SCHEME OF STUDIES & CURRICULUM
FOR
Associate Degree in Chemistry
(For Affiliated Colleges)
(Fall 2023)

INSTITUTE OF CHEMISTRY
UNIVERSITY OF SARGODHA
SARGODHA

Eligibility Requirements:

Duration	Minimum -2Years (4-Semesters), Maximum 4-Years (8-Semesters)
Admission Requirements:	1. Students with Pre-Medical / Pre-Engineering combinations in HSSC / A-level with Chemistry as an elective subject after 12-years of education. 2. Students with Pre-Medical / Pre-Engineering combinations in HSSC with Chemistry as an elective subject who have passed intermediate Part-I and awaiting Part-II result

Semester-I

Category	Course Code	Course Title	Credit Hours	Pre-Requisite
GE-1	URCG-5118	Functional English	3(3-0)	Nil
GE-2	URCG-5105 URCG-5126	Islamic Studies (OR) Religious Education/Ethics	2(2-0)	Nil
GE-3	URCG-5123	Applications of Information and Communication Technologies (ICT)	3(2-1)	Nil
Major-1	CHEM-5101	Inorganic Chemistry	4(3-1)	Nil
Major-2	CHEM-5102	Basic Mathematics for Chemists (*For Pre-Medical HSSC students only*)	2(2-0)	Nil
Major-3	CHEM-5103	Biochemistry	4(3-1)	Nil

Semester Total Credit Hours with Pre-Engineering Group: 16
Semester Total Credit Hours with Pre-Medical Group: 18

Semester-II

Category	Course Code	Course Title	Credit Hours	Pre-Requisite
GE-4	URCG-5112	Fables, Wisdom and EPICS	2(2-0)	Nil
GE-5	URCG-5116	Science of Society-I	2(2-0)	Nil
GE-6	URCG-5120	Exploring Quantitative Skills	3(3-0)	Nil
GE-7	URCG-5127	Seerat of the Holy Prophet (SAW) *	1(1-0)	Nil
GE-8	URCG-5111	Translation of Holy Quran *	NC	Nil
Major-4	CHEM-5104	Organic Chemistry	4(3-1)	Nil
Major-5	CHEM-5105	Analytical Chemistry	4(3-1)	Nil

Semester Total Credit Hours with Pre-Engineering and Pre-Medical Groups: 16

* For Muslim students only

Semester-III

Category	Course Code	Course Title	Credit Hours	Pre-Requisite
GE-9	URCG-5119	Expository Writing	3(3-0)	Nil
GE-10	URCG-5121	Tools for Quantitative Reasoning	3(3-0)	Nil
GE-11	URCG-5122	Ideology and Constitution of Pakistan	2(2-0)	Nil
Major-6	CHEM-5106	Physical Chemistry	4(3-1)	CHEM-5102
Major-7	CHEM-5107	Basic Statistics for Chemists	2(2-0)	Nil
Major-8	CHEM-5108	Laboratory Safety Measures	2(2-0)	Nil

Semester Total Credit Hours with Pre-Engineering and Pre-Medical Groups: 16

Semester-IV

Category	Course Code	Course Title	Credit Hours	Pre-Requisite
GE-12	URCG-5115	The Science of Global Challenges	3(2-1)	Nil
GE-13	URCG-5124	Entrepreneurship	2(2-0)	Nil
GE-14	URCG-5125	Civics and Community Engagement	2(2-0)	Nil
GE-8	URCG-5111	Translation of Holy Quran *	NC	Nil
Major-9	CHEM-5109	Chemistry Special Topics	4(3-1)	Nil
Interdisciplinary	ZOOL-5101 / PHYS-5101	Animal Diversity-I (Invertebrates) /Mechanics	4(3-1) / 3(3-0)	Nil

Semester Total Credit Hours with Pre-Engineering Group: 14

Semester Total Credit Hours with Pre-Medical Group: 15

* For Muslim students only

Degree Program Total with Pre-Engineering Group: 62

Degree Program Total with Pre-Medical Group: 65

SEMESTER-I

URCE-5118 Functional English 3 (3+0)

The course aims at providing understanding of a writer's goal of writing (i.e. clear, organized and effective content and to use that understanding and awareness for academic reading and writing. The objectives of the course are to make the students acquire and master the grammatical academic writing skills. The course would enable the students to develop argumentative writing techniques. The students would be able to logically add specific details on the topics such as facts, examples and statistical or numerical values. The course will also provide insight to convey the knowledge and ideas in an objective and persuasive manner. Furthermore, the course will also enhance the students' understanding of ethical considerations in writing academic assignments and topics including citation, plagiarism, formatting and referencing the sources as well as the technical aspects involved in referencing.

Contents:

1. Developing Analytical Skills
2. Transitional devices (word, phrase and expressions)
3. Development of ideas in writing
4. Reading Comprehension
5. Precis Writing
6. Developing argument
7. Sentence structure: Accuracy, variation, appropriateness, and conciseness
8. Appropriate use of active and passive voice
9. Organization and Structure of a Paragraph
10. Organization and structure of Essay
11. Types of Essays

Recommended Texts:

1. Bailey, S. (2011). Academic writing: A handbook for international students (3rd ed.). New York: Routledge.
2. Eastwood, J. (2011). A Basic English grammar. Oxford: Oxford University Press.
3. Swales, J. M., & Feak, C. B. (2012). *Academic writing for graduate students: Essential tasks and skills* (3rd ed.). Ann Arbor: The University of Michigan Press.
4. Swan, M. (2018). *Practical English usage* (8th ed.). Oxford: Oxford University Press.

Suggested Readings

1. Biber, D., Johansson, S., Leech, G., Conrad, S., Finegan, E., & Quirk, R. (1999). *Longman grammar of spoken and written English*. Harlow Essex: MIT Press.
2. Cresswell, G. (2004). *Writing for academic success*. London: SAGE.
3. Johnson-Sheehan, R. (2019). *Writing today*. Don Mills: Pearson.
4. Silvia, P. J. (2019). *How to write a lot: A practical guide to productive academic writing*. Washington: American Psychological Association

Thomson, A. J., & Martinet, A. V. (1986). *A Practical English Grammar*. Oxford: Oxford University Press.

URCI-5105 **Islamic Studies (Compulsory)** **2 (2+0)**

Islamic Studies engages in the study of Islam as a textual tradition inscribed in the fundamental sources of Islam; Qur'an and Hadith, history and particular cultural contexts. The area seeks to provide an introduction to and a specialization in Islam through a large variety of expressions (literary, poetic, social, and political) and through a variety of methods (literary criticism, hermeneutics, history, sociology, and anthropology). It offers opportunities to get fully introductory foundational bases of Islam in fields that include Qur'anic studies, Hadith and Seerah of Prophet Muhammad (PBUH), Islamic philosophy, and Islamic law, culture and theology through the textual study of Qir'an and Sunnah..

- To make students understand the relevance and pragmatic significance of Islam in their lives.
- To make learners comprehend the true spirit of Islam with reference to modern world.
- To generate a sense of Islamic principles as a code of living that guarantee the effective solutions to the current challenges of being.
- To provide Basic information about Islamic Studies
- To enhance understanding of the students regarding Islamic Civilization
- To improve Students skill to perform prayers and other worships
- To enhance the skill of the students for understanding of issues related to faith and religious life.

Contents:

Introduction to Qur'anic Studies

1. Basic Concepts of Qur'an
2. History of Quran
3. Uloom-ul-Quran

مطالعہ قرآن (تعارف قرآن ، منتخب آیات کا ترجمہ و تفسیر: سورۃ البقرہ آیات 1-5، 482-482؛ سورۃ الحجرات آیات 1-18؛
،سورۃ الفرقان آیات 26-77؛ سورۃ المومنون آیات 1-11؛ ،سورۃ االحزاب آیات 2، 41، 64- 66؛ ،24،
52- 55؛ سورۃ االنعام آیات
151-156؛، سورۃ الصف آیات 1- 12؛ الحشر آیات 18- 44؛ آل عمران آیات 154- 154؛ النحل آیات
14-12؛ لقمن
آیت 44، حم السجدہ آیت 65)

Introduction to Sunnah

1. Introduction of Hadith
2. Legal Status of Hadith
3. History of the compilation of Hadith 4. Kinds of Hadith

حدیث کا تعارف ،حدیث کی دینی حیثیت، حفاظت و
تدوین حدیث، حدیث کی اقسام متن، حدیث: 1درج
ذیل موضوعات پر احادیث کا مطالعہ
1- اعمال کا اجر نیت پر منحصر ہے۔ 4- بہترین انسان قرآن کا طالب علم اور اس کا معلم ہے-6کتا ب
وسنت گمراہی سے بچنے کا ذریعہ ہیں2- ارکان اسالم 5- اسالم ، ایمان ، احسان اور قیامت کی نشانیاں
،2-بچوں کی نماز کی تلقین 7- دین کا گہرا فہم ہلال کی خاص عنایت ہے 8- حصول علم، تالو ت قرآن اور
عمل کی اہمیت و فضیلت ،5 ۔روز محشرکا محاسبہ ،14- حقوق ہلال کے
ساتھ ساتھ حقوق العباد کا لحاظ رکھنا بھی الزم ہے11- حسن خلق کی عظمت اور فحش و بد گوئی کی مذمت 14- دنیا و آخژت
کی بھالئی

کی ضامن چار چیزیں ،16- ہالک کر دینے والی سات چیزیں،12- بے عمل مبلغ کا عبرت ناک انجام 15- ہر

ش

خص نگران ہے اور ہر شخص مسئول

1. Sirah of the Prohet
2. Importance of the Study of Sirah
3. Character building method of the Prophet

) سیرت النبیﷺ(مطالعہ سیرت کی ضرورت و اہمیت ، تعمیر،سیرت و شخصیت کا نبوی منہاج اور عملی نمونے ، اقامت دین کا نبوی طریق کار، اقامت دین بعہدِ خالفت راشدہ، میثاق مدینہ ، خطبہ حجۃ الوداع، اخالقی تعلیمات ، تشکیل اجتماعیت اور

