

SCHEME OF STUDIES
FOR
Associate degree in Biochemistry
(For Affiliated Colleges)
(Semester / Term System)
(Fall 2023)



INSTITUTE OF CHEMISTRY
UNIVERSITY OF SARGODHA
SARGODHA

1. **Title of Degree Program:** Associate Deegree in Biochemistry

2. **Program Learning Objectives:**

ADS/ADP Biochemistry, aiming at following PLOs.

- a) Comprehensive curriculum comparable to national and international standards.
- b) Peer review of curriculum and its continuous updating.
- c) Conducive environment for teaching and discussion
- d) Expand infrastructure for study, research/Practical understanding through experiments and research.
- e) Seek collaboration with industry and research organizations.

3. **Program Structure:**

Duration	Minimum 2-Years (4-Semesters), Maximum 3-Years (6-Semesters)		
Admission Requirements:	1. Students with Pre-Medical in HSSC / A-level with Chemistry or Biology as an elective subject after 12-years of education. 2. Students with Pre-Medical in HSSC with Chemistry or Biology as an elective subject who have passed intermediate Part-I and awaiting Part-II result		
Degree Completion Requirements:	Minimum 2.00 CGPA out of 4.0 scale with following minimum breakup		
	General Education courses	GE	31 Credit hours
	Disciplinary / Major courses	D	38 Credit hours
			69 Credit hours

4. **General Education (Gen Ed) Requirements: (Mandatory/Core Courses):**

	Semester	Course Code	Course Title	Credit Hours	Prerequisite
1.	1	URCG-5118	Functional English	3(3-0)	Nil
2.	1	URCG-5105 URCG-5126	Islamic Studies (OR) Religious Education / Ethics	2(2-0)	Nil
3.	1	URCG-5123	Applications of Information and Communication Technologies (ICT)	3(2-1)	Nil
4.	2	URCG-5112	Fables, Wisdom and EPICS	2(2-0)	Nil
5.	2	URCG-5116	Science of Society-I	2(2-0)	Nil
6.	2	URCG-5120	Exploring Quantitative Skills	3(3-0)	Nil
7.	2	URCG-5127*	Seerat of the Holy Prophet (SAW)	1(1-0)	Nil
8.	2, 4, 6, 8	URCG-5111*	Translation of Holy Quran	NC	Nil
9.	3	URCG-5119	Expository Writing	3(3-0)	Nil
10.	3	URCG-5121	Tools for Quantitative Reasoning	3(3-0)	Nil
11.	3	URCG-5122	Ideology and Constitution of Pakistan	2(2-0)	Nil
12.	4	URCG-5114	The Science of Global Challenges	3(2-1)	Nil
13.	4	URCG-5124	Entrepreneurship	2(2-0)	Nil
14.	4	URCG-5125	Civics and Community Engagement	2(2-0)	Nil
Total Credit Hours of GE Courses				31	

*Only for Muslim Students

5. Single Major Courses:

	Course Code	Course Title	Credit Hours	Prerequisite
1.	BCHM-5101	Amino Acids, Proteins and Nucleic Acids	4(3-1)	Nil
2.	BCHM-5102	Carbohydrates and Lipids	4(3-1)	Nil
3.	BCHM-5103	Laboratory Biosafety Measures	2(2-0)	Nil
4.	BCHM-5104	Enzymes and Vitamins	4(3-1)	BCHM-5101
5.	BCHM-5105	Basic Molecular Biology	2(2-0)	BCHM-5102
6.	BCHM-5106	Introduction to Computers in Biochemistry	3(2-1)	BCHM-5101, BCHM-5102,
7.	BCHM-5107	Cell Biology and Genetics	4(3-1)	BCHM-5104
8.	BCHM-5108	Bioinorganic and Analytical Chemistry	3(3-0)	Nil
9.	BCHM-5109	Basic Mathematics for Biochemists	2(2-0)	Nil
10.	BCHM-5110	Introduction to Microbiology	4(3-1)	BCHM-5101
11.	BCHM-5111	Basic Statistics for Biochemists	2(2-0)	Nil
12.	BCHM-5112	Cellular Metabolism	4(3-1)	BCHM-5105
Total Credit Hours of Major Courses			38	

Scheme of Studies

Associate degree in Biochemistry
(For Affiliated Colleges)

