction, Bias the p-n junction diode, diode, characteristics of diode. Different models, and types of diodes, half-wave and full-wave rectifier, full-wave bridge rectifier. Filter circuits. Bipolar junction transistor (BJT), base bias, emitter bias, voltage-divider bias. Amplifier classification, common emitter amplifier common collector, the common base amplifier.

18. Variation of photo electric current with intensity of incident light.
19. Design a full-wave rectifier and study its output without and with a capacitor filter.
20. Design a Half-wave rectifier and study its output without and with a capacitor filter.
21. To study characteristics of NOT, AND, NOR, NOR, NAND and XOR and verify their truth table.
Recommended Books:

9. Sears, Zemansky and Young, 2000, University Physics, 8th Ed, Addison-Wesley. Reading (MA) USA.

<table>
<thead>
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<th>Course Title</th>
<th>Zoology-III</th>
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<tr>
<td>Follow up</td>
<td>Animal Diversity -1 (Vertebrates)</td>
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<tr>
<td>Aims and Objectives</td>
<td>The students will be able to make comparison from simple unicellular to complex multicellular organization along with phylogenetic relationship</td>
<td></td>
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<tr>
<td>Learning Outcomes</td>
<td>The students will be able to achieve the aims and objectives of the course</td>
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<tr>
<td>Syllabus in Brief</td>
<td>Theory</td>
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<tr>
<td></td>
<td>1. Introduction</td>
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<td></td>
<td>Classification of organisms; evolutionary relationships and tree diagrams; patterns of organization.</td>
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<td>2. Animal-Like Protists: The Protozoa</td>
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<td>evolutionary perspective; life within a single plasma membrane; symbiotic life-styles. Pro</td>
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<td></td>
<td>tozoan taxonomy: (up to phyla, subphyla and super classes, wherever applicable). Pseudopodia and amoeboid locomotion; cilia and other pellicular structures; nutrition; genetic control and reproduction; symbiotic ciliates; further phylogenetic considerations.</td>
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<td>3. Multicellular and Tissue Levels of Organization</td>
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<td></td>
<td>evolutionary perspective: origins of multicellularity; animal origins.</td>
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<td></td>
<td>Phylum porifera: cell types, body wall, and skeletons; water currents and body forms; maintenance functions; reproduction.</td>
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<td>Phylum cnidaria (coelenterata) the body wall and nematocysts; alternation of generations; maintenance functions; reproduction and classification up to class. Phylum ctenophora; further phylogenetic considerations.</td>
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<td>4. Triploblastics and Acoelomate Body Plan</td>
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<td></td>
<td>evolutionary perspective; phylum platyhelminthes: classification up to class; the free-living flatworms and the tapeworms; phylum</td>
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nemertea; phylum gastrotricha; further phylogenetic considerations.
5. Pseudocoelomate Body Plan: Aschelminths
   evolutionary perspective; general characteristics; classification up to phyla with external features; feeding and the digestive system; other organ systems; reproduction and development of phylum rotifera and phylum nematoda; phylum kinorhyncha. Some important nematode parasites of humans; further phylogenetic considerations.
6. Molluscan Success
   evolutionary perspective: relationships to other animals; origin of the coelom; molluscan characteristics; classification up to class. The characteristics of shell and associated structures, feeding, digestion, gas exchange, locomotion, reproduction and development, other maintenance functions and diversity in gastropods, bivalves and cephalopods; further phylogenetic considerations.
7. Annelida: The Metameric Body Form
   evolutionary perspective: relationship to other animals, metamerism and tagmatization; classification up to class. External structure and locomotion, feeding and the digestive system, gas exchange and circulation, nervous and sensory functions, excretion, regeneration, reproduction and development, in polychaeta, oligochaeta and hirudinea; further phylogenetic considerations.
8. Arthropods: Blueprint for Success
   evolutionary perspective: classification and relationships to other animals; metamerism and tagmatization; the exoskeleton; metamorphosis; classification up to class; further phylogenetic considerations.
9. Hexapods and Myriapods: Terrestrial Triumphs
   evolutionary perspective; classification up to class. External structure and locomotion, nutrition and the digestive system, gas exchange, circulation and temperature regulation, nervous and sensory functions, excretion, chemical regulation, reproduction and development in hexapoda; insect behavior; insects and humans; further phylogenetic considerations.
Practicals
1. Study of *Euglena, Amoeba, Entamoeba, Plasmodium, Trypanosoma, Paramecium* as representative of animal like protists. (Prepared slides and from fresh water).
2. Study of sponges and their various body forms (prepared slides).
3. Study of principal representative classes of phylum Cnidaria.
4. Study of principal representative classes of phylum Platyhelminthes.
5. Study of representative of phylum Rotifera, phylum
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<td><strong>Chemistry Courses Outlines 2016-20</strong></td>
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<td>Nematoda.</td>
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<td>7. Study of principal representative classes of phylum Annelida.</td>
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<tr>
<td>8. Study of principal representative classes of groups of phylum Arthropoda.</td>
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<tr>
<td>10. Preparation of permanent stained slides of the following: <em>Obelia, Daphnia</em>, Cestode, Parapodia of <em>Nereis</em>.</td>
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<tr>
<td><strong>Reference Books</strong></td>
<td></td>
</tr>
</tbody>
</table>
Title of the course: Bot-401 Cell Biology, Genetics and Evolution
Credit hours: 4 (3+1)

Specific objectives of course: To understand:
1. Structure and function of cell.
2. Nature of genetic material and hereditary process
3. Familiarization with evolutionary processes.

Course outline:

a) Cell Biology
1. Structure and Function of Bio-molecules
   i. Carbohydrates
   ii. Lipids
   iii. Proteins
   iv. Nucleic Acids
2. Cell: Cell theory, cell types (prokaryotes, eukaryotes), basic properties of cell.
3. Brief description of following cell organelles
   i. Cell wall
   ii. Cell membrane
   iii. Nucleus
   iv. Endoplasmic reticulum
   v. Plastids
   vi. Mitochondria
   vii. Ribosomes
   viii. Dictyosomes
   ix. Vacuoles
4. Reproduction in somatic and embryogenic cell, mitosis, meiosis and cell cycle

b) Genetics
1. Introduction, scope and brief history of genetics. Mendelian inheritance; Laws of segregation and independent assortment, back cross, test cross, dominance and incomplete dominance.
2. Molecular genetics; DNA replication. Nature of gene, genetic code, transcription, translation, protein synthesis, regulation of gene expression (e.g. lac operon).

c) Evolution: Introduction and theories.
Lab Outline:

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

Genetics
1. Genetical problems related to transmission and distribution of genetic material.
2. Identification of chromosomes in plant material. Carmine/orcein staining.
3. Determination of blood groups

Recommended Books:
Chemistry Courses Outlines 2016-20

**Semester 4 (Session 2016-2020)**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHM-402</td>
<td>Chemistry (Special Topics)</td>
<td>4(3-1)</td>
</tr>
<tr>
<td>ENG-422</td>
<td>Technical writing</td>
<td>3(3-0)</td>
</tr>
<tr>
<td>CSI-422</td>
<td>Computer Applications &amp; Web– II</td>
<td>3(3-0)</td>
</tr>
<tr>
<td>MTH-426</td>
<td>Mathematics-IV</td>
<td>4(4-0)</td>
</tr>
<tr>
<td>PHY-424</td>
<td>Applied Physics-IV</td>
<td>4(3-1)</td>
</tr>
<tr>
<td>ZOL-402</td>
<td>Zoology-IV</td>
<td>4(3-1)</td>
</tr>
<tr>
<td>BOT-402</td>
<td>Plant Physiology and Ecology</td>
<td>4(3-1)</td>
</tr>
</tbody>
</table>

Optional (Any two subjects): Math & Physics or Botany & Zoology

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CHM-402 Chemistry (Special Topics) 4(3-1)

**Surface Chemistry**

**Chemistry of Solutions**
Ideal and non-ideal solutions, Raoult’s law and its applications, lowering of vapor pressure, elevation of boiling point, depression of freezing point, osmotic pressure, vapor pressure of non-ideal solutions and Henry’s law, abnormal colligative properties, degrees of association and dissociation of solutes, osmotic pressure and its measurement, fractional distillation and concept of azeotropic mixtures

**Nanomaterials**
Introduction to nanochemistry, Synthesis of nanoparticles, characterization and applications,

**Introduction to Nuclear Chemistry**
Natural and artificial radioactivity, Atomic nucleus, nuclides, nuclear stability, nuclear energetics, Nuclear models (shell + liquid drop model), fusion and fission, modes of decay, kinetics of nuclear reactions, nonspontaneous nuclear processes, nuclear reactors, beta decay systematic. Uses of radioisotopes in various fields. Nuclear hazards and safety measures.

**Biomolecules**
A brief introduction to the chemical nature of carbohydrates, proteins, lipids, nucleic acids and their importance in living systems.
CHM-402

Practicals

More experiments should be included according to the facilities available to the teaching institution.

Eight experiments in chromatography (TLC, column and paper) using cations, mixture of inks and organic compounds.

Determination of dipole moment of organic compounds.

Determination of specific and molar conductivities of strong weak electrolytes.

Books Recommended:


ENG-422

Technical writing

3(3-0)

Technical English(422) 4th Semeter (BS, honours)

Contents:

25. Writing

26. technical writing style

27. (Academic)
    • reports.
    • planning

Basic factors of Technical

Basic principles of

Report Writing

What is Report Writing?

When we need to write

Prior preparation and
Chemistry Courses Outlines 2016-20

- Structure and sections of a report
- Language appropriate for report writing:
- Social or university issue.

28. Proposal Writing:
- Types of proposals:
  - Business proposal
  - Research proposal
- Factors to consider while preparing an academic research proposal
- Writing style and written language appropriate for an academic research proposal:
- Analysis of a sample

29. Plagiarism and Citation:
- What is plagiarism
- How to avoid plagiarism
- How to cite:
  - Different styles to cite

30. How to do and write an academic research
- Sources of research
- Sections of an academic research paper

31. Academic writing

Compiled and prepared by: Ms. Fareeha Saleem
Approved and recommended by: Chairman of English Department
Dr. Mazhar Hayat
Computer Applications and Web-II

BS (Chemistry)  Course Code: CSI-422  Semester: 4th

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.
MTH-426 Mathematics-IV  4(4-0)

Higher Order Differential Equations:

- Cauchy-Euler’s equations, Reduction of order, Method of Variation of Parameter's, Exact Linear Equations, System of Linear Differential Equations, Power Series Solutions of first order Differential Equations.
- Laplace and Inverse Transformations with simple Application to Differential Equation.

RECOMMENDED BOOKS


PHY-424 Applied Physics-IV  4(3-1)

Kinetic theory of the ideal gas; work done on an ideal gas, material energy of an ideal gas, intermolecular forces. Statistical mechanics, statistical distribution and mean values, distribution molecular speeds, distribution of energies, Brownian motion. Heat, different theories of heat, specific heat, gram molecular specific heat, laws of thermodynamics. Zeroth law, first law, second law, third law of thermodynamics, reversible and irreversible processes, indicator diagram, entropy, law of thermodynamics, reversible and irreversible processes, indicator diagram, entropy law of increase of entropy, temperature-entropy diagram. Maxwell’s thermodynamics relations, TDS equations, Clapeyron’s equation, entropy and second law of thermodynamics. Temperature scale, entropy, low temperature physics. Thermoelectricity, Seabeck effect, Peltier effect, thermocouple.

11. The determination of wavelength of light by Diffraction grating
12. Design a full-wave rectifier and study its output without and with a capacitor filter.
13. Design a Half-wave rectifier and study its output without and with a capacitor filter.
14. To study characteristics of NOT, AND, NOR, NOR, NAND and XOR and verify their truth table.
Recommended Books:
9. Sears, Zemansky and Young, 2000, University Physics, 8th Ed, Addison-Wesley. Reading (MA) USA.