ت نبوی ﷺ کے مقاصد و حکمتیں

Islamic Culture & Civilization

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

2. اسالمی تہذیب و تمدن (اسالمی تہذیب کا مفہوم، اسالمی کے عوامل و عناصر، اسالمی تہذیب کی خصوصیات، ، اسالمی تہذیب ، علمی ، معاشرتی اور سماجی اثرات ، تہذیبوں کے تصادم کے نظریے کا تنقیدی جائزہ، تہذیبی تصادم کے اثرات و

نتائج، طبعی ، حیاتیاتی اور معاشرتی علوم میں مسلمانوں کا کردار، نام ور مسلمان سائنسدان) سوہ حسنہ ،قرآن مجید میں سیرت سرور عالم کا

بیان، غزوا

Recommended Texts:

1. Hameed ullah Muhammad, ―Emergence of Islam‖ , IRI, Islamabad
2. Hameed ullah Muhammad, ―Muslim Conduct of State
3. Hameed ullah Muhammad, _Introduction to Islam
4. Ahmad Hasan, ―Principles of Islamic Jurisprudence‖ Islamic Research, Institute, International Islamic University, Islamabad (1993)

Suggested Readings:

1. Dr. Muhammad Zia-ul-Haq, ―Introduction to Al Sharia Al Islamia‖ Allama Iqbal Open University, Islamabad (2001)
2. Dr. MuhammadShahbaz Manj, Teleeemat-e- Islam

UQCE-5126 **Ethics** **2(2-0)**

Contents:

1. Meaning and Scope of Ethics.
2. Relation of Ethics with:
    (a) Religion
    (b) Science
    (c) Law
3. Historical Development of
    Morality: (a). Instinctive
    Moral Life.
    (b). Customary Morality.
    (c). Reflective Morality.
4. Moral Theories:
    (a). Hedonism (Mill)
    (b). Intuitionism (Butler)
    (c). Kant's Moral Theory.
5. Moral Ethics and Society.
    (a). Freedom and Responsibility.
    (b). Tolerance
    (c). Justice
    (d). Punishment (Theories of Punishment)
6. Moral Teachings of Major
    Religions: a). Judaism
    b). Christianity
    c). Islam
7. Professional Ethics:
    a). Medical Ethics
    b). Ethics of Students
    c). Ethics of Teachers
    d). Business Ethics

Reference Books:

1. William Lille. An Introduction to Ethics., London Methuen & Co. latest edition.
2. Titus, H.H. Ethics for Today. New York: American Book, latest edition.
3. Hill, Thomas. Ethics in Theory and Practice. N.Y. Thomas Y. Crowel, latest edition
4. Ameer Ali, S. The Ethics of Islam. Culcutta: Noor Library Publishers, latest edition
Donaldson, D.M. Studies in Muslim Ethics. London: latest edition. 6. Sayeed, S.M.A.(Tr.) Ta'aruf-e-Akhlaqiat. Karachi: BCC&T, Karachi University

URCI-5123 Applications of Information and Communication Technologies (ICT) 3 (2+1)

The course introduces students to information and communication technologies and their application in the workplace. Objectives include basic understanding of computer software, hardware, and associated technologies. How computers can be used in the workplace, how communications systems can help boost productivity, and how the Internet technologies can influence the workplace. Students will get basic understanding of computer software, hardware, and associated technologies. They will also learn how computers are used in the workplace, how communications systems can help to boost productivity, and how the Internet technologies can influence the workplace.

Contents:

1. Introduction, Overview of Information Technology.
2. Hardware: Computer Systems & Components, Storage Devices.
3. Software: Operating Systems, Programming and Application Software.
4. Databases and Information Systems Networks.
5. File Processing Versus Database Management Systems.
6. Data Communication and Networks.
7. Physical Transmission Media & Wireless Transmission Media.
8. Applications of smart phone and usage.
9. The Internet, Browsers and Search Engines.
10. Websites and their types.
11. Email Collaborative Computing and Social Networking.
12. E-Commerce.
13. IT Security and other issues.
14. Cyber Laws and Ethics of using Social media.
15. Use of Microsoft Office tools (Word, Power Point, Excel) or other similar tools depending on the operating system.
16. Other IT tools/software specific to field of study of the students if any.

Recommended Book

1. Discovering Computers 2022: Digital Technology, Data and Devices by Misty E. Vermaat, Susan L. sebok; 17th edition.

Suggested Books

1. Computing Essentials 2021 by Timothy J. O'Leary and Linda I. O'Leary, McGraw Hill Higher Education; 26th edition.
2. Computers: Understanding Technology by Fuller, Floyd; Larson, Brian: edition 2018.

CHEM-5101 Inorganic Chemistry 4 (3+1)

This course covers a range of general topics of inorganic chemistry. It will provide a useful supplement to the advanced courses specified in the department. This course aims to enable the students to achieve the advance knowledge about the key introductory concepts of chemical bonding, acid-base chemistry, and properties of the representative and transition elements, as well as using this knowledge for qualitative and quantitative analysis of inorganic compounds during laboratory work. Learning objectives emphasized in CHEM-5102 involve developing an understanding of basic principles of inorganic chemistry. It develops critical thinking skills enabling students to solve chemistry problems that incorporate their cumulative knowledge. Students learned in class to modern chemistry techniques which give them opportunities to upgrade their knowledge about advanced inorganic concepts. The essence of this course is to develop study skills that students need to succeed in university-level chemistry courses and preparation of students for professional positions in chemistry.

Contents:

1. Periodic Table and Periodicity of Properties: Modern Periodic Table, Group trends and periodic properties, Atomic and ionic radii, ionization potentials, electron affinities and electronegativities; Redox potential, electrochemical series and its applications. Corrosion and electroplating.
2. Acid Base Equilibria: Acids and bases, relative strengths of acids, pH, pKa, pKb. Hard and soft acid and Bases. SHAB Principle and its application. Buffers, types of buffer, Preparation, Buffer capacity and applications of buffers. Indicators: (Acid-base, Redox, Adsorption), Solubility product, Common ion effect and its applications.
3. Chemical Bonding: Nature of a bond, hybridization, Valence Bond Theory (VBT), The Concept of Resonance, Molecular Orbital Theory (MOT), Valence Shell Electron Pair Repulsion (VSEPR) theory. Special types of bonds such as Metallic bonds, Hydrogen Bonding, Bent bond, Ion-dipole-dipole bond, ion induced-dipole bond.
4. Chemistry of p-Block Elements: Chemistry of the following compounds: Boranes and Boride; aluminium halides, hydrides and Alums; Silicates (Structural aspects, classifications and applications); silicones (Structural aspects, classifications and applications), phosphazenes, Oxoacids of Phosphorous; Oxoacids and salts of sulphur; Noble gases (compounds of Xe, Kr, Ra; bonding and applications). Production of pure silicon chips for solar energy cells.
5. Chemistry of d-Block Elements: Electronic configuration. Characteristics. Nomenclature. Nature of bonding in coordination compounds: Werner's theory, VBT, MOT and CFT for coordination compounds. Isomerism in coordination compounds. Chelates: Classification and applications. Applications of coordination compounds (Medicinal, Industrial, Agricultural).
6. Chemical Industries: Metallurgy of Al, Cr and U, fertilizers (Urea and Phosphate fertilizers) Cement and Sugar.

Inorganic Chemistry Lab:

1. Qualitative Analysis; four radicals (cations and anions) for salt mixture.
2. Chromatographic separation of cations
3. Determination of total hardness of water using EDTA.
4. Estimation of manganese (II) using EDTA.
5. Estimation of copper (iodometrically).
6. Determination of thiosulphate ion (lodometrically).
7. Determination of ferricyanide using KI solution.
8. Determination of chloride by Volhard's and Mohr's methods
9. Estimation of chloride ions using adsorption (Fluorescein) indicator.
10. Estimation of bromide ions using adsorption (Eosin) indicator.
11. Estimation of percentage of ferrous ions in the Mohr's salt using $KMnO_4$.
12. Percentage determination of ferric ions in ferric alum using $KMnO_4$ solution.
13. Determination of purity of commercial potassium oxalate using $KMnO_4$ solution.
14. Estimation of ferrous ions using $K_2Cr_2O_7$ solution.

Recommended Texts:

1. Shaheen, M.A. Concise Inorganic Chemistry (2021). *Jilani Notes, Sargodha,* Lahore
2. Lee, J. D. (1996). *Concise inorganic chemistry*. (5th ed.). UK: Chapman and Hall
3. Vogel, A. I. (1995). *A text book of macro and semi micro qualitative inorganic analysis.* New York: Longman Green and Co.
4. Shaheen, M.A. (2022) Jilani Manual of Practical Chemistry Vol. IV, Jilani Notes, Sargodha
5. Skoog, D. A., West, D.M., & Holler, F. J. (1994). *Analytical chemistry* (6th ed.). UK: Saunders College Publications.

Suggested Readings:

1. Graham, H., & Man, H. (2000). *Chemistry in context* (5th ed.). UK: Thomas Nelson Ltd.
2. Philp, M. (1996). *Advance chemistry*. UK: Cambridge Publishing.
3. David, H. (2000). *Modern analytical chemistry*. New York: McGraw Hil.

CHEM-5102 Basic Mathematics for Chemist 2(2+0)

This course introduces students with basic mathematics that is used in chemistry. This is the fundamental course of serving as the foundation of mathematics for its use in chemistry and chemical calculation during the lab experiments and research. The course , equally, emphasizes basic concepts and skills needed for mathematical manipulation. It focus on the study of functions of a logarithmic and exponential functions, single variables, differential equations and their use in chemical problems, and use of Integration, Determinants and Matrices. Applications of differential equations include computations involving velocity and acceleration, the slope of a curve, and optimization. Student are also expected to learn solutions of linear equations (simple, determinant and matrices methods), operator theory, differentiation, integration and matrices. This course will also provide applications of eigen value problem and curve fitting in chemistry. Upon successful completion of course students will be able to derive basic mathematics equations use in chemistry and apply them to seek solution for related problems in the experiments.