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	BCHM-5101	Amino Acids, Proteins and Nucleic Acids	4(3-1)	Nil
Major-2	BCHM-5102	Carbohydrates and Lipids	4(3-1)	Nil
Major-3	BCHM-5103	Laboratory Biosafety Measures	2(2-0)	Nil

Semester Total Credit Hours: 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	BCHM-5104	Enzymes and Vitamins	4(3-1)	BCHM-5101
Major-5	BCHM-5105	Basic Molecular Biology	2(2-0)	BCHM-5102
Major-6	BCHM-5106	Introduction to Computers in Biochemistry	3(2-1)	BCHM-5101, BCHM-5102,

Semester Total Credit Hours: 17

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-7	BCHM-5107	Cell Biology and Genetics	4(3-1)	BCHM-5104
Major-8	BCHM-5108	Bioinorganic and Analytical Chemistry	3(3-0)	Nil
Major-9	BCHM-5109	Basic Mathematics for Biochemists	2(2-0)	Nil

Semester Total Credit Hours: 17

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-10	BCHM-5110	Introduction to Microbiology	4(3-1)	BCHM-5104
Major-11	BCHM-5111	Basic Statistics for Biochemists	2(2-0)	Nil
Major-12	BCHM-5112	Cellular Metabolism	4(3-1)	BCHM-5105

Semester Total Credit Hours: 17

Total Cr Hrs.: 69

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

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 Qur'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: سورة البقرہ آیات 1-5، 482-482؛ سورة الحجرات آیات 1-18؛

سورة الفرقان آیات 26-77؛ سورة المومنون آیات 1-11؛ سورة الحزاب آیات 2، 41، 64-66؛
24، 52-55؛ سورة النعام آیات
151-156؛، سورة الصف آیات 1-12؛ الحشر آیات 18-44؛ آل عمران آیات 154-154؛ النحل آیات
14-12؛ لقمن

آیت 44، حم السجده 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: [درج 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۔ 6- کتا
ب و سنت گمراہی سے بچنے کا ذریعہ ہیں۔ 2- ارکان اسلام 5- اسلام ، ایمان ، احسان اور قیامت کی
نشانیوں ، 2- بچوں کی نماز کی تلقین 7- دین کا گہرا فہم ہلا کی خاص عنایت ہے 8- حصول علم، تالو
ت قرآن اور عمل کی اہمیت و فضیلت ، 5- روز محشر کا محاسبہ ، 14- حقوق ہلا کے
ساتھ ساتھ حقوق العباد کا لحاظ رکھنا بھی الزم ہے 11- حسن خلق کی عظمت اور فحش و بد گوئی کی مذمت 14- دنیا و
آخرت کی بھائی

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

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

(سیرت النبی ﷺ) 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، اخلاقی 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. اسلامی تہذیب و تمدن (اسلامی تہذیب کا مفہوم، اسلامی کے عوامل و عناصر، اسلامی تہذیب کی خصوصیات، اسلامی 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 Islaml , IRI, Islamabad
2. Hameed ullah Muhammad, —Muslim Conduct of State
3. Hameed ullah Muhammad, _Introduction to Islam
4. Ahmad Hasan, —Principles of Islamic Jurisprudencel Islamic Research, Institute, International Islamic University, Islamabad (1993)

Suggested Readings

1. Dr. Muhammad Zia-ul-Haq, —Introduction to Al Sharia Al Islamial Allama Iqbal Open University, Islamabad (2001)
2. Dr. Muhammad Shahbaz Manj, Teleemat-e- Islam

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
5. 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 Texts

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

Suggested Readings

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.

This course will cover the fundamental concepts in biochemistry specifically about amino acids, proteins and nucleic acids.