Course Zoology-IV :Course Code ZOL-402
Credit Hours 4(3-1)
Theory 3 Practical 1
Follow up BS Category
Aims and Objectives The course deals with the: a. Basis of structure and functions of animal nutrition, digestion, homeostasis and temperature regulation. b. It introduces the basic concepts in reproduction and development in animal kingdom. c. Provides knowledge about the development of chordate body plan and fate of germinal layers. Learning Outcomes
Syllabus in Brief 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: gastrointestinal motility and its control, oral cavity, pharynx and esophagus, stomach, small intestine: main site of digestion; large intestine; role of the pancreas in digestion; and role of the liver and gallbladder in digestion.
2. Temperature and Body Fluid Regulation Homeostasis and Temperature Regulation; The Impact of Temperature on Animal Life; Heat Gains and Losses; Some Solutions to Temperature Fluctuations; Temperature Regulation in Invertebrates, Fishes, Amphibians, Reptiles, Birds and Mammals; Heat Production in Birds and Mammals; Control of Water and Solutes (Osmoregulation and Excretion); 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; the human male reproductive system: spermatogenesis, transport and hormonal control, reproductive function; the human female reproductive system: folliculogenesis, transport and hormonal control, reproductive function; hormonal regulation in gestation; prenatal development and birth: the placenta; milk production and lactation.

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, amphibian embryology, development in terrestrial environments, avian embryology, the fate of mesoderm.

Books Recommended

Practicals
1. Study of excretory system in an invertebrate and a vertebrate representative (Model).
2. Study of nutritive canal in an invertebrate and a vertebrate representative (Dissection).
3. Study of male reproductive system in an invertebrate and a vertebrate representative (Dissection).
4. Study of female reproductive system in an invertebrate and a vertebrate representative (Dissection).
5. Study of hormonal influence of a reproductive function (Model).
6. Study of preserved advanced stages of avian and mammalian development for amniotic membranes and placenta (Model).
7. Study of stages in the development of an Echinoderm.
8. Study of early stages in the development of a frog, chick and a mammal.
Note for 9-10: Prepared slides and preserved specimen and/or projection slides and/or CD ROM computer projections may be used.

**Books Recommended**

Title of the course: Bot-402 Plant Physiology and Ecology
Credit hours: 4 (3+1)

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

Course Outline:

a) Plant Physiology

b) Ecology
   1. Introduction, aims and applications of ecology.
   2. Soil: Physical and Chemical properties of soil (soil formation, texture, pH, EC, organism and organic matter etc) and their relationships to plants.
   5. Wind: Wind as an ecological factor and its importance.
7. Community Ecology
   i. Ecological characteristics of plant community
   ii. Methods of sampling vegetation (Quadrat and line intercept)
   iii. Major vegetation types of the local area.

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, molar 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
4. Field trips to ecologically diverse habitats.
5. Measurements of wind velocity.
7. Effect of light and temperature on seed germination.

Recommended Books:

Chemistry Courses Outlines 2016-20

**Semester 5 (Session 2016-2020)**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>CHM-501</td>
<td>Inorganic Chemistry-II</td>
<td>4(3-1)</td>
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<tr>
<td>CHM-503</td>
<td>Organic Chemistry-II</td>
<td>4(3-1)</td>
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<tr>
<td>CHM-505</td>
<td>Physical Chemistry-II</td>
<td>4(3-1)</td>
</tr>
<tr>
<td>CHM-507</td>
<td>Analytical Chemistry-I</td>
<td>3(3-0)</td>
</tr>
<tr>
<td>BCH-509</td>
<td>Biochemistry-I</td>
<td>3(3-0)</td>
</tr>
<tr>
<td>MTH-525</td>
<td>Mathematics for Chemists</td>
<td>2(2-0)</td>
</tr>
</tbody>
</table>

Optional (Any one subject): Analytical Chemistry-I or Biochemistry-I

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**CHM-501**  
Inorganic Chemistry-II  
4(3-1)

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**Semester 5**

**CHM-501**  
Inorganic Chemistry-II  
4(3-1)

1. **BONDING MODELS FOR NON TRANSITION 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**

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.
Chemistry Courses Outlines 2016-20

**CHM-501  Practical**

1. Separation of cations by paper chromatography: (Pb$^{2+}$, Cd$^{2+}$, Cu$^{2+}$, Co$^{2+}$, Ni$^{2+}$, Ag$^{+}$)
2. Preparation And Characterization Of Complex Compounds:
   (i) Sodium Cobaltinitrate (ii) Potassium trioxalato aluminate (iii) Ammonium Nickel 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:**


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**CHM-503 Organic Chemistry-II**

**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.


**CHM-503 Practicals**

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

**Mixture Analysis:** Analysis of two component mixture.

**Books Recommended:**


**CHM-505 Physical Chemistry II 4 (3-1)**

**Kinetic Theory of Gases**


**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**


**CHM-505 Practicals**

- Equilibrium constant of the $\text{KI} + \text{I}_2 = \text{K}_3\text{I}_3$ reaction
Chemistry Courses Outlines 2016-20

- 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:


CHM-507 Analytical Chemistry-I 3(3-0)

Chemical Analysis and Data Handling
Accuracy of analytical processes such as sampling, weighing, volume measurements, precipitation, washing, filtration and ignition. Recent developments in the sampling techniques, statistical analysis; random and systematic errors, rounding off the data, arithmetic mean, median, mode, standard deviation, relative standard deviation, student t-test, F-test etc., quality control and quality assurance constructing and interpreting quality control plots. The use of computer in data handling.

Ionic Equilibria in Solutions

Separation Techniques
Chemistry Courses Outlines 2016-20

Solvent extraction Principle, factors affecting the extraction systems, Distribution la, coefficient and ratio, multiple batch extraction, practical applications in chemical analysis.
Chromatographic methods General theory of chromatography, classification of chromatographic methods, column, paper, thin-layer, and ion-exchange chromatography and their applications.

Books Recommended:


BCH-509 Biochemistry-I 3(3-0)

CHM-509 Biochemistry-I 3(3-0)

Introduction to biochemistry, scope of biochemistry, living systems, evolution and rise of living systems, important elements of living systems including carbon, nitrogen, phosphorus, hydrogen etc. foundations of biochemistry, the physical, cellular, chemical, genetic and evolutionary foundations of life, nature of organic matter, isomerism, general reactions of different functional groups, biologically important organic compounds, carbohydrates, proteins, lipids and nucleic acids

Books Recommended:

MTH-525 | Mathematics for Chemists | 2(2-0)


RECOMMENDED BOOKS

Semester 6 (Session 2016-2020)

<table>
<thead>
<tr>
<th>Semester 6</th>
<th>As per prospectus 2016 (available on GCUF website)</th>
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<tbody>
<tr>
<td>CHM-502</td>
<td>Inorganic Chemistry-III</td>
</tr>
<tr>
<td>CHM-504</td>
<td>Organic Chemistry-III</td>
</tr>
<tr>
<td>CHM-506</td>
<td>Physical Chemistry-III</td>
</tr>
<tr>
<td>CHM-508</td>
<td>Analytical Chemistry-II</td>
</tr>
<tr>
<td>BCH-510</td>
<td>Biochemistry-II</td>
</tr>
<tr>
<td>CHM-512</td>
<td>Introductory Spectroscopy</td>
</tr>
<tr>
<td>Optional</td>
<td>(Any one subject): Analytical Chemistry-II or Biochemistry-II</td>
</tr>
</tbody>
</table>

CHM-502 | Inorganic Chemistry-III | 4(3-1)

Semester 6

CHM-502 | Inorganic Chemistry-III | 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 NH₃, HF, SO₂, BrF₃, CH₃COOH and HCN. Reactions in molten salt system.

2. Pi-Acceptor Ligands

3. **Kinetics and mechanism of inorganic reactions**

**CHM- 502 Practical**

1. **Estimation Of Anions (Any four)**
   - Chloride/Phosphate; Chloride/Nitrate; Bromide/Nitrate; Iodide/Nitrate; Borate/Acetate; Oxalate/Chloride; Sulphate/Phosphate
2. **KIO₃ Titrations (Any two)**
3. **Gravimetric Estimations:**
   - Estimations of Ba²⁺; Oxalate ions.

**Books Recommended:**


**CHM-504 Organic Chemistry-III 4(3-1)**

**Aliphatic nucleophilic substitution and Elimination reactions**
Aliphatic nucleophilic substitution reactions Mechanisms 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 and substitution 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:**

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

CHM-506 Practical
- 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 KMnO₄ / K₂Cr₂O₇ 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:
Chemistry Courses Outlines 2016-20

**CHM-508  Analytical Chemistry II 3(3-0)**

Properties of Light and its interaction with matter, relation between frequency, velocity and wave number, Lambert-Beer’s Law and its limitations, Single and double beam spectrophotometers, sources of light (lamp and lasers), monochromators, photomultiplier tubes, detectors, diode array and charged coupled devices, applications of UV-Vis spectrophotometer in natural product research, pharmaceutical industry, separation process, enzyme essay study, clinical studies, microbiology. Applications of IR, NMR and Mass spectrophotometer in research & development and quality control process.

**Reference Books:**


**BCH-510  Biochemistry-II 3(3-0)**

**CHM-510  Biochemistry-II 3(3-0)**

Physical aspects of Biochemistry


**Digestion Absorption and Utilization:**

Carbohydrates, Lipids proteins nucleic acids, vitamins, minerals.

**Enzymes**


**Books Recommended:**

CHM-512  Introductory Spectroscopy  2(2-0)

CHM-512  Introductory Spectroscopy  2(2-0)

**Spectroscopy:**
Introduction to principle, instrumentation and application of Electronic (UV / Visible) Atomic (Emission /Absorption), Molecular (Infrared) and Nuclear Magnetic Spectroscopy.

**Recommended Books:**


**Semester 7 (Session 2016-2020)**
**For All specializations**

| ENG-611 | English for Employment | 2(3-0) |

**English for Employment 7th Semester (BS), 3rd Semester(MSc.)**
Contents:

32.
- Forms of Communication:
  - Verbal Communication
  - Non-Verbal Communication
  - Written Communication

33. Communication
- Non-Verbal Communication
  - What is Non-Verbal Communication
  - Characteristics of Non-Verbal Communication
  - Classification of Non-Verbal Communication
  - Advantages of learning Non-Verbal Communication
  - Guidelines to develop Non-Verbal Communication

34.
- Verbal Communication
  - Presentation Skills
    - What is presentation?
    - Qualities of a good presenter
    - Essential characteristics of a good presentation
    - Elements of a presentation
    - Designing of your presentation
  - Interview Skills
    - Preparation of an interview
    - How to handle difficult questions
    - Most common mistakes to avoid during an interview
    - Tips of a successful interview
  - Telephonic Conversations
    - How to enquire (job vacancy, scholarships, admissions)
    - How to respond to an enquiry
    - Effective use of Meta communication (Vocalization)

35. Written Communication
Chemistry Courses Outlines 2016-20

- Principles of effective writing
- Business writing- keys
- E-mail Writing
  - Advantages of e-mail
  - The most common complaints about e-mail in practice
  - How to create electronic rapport
  - Sample e-mail messages
  - Writing subject lines
  - Writing negative messages
  - Writing positive messages
  - Writing an enquiry e-mail
  - Writing a response to an enquiry
- CV Writing
  - How to read a job advertisement
  - Responding to Job advertisement
  - To identify individual strengths and skills to write CV
  - Writing an effective CV
- How to fill job application form
- How to write a Cover letter
- Report writing
- How to write a Research Proposal

Employability Skills

- Strategies to identify employment opportunities
- Business Etiquettes
  - Etiquette in the Workplace
  - Etiquette in the Social settings
- Workplace Ethics
- Cultural Awareness
  - Intercultural sensitivities
Chemistry Courses Outlines 2016-20

- Communicating effectively across cultures
- Positive thinking
  Role of positive thinking in successful career
  How to be positive in crucial situation

Recommended Readings:

Compiled by: Ms. Fareeha Saleem
Approved and recommended by: Chairman of English Department
Dr.Mazhar Hayat

Semester 7 (Session 2016-2020)
Specialization in Analytical Chemistry

| Semester 7 | As per prospectus 2016 (available on GCUF website) |
EN

ENG-611  EFE (English for Employment)  3(3-0)

CHM-601  Electroanalytical Techniques  3(3-0)

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

CHM-605  Atomic Spectroscopy  3(3-0)

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

**CHM-601  Electroanalytical Techniques  3(3-0)**

**Introduction:** Electrochemistry, Electrochemical cells, Standard cell potential, Indicator electrode, Reference electrodes, Classification of electro analytical methods, Bulk method, Interfacial methods, static methods, dynamic methods

**Potentiometric method of analysis:** Potentiometric measurements, Indicator electrodes, Metallic indicator electrode, Membrane indicator electrode, working of potentiometer and its application including pH measurements, ion selective electrode systems, ion exchange membrane electrode, solid state membrane electrodes and bio-membrane electrodes, potentiometric titrations.