Contents:

1. Introduction
2. Review of basic algebra
3. Graphs and their significance in chemistry
4. Trigonometric
5. Logarithmic functions
6. Exponential functions
7. Differentiation
8. Partial differentiation
9. Differential equations and their use in chemical problems
10. Concept of maxima and minima
11. Integration
12. Determinants
13. Matrices
14. Their properties and use in chemical problems.
15. Solutions of linear equations (simple, determinant and matrices methods)
16. Operator theory,
17. The eigen value problem
18. Curve fitting.

Recommended Texts:

1. Paul, M. (2006). *Mathematics for chemistry*. (1st ed.). Oxford, United Kingdom: Oxford University Press
2. Ghram, D. (1996). *Mathematics in chemistry*. (1st ed.). New York, USA: Prentice Hall Publishing.

Suggested Readings:

1. Tebutt, P. (1998). *Basic mathematics for chemists*. (2nd ed.). New York, USA: John Wiley & Sons.
2. Goldstein, L. J., Lay, D. C., Schneider, D. I., & Asmar, N. H. (2017). *Calculus and Its Applications* (14th ed.). London: Pearson

CHEM-5103 Biochemistry 4 (3+1)

This is a basic biochemistry course designed to provide the fundamental concepts about biomolecules, their classifications, functions, and significance. This course demonstrates a broad knowledge of the fundamental introductory concepts of biochemistry where students will gain a deep understanding of function of biomolecules with respect to chemical and molecular processes that occur in and between cells. Students will learn about proteins, carbohydrates, lipids and nucleic acids and their types. Lab experiments related to qualitative and quantitative estimation of biomolecules are also part of this course. Upon the successful completion of course, students will be able to show a deep understanding of fundamental principles of biochemistry along with scientific reasoning to solve problems. Students will demonstrate a comprehensive understanding of the theory and practice of modern instrumentation and apply it to appropriate chemical problems. This compulsory course is followed by advance biochemistry courses in next semesters.

Contents

1. History and scope of Biochemistry. Origin and nature of biomolecules.
2. Proteins: Amino acids, classification and properties of amino acid. Stereochemistry,
3. Primary, Secondary, Tertiary and Quaternary protein structures.
4. Motif and domains in proteins. Biological functions of proteins and peptides,
5. Enzymes: Chemical Nature, Nomenclature and Classification.
6. Enzyme activity. Coenzymes and immobilized enzymes, Specificity of Enzymes, introduction to enzyme kinetics
7. Enzyme Inhibition. Regulation of Enzyme activity.
8. Carbohydrates: Definition and Classification, Monosaccharides:
9. Pyranose and Furanose ring structures. Stereoisomerism and Optical isomerism.
10. Disaccharides; Structures, Polysaccharides; starch, Glycogen and Cellulose.
11. Modified carbohydrates, Glycoproteins and Glycolipids.
12. Derived sugars, Hemiacetal, Acetal and Glycosidic linkages,
13. Glycosaminoglycans and Glycoconjugates.
14. Lipids: Structures and classification of Fatty Acids, essential and non-essential fatty acids
15. Phospholipids, Fats and oils; Hydrogenation, Oxidation and Rancidity
16. Steroids, Eicosanoids, Fats and oils, Waxes
17. Nucleic Acids: Purines and pyrimidines, nucleosides and nucleotides
18. Structural and functional differences between DNA and RNA.
19. Types of DNA and RNA, their functions in biological systems.
20. Vitamins: A basic introduction, classification, and significance

Biochemistry Labs

1. Safety Lab Practices – Safety signs and significance, introduction to lab hazards
2. Operation and use of micropipettes – types and uses, demonstrations.
3. Buffer preparation and use of pH meter
4. Qualitative Tests for carbohydrates; Molisch's Test, Fehling's Test, Benedict's Test, Barfoed's Test, Seliwanoff's Test, Bial's Test, Osazone Test, effect of Alkalis on Sugars
5. Quantitative Determination of Reducing Sugars by using Calorimetric Method (Spectrometric)
6. Hydrolysis of Glycogen or Starch
7. Qualitative tests for Amino Acids; Xanthoproteic acid Test, Millon's Test, Hopkins-Cole Test, Sakaguchi Test
8. Estimation of proteins by Bradford and Lowery methods
9. Separation of Amino Acids using Paper Chromatography and Thin Layer Chromatography (TLC)

10. Qualitative tests for fats, Sterols and Phospholipids
11. Determination of Ascorbic acid in Lemon Juice.
12. Saponification Tests and Iodine Values of Fat
13. Introduction to use of online available protein databases to get protein and DNA sequence.
14. Online visualization of Secondary and tertiary structures of Proteins.

Recommended Texts

1. Nelson, D. L. & Cox, M. M. (2017). *Lehninger principles of biochemistry.* (7th ed.). New York, USA: W. H. Freeman Publishers.
2. Voet, D. & Voet, J. G. (2016). *Biochemistry.* (5th ed.). New York, USA: John Wiley & Sons.
3. Boyer R. F. (2000). *Modern experimental biochemistry.* (3rd ed.). London, England: Pearson Press.

Suggested Readings

1. Murray, R. K., Grammer, D. K., Mayes, P. A., & Rodwell, V.W. (2000). *Harper's biochemistry*. (25th ed.). New York, USA: Appleton & Lange.
2. Stryer, L. (2010). *Biochemistry*. (7th ed.). New York, USA: Freeman & Co.
3. Ausubel, F. M. (2010). *Short protocols in molecular biology.* (5th ed.). New Jersey, USA: John Wiley & Sons.

SEMESER-II

URCG-5112 Fables, Wisdom, and Epics 2(2-0)

The course will enable students to explore human experiences, cultivate an appreciation of the past, enrich their capacity to participate in the life of their times, and enable an engagement with other cultures and civilizations, both ancient and modern. But independently of any specific application, the study of these subjects teaches understanding and delight in the highest achievements of humanity. The three components of the course, including fables, wisdom literature and epic, will enable the learners to explore and understand the classic tradition in literature. Development of personal virtue, a deep Sufi ethic and an unwavering concern for the permanent over the fleeting and the ephemeral are some of the key themes explored in the contents that will develop an intimate connection between literature and life.

Contents

1. Fables
   The Fables of Bidpai
   The Lion and the Bull
   The Ring-dove
   The Owls and the Crows

   Selected poem from Bang-i-Dara

2. Gulistan-e- Sa'di
   Ten ḥikāyāt from John T. Platts, *The Gulistan*
3. Epic
   THE SHĀHNĀMA OF FIRDAUSI

Recommended Texts

1. John T. P. (1876). *The Gulistan; or, Rose Garden of Shaikh Muslihu'd- Dīn Sa'dī of Shīrāz*. London: Wm. II. Allen.
2. Chishti, Y.S. (1991). *Sharaḥ-i bāng-i darā.* Lāhaur: Maktaba-i taʿmīr-i insāniyat

Suggested Readings

1. Thackston, W. (2000). A Millennium of Classical Persian Poetry. Maryland: Ibex Publishers.
2. Wood, R. (2013). Kalila and Dimna: Fables of Conflict and Intrigue. United Kingdom: Medina Publishing, Limited.

URCG-5116 Science of Society-I 2(2-0)

This course will introduce students with the subject matter of social science, its scope, nature and ways of looking at social phenomenon. It will make the participants acquaintance with the foundations of modern society, state, law, knowledge and selfhood. While retaining a focus on Pakistani state and society, students will encounter theoretical concepts and methods from numerous social science disciplines, including sociology, politics, economics anthropology and psychology and make them learn to think theoretically by drawing on examples and case studies from our own social context. Students will be introduced to the works of prominent social theorists from both western and nonwestern contexts. Instruction will include the use of written texts, audio visual aids and field visits.

Course Contents

1. Introduction to Social Sciences
- Social world, Human Social behavior, Foundations of society
- Evolution of Social sciences
- Philosophy of Science
- Scope and nature of social sciences
- Modernity and social sciences
- Branches of social science: Sociology, Anthropology, Political Science, Economics

Society and Community, Historical evolution of Society
- Types of Societies
- Foraging society, Horticultural society, Pastoralist society
- Agrarian societies, Industrial society, Postindustrial society

2. Philosophy of Knowledge in social Science and social inquiry
- Understanding social phenomenon
- Alternative ways of knowing
- Science as a source to explore social reality
- Objectivity, Value-Free research
- Positivism vs Interpretivism
- Qualitative vs Quantitative

3. Culture and Society
- Idea of Culture, Assumptions of Culture
- Types, Components, Civilization and culture
- Individual and culture. Cultural Ethnocentrism, Cultural Relativism
- Outlook of Pakistani culture
- Global Flows of culture, Homogeneity, Heterogeneity

4. Social Stratification and Social inequality
- Dimensions of inequality, social class
- Gender, Race, Religion, Ethnicity, Caste
- Patterns of social stratification in Pakistan
- Class, caste system in agrarian society
- Ascription vs Achievement, Meritocracy
- Global stratification in modern world, Global patterns of inequality

5. Personality, Self and Socialization
- Concept of self, Personality
- Nature vs Nurture, Biological vs Social
- Development of Personality
- Socialization as a process, Agents of socialization
- Socialization and self/group identity

6. Gender and Power
- Understanding Gender
- Social construction of Patriarchy
- Feminism in Historical context, Gender Debates
- Gender and Development
- Gender issues in Pakistani society, Women Participation in politics, economy and education
- Toward a gender sensitive society, Gender mainstreaming

Pakistan: State, Society, Economy and Polity
- Colonialism, colonial legacy, National identity

- Transformation in Pakistani society: Traditionalism vs Modernism
- Economy, Informality of Economy, Modern economy and Pakistan
- Political Economy, Sociology of Economy

Recommended Texts

1. Giddens, A. (2018). Sociology (11th ed.). UK: Polity Press.
2. Henslin, J. M. (2018). Essentials of Sociology: A Down-to-Earth Approach. (18th Edition) Pearson Publisher.
3. Macionis, J. J. (2016). Sociology (16th ed.). New Jersey: Prentice-Hall.
4. Qadeer, M. (2006) Pakistan - Social and Cultural Transformation in a Muslim Nation.
5. Smelser, N.J. and Swedburg, R., The Handbook of Economic Sociology, Chapter 1 'Introducing Economic Sociology', Princeton University Press, Princeton.