- A general introduction to the science of biochemistry, importance, and the scope of biochemistry.
- Introduction to amino acids and classification
- Structures and functions of amino acids
- Acid- base properties of amino acids
- pH dependent ionization of amino acids
- Identification of amino acids by different methods
- Chemical and enzymatic reactions of amino acids
- Proteins and its types
- Introduction, classification; structure and function of proteins; physical and chemical properties; conjugated proteins; primary, secondary, tertiary, and quaternary structure determination
- Protein denaturation and renaturation
- Isolation, purification, and characterization of proteins; advanced techniques for protein analysis
- Brief introduction of nucleic acids
- Composition and structure of DNA & RNA
- Types of DNA and RNA
- Function of the DNA & RNA
- Extra nuclear DNA

Labs

- Qualitative tests of proteins & amino acids: Biuret Test; Ninhydrin Test; Xanthoproteic Test; Pauly's Test; Hoplein's Test; Ehrlich's Test; Sakaguchi Test; Sodium nitroprusside Test; sulphate Test Phosphate Test; Aldehyde Test
- Extraction of proteins from plant sources and their confirmative tests.
- Separation of Amino Acids using Paper and Thin Layer Chromatography
- Determination of total proteins by using different methods
- Protein estimation by using UV/Visible spectrophotometer.
- Determination of Secondary structure of Proteins using online available software; Protein purification by using different chromatographic techniques
- Isolation of DNA from plants sample
- Quantification of DNA and RNA

Recommended Texts

1. Lehninger Principles of Biochemistry. (2012) 6th Ed. By David L. Nelson, Michael M. Cox W.H. Freeman; 6th Edition.
2. Principles of Biochemistry. (2011) 5th Ed. by Laurence A. Moran, Robert A Horton, Gray Scrimgeour and Marc Perry.
3. Fundamentals of Biochemistry (2010) 4th Ed. by D. J. Voet, G.J. Voet and C. W. Pratt. J. Wiley & Sons Inc.

Suggested Readings

1. Textbook of Practical Biochemistry. Joshi A. Rashmi. B. Jain Publishers, 2002.
2. Introductory Practical Biochemistry. 2005. 2ndEd. By S. K. Sawhney, Randhir Singh. Alpha Science International, Ltd.
3. Harpers Illustrated Biochemistry. (2012). 29th Ed. By Robert Murray, David Bender, Kathleen M. Botham, Peter J. Kennelly, Victor Rodwell, P. Anthony Weil. McGraw-Hill Medical.

To understand the principles and concepts concerning the chemical, physical, and biological properties of carbohydrates and lipid in biological processes including signal transduction.

Contents

- Introduction, historical background, occurrence and biological significance of carbohydrates
Nomenclature and classification of carbohydrates
- Structures, chemical and physical properties of monosaccharides, oligosaccharides and polysaccharides
- Introduction, classification, and biological functions of lipids
- Classification, nomenclature, structures and properties of fatty acids
- Structure and properties of simple and mixed triglycerides and waxes
- Structure, properties and functions of phospholipids, sphingolipids and glycolipids
- Steroids: Structure, classification, nomenclature and their biological role. Lipids as signals, cofactors and pigments
- Proteolipids and functions, membranes

Lab

- Qualitative Analysis of known carbohydrates (e.g., Glucose, galactose, fructose, maltose, lactose, sucrose, starch glycogen and cellulose).
- Qualitative Analysis of carbohydrates of given unknown samples
- Extraction of starch from plant sources and its confirmative tests (e.g., Potato, Wheat, Rice, Pulses, Barely, Maize etc).
- Extraction of Glycogen from animal sources (e.g., liver, muscle, etc) & its confirmative tests.
- Qualitative tests for lipids and fatty acids
- Extraction of lipids from animal and plant sources.

Recommended Books

1. Harpers Illustrated Biochemistry. (2012). 29th Ed. By Robert Murray, David Bender, Kathleen M. Botham, Peter J. Kennelly, Victor Rodwell, P. Anthony Weil. McGraw-Hill Medical.
2. Biochemistry. 7th Ed. By Jeremy M. Berg, John L. Tymoczko and Lubert Stryer. Publisher: Palgrave MacMillan; 7th revised international edition (April 1, 2011).

Suggested Books

1. Fundamentals of Biochemistry (2008) 3rd Ed. by D. J. Voet, G.J. Voet and C. W. Pratt. J. Wiley & Sons Inc.
2. Lehninger Principles of Biochemistry. (2012) 6th Ed. By David L. Nelson, Michael M. Cox . W.H. Freeman; 6th Edition (November 21, 2012).

This course is designed to meet the needs of undergraduate students for a comprehensive overview in the historical, theoretical, and practical aspects of applied biological safety in research and industrial environments. This will teach students how to handle biological issues and make rational decisions. Biosafety is also one of the concerns of current era specially for the lab biologists and all health-related professionals. Similarly, biosecurity is one of another challenge which was addressed here in this course very efficiently and in a productive manner.