**Coulometry and Electrogravimetry:** Basic electrochemistry, principle, instrumentation of coulometry, principle, instrumentation of electrogravimetry, consequences of electrogravimetry, Ohmic drop, activation over potential, concentration and gas polarization, basic difference and merits/demerits of coulometry and electrogravimetry.

**Reference Books:**


**CHM-603  Advanced Separation techniques  3(3-0)**

**CHM-603  Advanced Separation techniques  3(3-0)**

**Chromatography:**
Classification of chromatographic techniques, chromatographic processes, rate theory of chromatography, Van-Deemter equation and its significance in evaluating column efficiency.

**Gas Liquid Chromatography:**
General principle, sample preparation/derivatization, separation process and instrumental aspects and its applications.
High Performance Liquid Chromatography:
General principle, sample preparation, separation process (normal phase and reverse phase separation), instrumentation, method development and applications.

Capillary Electrophoresis (CE):
Introduction to Electrophoresis, Theory and principle of CE, mobility, electro-osmotic flow separation by CE, instrumentation, modes of operation, applications.

Reference Books:

CHM-605 Atomic Spectroscopy 3(3-0)

Atomic Absorption Spectrophotometry:
principle of atomic absorption spectrophotometry, concentration dependence of absorption, quantitative methodology, instrumentation for atomic absorption spectrophotometry, radiation sources, atomizers, flames, graphite furnaces and electrochemical atomizers, wavelength selectors, detectors, handling background absorption, interferences in atomic absorption spectrophotometry, sample handling in atomic absorption spectrophotometry, preparation of the sample, use of organic solvents, microwave, digestion, sample introduction methods, applications of atomic absorption spectrophotometry.

Atomic Emission Spectrophotometry:
introduction, principle of atomic emission spectrometry, atomic emission spectrometry using plasma sources, plasma and its characteristics, inductively plasma, direct current plasma, microwave induced plasma, choice of argon as plasma gas, instrumentation for ICP-MS.

Atomic Fluorescence Spectrometry:
Origin of atomic fluorescence, atomic fluorescence spectrum, types of atomic fluorescence transitions, principle of atomic fluorescence spectrometry, fluorescence intensity and analyte concentration, instrumentation for atomic fluorescence spectrometry, applications of atomic absorption spectrophotometry, interferences, merits and limitations.

Reference Books:


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

Practicals
The experiments may be set making use of the following instruments depending upon their availability, special experiments may also be designed for which a specimen list of instruments is given below. For the innovative designing of experiments the Journal of Chemical Education may be consulted.

INSTRUMENTS
UV/Visible spectrophotometers
Flame photometers
pH-meters
Conductivity bridge
Gas chromatography
HPLC chromatography
Electro gravimetric apparatus
Atomic absorption spectrophotometer
Infrared spectrophotometers

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 1organic compounds.

Semester 7 (Session 2016-2020)
Specialization in Inorganic chemistry

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<tr>
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<tr>
<td>CHM-617</td>
<td>Main Group Organometallic and Organic Reagents</td>
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<tr>
<td>CHM-619</td>
<td>Spectroscopic Methods of Analysis</td>
</tr>
<tr>
<td>CHM-621</td>
<td>Metal Cluster Compounds</td>
</tr>
<tr>
<td>CHM-623</td>
<td>Inorganic Chemistry Practicals-I</td>
</tr>
</tbody>
</table>

CHM-617 Main Group Organometallic and Organic Reagents 3(3-0)

Main Group Organometallic Reagents
Introduction, Preparation, classes of nucleophilic organometallic reagents organo-Li, S, Sc, Si, B, Sn, Sb and Zn in organic synthesis, control side reaction (Enolization vs. nucleophilic 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:


CHM-619 Spectroscopic Methods of Analysis 3(3-0)

CHM-619 Spectroscopic Methods of Analysis


Recommended Books:


CHM-621 Metal Cluster Compounds 3(3-0)

CHM-621 Metal Cluster Compounds

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
11. **Conductometry**  
- Titration of strong acid and weak acid with a strong base.  
- Precipitation titration involving AgNO$_3$ and KCl.

12. **Potentiometry**  
- Determination of K1, K2 and K3 for H$_3$PO$_4$  
- Determination of chloride in the presence of iodide and evaluation of AgI and AgCl

13. **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.

14. **Use of some Organic Reagents for the estimation of various elements by gravimetric estimation.**  
- 8-Hydroxyquinoline Al (III) and Fe (III)  
- Salicylaldoxime: Ni (II) in the presence of Cu (II)  
- Anthranilic acid: Co (II) and Zn (II)

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

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**Semester 7 (Session 2016-2020)**  
**Specialization in Organic chemistry**

**Semester 7**  
As per prospectus 2016 (available on GCUF website)
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<td>3(3-0)</td>
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<tr>
<td>CHM-625</td>
<td>Spectroscopic Organic Techniques</td>
<td>3(3-0)</td>
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<tr>
<td>CHM-627</td>
<td>Rearrangements and Pericyclic Reactions</td>
<td>3(3-0)</td>
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<tr>
<td>CHM-633</td>
<td>Pharmaceutical Chemistry</td>
<td>3(3-0)</td>
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<tr>
<td>CHM-635</td>
<td>Organic Chemistry Practicals-I</td>
<td>2(2-0)</td>
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</tbody>
</table>

**CHM-625 Spectroscopic Organic Techniques 3(3 – 0)**

(a) **Introduction**

(b) **Ultraviolet/Visible 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:**


CHM-627 Rearrangements and Pericyclic Reactions 3(3-0)

**CHM-627 Rearrangements and Pericyclic Reactions 3(3 – 0)**


**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. Suprafacial 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:**


CHM-633 Pharmaceutical Chemistry 3(3-0)
CHM-633  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:

CHM-635 Organic Chemistry Practicals-I  2(2-0)

CHM- 635 Organic Chemistry Practicals -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:
Chemistry Courses Outlines 2016-20

Semester 7 (Session 2016-2020)

Specialization in Physical Chemistry

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<td>CHM-637</td>
<td>Kinetics of Complex Reactions</td>
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<tr>
<td>CHM-639</td>
<td>Thermodynamics and Spectroscopy</td>
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<tr>
<td>CHM-641</td>
<td>Material Chemistry</td>
</tr>
<tr>
<td>CHM-643</td>
<td>Physical Chemistry Practicals-I</td>
</tr>
</tbody>
</table>

CHM-637 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:

**CHM-639 Thermodynamics and Spectroscopy 3(3-0) 3(3-0)**

**CHM-639 Thermodynamics and Spectroscopy 3(3-0)**

**Molecular Spectroscopy**
Electromagnetic radiations, interactions of electromagnetic radiations with matter, microwave, infrared and Raman spectroscopy, Nuclear magnetic resonance spectroscopy

**Nuclear chemistry I**
Introduction to Nuclear chemistry, Nuclear systematic, sources of nuclear instability, nuclear energetic, nuclear fission and fusion

**Energy Balance and Thermodynamics**
Thermodynamics terminology, material balance, energy balance, correlation of energy balances and thermodynamics, energy balances in open and closed system.

**Recommended Books:**


**CHM-641 Material Chemistry 3(3-0) 3(3-0)**

**CHM-641 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 rheology

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:
17. Joel R. Fried “Polymer Science and Technology” Prentice Hall PTR. 1995. USA.

CHM-643 Advanced Physical Chemistry Practicals 1 2(2-0)

CHM-643 Physical Chemistry Practicals 2(0–2)

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

29. Sugar analysis and inversion studies by polarimetry
30. Verify Beer’s Lambert’s Law for the given solution.
31. Investigate the kinetics of hydrolysis of ethyl acetate in the presence of hydrochloric acid at room temperature and determination of order of reaction.
32. Interpretation of IR and NMR spectra
33. Determination of molecular weight of given sample of polymer viscometrically
34. Thermal analysis of given polymer sample with the help of available established literature
35. Surface characteristics of given polymer sample with the help of available established literature
36. Waste water treatment using chemicals
37. Waste water treatment using advanced oxidation process
38. Study of isotherms and experiments of surface chemistry
39. Preparation of colloidal solution and determination of precipitation value of colloidal solution by using monovalent, bivalent and trivalent cations
40. Determination of apparent molar volume of different sample solutions
41. Calculation of partial molar volume by graphical method
42. Kinetic study of enzyme catalyzed reactions

**Semester 8 (Session 2016-2020)**
**For All Specializations**

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<thead>
<tr>
<th>Course Code</th>
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<tbody>
<tr>
<td>STA-321</td>
<td>Introduction to Statistical Theory</td>
<td>3(3-0)</td>
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</table>

Course Title: Introduction to Statistical Theory
Credit Hours: 3(3-0)
Course Code: STA-595/321

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
Chemistry Courses Outlines 2016-20

(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

10. Sher M. Chaudhry, Shahid Kamal, “Introduction to Statistical Theory I and II”.


Semester 8 (Session 2016-2020)
Specialization in Analytical Chemistry

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<td>CHM-629</td>
<td>Seminar 1(0-1)</td>
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<tr>
<td>STA-351</td>
<td>Introduction to Statistical Theory 3(3-0)</td>
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<tr>
<td>CHM-602</td>
<td>Thermal Methods of Analysis 3(3-0)</td>
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<tr>
<td>CHM-604</td>
<td>Nuclear Analytical Techniques 3(3-0)</td>
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<tr>
<td>CHM-606</td>
<td>Luminescence Spectroscopy 3(3-0)</td>
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<tr>
<td>CHM-608</td>
<td>Food and Drug Chemistry 3(3-0)</td>
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CHM-602 Thermal Methods of Analysis 3(3-0)

Thermal Analysis:
Introduction, classification and principles of thermal analysis, thermograms, instrumentations, applications and limitations of thermal analysis.

**Thermogravimetric Analysis (TGA) and Derivative Thermal analysis (DTA):**
Introduction and principle of thermogravimetric analysis and derivative thermal analysis, its instrumentation, applications, data interpretations, limitations.

**Differential Thermal Analysis (DTA):**
Introduction and principle of differential thermal analysis, its instrumentation, applications, data interpretations, limitations.

**Differential Scanning Calorimetry (DSC):**
Introduction and principle of differential scanning calorimetry, its instrumentation, applications, data interpretations, limitations.

**Differential Photo-Calorimetry (DPC):**
Introduction and principle of evolved gas analysis, its instrumentation, data interpretations, applications.

**Evolved Gas Analysis (EGA):**
Introduction and principle of evolved gas analysis, its instrumentation, data interpretations, applications.

**Thermo-mechanical Analysis (TMA):**
Introduction and principle of thermo-mechanical analysis, its instrumentation, applications, data interpretations, limitations.

**Dynamic Mechanical Analysis (DMA):**
Introduction and principle of dynamic mechanical analysis, its instrumentation, data interpretations, applications.

**Di-electric Thermal Analysis (DETA):**
Introduction and principle of di-electric thermal analysis, its instrumentation, data interpretations, applications.

**Reference Books:**
CHM-604        **Nuclear Analytical Techniques**          3(3-0)

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

Introduction to Nuclear sciences, Radioactive decay, Production of nuclear radiation, Interaction of radiation with matter, Radio-analytical techniques, Radiation detection and measurement instruments, Role of radiotracers in development of modern nuclear analytical techniques, Applications of radio-tracers in medical, environment, agriculture and industrial.

Reference Books:

CHM-608        **Food and Drug Chemistry**          3(3-0)

**CHM-608**        **Food and Drug Analysis**          3(3-0)

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

**Pharmaceuticals:**
Classification of drugs, test for analysis of different pharmaceuticals, introduction to US and British pharmacopeia.

**Forensics:**
History and scope of forensic Science, forensic ethics, forensic toxicology. Classification and analysis of narcotics & dangerous drugs, examination of crime scene evidences, fingerprinting, skeletal material to provide scientific opinion for legal.