Suggested Readings

1. Systems of Stratification | Boundless Sociology (no date). Available at: https://courses.lumenlearning.com/boundless-sociology/chapter/systemsof-stratification/
2. Jalal, A. (ed.) (1995) 'The colonial legacy in India and Pakistan', in Democracy and Authoritarianism in South Asia: A Comparative and Historical Perspective. Cambridge: Cambridge University Press (Contemporary South Asia)
3. Zaidi, S. A. (2015) Issues in Pakistan's Economy: A Political Economy Perspective. Oxford University Press. Chapter 26
4. Akhtar, A. S. (2017) The Politics of Common Sense: State, Society and Culture in Pakistan. Cambridge: Cambridge University Press.

Smelser, N.J. and Swedburg, R., The Handbook of Economic Sociology, Chapter 1 'Introducing Economic Sociology', Princeton University Press, Princeton.

Seerat of the Holy Prophet مطالعہ سیرت النبی صلی اللہ علیہ وسلم

Course Code URCG-5127

Title	Description
Semester	
Nature of Course	
No. of C.Hrs.	1(1-0)
Total Teaching weeks	18
Objectives of the Course	۱۔ طلباء کو مطالعہ سیرۃ طیبہ کی ضرورت واہمیت سے آگاہ کرنا ۲۔ تعمیر شخصیت میں مطالعہ سیرۃ طیبہ کے کردار کو واضح کرنا ۳۔ بعثت نبوی کے موقع پر اقوام عالم کی عمومی صورت حال سے آگاہ کرنا ۴۔ رسول اکرم صلی اللہ علیہ وسلم کی مکی اور مدنی زندگی کا اس طرح مطالعہ کروانا کہ طلباء ان واقعات سے نتائج کا استنباط کر سکیں ۵۔ طلباء کو عہد نبوی کی معاشرت، سیاست، معیشت سے آگاہ کرنا

Course Description

S.No.	Title	Description
1	حضور صلی اللہ علیہ وسلم کے ابتدائی حالاتِ زندگی	۱۔ حضور صلی اللہ علیہ وسلم کا خاندانی حسب ونسب ۲۔ پیدائش اور ابتدائی تربیت ۳۔ لڑکپن اور جوانی کے حالات زندگی
2	بعثت نبوی کے وقت دنیا کے حالات (۱)	۱۔ بعثت نبوی کے وقت اہم تہذیبیں ۲۔ عرب، مصر، حبشہ، بازنطینی، ساسانی
3	بعثت نبوی	۱۔ مکی عہد میں دعوت اسلام
4	بعثت نبوی	۱۔ مدنی عہد میں دعوت اسلام
5	خصائص النبیؐ	آپؐ بطور پیغامبر امن
6	خصائص النبیؐ	بحثیت استاد ومعلم
7	خصائص النبیؐ	بحثیت تاجر
8	خصائص النبیؐ	بحثیت سربراہ ریاست
9	خصائص النبیؐ	ذاتی محاسن اور عالمگیر اثرات

ناموس رسالت	خصائص النبیؐ	10
غیر مسلموں سے تعلقات	اسوہ حسنہ اور عصر حاضر	11
اسوہ حسنہ کی روشنی میں گھریلو زندگی	اسوہ حسنہ اور عصر حاضر	12
مستشرقین اور مطالعہ سیرت	اسوہ حسنہ اور عصر حاضر	13
وطن سے محبت اور سیرت	اسوہ حسنہ اور عصر حاضر	15
مستشرقین کے اعتراضات اور ان کے جوابات	اسوہ حسنہ اور عصر حاضر	16

نصابی کتب

نمبر شمار	نام مؤلف	نام کتاب
1	ابن ہشام	السیرۃ النبویۃ
2	مولانا شبلی نعمانی، سید سلمان ندوی	سیرۃ النبی صلی اللہ علیہ وسلم
3	قاضی محمد سلیمان سلمان منصور پوری	رحمۃ للعالمین
4	مولانا سید ابوالحسن علی ندوی	نبی رحمت صلی اللہ علیہ وسلم
5	ڈاکٹر یسین مظہر صدیقی	عہد نبوی کا نظام حکومت
6	ڈاکٹر خالد علوی	انسان کامل ؐ

حوالہ جاتی کتب

نمبر شمار	نام مؤلف	نام کتاب
1	سید ابوالاعلیٰ مودودی	سیرت سرور عالم صلی اللہ علیہ وسلم
2	مولانا صفی الرحمن مبارکپوری	الرحیق المختوم
3	پیر محمد کرم شاہ الازہری	ضیاء النبی صلی اللہ علیہ وسلم
4	ڈاکٹر اکرم الضیاء العمری	السیرۃ النبویۃ الصحیحۃ
5	مولانا عبدالرؤف دانا پوری	اصح السیر

URCQ-5120 Exploring Quantitative Skills 3(3+0)

Since ancient times, numbers, quantification, statistics and mathematics has played a central role in scientific and technological development. In the 21st century, Quantitative Reasoning (QR) skills are essential for life as they help to better understand socio-economic, political, health, education, and many other issues, an individual now faces in daily life. The skills acquired by taking this course will help the students to apply QR methods in their daily life and professional activities. This course will also change student's attitude about statistics and mathematics. It will not only polish their QR skills, but also enhance their abilities to apply these skills.

Contents

1. Introduction to quantitative reasoning
2. Overview of contributions of Mathematicians and Statisticians especially Muslim scholars.
3. Types of standard numbers
4. Proportions, rates, ratio and percentages
5. Odds and odds ratio
6. Scale of measurements
7. Number sequence and series
8. Unit analysis as a problem-solving tool
9. Data handling (small and large)
10. Data errors, absolute and relative and their applications
11. Descriptive statistics
12. Rules of counting: multiplication rule, factorial, permutation and combination
13. Probability and its application in real life
14. A graphical perspective through Venn Diagram
15. Financial indicator analysis, and money management (profit, loss, simple and compound interest)
16. Practical scenarios involving algebraic expressions: linear and quadratic

Recommended Texts

1. Akar, G. K., Zembat, İ. Ö., Arslan, S., & Thompson, P. W. (2023). *Quantitative Reasoning in Mathematics and Science Education*. 1st Ed., Springer, USA.
2. Peck, R., Olsen, C., & Devore, J. L. (2015). *Introduction to statistics and data analysis*. 5th Ed., Brooks Cole, USA.
3. Devlin, K. J. (2012). *Introduction to mathematical thinking*. Palo Alto, CA: Keith Devlin.

Suggested Readings

1. Triola, M. F., Goodman, W. M., Law, R., & Labute, G. (2006). *Elementary statistics*. Reading, MA: Pearson/Addison-Wesley.
2. Blitzer, R., & White, J. (2005). *Thinking mathematically*. Pearson Prentice Hall.

Course Contents:	· تیسواں پارہ - ناظرہ مع تجوید · بنیادی عربی گرامر اسم اور اسکے متعلقات : اسم فاعل ،مفعول ،تفضیل ،مبالغہ فعل اور اسکی اقسام : ماضی ،مضارع ،امر ، نہی حرف اور اسکی اقسام : حروف علت ،حروف جارہ ،مشبہ بالفعل
Memorization:	تیسویں پارے کی آخری بیس سورتیں (حفظ مع ترجمہ)

CHEM-5104 Organic Chemistry 4 (3+1)

The students will acquire knowledge about the basic concepts of organic chemistry, chemistry of hydrocarbons, functional groups, and the mechanism of organic reactions. It will be useful for the qualitative analysis and synthesis of organic compounds. Understanding and knowledge of new and advanced field of organic and significances the importance of application of advanced techniques. This course is a foundation course for Organic Chemistry major courses of higher semester. The main objectives emphasized in this course involve developing an understanding of basic principles of organic chemistry. It develops critical thinking skills enabling students to solve general chemistry problems that incorporate their cumulative knowledge. Students learned in class advanced organic chemistry concepts which give them opportunities to upgrade their knowledge about advanced organic concepts. The essence of this course is to develop study skills that students need to succeed in university-level chemistry courses and prepare students for professional positions in the field of synthesis chemistry.

Contents

1. Basic concepts: atomic, molecular and hybrid orbitals: multiple localized and delocalized bonds, properties of bonds, inductive effect (*+I*, *-I*) and dipole moment. The concept of aromaticity, resonance, rules of resonance, resonance energy, resonance effect (including *+M*, *-M*), hyperconjugation, hydrogen bonding, tautomerism.
2. Hydrocarbons: classification of hydrocarbons, nomenclature. Methods of preparation, physical characteristics and chemical reactions of alkanes, alkenes and alkynes. Source of aromatic hydrocarbons.
3. Alkyl halides: nomenclature, method of preparation and chemical reaction with special reference to the nucleophilic substitution and elimination reaction of alkyl halide. Preparation, structure and synthetic application of Grignard reagent.
4. Alcohols & ethers: classification, nomenclature, properties, preparation and chemical reactions of alcohol/phenol and ether, Lucas test, polyhydric alcohols.
5. The carbonyls: classification, nomenclature, properties, preparation and chemical reactions of aldehydes, ketones, carboxylic acids and its derivatives. 2,4-DNPH, Tollen and Bendict tests. Introduction to amino acids.
6. Nitrogen compounds: classification, nomenclature, properties, preparation and chemical reactions of amines and diazonium; distinction between primary, secondary, and tertiary amines. Preparation and reaction of aniline.

Organic Chemistry Lab.

1. Qualitative organic analysis; systematic identification of an organic compound containing functional group(s) like COOH, OH, NH_2, C=O.
2. Purification techniques (solvent extraction, distillation and recrystallization) etc.