Contents

1. Introduction to biosafety
2. Definition, concept, uses and abuses of genetic information.
3. Personal Protective Equipment (PPE)
4. Biohazards; Biological risks, Classification of biological agents, biological agents and risk groups
5. Good laboratory practices
6. Classification of laboratories on the bases of biosafety levels
7. Biosafety cabinets and their types
8. Biosecurity
9. Laboratory waste management
10. Introduction to bioethics
11. Ethical issues to use animals in research
12. Ethical issues related to GMOs
13. Euthanasia □ Transgenic organisms
14. Biological and toxin weapons convention
15. Ethics related to reproductive and cloning technologies.
16. Genetic counseling and related issues
17. Transplants and eugenics

Recommended Books

1. Fleming, Diane O. and Hunt, Debra A., Biological Safety: Principles and Practices, Amer Society for Microbiology, 4th Edition, 2006
2. Burnette, Ryan, Biosecurity: Understanding, Assessing, and Preventing the Threat, Wiley, 2013.

Suggested Readings

1. Collins CH, Kennedy DA. Laboratory-acquired Infections: History, incidence, causes and preventions. 4th ed. Butterworth-Heinemann, Oxford, 1999 2.
2. Wooley and Byers. Biological Safety, Principles and Practices. 6th ed. ASM Press, Washington, D.C., 2017

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 hikāyāt 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 ta'mīr-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.

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
7. 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.
5. Smelser, N.J. and Swedburg, R., *The Handbook of Economic Sociology*, Chapter 1 'Introducing Economic Sociology', Princeton University Press, Princeton.

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

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	<p>۱۔ طلباء کو مطالعہ سیرۃ طیبہ کی ضرورت و اہمیت سے آگاہ کرنا</p> <p>۲۔ تعمیر شخصیت میں مطالعہ سیرۃ طیبہ کے کردار کو واضح کرنا</p> <p>۳۔ بیعت نبوی کے موقع پر اقوام عالم کی عمومی صورت حال سے آگاہ کرنا</p> <p>۴۔ رسول اکرم صلی اللہ علیہ وسلم کی کئی اور مدنی زندگی کا اس طرح مطالعہ کرانا کہ طلباء ان واقعات سے نتائج کا استفادہ کر سکیں</p> <p>۵۔ طلباء کو عہد نبوی کی معاشرت، سیاست، معیشت سے آگاہ کرنا</p>

Course Description

S.No.	Title	Description
1	حضور صلی اللہ علیہ وسلم کے ابتدائی حالات زندگی	<p>۱۔ حضور صلی اللہ علیہ وسلم کا تعلق انی حسب و نسب</p> <p>۲۔ پیدائش اور ابتدائی تربیت</p> <p>۳۔ لڑکپن اور جوانی کے حالات زندگی</p>
2	بیعت نبوی کے وقت دنیا کے حالات (۱)	<p>۱۔ بیعت نبوی کے وقت اہم تہذیبیں</p> <p>۲۔ عرب، مصر، حبشہ، یونانی، ساسانی</p>
3	بیعت نبوی	۱۔ کئی عہد میں دعوت اسلام
4	بیعت نبوی	۱۔ مدنی عہد میں دعوت اسلام
5	مخصائص النبی	آپ کی بطور پیغمبر امن
6	مخصائص النبی	بہنیت استاد و معلم
7	مخصائص النبی	بہنیت تاجر
8	مخصائص النبی	بہنیت سربراہ ریاست
9	مخصائص النبی	ذاتی محاسن اور عالمگیر اثرات

10	مخصا نكس النبى	ناموس رسالت
11	اسوہ حسنہ اور عصر حاضر	غير مسلموں سے تعلقات
12	اسوہ حسنہ اور عصر حاضر	اسوہ حسنہ كى روشنى ميں گھريلو زندگى
13	اسوہ حسنہ اور عصر حاضر	مستشرقين اور مطالعہ سيرت
15	اسوہ حسنہ اور عصر حاضر	وطن سے محبت اور سيرت
16	اسوہ حسنہ اور عصر حاضر	مستشرقين كے اعتراضات اور ان كے جوابات