Reference Books:
10. Yolanda Picó, Chemical Analysis of Food: Techniques and Applications

CHM-648 Standard Methods & Quality Assurance 3(3-0)

CHM- 648 Standard Methods and Quality Assurance 3(3– 0)

COURSE OBJECTIVES
The objectives of this course are to:
- Introduce students to the concept and benefits of quality assurance/quality control in the manufacturing industries
- Expose students to the process of conducting quality control of products in chemical and allied industries
- Expose students to the causes and effects of industrial and laboratory hazards and accidents
- Educate them on prevention and control of industrial and laboratory accidents

CONTENTS

Method development and validation: Selection of analytical methods for problem solving, Optimizing the experimental procedures, 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: Introduction and concept of quality control and quality assurance, Development of quality standards in industries, Quality control chart, Quality control in some industries, General safety practices, Good laboratory practices


Automation in analytical methods: Automatic, automated and smart instruments and their applications with special emphasis on clinical, industrial and quality control aspects

Books Recommended:

**CHM-606**  **Luminescence Spectroscopy**  **3(3-0)**

**Semester 8 (Session 2016-2020)**

**Specialization in Organic Chemistry**

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<td>CHM-610</td>
<td>Organic Polymers</td>
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<tr>
<td>CHM-612</td>
<td>Reactive Intermediates and Photochemistry</td>
</tr>
<tr>
<td>CHM-614</td>
<td>Disconnection Approach</td>
</tr>
<tr>
<td>CHM-616</td>
<td>Organic Catalyst and Protective Group</td>
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**CHM-610**  **Organic Polymers**  **3(3-0)**
CHM–610  Organic Polymers  3(3 – 0)

Recommended Books:

CHM-612  Reactive Intermediates and Photochemistry  3(3-0)

CHM–612  Reactive Intermediates and Photochemistry  3(3 –0)

Photochemistry:

Recommended Books:

CHM-614  Disconnection Approach  3(3-0)

CHM – 614  Disconnection Approach  3(3 – 0)

The Disconnection Approach

Recommended Books:


CHM – 616 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:

Semester 8 (Session 2016-2020)

Specialization in Inorganic Chemistry

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<tr>
<td>CHM-618</td>
<td>X-ray Spectroscopy</td>
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<td>CHM-620</td>
<td>Homogeneous Catalysis</td>
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<tr>
<td>CHM-622</td>
<td>Radio Nuclear Chemistry</td>
<td>3(3-0)</td>
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<tr>
<td>CHM-624</td>
<td>Magneto Chemistry</td>
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CHM-618 X-ray Spectroscopy 3(3-0)

CHM-618 X-ray Spectroscopy

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

Recommended Books:


CHM-620 Homogeneous Catalysis 3(3-0)

CHM-620 Homogeneous Catalysis

Reaction of CO and hydrogen Hydroformylation, reductive carbonylation, reduction of CO by hydrogen, synthesis of water gas and shift reactions. Carbonylation reaction, synthesis of methanol and methyl acetate, adipic ester, other carbonylation and
decarbonylation reactions. Catalytic addition of molecules to C-C multiple bonds. Homogeneous hydrogenation, and hydrocylation and hydrocyanation.

**Recommended Books:**


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**CHM-622 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:**


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**CHM-624 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:**


**Semester 8 (Session 2016-2020)**

**Specialization in Physical Chemistry**

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<td>CHM-638</td>
<td>Applications of Symmetry &amp; Group Theory</td>
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<tr>
<td>CHM-640</td>
<td>Quantum Mechanics</td>
<td>3(3-0)</td>
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<td>CHM-642</td>
<td>Nuclear and Radiation Chemistry</td>
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<tr>
<td>CHM-644</td>
<td>Electrochemical Aspects of Solutions</td>
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CHM-638  Applications of Symmetry & Group Theory  3(3-0)

CHM-638  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:**


CHM-640  Quantum Mechanics  3(3-0)

CHM-640  Quantum Mechanics  3(3-0)

**Statistical Mechanics**

**Quantum Chemistry**

Theoretical and Computational Chemistry

Recommended Books:

CHM-642 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

Radiation Chemistry

Recommended Books:
CHM-644  
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, Butler 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:
Instructions

*Please follow the scheme of studies of relevant prospectus strictly.

*The Outlines of Allied courses (i.e. English, Physics, Mathematics, Computer Sciences, Zoology, Botany) are at the end of this file.

*Course Code and Course Title should be carefully noted.

*Prospectus are available in soft form at university website.

*For any clash of scheme of studies in prospectus and outlines, please contact the Focal person (Department of Chemistry)

Dr. Matloob Ahmad

Matloob.Ahmad@gcuf.edu.pk
BS Chemistry

Session 2015-2019

Semester 1 (Session 2015-2019)

<table>
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<td>ENG-321</td>
<td>Functional English</td>
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<tr>
<td>PST-321</td>
<td>Pakistan Studies</td>
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<tr>
<td>MTH-321</td>
<td>Mathematics –I</td>
<td>3(3-0)</td>
</tr>
<tr>
<td>PHY-323</td>
<td>Applied Physics –I</td>
<td>4(3-1)</td>
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<tr>
<td>ZOL-301</td>
<td>Zoology-I</td>
<td>4(3–1)</td>
</tr>
<tr>
<td>BOT-301</td>
<td>Diversity of Plants</td>
<td>4(3–1)</td>
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Optional (Any two subjects): Math & Physics or Botany & Zoology

### CHM-301 Organic Chemistry – I 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 isomerism Optical activity, chirality and optical activity, racemisation and resolution of racemic mixture, R, S notation, disasteroisomers. 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-301 Practicals**
Sixteen experiments shall be conducted based on the following

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

b. **Qualitative Organic Analysis**
   - Systematic identification of organic compound (1 compounds)

c. **Preparation of Organic Compounds**
   - Preparation of simple organic compound like iodoform, aspirin, acetanilide etc (1 preparations)

**Books Recommended:**

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

Prepared by: Noor ul Qamar Qasmi, Head, Department of English
• 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:

References:
- Allama Iqbal Open University, Compulsory English I (Code 1423) (Islamabad: AIOU Press).
10. Regeneration of Muslim Society in sub-continent and causes of decline of Muslim Rule


12. Sir Syed Ahmed Khan and Aligarh Movement:
   i) Educational Services
   ii) Political Services
   iii) Rational Interpretation of Islam

4. All India Muslim League:
   i) Multiple approaches and causes of the formation of Muslim League.
   ii) Objectives of the party.
   iii) Comparison of the policies of All Indian National congress and All India Muslim League.
   iv) Politics of Muslim League after the creation of Pakistan

5. Lucknow Pact 1916, high water mark of Hindu-Muslim Unity.

6. Khilafat Movement:
   i) Khilafat as an institution.
   ii) Hindu-Muslim Unity.
   xii) Role of Gandhi
   xiii) Emergence of Muslim Ulma in Indian politics.
   xiv) Causes of the failure and impacts of the movement.

31. Iqbal’s Address at Allahabad 1930 and political thoughts of Ch. Rehmat Ali.

32. Congress Ministries.

33. Pakistan Resolution 1940.

34. Muhammad Ali Jinnah:
   i) Jinnah’s role in Indian politician.
   ii) As a governor General

35. Initial problems and constitutional development in Pakistan.

36. The study of constitutions of Pakistan (1956-1962-1973)
37. Political culture of Pakistan.

38. Foreign Policy of Pakistan:
   i) Major determinants and objectives
   ii) Overview.

**Recommended Books:**


**MTH-321 Mathematics – I**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hour</th>
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<tbody>
<tr>
<td>MTH-321</td>
<td>Mathematics – I</td>
<td>3(3-0)</td>
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</table>


**RECOMMENDED BOOKS:**

Vector, Properties of vectors, Position, Velocity and acceleration vectors, 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, Simple harmonic motion, 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,

9. To Study the damping features of an oscillation system using simple pendulum of variable mass.
10. To determine the value of ‘g’ be compound pendulum.
11. To determine the modulus of rigidity of a flat spiral spring.
12. To determine the modulus of rigidity of a wire by solid cylindrical rod.

Recommended Books:

12. Sears, Zemansky and Young, 2000, University Physics, 8th Ed, Addison-Wesley. Reading (MA) USA.
### Course Title

**PRINCIPLES OF ANIMAL LIFE – I**

### Course Code

ZOL-301

### Credit Hours

4(3–1)

### Theory

3

### Practical

1

### Follow up

BS

### Aims and Objectives

The course aims to impart knowledge and understanding of:

a. The concept and status of Zoology in life sciences.

b. The common processes of life through its chemistry, biochemical and molecular processes.

c. The structure and function of cell organellae and how common animal cell diversified in various tissues, organs and organ systems.

d. Biochemical mechanisms eventually generating energy for animal work.

e. Animals and their relationship with their environment.

### Learning Outcomes

### Syllabus in Brief

#### Course Contents

1. Place of Zoology in Science
   A one-world view: genetic unity, the fundamental unit of life, evolutionary oneness and the diversity of life, environment and world resources; what is Zoology? The classification of animals; the scientific method.

2. The Chemical Basis of Animal Life
   Atoms and elements: building blocks of all matter; compounds and molecules: aggregates of atoms; acids, bases, and buffers; the molecules of animals: fractional account of carbohydrates, lipids, proteins, nucleotides and nucleic acids based on their structural aspects.

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

4. Energy and Enzymes: Life’s Driving and Controlling Forces
   Energy and the laws of energy transformation; activation
energy; enzymes: structure, function and factors affecting their activity; cofactors and coenzymes; ATP: how cells convert energy? An overview.


7. Ecology II: Communities and Ecosystems Community structure and diversity; ecosystems; ecosystems of the earth; ecological problems; human population growth, pollution, resource depletion and biodiversity.

Practicals
1. Tests for different carbohydrates, proteins and lipids. 
   Note: Emphasis on the concept that tests materials have been ultimately obtained from living organisms and constituted their body.

2. Study of the prepared slides of epithelial tissue (squamous, cuboidal, columnar), connective tissue (adipose, cartilage, bone, blood), nervous tissue and muscle tissue (skeletal, smooth and cardiac).
   Note: Prepared microscopic and/or projection slides and/or CD ROM computer projections must be used.

3. Plasmolysis and deplasmolysis in blood.

4. Protein digestion by pepsin.

5. Ecological notes on animals of a few model habitats.

6. Field observation and report writing on animals in their ecosystem (a terrestrial and an aquatic ecosystem study).

Books Recommended


6. Miller, S.A. GENERAL ZOOLOGY LABORATORY
<table>
<thead>
<tr>
<th>Source</th>
<th>Details</th>
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<tbody>
<tr>
<td>BS (Hons) Chemistry Session 2015-19</td>
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<tr>
<td>7. Hickman, C.P. and Kats, H.L., LABORATORY STUDIES IN INTEGRATED</td>
<td></td>
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<tr>
<td>McGraw Hill, New York, USA.</td>
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<td>Education Ltd. UK.</td>
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</tbody>
</table>
Title of the Course: Bot-301 Diversity of Plants
Credit Hours: 4 (3+1)

Specific Objectives of course:
To introduce the students to the diversity of plants and their structures and significance.

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

a) Viruses (RNA and DNA types) with special reference to TMV;
b) Bacteria and Cyanobacteria (Nostoc, Anabaena, Oscillatoria) with specific reference to biofertilizers, pathogenicity and industrial importance;
c) Algae (Chlamydomonas, Spirogyra, Chara, Vaucheria, Pinnularia, Ectocarpus, Polysiphonia)
d) Fungi (Mucor, Penicillium, Phyllactinia, Ustilago, Puccinia, Agaricus), their implication on crop production and industrial applications.
e) Lichens (Physcia)
f) Bryophytes
   i. Riccia
   ii. Anthoceros
   iii. Funaria

g) Pteridophytes.
   i. Psilopsida (Psilotum)
   ii. Lycopsida (Selaginella)
   iii. Sphenopsida (Equisetum)
   iv. Pteropsida (Marsilea)

h) Gymnosperms
   i. Cycas
   ii. Pinus
   iii. Ephedra

i) Angiosperms
   i. Monocot (Poaceae)
   ii. Dicot (Solanaceae)

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

**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**

- **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-302 Practical***s

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 KmnO₄:**

4. **Quantitative analysis**
   - Determination of total hardness of water using EDTA.
   - Estimation of magnesium using EDTA.
   - Estimation of copper (iodometrically).
   - Determination 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 KMnO₄ solution.
• Determination of purity of commercial potassium oxalate using KMnO₄ solution
• Estimation of ferrous / ferric ions using K₂Cr₂O₇ solution.
• Percentage determination of barium in barium nitrate by gravimetric method.
• Gravimetric determination of nickel.