Recommended Texts

1. Younas, M. (2006). Organic spectroscopy. Lahore: A. H. Publisher
2. Solomons, T. W. G. (2016). Fundamentals of organic chemistry. (12th ed.). New York: Wiley.
3. Vogel, A. I. (1996). A textbook of practical organic chemistry. New York: Prentice Hall.

Suggested Readings

1. Kemp, W. (1990). Organic spectroscopy. London: Macmillan
2. Chughtai, F. A. (1995). Organic reactions. Lahore: Majid Book Depot.
3. Streitwieser, A.Heathcock, C. & Kosower, E. M. (2017). Introduction to organic chemistry. (4th ed.). New York: Macmillan.

CHEM-5105 Analytical Chemistry 4 (3+1)

This course is aimed to build foundation of Analytical Chemistry among the beginners, introducing them with the basic terminology and phenomenon of Analytical Chemistry, methods and precautions in collection and preservation of different type of samples for chemical analysis. It provides fundamental to deep insight about characterizing a material into its constituents as well as proportion of different ingredients in given sample. All the techniques and precautions for sample collection, and preparation are included in this course. Accuracy of this information is influenced by mode of sampling. This course provides a comprehensive skill development for preparation of solutions for measurements, calibration of volumetric glassware, and measurement of reagents with different types of balances. Skill about data analysis is also included in this course. Besides, basic principle, operational mechanism and applications of three different chromatographic techniques is contained in this course. For advanced information, overview of spectroscopic techniques, with comprehensive focus on UV/Visible spectrophotometry is also included in this course. After studying this course, students will be able to work independently in any quality control laboratory of any industry.

Contents

1. Data Handling: introduction to analytical chemistry
2. Sampling; types of samples, techniques/ steps involved in sample preparation
3. Drying and ignition
4. Weighing, analytical balance, its construction working
5. volumetric glassware; errors in measurements, calibration of glassware
6. Steps involved in chemical analysis, system for units of measurements and their interconversion
7. Chemical concentration and preparation of solutions
8. Calibration and calibration curves (construction and interpretation), Standard addition and internal standard methods
9. Statistical treatment of analytical data; Precision, accuracy and types of errors, sample, population, mean, average, median, range, standard deviation, variance, significant figures
10. Chemical equilibrium ant its types
11. Separation techniques: chromatography (introduction, classification) TLC, column & ion exchange chromatography (with reference to principles & applications), electrophoresis & solvent extraction

Analytical Chemistry Lab – I

1. Calibration of glassware (Pipette, Burette, Flask) used for volumetric Analysis.
2. Use of Analytical balance and calculation of standard deviation.
3. Use of pH meter for plotting acid - base titration curve and assay of commercial caustic soda.
4. Plotting of first differential curve for titration of acetic acid and commercial soda.
5. Measurement of solubility products of sparingly soluble salts.
6. Determination of HCl by titrating with NaOH and plotting of a titration curve.
7. Packing of chromatographic column and separation of mixture of dyes.
8. Separation of various components of plant extract by column chromatography.
9. Separation of mixture of dyes by Radial chromatography.
10. Separation of mixture of Amino acids by paper chromatography.
11. Coating of TLC plates and separation of mixture of dyes.
12. Separation of mixture of Amino acids by TLC.

Recommended Texts

1. Robinson J.W., Frame E.S., & Frame G.M. (2014). *Undergraduate instrumental analysis.* (7th ed.). New York: Marcel Dekker.
2. Harris, D.C. (2016). *Quantitative chemical analysis*. (9th ed.) New York: W.H. Freeman and Company.

Suggested Readings

1. Skoog, D.A., West, D.M., Holler, F.J., & Crouch S. R. (2014). *Fundamentals of analytical chemistry*. (9th ed.) Philadelphia: Saunders College Publishing.
2. Christian, G.D., Dasgupta, P.K., & Schug, K.A. (2013). *Analytical chemistry.* (4th ed.). New York, John Wiley & Sons.

SEMESTER-III

URCE-5119 Expository Writing 3 (3+0)

This course prepares undergraduates to become successful writers and readers of English. The course helps students develop their fundamental language skills with a focus on writing so that they can gain the confidence to communicate in oral and written English outside the classroom. The course is divided into five units and takes a Project-based Learning approach. Unit themes target the development of 21st century skills and focus on self-reflection and active community engagement. The course completion will enable the students to develop communication skills as reflective and self-directed learners. They will be able to intellectually engage with different stages of writing process, and develop analytical and problem-solving skills to address various community-specific challenges.

Contents

1. Self-Reflection
    - Introduction to the basics of the writing process
    - Introduction to the steps of essay writing
    - Prewriting activities: Brainstorming, listing, clustering and freewriting
    - Practicing Outlining of the essay
2. Personalized Learning
    - Learning Process, Learning Styles, Goal Setting and Learning Plan
3. Oral Presentation
    - Structure and Significance, Content Selection and Slide Presentation, Peer Review
4. Critical Reading Skills
    - Introducing Authentic Reading (Dawn and non-specialist academic books/texts)
    - Reading Strategies and Practice: Skimming, scanning, SQW3R, Annotating, Detailed reading and note-taking, Standard Test Practice: TOEFL and IELTS, Model Review Reports and Annotated Bibliographies
5. Community Engagement
    - Student-led brainstorming on local versus global issues, Identifying research problems
    - Drafting research questions, Drafting interview/survey questions for community research (in English or L1)
    - Engaging students in Critical reading, Presenting interview/ survey information, Field work
    - Writing Community Engagement Project
6. Letter to the Editor
    - Types of letters, Format and purpose of letter to the editor, Steps in writing letter-to-editor

Recommended Texts

1. Bailey, S. (2011). Academic writing: A handbook for international students (3rd ed.). New York: Routledge.
2. Swales, J. M., & Feak, C. B. (2012). *Academic writing for graduate students: Essential tasks and skills* (3rd ed.). Ann Arbor: The University of Michigan Press.

Suggested Readings

1. Cresswell, G. (2004). *Writing for academic success*. London: SAGE.
2. Johnson-Sheehan, R. (2019). *Writing today*. Don Mills: Pearson.
3. Silvia, P. J. (2019). *How to write a lot: A practical guide to productive academic writing*. Washington: American Psychological Association.

URCQ-5121 **Tools for Quantitative Reasoning** **3(3+0)**

This course is based on quantitative reasoning 1 course. It will enhance the quantitative reasoning skills learned in quantitative reasoning 1 course. Students will be introduced to more tools necessary for quantitative reasoning skills to live in the fast paced 21st century. Students will be introduced to importance of statistical and mathematical skills in different professional settings, social and natural sciences. These quantitative reasoning skills will help students to better participate in national and international issues like political and health issues. This course will prepare the students to apply quantitative reasoning tools more efficiently in their professional and daily life activities. This course will help them to better understand the information in form of numeric, graphs, tables, and functions.

Contents

1. Types of data and its graphical representation (Histogram, Stem and Leaf display, Box Plot, Scatter diagram, Historgram, Bar chart, etc.)
2. Solving practical problems using linear and exponential models
3. Population growth models
4. Analytical approach to solve simultaneous equations
5. Inequalities and their application
6. Comparing quantities using analytical tools
7. Logical reasoning and their application in modern age
8. Logical reasoning and decision making
9. Data tendencies via measure of location
10. Variability and Measure of dispersion
11. Measuring relationships via Regression analysis and correlation
12. Statistical inference: sampling techniques, estimation techniques and hypothesis testing for decision and policy making

Recommended Texts

1. Akar, G. K., Zembat, İ. Ö., Arslan, S., & Thompson, P. W. (2023). *Quantitative Reasoning in Mathematics and Science Education*. 1st Ed., Springer, USA.
2. Sharma, A. K. (2005). *Text book of elementary statistics*. Discovery Publishing House.
3. Blitzer, R. (2014). *Precalculus*, 5th Ed.. Pearson Education, Limited. New York

Suggested Readings

1. Gupta, S. C., & Kapoor, V. K. (2020). *Fundamentals of mathematical statistics*. 12th Ed, Sultan Chand & Sons.
2. Aufmann, R. N., Lockwood, J., Nation, R. D., & Clegg, D. K. (2007). *Mathematical thinking and quantitative reasoning*. Cengage Learning
3. Blitzer, R., & White, J. (2005). *Thinking mathematically*. Pearson Prentice Hall.

URCP-5122 Ideology and Constitution of Pakistan 2 (2-0)

This course focuses on ideological background of Pakistan. The course is designed to give a comprehensive insight about the constitutional developments of Pakistan. Starting from the Government of India Act, 1935 till to date, all important events leading to constitutional developments in Pakistan will be the focus of course. Failure of the constitutional machinery and leading constitutional cases on the subject. Moreover, students will study the process of governance, national development, issues arising in the modern age and posing challenges to Pakistan. It will also cover the entire Constitution of Pakistan 1973. However, emphasis would be on the fundamental rights, the nature of federalism under the constitution, distribution of powers, the rights and various remedies, the supremacy of parliament and the independence of judiciary.