تصالي كتب

نمبر شمار	نام مؤلف	نام كتاب
1	ابن هشام	السيرة النبوية
2	مولانا شبلى نعمانى، سيد سلمان ندوى	سيرة قائللى صلى الله عليه وسلم
3	قاضى محمد سليمان سلمان منصور پورى	رحمة اللعالمين
4	مولانا سيد ابوالحسن على ندوى	نبى رحمت صلى الله عليه وسلم
5	ڈاكٲر شمس مظهر صدائى	عهد نبوى كا نظام حكومت
6	ڈاكٲر خالد علوى	انسان كامل

حوالہ جاتى كتب

نمبر شمار	نام مؤلف	نام كتاب
1	سيد ابوالاعلى مودودى	سيرت سرور عالم صلى الله عليه وسلم
2	مولانا مفتى ارمن سيد كبرى	ار حيق الختم
3	مير محمد كرم شاهه الازهرى	فضيلاء النبى صلى الله عليه وسلم
4	ڈاكٲر اكرم انصيارا العبرى	السيرة النبوية الصحيحة
5	مولانا سيد ارفق دانا پورى	اصح السير

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

The objective of this course is to provide in depth knowledge of how enzymes work as biological catalysts and how the rates of reactions are impacted by a variety of different factors and environmental conditions.

Contents

- Introduction to enzymes, nomenclature and classification
- Isoenzymes, coenzymes and role of cofactors
- Structure of enzyme; active site and regulatory sites
- Enzyme specificity and different types
- Kinetics of chemical reactions
- Michaelis-Menten equation and other models used to understand kinetics • Multienzyme system and two substrate reactions.
- Enzyme Inhibition and types of inhibition
- Ribozyme
- Enzyme catalysis; catalytic strategies and mechanisms of different enzymes
- Regulation of enzyme activity
- Effect of various factors on rate of reactions
- Enzyme assays
- Immobilized enzyme
- Applications of enzyme
- Type and function of fat soluble and water-soluble vitamin.
- Genetic Diseases related to vitamins.

Labs

- Extraction and estimation of enzymes from plant source.
- Acid and enzymatic hydrolysis of glycogen and starch Biosynthesis of enzymes by fungi and bacteria.
- Effect of Temperature on enzymes activity.
- Effect of Substrate concentration on enzyme activity.
- Effect of Enzyme concentration on enzyme activity.
- Effect of heat on stability of enzyme.
- Estimation of ascorbic acid.

Recommended Texts

1. Biochemistry (2007) 6th edition by J.M. Berg, J.L. Tymoczko & L. Stryer W.H. Freeman & Co.
2. Fundamentals of Biochemistry (2008) 3rd Ed. by D. J. Voet, G.J. Voet and C. W. Pratt. J. Wiley & Sons Inc.
3. Lehninger Principles of Biochemistry 5th Ed. by D. L. Nelson, M. M. Cox. W. H. Freeman Publishers.

Suggested Reading

1. Biochemistry. (1999) 3rd Ed. by C. K. Mathews, K. E. Van Holde, & K.G. Ahern. Prentice Hall.
2. Harper's Illustrated Biochemistry, 27th Ed. By R.K. Murray, D.K. Grannar, V.W.

This course introduces basic concepts of molecular biology. This course makes students to understand the basic knowledge and life processes at molecular level. This course will impart knowledge about structure and function of nucleic acids and understand the concept of central dogma of molecular biology. Upon successful completion of the course, the student will be able to acquire the basic knowledge and concepts of molecular biology. They will understand the process of DNA replication, DNA damage and repair, transcription and translation. Understand and explain the concepts of basic principles and techniques of molecular biology which prepares students for further education and/or employment in teaching, and basic research.

Contents

1. Introduction to molecular biology and history.
2. Structure and function of nucleic acids
3. Organelles genome (Mitochondrial and chloroplast).
4. DNA replication in prokaryotes and eukaryotes
5. DNA damage and repair
6. Transcription in prokaryotes and eukaryotes
7. Post transcriptional processing (e.g., RNA splicing, alternative splicing, editing)
8. Genetic code
9. Translation in prokaryotes and eukaryotes
10. Post-translational processing in prokaryotes and eukaryotes.
11. Protein folding, targeting and turnover.