Books Recommended:
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

Prepared by: Noor ul Qamar Qasmi, Head, Department of English
• Expository
• Argumentative

II. 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
BA BSc (Compulsory, Elective, Optional)

كالجع اسلامیات (انزی) لیس اسٹیٹیک وہ گروائم

نصاب طالبین اسلامیات (انزی)

60 بحثیہ کے رنگ کے گروائم

نصاب بانگار

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(لاس کہ یہ معلومات سے سلب سمجھنے کے لیے)

اپنے انتظام کے کیا ہوں دفاعات ہیں کہ ایسے قسم کی بحثیہ جو اس فیلڈ میں کلاسیفیک ہوں جاتے ہیں۔

نصائحیات:

1. فلیٹر آن میں کیا ہو گیا?
2. طلب کے ذائقہ کیڑ اور ان کی کیا کہ ہے?
3. طلب کے ذائقہ اور ان کی کیا کہ ہے?
4. اسلام کی بحرانی اور ان کی کیا کہ ہے؟
5. اپنے انتظام کے کیا ہوں دفاعات ہیں کہ ایسے قسم کی بحثیہ جو اس فیلڈ میں کلاسیفیک ہوں جاتے ہیں۔

(اندی) تھامی فرنٹ آن (ترکیب گروائم)
لا يوجد نص يمكن قراءته بشكل طبيعي من الصورة المقدمة.
كان كنلهلا أن لا يدله إلا أنه وإن كنلهلا لمسك رضى الله صلى الله عليه وسلم وتعظيم الدعوة وذو الزيادة في الر(startTime: 0, endTime: 0)}

(واحد من خمس: عن عمرة، فيما أخذها عن أبيه أبى، سُجِّلُهُ عَلَىَّ عَلَىَّ بِهِ، وَهُوَ مَعَ عَنْهُ في عَلَىَّ عَلَىَّ بِهِ، وَهُوَ مَعَ عَنْهُ في عَلَىَّ عَلَىَّ بِهِ، وَهُوَ مَعَ عَنْهُ في عَلَىَّ عَلَىَّ بِهِ، وَهُوَ مَعَ عَنْهُ في عَلَىَّ عَلَىَّ بِهِ، وَهُوَ مَعَ عَنْهُ في عَلَىَّ عَلَىَّ بِهِ، وَهُوَ مَعَ عَنْهُ في عَلَىَّ عَلَىَّ بِهِ، وَهُوَ M
15. إنكم في خلق يوم عز لا يتفق عليه غير الله ورسوله فإن أخرج من أعلمه فقد أعطاه خير الدنيا والأزل فعلى ذلك ما خيراً.

(◐دواليد الروم: 1289)

16. ومن أبين هجرته ورحمة الله علية قال: يا رسول الله إني نزلت فيك أن لا شريك لك إلا الله أنت الوحيد الحامل من جميع الآثارات ولا أنت الحكيم من جميع الأفعال ولا أنت ذي القدر.

(مرجع القواعد، صفحة ١٤٣)

17. ومن أنصوم المؤمنين، قال: يا رسول الله إني نزلت فيك أن لا شريك لك إلا الله أنت الوحيد الحامل من جميع الآثارات ولا أنت الحكيم من جميع الأفعال ولا أنت ذي القدر.

(مرجع القواعد، صفحة ١٤٣)

18. ومن أنصوم المؤمنين، قال: يا رسول الله إني نزلت فيك أن لا شريك لك إلا الله أنت الوحيد الحامل من جميع الآثارات ولا أنت الحكيم من جميع الأعمال ولا أنت ذي القدر.

(مرجع القواعد، صفحة ١٤٣)

19. ومن أنصوم المؤمنين، قال: يا رسول الله إني نزلت فيك أن لا شريك لك إلا الله أنت الوحيد الحامل من جميع الآثارات ولا أنت الحكيم من جميع الأفعال ولا أنت ذي القدر.

(مرجع القواعد، صفحة ١٤٣)
ISL-322  Ethics (For Non-Muslim only)  2(2–0)
MTH-322  Mathematics-II  3(3-0)

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<thead>
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<td>MTH-322</td>
<td>Mathematics-II</td>
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RECOMMENDED BOOKS


PHY-324  Applied Physics-II  4(3-1)

PHY-324  Applied Physics-II  4(3-1)

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, Photon, Photoelectric effect, Compton effect

23. To study the behavior of RLC series circuit and determination of its resonance frequency.
24. To study the behavior of RLC Parallel circuit and determination of its resonance frequency.
25. Calibration of a voltmeter by a potentiometer.
27. To determine the high resistance by Neon flash lamp and a capacitor.
Recommended Books:

Sears, Zemansky and Young, 2000, University Physics, 8th Ed, Addison-Wesley. Reading (MA) USA.

<table>
<thead>
<tr>
<th>Course Title</th>
<th>PRINCIPLES OF ANIMAL LIFE – II</th>
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<tbody>
<tr>
<td>Course Code</td>
<td>ZOL-302</td>
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<tr>
<td>Credit Hours</td>
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<tr>
<td>Theory</td>
<td>3</td>
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<tr>
<td>Practical</td>
<td>1</td>
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<tr>
<td>Follow up</td>
<td>BS</td>
</tr>
<tr>
<td>Aims and Objectives</td>
<td>The course imparts knowledge and understanding of:</td>
</tr>
<tr>
<td></td>
<td>a. cell division and its significance in cell cycle.</td>
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<td></td>
<td>b. concepts and mechanisms of inheritance pattern, chromosome and gene linkage and molecular basics of genetics.</td>
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<td>c. animal behaviour and communication.</td>
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<td></td>
<td>d. theories of evolution, gene flow and mechanism of evolution with reference to animals and diversity.</td>
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<tr>
<td>Learning Outcomes</td>
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<tr>
<td>Syllabus in Brief</td>
<td>Course Contents</td>
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<tr>
<td></td>
<td>1. Cell Division</td>
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<td>Mitosis, cytokinesis, and the cell cycle: an overview; control of the cell cycle; meiosis: the basis of sexual reproduction; gamete formation.</td>
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<td>2. Inheritance Patterns</td>
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<td>The birth of modern genetics; Mendelian inheritance patterns; other inheritance patterns; environmental effects and gene expression.</td>
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<td>3. Chromosomes and Gene Linkage</td>
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<td>Eukaryotic chromosomes; linkage relationships; changes in chromosome number and structure.</td>
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<td>4. Molecular Genetics: Ultimate Cellular Control</td>
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<tr>
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<td>DNA: the genetic material; DNA replication in eukaryotes; genes in action; control of gene expression in eukaryotes; mutations; applications of genetic technologies; recombinant DNA.</td>
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</tbody>
</table>
5. Animal Behaviour
Four approaches to animal behaviour; proximate and ultimate causes; anthropomorphism; development of behavior; learning; control of behavior; communication; behavioral ecology; social behavior.

6. 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 evolution by natural selection; evolutionary thought after Darwin; biogeography.

7. Evolution and Gene Frequencies
The modern synthesis: a closer look; 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.

Books Recommended


Practicals

1. Study of mitosis in onion root tip.

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

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

3. Problem based study of Mendelian ratio in animals.

4. Multiple alleles study in blood groups.

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


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

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

9. Study to demonstrate social behaviour (documentary film be shown, honey bee, monkey group in a zoo).
Books Recommended

**BOT-302** Systematic, Anatomy and Development 4(3–1)

1st Year 2nd Semester

Title of the Course: **Bot-302 Plant Systematics, Anatomy and Development/Embryology**

Credit Hours: 4 (3+1)

Specific Objectives of course:
To understand: 1. various systems of classification, identification and nomenclature of Angiosperms, 2- Structures and functions of tissues and organs at embryonic level.

Course Outline:

a) **Plant systematics**
   1. Introduction to Plant Systematics: aims, objectives and importance.
   2. Classification: brief history of various systems of classification with emphasis on Takhtajan.
   4. Morphology: a detailed account of various morphological characters root, stem, leaf, inflorescence, flower, placentation and fruit types.
   5. Diagnostic characters, economic importance and distribution pattern of the following families:
      i. Ranunculaceae
ii. Brassicaceae (Cruciferae)
iii. Fabaceae (Leguminosae)
iv. Rosaceae
v. Euphorbiaceae
vi. Cucurbitaceae
vii. Lamiaceae (Labiatae)
viii. Apliceae (Umbelliferae)
ix. Asteraceae (Compositae)
x. Liliaceae (Sen. Lato)

b) Anatomy
1. Cell wall: structure and chemical composition
2. Concept, structure and function of various tissues like:
   i. Parenchyma
   ii. Collenchyma
   iii. Sclerenchyma
   iv. Phloem Epidermis (including stomata and trichomes)
   v. Xylem
3. Meristem: types, stem and root apices
4. Vascular cambium
5. Structure and development of root, stem and leaf. Primary and secondary growth of dicot stem, periderm
6. Characteristics of wood: diffuse porous and ring porous, sap and heart wood, soft and hard wood, annual rings.

c) Development/Embryology
1. Early development of plant body:
2. Capsella bursa-pastoris
3. Structure and development of Anther Microsporogenesis, Microgametophyte
4. Structure of Ovule Megasporogenesis Megagametophyte
5. Endosperm formation
6. Parthenocarpy
7. Polyembryony

Lab Outline:

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

Anatomy and Embryology
1. Study of stomata and epidermis.
2. Tissues of primary body of plant.
3. Study of xylem 3-dimensional plane of wood.
4. T. S of angiosperm stem and leaf.
5. Anatomy of germinating seeds
6. Study of pollens
Recommended Books:
### 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).
BS (Hons) Chemistry Session 2015-19

- Determination of heat of solution by solubility method.
- Determination of heat of neutralization of an acid with a base.

**Books Recommended:**
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 comprehension
   • 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
- Hargie, O. (ed.) *Hand book of Communications Skills*
Course Outline

- Introduction to Computers
- Different Input and Output devices (Specially modern devices)
- Software and its different types
- Operating System Concepts
- Services and functions of operating system
- Network and its types
- Network Topologies and its types
- Introduction to Internet
- Different Web terminologies (Http, Web Browsers, Ftp, Search Engines, WWW)
- Introduction to common web devices specially modems.
- Introduction to protocols and use of protocols in Web.
### MTH-423 | Mathematics –III | 4(4–0)

| The Laplace transform: | Laplace transforms and their properties. Initial-value problems. Delta or impulse function and Heaviside or step function. |

### RECOMMENDED BOOKS


### PHY-423 | Applied Physics-III | 4(3-1)

**PHY-423** | **Applied Physics – III** | 4(3-1)
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Thermal radiation and laws, quantization of energy, Photoelectric effect, the Compton effect, line spectra, wave behavior of particles. Testing de Broglie’s hypothesis, waves, wave packets and particles, Hersenberg’s uncertainty principle, wave function, Schrodinger equation, trapped particles and probability densities, the correspondence principle, dual nature of matter. The atomic structure of hydrogen. Bohar’s theory, angular momentum of electrons, electron spin, X-ray spectrum, LASERS. Discovering the nucleus, basic nuclear properties. Radioactive decay. Energy from the nucleus, nuclear fission. Nuclear fusion, Nuclear reactors. Electronics, the p-n junction, Bias the p-n junction diode, diode, characteristics of diode. Different models, and types of diodes, half-wave and full-wave rectifier, full-wave bridge rectifier. Filter circuits. Bipolar junction transistor (BJT), base bias, emitter bias, voltage-divider bias. Amplifier classification, common emitter amplifier common collector, the common base amplifier.