Contents:

- Ideology of Pakistan
  - Ideological rationale with special reference to Sir Syed Ahmed Khan, Allama Muhammad Iqbal and Quaid-e-Azam Muhammad Ali Jinnah.
  - Two Nation Theory and Factors leading to Muslim separatism.
- Constitutional Developments
  - Salient Feature of the Government of India Act 1935
  - Salient Feature of Indian Independence Act 1947
  - Objectives Resolution
  - Salient Feature of the 1956 Constitution
  - Developments leading to the abrogation of Constitution of 1956
  - Salient features of the 1962 Constitution
  - Causes of failure of the Constitution of 1962
  - Comparative study of significant features of the Constitution of 1956, 1962 and 1973
- Fundamental rights
- Principles of policy
- Federation of Pakistan
  - President
  - Parliament
  - The Federal Government
- Provinces
  - Governors
  - Provincial Assemblies
  - The Provincial Government
- The Judicature
  - Supreme Court
  - High Courts
  - Federal Shariat Courts
  - Supreme Judicial Council
  - Administrative Courts and tribunals
- Islamic Provisions in Constitution
- Significant Amendments of Constitution of Pakistan 1973

Recommended Books:

1. Constitutional and Political History of Pakistan by Hamid Khan
2. Mahmood, Shaukat and Shaukat, Nadeem. Constitution of the Islamic Republic of Pakistan, 3rd re edn. Lahore: Legal Research Centre, 1996.
3. Munir, Muhammad. Constitution of the Islamic Republic of Pakistan: Being a Commentary on the Constitution of Pakistan, 1973. Lahore, Law Pub., 1975.
4. Rizvi, Syed Shabbar Raza. Constitutional Law of Pakistan: Text, Case Law and Analytical Commentary. 2nd re edn. Lahore: Vanguard, 2005.
5. The Text of the Constitution of the Islamic Republic of Pakistan, 1973 (as amended).
6. Fundamental Laws of Pakistan by A.K. Brohi

CHEM-5106 Physical Chemistry 4 (3+1)

This course is the first part of this program, introduction to Physical Chemistry. This foundation course of physical chemistry covers basic knowledge and its application for learning chemical principles of physics to chemistry. This course offer complementary approaches to the fundamental understanding of chemical systems. Students will acquire knowledge to enable themselves to understand the kinetic theory of gases, collision theory of reactions, chemical equilibria and to investigate the physical properties of ideal/non-ideal binary solutions. Students will also be able to study the rates of reactions and perform related calculations. The general goal of learning physical chemistry is to obtain a vision of matter-energy relationship in physical and chemical systems. Learning objectives emphasized in CHEM-5101 involve developing an understanding of basic principles of physical chemistry. Students learned in class to modern physical chemistry techniques which give them opportunities to see how Physical Chemists are solving current, real-world problems.

Contents

1. Physical States of Mater:
   Gases: Van der Waal's equation, critical Phenomena, Critical values of T, P and V, liquefaction of gases, molecular collisions, collision diameter, mean free path
   Liquids: viscosity, Parachor value, Refractive index, molar refraction and its applications. Dipole moment
   Solids: Unit cells. Bragg crystal analysis, crystal structure of NaCl, powder method of crystal structure analysis.
2. Solutions: composition, ideal and non-ideal solutions. Raoult's law. Colligative properties, ebullioscopy, cryoscopy, osmotic pressure, distillation and concept of azeotropes
3. Chemical Equilibrium: Law of Mass Action, equilibrium constant, relationship between Kc, Kp, Kx and Ka and Le-Chaterlier's Principle
4. Atomic Structure: De Brogile equation. Black body radiation, quantization concept, Heisenberg Uncertainty Principle, Pauli Exclusion Principle, Hund's Rule

Physical Chemistry Lab

1. Determination of surface tension and Parachor value by stalagmometer.
2. Determination of percent composition of liquid solutions from surface tension measurement.
3. Determination of viscosity and Rhechor value of liquids from viscosity measurement.
4. Determination of percent composition of liquid solutions using viscometer.
5. Determination of refractive index and molar refractivity by refractometer.
6. Determination of percent composition of liquid solutions by refractive index measurements.
7. Determination of heat of neutralization of an acid with a base.
8. Determination of molecular weight of a compound by elevation in boiling point (Ebullioscopic method).
9. Determination of molecular weight of a compound by lowering of freezing point (Cryoscopic method).

Recommended Texts

1. Atkins, P., Paula, J., & Keeler, J. (2017). *Atkins' Physical Chemistry* (11th ed.). UK: Oxford University Press.
2. Kuhn, H., Försterling, H., & Waldeck, D. H. (2009). *Principles of Physical Chemistry* (2nd ed.). USA: Wiley Publisher.

Suggested Readings

1. Akhtar, M. N., & Nabi, G. (2006). *Text Book of Physical Chemistry*. Lahore: Ilmi Kitab Khawna.
2. Das, R. C., & Behera, B. (2003). *Experimental Physical Chemistry.* Delhi: Tata McGraw Hill.

CHEM-5107 Basic Statistics for Chemists 2 (2+0)

This course aims at providing students basic knowledge of statistics. Student will be able to use Simple linear regression, multiple regression (for two independent variables), and Correlation in terms of chemistry. Students will be provided with the theoretical concepts, tools and methods of statistics as well as the opportunity to work through example problems. This course also provides basic statistical concepts for measuring the central tendency and dispersion, probability distributions, the central limit theorem, sampling, estimation, hypothesis testing, analysis of variance, correlation and regression analysis, multiple regression and statistical forecasting. Upon the completing this course the students will be able to compute and interpret the results of Bivariate and Multivariate Regression and Correlation Analysis, for forecasting and also perform ANOVA and F-test. This will further enhance student knowledge to understand both the meaning and applicability of a dummy variable and the assumptions which underline a regression model. Be able to perform a multiple regression using computer software.

Contents

1. Statistics- Introduction.
2. Definition, Descriptive and inferential statistics, Population, Sample, Data collecting. Use of Microsoft Excel for data analysis
3. Applications of statistics in chemistry.
4. Graphical Representation.
5. Simple Bar chart, Multiple Bar chart
6. Rectangle Sub-divided Chart, Histogram
7. Frequency Polygon, Histogram, Pi- Chart
8. Central Tendencies (A.M., G.M. Median, Mode, H.M. for Ungrouped Data.
9. Quantiles with Interpretation (for ungrouped data)
10. Quartiles, Percentiles, Deciles
11. Measures of dispersion (Mean Deviation, Variance, Standard Deviation, Coefficient of Variation).
12. Basic Probability Theory.
13. Regression, Definitions of Simple linear regression
14. Multiple regression (for two independent variables), and Correlation.
15. Estimation: Point estimate, interval estimates
16. Confidence Interval for Single Mean, Difference of Mean.
17. Testing of Hypothesis: t- test for single mean for paired samples and for Independent samples.
18. ANOVA, Multiple Comparison Test, (LSD and DUCANSAN).
19. Chi Square for Association.

Recommended Texts

1. Navidi, J. (2010). *Statistics for engineers and scientists.* (1st ed.). New York, USA: John Wiley.
2. Schuenemeyer, J. (2011). *Larry drew statistics for earth and environmental scientists*. New York, USA: John Wiley.

Suggested Readings

1. Miller, C. J. & Miller, N. J. (1993). *Statistics for analytical chemistry*. New York: Ellis Horwood Ltd.
2. Miller, N. J. & Miller, C. J. (2001) *Statistics and chemometrics for analytical chemistry*. (4th ed.). New York: Prentice Hall.

CHEM-5108 Laboratory Safety Measures 2(2-0)

a) Fire/Electricity/Chemical/Biological/Radiation safety measures

b) Common pitfalls in laboratory

c) First aid in laboratory

d) Laboratory managements

e) Different lab skills such as glass blowing, preliminary calibration/maintenance of instruments

Reference Books

1. Armour, M.A. Hazardous Laboratory Chemical Disposal Guide. CRC Press, LLC. (2003).
2. Urban P.G. Bretherick's Handbook of Reactive Chemical Hazards. 7th ed. Academic Press, NY. (2006)
3. Prudent Practices in Laboratory Handling & Disposal of Chemicals. National Academy Press, Washington D.C., USA. (2008).
4. Safety in Academic Chemistry Laboratories, Vol. 1, 2; American Chemical Society. Washington DC (2003)

SEMESTER-IV

URCT-5115 Course –II: The Science of Global Challenges 3 (2+1)

Climate Change i.e., Global Warming, Natural and Anthropogenic Activities and their impact; Energy i.e., Renewable and non-renewable energy resources; Water Security i.e., water scarcity and waste water treatment; Land Degradation i.e., salinity, water logging, deforestation, land erosion; Food Security and roll of Biotechnology in food production; Global Health Pandemics i.e., Infectious diseases, vaccine, development of drug discovery for newly explored diseases

Practical:

1. Preparation of standard solution and their standardizations
2. Soil and Water Analysis

Recommended Text:

Usman, M. (2022). *Science of Global Challenges*. Ilmi Kitab Khana, Lahore

Suggested Books

1. Thieman, W.J. & Palladino, M.A. (2014*). Introduction to biotechnology*. Edinburgh Gate UK: Pearson Education Limited.
2. Daugherty, E. (2012). *Biotechnology: Science for the New Millennium*, 1st Edition, Revised, USA: Paradigm Publication.
3. Karaduman, I. C. (Ed.) (2014) *Global Challenges for the world*. Obronnosc. Zeszytl Naukowe. Turkey

URCE- 5124 Entrepreneurship 2(2+0)

This course addresses the unique entrepreneurial experience of conceiving, evaluating, creating, managing, and potentially selling a business idea. The goal is to provide a solid background with practical application of important concepts applicable to the entrepreneurial environment. Entrepreneurial discussions regarding the key business areas of finance, accounting, marketing and management include the creative aspects of entrepreneurship. The course relies on classroom discussion, participation, the creation of a feasibility plan, and building a business plan to develop a comprehensive strategy for launching and managing a new venture.