22. Variation of photo electric current with intensity of incident light.
23. Design a full-wave rectifier and study its output without and with a capacitor filter.
24. Design a Half-wave rectifier and study its output without and with a capacitor filter.
25. To study characteristics of NOT, AND, NOR, NOR, NAND and XOR and verify their truth table.
**Recommended Books:**

12. Sears, Zemansky and Young, 2000, University Physics, 8th Ed, Addison-Wesley. Reading (MA) USA.

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<thead>
<tr>
<th>Course Title</th>
<th>Zoology-III</th>
<th>4(3–1)</th>
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<tbody>
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<td>Course Code</td>
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<td>Credit Hours</td>
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<tr>
<td>Practical</td>
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<td>Follow up</td>
<td>Animal Diversity -1 (Vertebrates)</td>
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<td>Category</td>
<td>BS (Hons)</td>
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<tr>
<td>Aims and Objectives</td>
<td>The students will be able to make comparison from simple unicellular to complex multicellular organization along with phylogenetic relationship</td>
<td></td>
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<tr>
<td>Learning Outcomes</td>
<td>The students will be able to achieve the aims and objectives of the course</td>
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<tr>
<td>Syllabus in Brief</td>
<td>Theory</td>
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<tr>
<td></td>
<td>1. Introduction</td>
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<td>classification of organisms; evolutionary relationships and tree diagrams; patterns of organization.</td>
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<td>2. Animal-Like Protists: The Protzoa</td>
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<td></td>
<td>evolutionary perspective; life within a single plasma membrane; symbiotic life-styles. Protozoan taxonomy: (up to phyla, subphyla and super classes, wherever applicable). Pseudopodia and amoeboid locomotion; cilia and other pellicular structures; nutrition; genetic control and reproduction; symbiotic ciliates; further phylogenetic considerations.</td>
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<td>3. Multicellular and Tissue Levels of Organization</td>
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<td>evolutionary perspective: origins of multicellularity; animal origins. Phylum porifera: cell types, body wall, and skeletons; water currents and body forms; maintenance functions; reproduction. Phylum cnidaria (coelenterata) the body wall and nematocysts; alternation of generations; maintenance functions; reproduction and classification up to class. Phylum ctenophora; further phylogenetic considerations.</td>
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<td>4. Triploblastics and Acoelomate Body Plan</td>
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<td>evolutionary perspective; phylum platyhelminthes: classification up to class; the free-living flatworms and the tapeworms; phylum</td>
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</table>
5. Pseudocoelomate Body Plan: Aschelminths
Phylum gastrotricha; further phylogenetic considerations.

6. Molluscan Success
Phylum gastropoda; origin of the coelom; molluscan characteristics; classification up to class.
The characteristics of shell and associated structures, feeding, digestion, gas exchange, locomotion, reproduction and development, other maintenance functions and diversity in gastropods, bivalves and cephalopods; further phylogenetic considerations.

7. Annelida: The Metameric Body Form
Phylum annelida; relationship to other animals, metamerism and tagmatization; classification up to class. External structure and locomotion, feeding and the digestive system, gas exchange and circulation, nervous and sensory functions, excretion, regeneration, reproduction and development, in polychaeta, oligochaeta and hirudinea; further phylogenetic considerations.

8. Arthropods: Blueprint for Success
Phylum arthropoda; classification and relationships to other animals; metamerism and tagmatization; the exoskeleton; metamorphosis; classification up to class; further phylogenetic considerations.

9. Hexapods and Myriapods: Terrestrial Triumphs
Phylum hexapoda; classification up to class. External structure and locomotion, nutrition and the digestive system, gas exchange, circulation and temperature regulation, nervous and sensory functions, excretion, chemical regulation, reproduction and development in hexapoda; insect behavior; insects and humans; further phylogenetic considerations.

Practicals
2. Study of sponges and their various body forms (prepared slides).
3. Study of principal representative classes of phylum Cnidaria.
4. Study of principal representative classes of phylum Platyhelminthes.
5. Study of representative of phylum Rotifera, phylum nemertea; phylum gastrotricha; further phylogenetic considerations.
Nematoda.
7. Study of principal representative classes of phylum Annelida.
8. Study of principal representative classes of groups of phylum Arthropoda.
9. Brief notes on medical/economic importance of the following:
10. Preparation of permanent stained slides of the following:
    *Obelia*, *Daphnia*, Cestode, Parapodia of *Nereis*.

Reference Books
Title of the course: Bot-401 Cell Biology, Genetics and Evolution
Credit hours: 4 (3+1)

Specific objectives of course: To understand:
1. Structure and function of cell.
2. Nature of genetic material and hereditary process
3. Familiarization with evolutionary processes.

Course outline:

a) Cell Biology
1. Structure and Function of Bio-molecules
   i. Carbohydrates
   ii. Lipids
   iii. Proteins
   iv. Nucleic Acids

2. Cell: Cell theory, cell types (prokaryotes, eukaryotes), basic properties of cell.

3. Brief description of following cell organelles
   i. Cell wall
   ii. Cell membrane
   iii. Nucleus
   iv. Endoplasmic reticulum
   v. Plastids
   vi. Mitochondria
   vii. Ribosomes
   viii. Dictyosomes
   ix. Vacuoles

4. Reproduction in somatic and embryogenic cell, mitosis, melosis and cell cycle

b) Genetics
1. Introduction, scope and brief history of genetics. Mendelian inheritance; Laws of segregation and independent assortment, back cross, test cross, dominance and incomplete dominance.
2. Molecular genetics; DNA replication. Nature of gene, genetic code, transcription, translation, protein synthesis, regulation of gene expression (e.g. lac operon).

c) Evolution: Introduction and theories.
Lab Outline:

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

Genetics
1. Genetical problems related to transmission and distribution of genetic material.
2. Identification of chromosomes in plant material. Carmine/orcein staining.
3. Determination of blood groups

Recommended Books:
Semester 4 (Session 2015-2019)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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<tr>
<td>CHM-402</td>
<td>Chemistry (Special Topics)</td>
<td>4(3-1)</td>
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<tr>
<td>ENG-422</td>
<td>Technical writing</td>
<td>3(3-0)</td>
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<td>CSI-422</td>
<td>Computer Applications &amp; Web– II</td>
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<td>MTH-426</td>
<td>Mathematics-IV</td>
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<td>PHY-424</td>
<td>Applied Physics-IV</td>
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<td>ZOL-402</td>
<td>Zoology-IV</td>
<td>4(3-1)</td>
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<tr>
<td>BOT-402</td>
<td>Plant Physiology and Ecology</td>
<td>4(3–1)</td>
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Optional (Any two subjects): Math & Physics or Botany & Zoology

Semester 4

CHM-402 Chemistry (Special Topics) 4(3-1)

Surface Chemistry

Chemistry of Solutions
Ideal and non-ideal solutions, Raoult’s law and its applications, lowering of vapor pressure, elevation of boiling point, depression of freezing point, osmotic pressure, vapor pressure of non-ideal solutions and Henry’s law, abnormal colligative properties, degrees of association and dissociation of solutes, osmotic pressure and its measurement, fractional distillation and concept of azeotropic mixtures

Nanomaterials
Introduction to nanochemistry, Synthesis of nanoparticels, characterization and applications,

Introduction to Nuclear Chemistry
Natural and artificial radioactivity, Atomic nucleus, nuclides, nuclear stability, nuclear energetics, Nuclear models (shell + liquid drop model), fusion and fission, modes of decay, kinetics of nuclear reactions, nonspontaneous nuclear processes, nuclear reactors, beta decay systematic. Uses of radioisotopes in various fields. Nuclear hazards and safety measures.

Biomolecules
A brief introduction to the chemical nature of carbohydrates, proteins, lipids, nucleic acids and their importance in living systems.

CHM-402 Practical
More experiments should be included according to the facilities available to the facilities
available to the teaching institution.
Eight experiments in chromatography (TLC, column and paper) using cations, mixture of inks and organic compounds.
Determination of dipole moment of organic compounds.
Determination of specific and molar conductivities of strong weak electrolytes.

**Books Recommended:**

• Writing style and written language appropriate for report writing:
• Write a short report on any social or university issue.

40. **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

41. **Plagiarism and Citation:**

➢ What is plagiarism
➢ How to avoid plagiarism
➢ How to cite:

Different styles to cite

42. **How to do and write an academic research:**

Sources of research

Sections of an academic research paper

43. **Analysis and synthesis in Academic writing**

Compiled and prepared by: Ms. Fareeha Saleem

Approved and recommended by: Chairman of English Department

Dr. Mazhar Hayat
## 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.
Higher Order Differential Equations:

Initial and Boundary value problem, Existence of a unique solution, Homogeneous DEs, Linear Dependence and Independence, Wronskian and non-homogeneous Linear Differential Equation, Non-Homogenous Differential Equations with constant Coefficient, D & Inverse D⁻¹, Operators, General & Particular Integrals, Cauchy-Euler’s equations, Reduction of order, Method of Variation of Parameter’s, Exact Linear Equations, System of Linear Differential Equations, Power Series Solutions of first order Differential Equations, Laplace and Inverse Transformations with simple Application to Differential Equation.

RECOMMENDED BOOKS


Kinetic theory of the ideal gas; work done on an ideal gas, material energy of an ideal gas, intermolecular forces. Statistical mechanics, statistical distribution and mean values, distribution molecular speeds, distribution of energies, Brownian motion. Heat, different theories of heat, specific heat, gram molecular specific heat, laws of thermodynamics. Zeroth law, first law, second law, third law of thermodynamics, reversible and irreversible processes, indicator diagram, entropy, law of thermodynamics, reversible and irreversible processes, indicator diagram, entropy law of increase of entropy, temperature-entropy diagram. Maxwell’s thermodynamics relations, TDS equations, Clapeyron’s equation, entropy and second law of thermodynamics. Temperature scale, entropy, low temperature physics. Thermoelectricity, Seabeck effect, Peltier effect, thermocouple.

15. The determination of wavelength of light by Diffraction grating.
16. Design a full-wave rectifier and study its output without and with a capacitor filter.
17. Design a Half-wave rectifier and study its output without and with a capacitor filter.
18. To study characteristics of NOT, AND, NOR, NOR, NAND and XOR and verify their truth table.

Recommended Books:
Course Title Zoology-IV
Course Code ZOL-402
Credit Hours 4(3-1)
Theory 3 Practical 1
Follow up BS Category
Aims and Objectives The course deals with the: a. Basis of structure and functions of animal nutrition, digestion, homeostasis and temperature regulation. b. It introduces the basic concepts in reproduction and development in animal kingdom. c. Provides knowledge about the development of chordate body plan and fate of germinal layers. Learning Outcomes

Syllabus in Brief 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: gastrointestinal motility and its control, oral cavity, pharynx and esophagus, stomach, small intestine: main site of digestion; large intestine; role of the pancreas in digestion; and role of the liver and gallbladder in digestion.
2. Temperature and Body Fluid Regulation Homeostasis and Temperature Regulation; The Impact of Temperature on Animal Life; Heat Gains and Losses; Some Solutions to Temperature Fluctuations; Temperature Regulation in Invertebrates, Fishes, Amphibians, Reptiles, Birds and Mammals; Heat Production in Birds and Mammals; Control of Water and Solutes (Osmoregulation and Excretion); 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; the human male reproductive system: spermatogenesis, transport and hormonal control, reproductive function; the human female reproductive system: folliculogenesis, transport and hormonal control, reproductive function; hormonal regulation in gestation; prenatal development and birth: the placenta; milk production and lactation.

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, amphibian embryology, development in terrestrial environments, avian embryology, the fate of mesoderm.

**Books Recommended**

**Practicals**
1. Study of excretory system in an invertebrate and a vertebrate representative (Model).
2. Study of nutritive canal in an invertebrate and a vertebrate representative (Dissection).
3. Study of male reproductive system in an invertebrate and a vertebrate representative (Dissection).
4. Study of female reproductive system in an invertebrate and a vertebrate representative (Dissection).
5. Study of hormonal influence of a reproductive function (Model).
6. Study of preserved advanced stages of avian and mammalian development for amniotic membranes and placenta (Model).
7. Study of stages in the development of an Echinoderm.
8. Study of early stages in the development of a frog, chick and a mammal.
Note for 9-10: Prepared slides and preserved specimen and/or projection slides and/or CD ROM computer projections may be used.

**Books Recommended**


| BOT–402 | Plant Physiology and Ecology | 4(3–1) |
Title of the course: Bot-402 Plant Physiology and Ecology
Credit hours: 4 (3+1)

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

Course Outline:

a) Plant Physiology

b) Ecology
   1. Introduction, aims and applications of ecology.
   2. Soil: Physical and Chemical properties of soil (soil formation, texture. pH, EC, organism and organic matter etc) and their relationships to plants.
   5. Wind: Wind as an ecological factor and its importance.
7. Community Ecology
   i. Ecological characteristics of plant community
   ii. Methods of sampling vegetation (Quadrat and line intercept)
   iii. Major vegetation types of the local area.

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, molar 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
4. Field trips to ecologically diverse habitats.
5. Measurements of wind velocity.
7. Effect of light and temperature on seed germination.