Contents

1. Background: What is an Organization, Organizational Resources, Management Functions, Kinds of Managers, Mintzberg's Managerial Roles.
2. Forms of Business Ownership: The Sole proprietorship, Partnership, Joint Stock Company
3. Entrepreneurship: The World of the Entrepreneur, what is an entrepreneur? The Benefits of Entrepreneurship, The Potential Drawbacks of Entrepreneurship, Behind the Boom: Feeding the Entrepreneurial Fire.
4. The Challenges of Entrepreneurship: The Cultural Diversity in Entrepreneurship, The Power of "Small" Business, Putting Failure into Perspective, The Ten Deadly Mistakes of Entrepreneurship, How to Avoid the Pitfalls, Idea Discussions & Selection of student Projects, Islamic Ethics of Entrepreneurship.
5. Inside the Entrepreneurial Mind: From Ideas to Reality: Creativity, Innovation, and Entrepreneurship, Creativity – Essential to Survival, Creative Thinking, Barriers to Creativity, How to Enhance Creativity, The Creative Process, Techniques for Improving the Creative Process, Protecting Your Ideas, Idea Discussions & Selection of student Projects.
6. Products and technology, identification opportunities
7. Designing a Competitive Business Model and Building a Solid Strategic Plan: Building a strategic plan, Building a Competitive Advantage, The Strategic Management Process, Formulate strategic options and select the appropriate strategies, Discussion about execution of Students' Project.
8. Conducting a Feasibility Analysis and Crafting a Winning Business Plan: Conducting a Feasibility Analysis, Industry and market feasibility, Porter's five forces model, Financial feasibility analysis. Why Develop a Business Plan, The Elements of a Business Plan, What Lenders and Investors Look for in a Business Plan, Making the Business Plan Presentation.
9. Building a Powerful Marketing Plan: Building a Guerrilla Marketing Plan, Pinpointing the Target Market, Determining Customer Needs and Wants Through Market Research.Plotting a Guerrilla Marketing Strategy: How to Build a Competitive Edge, Feed Back & Suggestions on Student Project, Islamic Ethics for Entrepreneurial Marketing
10. E-Commerce and the Entrepreneur: Factors to Consider before Launching into E-Commerce, Ten Myths of E-Commerce, Strategies for E-Success, Designing a Killer Web Site, Tracking Web Results, Ensuring Web Privacy and Security, Feed Back & Suggestions on Student Project.
11. Pricing Strategies: Three Potent Forces: Image, Competition, and Value, Pricing Strategies and Tactics, Pricing Strategies and Methods for Retailers, The Impact of Credit on Pricing
12. Attracting Venture Capitalist: Projected Financial Statements, Basic Financial Statements, Ratio Analysis, Interpreting Business Ratios, Breakeven Analysis, Feed Back &Suggestions on Student Project,
13. Idea Pitching: Formal presentation, 5-minutes pitch, funding negotiation and launching.

Recommended Texts:

1. Scarborough, N. M. (2011). *Essentials of entrepreneurship and small business management*. Publishing as Prentice Hall, One Lake Street, Upper Saddle River, New Jersey 07458.

Suggested Readings:

1. Burstiner, I. (1989). S*mall business handbook*. Prentice Hall Press.

URCC-5125 Civics and Community Engagement 2(2-0)

The Civics and Community Engagement course is designed to provide students with an understanding of the importance of civic participation, culture and cultural diversity, basic foundations of citizenship, group identities and the role of individuals in creating positive change within their communities. The course aims at developing students' knowledge, skills and attitudes necessary for active and responsible citizenship.

Contents:

Introduction to Civics & Community Engagement

- Overview of the course: Civics & Community Engagement
- Definition and importance of civics
- Key concepts in civics: citizenship, democracy, governance, and the rule of law
- Rights and responsibilities of citizens

Citizenship and Community Engagement

- Introduction to Active Citizenship: Overview of the Ideas, Concepts, Philosophy and Skills
- Approaches and Methodology for Active Citizenship

Identity, Culture, and Social Harmony

- Concept and Development of Identity, Group identities
- Components of Culture, Cultural pluralism, Multiculturalism, Cultural Ethnocentrism, Cultural relativism, Understanding cultural diversity, Globalization and Culture, Social Harmony,
- Religious Diversity (Understanding and affirmation of similarities & differences)
- Understanding Socio-Political Polarization
- Minorities, Social Inclusion, Affirmative actions

Multi-cultural society and inter-cultural dialogue

- Inter-cultural dialogue (bridging the differences, promoting harmony)
- Promoting intergroup contact/ Dialogue
- Significance of diversity and its impact
- Importance and domains of Inter-cultural dialogue

Active Citizen: Locally Active, Globally Connected

- Importance of active citizenship at national and global level
- Understanding community
- Identification of resources (human, natural and others)
- Utilization of resources for development (community participation)
- Strategic planning, for development (community linkages and mobilization)

Human rights, constitutionalism and citizens' responsibilities

- Introduction to Human Rights
- Human rights in constitution of Pakistan
- Public duties and responsibilities
- Constitutionalism and democratic process

Social Institutions, Social Groups, Formal Organizations and Bureaucracy

- Types of Groups, Group identities, Organizations
- Bureaucracy, Weber’s model of Bureaucracy
- Role of political parties, interest groups, and non-governmental organizations

Civic Engagement Strategies

- Grassroots organizing and community mobilization
- Advocacy and lobbying for policy change
- Volunteerism and service-learning opportunities

Social issues/Problems of Pakistan

- Overview of major social issues of Pakistani society

Social Action Project

Recommended Books:

1. Kennedy. J. K., & Brunold, A. (2016). Regional context and Citizenship education in Asia and Europe. New Yourk: Routledge, Falmer.
2. Henslin, James M. (2018). Essentials of Sociology: A Down to Earth Approach (13th ed.). New York: Pearson Education
3. Macionis, J. J., & Gerber, M.L. (2020). Sociology. New York: Pearson Education

Reference Books:

1. Glencoe McGraw-Hill. (n.d.). Civics Today: Citizenship, Economics, and Youth.
2. Magleby, D. B., Light, P. C., & Nemacheck, C. L. (2020). Government by the People (16th ed.). Pearson.
3. Sirianni, C., & Friedland, L. (2005). The Civic Renewal Movement: Community-Building and Democracy in the United States. Kettering Foundation Press.
4. Bloemraad, I. (2006). Becoming a Citizen: Incorporating Immigrants and Refugees in the United States and Canada. University of California Press.
5. Kuyek, J. (2007). Community Organizing: Theory and Practice. Fernwood Publishing.
6. DeKieffer, D. E. (2010). The Citizen's Guide to Lobbying Congress. TheCapitol.Net.
7. Rybacki, K. C., & Rybacki, D. J. (2021). Advocacy and Opposition: An Introduction to Argumentation (8th ed.). Routledge.
8. Kretzmann, J. P., & McKnight, J. L. (1993). Building Communities from the Inside Out: A Path Towards Finding and Mobilizing a Community's Assets. ACTA Publications.
9. Patterson, T. E. (2005). Engaging the Public: How Government and the Media Can Reinvigorate American Democracy. Oxford University Press.

Love, N. S., & Mattern, M. (2005). Doing Democracy: Activist Art and Cultural Politics. SUNY Press.

Course Contents:	o ایمانیات اور عبادات ہلا پر ایمان ،فرشتوں پر ایمان ،رسولوں پر ایمان ،آسمانی کتابوں پر ایمان یوم آخرت پر ایمان ، تقدیر پر ایمان نماز ،روزہ ،زکوۃ،حج ،جہاد o معاشرے کے حقوق · خاندان کی تکوین · حق مہر · رضاعت و حمل · اوالد کو قتل کرنے کے ممانعت · شوہرکی نافرمانی · طالق · بیوہ کی عدت کے احکام · نکاح کا پیغام بھیجنا · عورت کی وراثت)اس کے شوہر کی طرف سے(· والدین کے حقوق · بیویوں اور اوالد کے بیچ عداوت o خاندان کے حقوق · مہمان کی عزت · اجازت طلب کرنے کے اصول · مجلس کے ٓاداب · تعاون اور بھائی چارہ · گروہ بندی · محبت · لوگوں کے درمیان صلح · عفو ودرگزر، غصہ پر قابو اور معاف کرنا · شعوب و قبائل · لوگوں کے بیچ اختالفات · حمایت و نگہبانی

Grammar:	• قرآنی عربی گرامر کے اصول اور انکے اطالقات (متن قرآنی پر اطالق سے توضیحات)
Details of Chapters and verse Numbers:	▪ منتخب آیات مع ترجمہ وتجوید ▪ البقرہ ((۱۱۷، ۲۳۸، ۴۵، ۱۱۸، ۲۷۸، ۱۷۷، ۴۵، ۳۴۷، ۱۵۸، ۷۱۸، ۴۲۸، ۵۳، ۴۲۸، ۵۲۷، ۱۱۸، ۲۲۷، ۲۳۷، ۱۱۷، ۲۴۸، ۴۲۸، ۲۸۷، ۸۲، ۲۲، ۳۴۸، ۲۸۷، ۴۷، ۳۲۷، ۱۳۸ ، ۴۳۸، ۱۳۸، ۷۳۸، ۲۸۸، ۲۸۸، ۱۳۸، ۲۸۸، ۱۸۸، ۲۲۷،۷۵۸، ۲۴۷، ۲۷۸ (۳۲ ،۱۲۷، ۸۲۷، ۳۳۸، ۵۲۷ ، ۸۲ ▪ النساء (۴۲، ۸۲، ۲۴، ۲۳۷، ۲۲، ۱۲، ۳۷، ۲۲، ۲۲،۱۲، ۲۳، ۲۱۷، ۸۷، ۴۳، ۲۸۷، ۷، ۱۸، ۷، ۲، ۷۲۷، ۴۳، ۱۸، ۴۳، ۷۲۷، ۲۸۷، ۷۷، ۷۷، ۴۸، ۵۸، ۲۱۷، ۵، ۷۷، ۵۳، ۷۲) ۲۸۷، ۵۴، ۲۵۷، ۲۷ ▪ االنعام (۸۸، ۸۲،۵۷،۱۳۷، ۷۴۷، ۲۵، ۵۴) ▪ ال عمران (۱۲، ۲۳، ۴۲، ۴۸۷، ۵۲، ۵۵۷، ۲۷،۷) ▪ المائده (۵۴، ۸، ۸۲، ۲۳،۲۷، ۸۲، ۸، ۴) ▪ االعراف (۴۳، ۲۲۷، ۲۲۷) ▪ التوبہ (۱۸، ۲۷،۷۱) ▪ ہود (۸۷) ▪ الزمر (۲) ▪ النور (۵۴، ۲۸،۸۴، ۱۸، ۱۲، ۲۸) ▪ محمد (۳۳) ▪ انفال (۸۲، ۱۸) ▪ الرعد (۳) ▪ الطالق (۵) ▪ الحج(۴) ▪ ابراہیم ((۳۸،۵۵) ▪ االسراء (۳۸، ۵۸) ▪ االحقاف (۴۷) ▪ المومنون (۱۸) ▪ العنکبوت (۲۵،۴۸، ۲) ▪ النحل (۸۸) ▪ لقمان (۵،۴۷، ۵۷) ▪ االحزاب ((۴۳، ۱۴،۲۳، ۲۵) ▪ الشعراء (۱) ▪ الروم (۷۸) ▪ مریم (۲۸،۵۷) ▪ المجادلہ (۸۷، ۷۷)

CHEM-5109 Chemistry Special Topics 4 (3+1)

This course covers a range of specialized topics in chemistry which provide a useful supplement to the advanced courses specified in the department. Student will be able to learn the basic knowledge of biomolecules, simple heterocycles and introductory organic spectroscopy, is helpful in identification of organic compounds. In addition to it, basics of surface chemistry, modern material and detail study of unit operations in chemical industry and metallurgy can be a beneficial for new learners who are ambitious for specialized area of chemistry. The main objectives emphasized in this course involve developing an understanding of basic principles of different branches of chemistry. It develops critical thinking skills enabling students to solve general chemistry problems that incorporate their cumulative knowledge. Students learned in class to advanced chemistry concepts which give them opportunities to upgrade their applicable knowledge. This course is to develop study skills that students need to succeed in university-level advanced chemistry courses and preparation of students for professional positions in this field and their industrial skill.

Contents

1. Introduction to Spectroscopy: IR and UV-Vis, Atomic Absorption Spectroscopy, Flame Emission Spectrometry, ICP (Principle, instrumentations, and applications).
2. Introduction to separation techniques
   (a) Chromatography: Classification, Paper Chromatography, TLC, Coulmn Chromatography, Ion-Exchange Chromatography.
   (b) Solvent Extraction
3. Surface Phenomena and Colloids: (Physisorption and chemisorption, isotherms, types, properties, preparation and applications of colloids).
4. Computational Chemistry: Introduction, computational approaches to explore chemical phenomenon, Theories (wave function theory & density functional theory), methods, basis set
5. Modern Materials: (Introduction to liquid crystals, Inorganic polymers, Ceramics, Fiber glass, Thin films, Semiconductors and Composite materials).
6. Chemical Industries: (Metallurgy of Al, manufacturing of H_2SO_4, HNO_3, fertilizers, cement and glass).

Chemistry Special Topics Lab

1. Percentage determination of barium in barium nitrate by gravimetric method.
2. Gravimetric determination of nickel.
3. Estimate the glucose content in the sample by titration method
4. Determination of adsorption parameters using Langmuir adsorption isotherm of acetic acid on charcoal.
5. To determine the wavelength of maximum absorption of compounds using spectrophotometer.
6. To determine the concentration of Cr in water sample by using spectrophotometer.
7. To determine the concentration of Mn in water sample by using spectrophotometer.
8. To determine the concentration of the Sucrose, glucose and dextrose in samples by using polarimeter.
9. To determine the Iodine value of the oil and fat
10. Estimate the glucose content in the sample by titration method
11. Identification Al^{3+}, Cr^{3+} and Fe^{3+} in samples by TLC
12. Determine the partition coefficient of iodine between H_2O and CCl_4
13. Qualitative analysis of lipids, proteins, carbohydrates

Recommended Texts

1. Younas, M. (2005). *Organic spectroscopy*. Lahore: A. H. Publisher

2. Shaheen, M.A. (2022) Selected Topics in Chemistry, Jilani Notes, Sargodha
3. Solomons, T. W. G. (2016). *Fundamentals of organic chemistry* (12th ed.). New York: Wiley,
4. Shaheen, M.A. (2022) Jilani Manual of Practical Chemistry Vol. IV, Jilani Notes, Sargodha

Suggested Readings

1. Kent, J. A. (1997). *Riegal's hand book of industrial chemistry*. New Delhi: CBS Publishers and Distributors.
2. Arnikar, H. J. (1998). *Nuclear chemistry*. India: Krishna Prakashan Media (P) Ltd.
3. Gurdeep, R. (2002). *Advanced physical chemistry*. India: Krishna Prakashan Media (P) Ltd.

ZOOL-5101 Animal Diversity-I (Invertebrates) 4 (3+1)

This course will provide the knowledge of evolutionary/phylogenetic relationship. It imparts the basic taxonomic characteristics and classification of all the invertebrate phyla. This includes more than 95% of all of the described species of animals and far more than 99% of all of the individual animals on the planet. The central theme running throughout this course will be phylogeny. It provides understanding of body organization, mode of feeding, digestion, reproduction and development of invertebrates. It delivers information to students about economic and ecological importance of invertebrates. Students will understand invertebrate organismal concepts in laboratory and field. The primary objectives for the laboratory section of this course includes; introduction of structure, function and behavior of selected invertebrate types through the observation of both living and preserved specimens, to reinforce basic laboratory skills of students like microscopy, dissection and careful observation, to provide students with the ability to recognize the major groups of invertebrate and to increasing understanding of the methods of investigating animal evolution.

Contents

1. Introduction: Classification of organisms, Evolutionary relationships and Tree diagrams: Patterns of organization.
2. Animal-like protists: the protozoa: Evolutionary perspective; Life within a single plasma Membrane, Symbiotic Life-styles, Protozoon Taxonomy, Pseudopodia and Amoeboid Locomotion; Cilia and other pellicular structure, Nutrition; Genetic Control and Reproduction; Symbiotic ciliates, Further Phylogenetic consideration.
3. Multicellular and tissue levels of organization: Evolutionary Perspective, Origins of Multicellularity; Animal Origins, Phylum Porifera, Cnidaria, Ctenophora, Characters and Classification, Maintenance functions.
4. The triploblastic and with acoelomate body plan: Phylum Platyhelminthes, Phylum Nematode, Gastrotricha, Evolutionary Perspective; Classification up to class, Body plan and functions.
5. Pseudocoelomate body plan: Phylum Aschelminths, Evolutionary perspective; General Characteristics; Classification up to order with External Features, Feeding and Digestive system; Other Organ System; Reproduction and Development including Phylum Rotifera, Phylum Nematoda and Phylum Kinorhyncha. Some important Nematode parasites of Humans.
6. Phylum Mollusca: Evolutionary perspective; Relationship to other animals; Origin of the Coelom; 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.
7. Phylum Annelida: The Metameric Body Form; Evolutionary perspective; Relationship to other animals, Metamerism and Tag-matization, 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, Polychaeta, Oligochaeta and Hirudinea, Further Phylogenetic Consideration.
8. Phylum Arthropoda: Evolutionary Perspective: Classification and relationship to other Animals; Metamerism and Tagmatization; The Exoskeleton; Metamorphosis; Classification up to Class.
9. The Hexapods and Myriapods: Evolutionary Perspective: Classification upto 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, Insects Behavior, Insect and Human.
10. Phylum Echinoderms: Evolutionary Perspective: Relationship to other Animals; Echinoderm Characteristics; Classification up to class. Maintenance functions, regeneration, reproduction, and development in Asteroida, Ophiuroidea, Echinoidea, Holothuridea and Crinoidea.
11. Some lesser known Invertebrates: Lophorates, Entoprocts, Cycliophores, and Cheatognaths.

Animal Diversity-I (Invertebrates) lab

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

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

Recommended Texts

1. Miller, A. S., & Harley, J. B. (1999, 2002, 2007, 2009, 2012 and2016). *Zoology (*4th, 5th, 6th, 7th, 8th, 9th and 10th ed.) Singapore: McGraw Hill.

2. Hickman, C. P., Roberts, L. C. & Larson, A. (2007). *Integrated principles of zoology* (11th and 12th ed.). Singapore: McGraw-Hill.

Suggested Readings

1. Hickman, C. P., Roberts, L. C., & Larson, A. (2018). *Integrated principles of zoology* (15th ed.). Singapore: McGraw-Hill.
2. Pechenik, J. A. (2015). *Biology of invertebrates* (7th ed.). Singapore: McGraw-Hill
3. Kent, G. C., & Miller, S. (2001). *Comparative anatomy of vertebrates*. New York: McGraw-Hill

PHYS-5101 **Mechanics** **3(3-0)**

Mechanics is all about motion of a body. It deals with forces, motion and further to the laws of motion in inertial frames specifically. This course provides the students a broad understanding of the physical principles of the mechanics, to describe mechanical events that involve forces acting on macroscopic objects. The main objective of this course is to create quantitative skills in the students and to motivate them to think creatively and critically about scientific problems and experiments. Students are encouraged to share their thinking with teacher and the other students to examine different problem-solving strategies.

Course Contents

1 Motion in one/two/three dimensions.
2 Newtonian mechanics, Friction, Drag force, Work and kinetic/potential energy.
3 Linear momentum, Conservation of momentum/energy, Power, System of particles, Collisions in one/two dimensions.
4 Rotational dynamics, Moment of inertia, Principles of parallel and perpendicular axis theorem.
5 Determination of moment of inertia of various shapes.
6 Rotational dynamics of rigid bodies and its effect on the application of torque.
7 Angular momentum and its conservation, Effect of torque on the angular momentum.
8 The motion of planets and Kepler laws in detail, Motion of satellite and its energy consideration in planetary and satellite motion.
9 Fluid statics, Fluid dynamics.

Recommended Books

1. Halliday, D., Resnick, R. & Walker, J. (2014). *Fundamentals of physics* (10th Ed.). New York: Wiley.
2. Halliday, D., Resnick, R. & Krane, K. S. (2003). *Physics* (5th Ed.). New York: Wiley.

Suggested Books

1. Young, H. D., Freedman, R. A. & Ford, A. L. (2019). *University physics* (15th Ed.). New York: Pearson.
2. Serway, R. A. & Jewelt, J. W. (2014). *Physics for scientist and engineers* (9th Ed.). New York: Brooks/Cole.
3. Melissinos, A.C. (2008). *Experiments in modern physics.* New York: Academic press.