Recommended Books:
# Semester 5 (Session 2015-2019)

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<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
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<tr>
<td>CHM-501</td>
<td>Inorganic Chemistry-II</td>
<td>4(3-1)</td>
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<tr>
<td>CHM-503</td>
<td>Organic Chemistry-II</td>
<td>4(3-1)</td>
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<tr>
<td>CHM-505</td>
<td>Physical Chemistry-II</td>
<td>4(3-1)</td>
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<tr>
<td>CHM-507</td>
<td>Analytical Chemistry-I</td>
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<td>BCH-509</td>
<td>Biochemistry-I</td>
<td>3(3-0)</td>
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<tr>
<td>MTH-525</td>
<td>Mathematics for Chemists</td>
<td>2(2-0)</td>
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</table>

Optional (Any one subject): Analytical Chemistry-I or Biochemistry-I

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**CHM-501 Inorganic Chemistry-II 4(3-1)**

1. **BONDING MODELS FOR NON TRANSITION 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**

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$^{+}$)
2. Preparation And Characterization Of Complex Compounds:
   (i) Sodium Cobaltinitrate (ii) Potassium trioxalato aluminate (iii) Ammonium Nickel 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:


CHM-503 Organic Chemistry-II 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, dissubstituted 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**  

**CHM-503**  
**Practicals**

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

**Mixture Analysis:** Analysis of two component mixture.

**Books Recommended:**


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**CHM-505**  
**Physical Chemistry II**  
4 (3-1)

**Kinetic Theory of Gases**


**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**


**CHM-505**  
**Practicals**

- Equilibrium constant of the \( \text{KI} + \text{I}_2 = \text{KI}_3 \) 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:


CHM-507 Analytical Chemistry-I 3(3-0)

Chemical Analysis and Data Handling
Accuracy of analytical processes such as sampling, weighing, volume measurements, precipitation, washing, filtration and ignition. Recent developments in the sampling techniques, statistical analysis; random and systematic errors, rounding off the data, arithmetic mean, median, mode, standard deviation, relative standard deviation, student t-test, F-test etc., quality control and quality assurance constructing and interpreting quality control plots. The use of computer in data handling.

Ionic Equilibria in Solutions

Separation Techniques
Solvent extraction Principle, factors affecting the extraction systems, Distribution Ia,
coefficient and ratio, multiple batch extraction, practical applications in chemical analysis.

Chromatographic methods
General theory of chromatography, classification of chromatographic methods, column, paper, thin-layer, and ion-exchange chromatography and their applications.

Books Recommended:


Introduction to biochemistry, scope of biochemistry, living systems, evolution and rise of living systems, important elements of living systems including carbon, nitrogen, phosphorus, hydrogen etc. foundations of biochemistry, the physical, cellular, chemical, genetic and evolutionary foundations of life, nature of organic matter, isomerism, general reactions of different functional groups, biologically important organic compounds, carbohydrates, proteins, lipids and nucleic acids

Books Recommended:

MTH-525  Mathematics for Chemists  2(2-0)


RECOMMENDED BOOKS

Semester 6 (Session 2015-2015)

<table>
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<tr>
<th>Course Code</th>
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<tr>
<td>CHM-502</td>
<td>Inorganic Chemistry-III</td>
<td>4(3-1)</td>
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<tr>
<td>CHM-504</td>
<td>Organic Chemistry-III</td>
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<tr>
<td>CHM-506</td>
<td>Physical Chemistry-III</td>
<td>4(3-1)</td>
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<td>CHM-508</td>
<td>Analytical Chemistry-II</td>
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<tr>
<td>BCH-510</td>
<td>Biochemistry-II</td>
<td>3(3-0)</td>
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<tr>
<td>CHM-512</td>
<td>Introductory Spectroscopy</td>
<td>2(2-0)</td>
</tr>
</tbody>
</table>

Optional (Any one subject): Analytical Chemistry-II or Biochemistry-II

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

Semester 6

CHM-502  Inorganic Chemistry-III  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 NH₃, HF, SO₂, BrF₃, CH₃COOH and HCN. Reactions in molten salt system.

2. Pi-Acceptor Ligands
   Class of ligands. Metal carboxyls, molecular structure, localized bonding (EAN rule, 18 electron rule). Delocalized bonding (Wades rule), spectroscopic evidence of bonding

3. **Kinetics and mechanism of inorganic reactions**

CHM-502 **Practicals**

1. **Estimation Of Anions (Any four)**
   - Chloride/Phosphate; Chloride/Nitrate; Bromide/Nitrate; Iodide/Nitrate; Borate/Acetate; Oxalate/Chloride; Sulphate/Phosphate

2. **KIO3 Titrations (Any two)**

3. **Gravimetric Estimations:**
   - Estimations of Ba$^{2+}$; Oxalate ions.

**Books Recommended:**


CHM-504 **Organic Chemistry-III** 4(3-1)

CHM-504 **Organic Chemistry-III** 4(3-1)

**Aliphatic nucleophilic substitution and Elimination reactions**
Aliphatic nucleophilic substitution reactions Mechanisms 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 Reactions Mechanisms 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 and substitution 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:**

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

**Symmetry Elements**

**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$_2$Cr$_2$O$_7$ 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:**

CHM-508        Analytical Chemistry II 3(3-0)

Properties of Light and its interaction with matter, relation between frequency, velocity and wave number, Lambert-Beer’s Law and its limitations, Single and double beam spectrophotometers, sources of light (lamp and lasers), monochromators, photomultiplier tubes, detectors, diode array and charged coupled devices, applications of UV-Vis spectrophotometer in natural product research, pharmaceutical industry, separation process, enzyme essay study, clinical studies, microbiology. Applications of IR, NMR and Mass spectrophotometer in research & development and quality control process.

Reference Books:

BCH-510        Biochemistry-II 3(3-0)

CHM-510        Biochemistry-II 3(3-0)

Physical aspects of Biochemistry

Digestion Absorption and Utilization:
Carbohydrates, Lipids proteins nucleic acids, vitamins, minerals.

Enzymes

Books Recommended:
CHM-512  
**Introductory Spectroscopy**  

2(2-0)

**Spectroscopy:**
Introduction to principle, instrumentation and application of Electronic (UV / Visible) Atomic (Emission / Absorption), Molecular (Infrared) and Nuclear Magnetic Spectroscopy.

**Recommended Books:**

English for Employment 7th Semester (BS), 3rd Semester (MSc.)

Contents:

44. Forms of Communication:
   • Verbal Communication
   • Non-Verbal Communication
   • Written Communication

45. Communication
   • Non-Verbal Communication
      ▪ What is Non-Verbal Communication
      ▪ Characteristics of Non-Verbal Communication
      ▪ Classification of Non-Verbal Communication
      ▪ Advantages of learning Non-Verbal Communication
      ▪ Guidelines to develop Non-Verbal Communication

46. Verbal Communication
   • Presentation Skills
      ▪ What is presentation?
      ▪ Qualities of a good presenter
      ▪ Essential characteristics of a good presentation
      ▪ Elements of a presentation
      ▪ Designing of your presentation
   • Interview Skills
      ▪ Preparation of an interview
      ▪ How to handle difficult questions
      ▪ Most common mistakes to avoid during an interview
      ▪ Tips of a successful interview
   • Telephonic Conversations
      ▪ How to enquire (job vacancy, scholarships, admissions)
How to respond to an enquiry

Effective use of Meta communication (Vocalization)

**Written Communication**

- Principles of effective writing
- Business writing - keys
- E-mail Writing
- Advantages of e-mail
- The most common complaints about e-mail in practice
- How to create electronic rapport
- Sample e-mail messages
- Writing subject lines
- Writing negative messages
- Writing positive messages
- Writing an enquiry e-mail
- Writing a response to an enquiry

**CV Writing**
- How to read a job advertisement
- Responding to Job advertisement
- To identify individual strengths and skills to write CV
- Writing an effective CV
- How to fill job application form
- How to write a Cover letter
- Report writing
- How to write a Research Proposal

**Employability Skills**
- Strategies to identify employment opportunities

- Business Etiquettes
- Etiquette in the Workplace
Etiquette in the Social settings

Workplace Ethics

Cultural Awareness

Intercultural sensitivities

Communicating effectively

Intercultural sensitivities across cultures

Positive thinking

Role of positive thinking in successful career

How to be positive in crucial situation

Recommended Readings:


Compiled by: Ms. Fareeha Saleem
Approved and recommended by: Chairman of English Department
Dr.Mazhar Hayat

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Specialization in Analytical Chemistry

Semester 7 (Session 2015-2019)

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<th>Semester 7</th>
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<td>CHM-601</td>
<td>Electroanalytical Techniques 3(3-0)</td>
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<tr>
<td>CHM-603</td>
<td>Advanced Separation techniques 3(3-0)</td>
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<tr>
<td>CHM-605</td>
<td>Atomic Spectroscopy 3(3-0)</td>
</tr>
<tr>
<td>CHM-607</td>
<td>Analytical Chemistry Practicals -I 2(2-0)</td>
</tr>
</tbody>
</table>
Introduction: Electrochemistry, Electrochemical cells, Standard cell potential, Indicator electrode, Reference electrodes, Classification of electro analytical methods, Bulk method, Interfacial methods, static methods, dynamic methods

Potentiometric method of analysis: Potentiometric measurements, Indicator electrodes, Metallic indicator electrode, Membrane indicator electrode, working of potentiometer and its application including pH measurements, ion selective electrode systems, ion exchange membrane electrode, solid state membrane electrodes and bio-membrane electrodes, potentiometric titrations.

Coulometry and Electrogravimetry: Basic electrochemistry, principle, instrumentation of coulometry, principle, instrumentation of electrogravimetry, consequences of electrogravimetry, Ohmic drop, activation over potential, concentration and gas polarization, basic difference and merits/demerits of coulometry and electrogravimetry.

Reference Books:

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

Chromatography: Classification of chromatographic techniques, chromatographic processes, rate theory of chromatography, Van-Deemter equation and its significance in evaluating column efficiency.

Gas Liquid Chromatography: General principle, sample preparation/derivatization, separation process and instrumental aspects and its applications.

High Performance Liquid Chromatography: General principle, sample preparation, separation process (normal phase and reverse phase separation), instrumentation, method development and applications.


Reference Books:
| CHM-605 | Atomic Spectroscopy | 3(3-0) |

**Atomic Absorption Spectrophotometry:**
principle of atomic absorption spectrophotometry, concentration dependence of absorption, quantitative methodology, instrumentation for atomic absorption spectrophotometry, radiation sources, atomizers, flames, graphite furnaces and electrochemical atomizers, wavelength selectors, detectors, handling background absorption, interferences in atomic absorption spectrophotometry, sample handling in atomic absorption spectrophotometry, preparation of the sample, use of organic solvents, microwave, digestion, sample introduction methods, applications of atomic absorption spectrophotometry.

**Atomic Emission Spectrophotometry:**
introduction, principle of atomic emission spectrometry, atomic emission spectrometry using plasma sources, plasma and its characteristics, inductively plasma, direct current plasma, microwave induced plasma, choice of argon as plasma gas, instrumentation for ICP-MS.

**Atomic Fluorescence Spectrometry:**
Origin of atomic fluorescence, atomic fluorescence spectrum, types of atomic fluorescence transitions, principle of atomic fluorescence spectrometry, fluorescence intensity and analyte concentration, instrumentation for atomic fluorescence spectrometry, applications of atomic absorption spectrophotometry, interferences, merits and limitations.

**Reference Books:**
Practicals
The experiments may be set making use of the following instruments depending upon their availability, special experiments may also be designed for which a specimen list of instruments is given below. For the innovative designing of experiments the Journal of Chemical Education may be consulted.

INSTRUMENTS
- UV/Visible spectrophotometers
- Flame photometers
- pH-meters
- Conductivity bridge
- Gas chromatography
- HPLC chromatography
- Electrogravimetric apparatus
- Atomic absorption spectrophotometer
- Infrared spectrophotometers

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 food 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 and 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 1 organic compounds.
Specialization in Inorganic chemistry

Semester 7 (Session 2015-2019)

<table>
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<tr>
<td>CHM-617</td>
<td>Main Group Organometallic and Organic Reagents</td>
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<tr>
<td>CHM-619</td>
<td>Spectroscopic Methods of Analysis</td>
<td>3(3-0)</td>
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<tr>
<td>CHM-621</td>
<td>Metal Cluster Compounds</td>
<td>3(3-0)</td>
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<tr>
<td>CHM-623</td>
<td>Inorganic Chemistry Practicals-I</td>
<td>2(2-0)</td>
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CHM-617 Main Group Organometallic and Organic Reagents 3(3-0)

Main Group Organometallic Reagents
Introduction, Preparation, classes of nucleophilic organometallic reagents organo-Li, S, Sc, Si, B, Sn, Sb and Zn in organic synthesis, control side reaction (Enolization vs. nucleophilic addition, substitution vs. elimination, selectively among functional groups 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:


CHM-619 Spectroscopic Methods of Analysis 3(3-0)

CHM-619 Spectroscopic Methods of Analysis 3(3-0)

**Recommended Books:**


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**CHM-621**  **Metal Cluster Compounds**  **3(3-0)**

**CHM-621**  **Metal Cluster 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, Polylefins, Allyl, Alkyne and Arene Complexes.

**Recommended Books**


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**CHM-623**  **Inorganic Chemistry Practicals-I**  **2(2-0)**
CHM-623   Inorganic Chemistry Practicals   2(0-2)

16. **Conductometry**
   - Titration of strong acid and weak acid with a strong base.
   - Precipitation titration involving AgNO₃ and KCl.

17. **Potentiometry**
   - Determination of K₁, K₂ and K₃ for H₃PO₄
   - Determination of chloride in the presence of iodide and evaluation of AgI and AgCl

18. **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.

19. **Use of some Organic Reagents for the estimation of various elements by gravimetric estimation.**
   - 8-Hydroxyquinoline Al (III) and Fe (III)
   - Salicylaldoxime: Ni (II) in the presence of Cu (II)
   - Anthranilic acid: Co (II) and Zn (II)

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

**Specialization in Organic chemistry**

**Semester 7 (Session 2015-2019)**

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<tr>
<td>CHM-625</td>
<td>Spectroscopic Organic Techniques</td>
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<tr>
<td>CHM-627</td>
<td>Rearrangements and Pericyclic Reactions</td>
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<tr>
<td>CHM-633</td>
<td>Pharmaceutical Chemistry</td>
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<tr>
<td>CHM-635</td>
<td>Organic Chemistry Practicals-I</td>
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**CHM-625**   Spectroscopic Organic Techniques   3(3 – 0)

(a) **Introduction**

(b) **Ultraviolet/Visible Spectroscopy:**
Introduction, Electronic transitions and absorption of electromagnetic radiations,

(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:

**CHM-627  Rearrangements and Pericyclic Reactions  3(3 – 0)**


**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. Suprafacial and Antanafacial addition woodward Hofman Rule. Frontier theory and mobius huckle theory for (2 + 2) and (2 + 4) thermal and photochemical cycloaddition reaction.

**Recommended Books:**


**CHM-633  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:**

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:

Specialization in Physical Chemistry

Semester 7 (Session 2015-2019)

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<td>CHM-637</td>
<td>Kinetics of Complex Reactions</td>
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<td>CHM-639</td>
<td>Thermodynamics and Spectroscopy</td>
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<td>CHM-641</td>
<td>Material Chemistry</td>
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<td>CHM-643</td>
<td>Physical Chemistry Practicals-I</td>
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CHM-637  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:

CHM-639  Thermodynamics and Spectroscopy 3(3-0)  3(3-0)

Molecular Spectroscopy
Electromagnetic radiations, interactions of electromagnetic radiations with matter, microwave, infrared and Raman spectroscopy, Nuclear magnetic resonance spectroscopy

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

Energy Balance and Thermodynamics
Thermodynamics terminology, material balance, energy balance, correlation of energy balances and thermodynamics, energy balances in open and closed system.

Recommended Books:


CHM-641  Material Chemistry 3(3-0)  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 rehology

**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:**

22. Robert J. Young, “ Introduction to polymers” Capmann and Hall, 1981, USA.

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<tr>
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<th>Advanced Physical Chemistry Practicals-I</th>
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<th>Physical Chemistry Practicals</th>
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**Note:** Any ten Experiments will be Conducted according to the Availability of Apparatus & Chemicals

43. Sugar analysis and inversion studies by polarimetry
44. Verify Beer’s Lambert’s Law for the given solution.
45. Investigate the kinetics of hydrolysis of ethyl acetate in the presence of hydrochloric acid at room temperature and determination of order of reaction.
46. Interpretation of IR and NMR spectra
47. Determination of molecular weight of given sample of polymer viscometrically
48. Thermal analysis of given polymer sample with the help of available established literature
49. Surface characteristics of given polymer sample with the help of available established literature
50. Waste water treatment using chemicals
51. Waste water treatment using advanced oxidation process
52. Study of isotherms and experiments of surface chemistry
53. Preparation of colloidal solution and determination of precipitation value of
54. Determination of apparent molar volume of different sample solutions
55. Calculation of partial molar volume by graphical method
56. Kinetic study of enzyme catalyzed reactions
Semester 8 (Session 2015-2019)

For All Specializations

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<tr>
<th>Code</th>
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<th>Credit Hours</th>
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<tr>
<td>STA-321</td>
<td>Introduction to Statistical Theory</td>
<td>3(3-0)</td>
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Course Title: Introduction to Statistical Theory
Credit Hours: 3(3-0)
Course Code: STA-595/321

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


14. Sher M. Chaudhry, Shahid Kamal, “Introduction to Statistical Theory I and II”.


BS (Hons) Chemistry Session 2015-19

Semester 8 (Session 2015-2019)
Specialization in Analytical Chemistry

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<td>CHM-602</td>
<td>Thermal Methods of Analysis</td>
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<td>CHM-604</td>
<td>Nuclear Analytical Techniques</td>
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<td>CHM-606</td>
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<tr>
<td>CHM-608</td>
<td>Food and Drug Chemistry</td>
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CHM-602 Thermal Methods of Analysis 3(3-0)

CHM-602 Thermal Methods of Analysis

Thermal Analysis:
Introduction, classification and principles of thermal analysis, thermograms, instrumentations, applications and limitations of thermal analysis.

Thermogravimetric Analysis (TGA) and Derivative Thermal analysis (DTA):
Introduction and principle of thermogravimetric analysis and derivative thermal analysis, its instrumentation, applications, data interpretations, limitations.

Differential Thermal Analysis (DTA):
Introduction and principle of differential thermal analysis, its instrumentation, applications, data interpretations, limitations.

Differential Scanning Calorimetry (DSC):
Introduction and principle of differential scanning calorimetry, its instrumentation, applications, data interpretations, limitations.

Differential Photo-Calorimetry (DPC):
Introduction and principle of evolved gas analysis, its instrumentation, data interpretations, applications.

Evolved Gas Analysis (EGA):
Introduction and principle of evolved gas analysis, its instrumentation, data interpretations, applications.

Thermo-mechanical Analysis (TMA):
Introduction and principle of thermo-mechanical analysis, its instrumentation, applications, data interpretations, limitations.

Dynamic Mechanical Analysis (DMA):
Introduction and principle of dynamic mechanical analysis, its instrumentation, data interpretations, applications.

Di-electric Thermal Analysis (DETA):
Introduction and principle of di-electric thermal analysis, its instrumentation, data interpretations, applications.
Reference Books:

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

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

Introduction to Nuclear sciences, Radioactive decay, Production of nuclear radiation, Interaction of radiation with matter, Radio-analytical techniques, Radiation detection and measurement instruments, Role of radiotracers in development of modern nuclear analytical techniques, Applications of radio-tracers in medical, environment, agriculture and industrial.

Reference Books:
Introduction to food analysis, food gradients and nutritional values, sampling of food, general methods of analysis. Analysis of milk, butter, wheat flour, meat, beverages, tea, coca, honey and soft drinks.

**Pharmaceuticals:**
Classification of drugs, test for analysis of different pharmaceuticals, introduction to US and British pharmacopeia.

**Forensics:**
History and scope of forensic Science, forensic ethics, forensic toxicology. Classification and analysis of narcotics & dangerous drugs, examination of crime scene evidences, fingerprinting, skeletal material to provide scientific opinion for legal.

**Reference Books:**

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**COURSE OBJECTIVES**
The objectives of this course are to:
- Introduce students to the concept and benefits of quality assurance/quality control in the manufacturing industries
- Expose students to the process of conducting quality control of products in chemical and allied industries
- Expose students to the causes and effects of industrial and laboratory hazards and accidents
- Educate them on prevention and control of industrial and laboratory accidents

**CONTENTS**
**Method development and validation:** Selection of analytical methods for problem solving, Optimizing the experimental procedures, 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: Introduction and concept of quality control and quality assurance, Development of quality standards in industries, Quality control chart, Quality control in some industries, General safety practices, Good laboratory practices


Automation in analytical methods: Automatic, automated and smart instruments and their applications with special emphasis on clinical, industrial and quality control aspects

Books Recommended:


<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHM-606</td>
<td>Luminescence Spectroscopy</td>
<td>3(3-0)</td>
</tr>
</tbody>
</table>

Semester 8 (Session 2015-2015)

Specialization in Organic Chemistry

<table>
<thead>
<tr>
<th>Semester 8</th>
<th>As per prospectus 2015 (available on GCUF website)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHM-629</td>
<td>Seminar (Research)</td>
</tr>
<tr>
<td>STA-321</td>
<td>Introduction to Statistical Theory</td>
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<tr>
<td>CHM-610</td>
<td>Organic Polymers</td>
</tr>
<tr>
<td>CHM-612</td>
<td>Reactive Intermediates and Photochemistry</td>
</tr>
</tbody>
</table>

Recommended Books:


Photochemistry:

Recommended Books:

CHM – 614  Disconnection Approach  3(3 – 0)

The Disconnection Approach


Recommended Books:


CHM-616  Organic Catalyst and Protective Group  3(3-0)

CHM – 616  Organic Catalyst and Catalysis  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.

Recommended Books:

Semester 8 (Session 2015-2019)

Specialization in Inorganic Chemistry

<table>
<thead>
<tr>
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<th>Credit Hours</th>
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<tbody>
<tr>
<td>STA-321</td>
<td>Introduction to Statistical Theory</td>
<td>3(3-0)</td>
</tr>
<tr>
<td>CHM-618</td>
<td>X-ray Spectroscopy</td>
<td>3(3-0)</td>
</tr>
<tr>
<td>CHM-620</td>
<td>Homogeneous Catalysis</td>
<td>3(3-0)</td>
</tr>
<tr>
<td>CHM-622</td>
<td>Radio Nuclear Chemistry</td>
<td>3(3-0)</td>
</tr>
<tr>
<td>CHM-624</td>
<td>Magneto Chemistry</td>
<td>3(3-0)</td>
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</tbody>
</table>

CHM-618  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 diffractometer, identification and applications.

Recommended Books:


CHM-620  Homogeneous Catalysis  3(3-0)
**CHM-620**  
**Homogenous Catalysis**  
3(3-0)  
Reaction of CO and hydrogen
Hydroformylation, reductive carbonylation, reduction of
CO by hydrogen, synthesis of water gas and shift reactions. Carbonylation
reaction
Synthesis of methanol and methyl acetate, adipic ester, other carbonylation and
decarbonylation reactions. Catalytic addition of molecules to C-C multiple
bonds
Homogeneous hydrogenation, and hydrocycylation and hydrocyanation.

**Recommended Books:**

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-
   (2008).

**CHM-622**  
**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).

**CHM-624**  
**Magneto Chemistry**  
3(3-0)

**Recommended Books:**

Semester 8 (Session 2015-2019)

Specialization in Physical Chemistry

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<tr>
<td>STA-321</td>
<td>Introduction to Statistical Theory</td>
<td>3(3-0)</td>
</tr>
<tr>
<td>CHM-638</td>
<td>Applications of Symmetry &amp; Group Theory</td>
<td>3(3-0)</td>
</tr>
<tr>
<td>CHM-640</td>
<td>Quantum Mechanics</td>
<td>3(3-0)</td>
</tr>
<tr>
<td>CHM-642</td>
<td>Nuclear and Radiation Chemistry</td>
<td>3(3-0)</td>
</tr>
<tr>
<td>CHM-644</td>
<td>Electrochemical Aspects of Solutions</td>
<td>3(3-0)</td>
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</tbody>
</table>

CHM-638 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:


<table>
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<tr>
<th>CHM-640</th>
<th>Quantum Mechanics</th>
<th>3(3-0)</th>
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**Quantum Mechanics**

**Statistical Mechanics**

**Theoretical and Computational Chemistry**

**Recommended Books:**

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<th>CHM-642</th>
<th>Nuclear and Radiation Chemistry</th>
<th>3(3-0)</th>
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**Nuclear and Radiation 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

**Radiation Chemistry**

**Recommended Books:**


**CHM-644**  **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, Butler Volmer equation, cyclic voltammetry 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:**