Labs

1. Cell lysis and Centrifugation
2. Isolation of DNA from bacteria
3. Isolation of RNA from animal cells
4. Agarose electrophoresis

Recommended Texts

1. Fundamentals of Biochemistry. (2008) 3rd Ed. by D. J. Voet, G.J. Voet and C. W. Pratt. J. Wiley & Sons Inc.
2. Textbook of Biochemistry (1970) by E. West & W. Todd Macmillan

Suggested Readings

1. Principles of Biochemistry (2017), 7th Edition by Lehninger A.L., Nelson D.L. and Cox M.M., Worth Publishers, New York 4.
2. Harper's Illustrated Biochemistry, 27th Ed. by R.K. Murray, D.K. Grannar, V.W. Rodwell. McGraw-Hill.

This course will introduce you to the field of computer science and the fundamentals of computer programming. This is specifically designed for students with no prior programming experience and touches upon a variety of fundamental topics. There are many ways computers are used in life science; usually through either the use of sensors and other hardware that only a computer can understand, or computers' incredible capacity for doing complex analyses quickly. A piece of analysis that would take a human 20 years to complete could be done by computer in days. The examples of computers in life science we will discuss in this lesson are medical imaging, genomics, drug design and discovery, assistive technology, and simulation.

Contents

1. Basic Definitions & Concepts Hardware
2. Computer Systems & Components Storage Devices
3. Number Systems Software
4. Operating Systems, Programming and Application Software
5. Introduction to Programming; python concepts
6. Databases and Information Systems Networks Data Communication
7. The Internet, Browsers and Search Engines
8. The Internet: Email, Collaborative Computing and Social Networking
9. The Internet: E-Commerce IT Security and other issues Project Week Review Week
10. MS Office for Life science students
11. Use of chemical sketching software
12. Molecular Visualization

Recommended Texts

1. Introduction to Computers by Peter Norton, 6th International Edition, McGraw-Hill 197
2. Using Information Technology: A Practical Introduction to Computer & Communications by Williams Sawyer, 6th Edition, McGraw-Hill

Suggested Readings

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.

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.

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, Histogram, 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.

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)

Cell biology, genetics and evolution are fundamental to an understanding of the processes of life. In this unit, students will be able to examine the structure and function of prokaryotic and eukaryotic cells, including a discussion of the energy flow in photosynthesis, respiration and metabolism. A brief introduction to DNA structure and function from molecular to organism levels and current applications of DNA technology will be studied. This will also enlighten and introduce with classical genetic and evolutionary theory as unifying explanations of life. This course is intended for the student interested in understanding and appreciating common biological topics in the study of the smallest units within biology: molecules and cells. There are thousands of opportunities within the medical, pharmaceutical, agricultural, and industrial fields for a person with a concentrated knowledge of molecular and cellular processes. This course will give you a general introduction of cell organelles, cell division and enzymes which are involved in the process of metabolism. Evolution is the process of change in all forms of life over generations, and evolutionary biology is the study of how evolution occurs. Laboratory practicals will investigate enzyme function, cytogenetics and the genetic analysis of populations.

Contents

1. Structure and Function of Bio-molecules (Carbohydrates, Lipids, Proteins, Nucleic Acids)
2. Cell: Cell theory, cell types (prokaryotes, eukaryotes), basic properties of cell.
3. Brief description of structure and function of the cell organelles
4. Cell wall, Cell membrane, Nucleus, Endoplasmic reticulum, Plastids, Mitochondria, Ribosomes, Dictyosomes, Vacuoles
5. Reproduction in somatic and embryonic cell, mitosis, meiosis and cell cycle
6. Introduction, scope and brief history of genetics.
7. Mendelian inheritance: Laws of segregation and independent assortment, back cross, test cross, dominance and incomplete dominance
8. Molecular genetics; DNA replication, nature of gene, genetic code, transcription, translation, protein synthesis, regulation of gene expression (e.g. lac operon).
9. Chromosomal aberrations; Changes in the number of chromosomes.
10. Aneuploidy and Euploidy.
11. Changes in the structure of chromosomes, deficiency, duplication, inversion and translocation.

Cell Biology, Genetics and Evolution Lab

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

Genetics

6. Genetical problems related to transmission and distribution of genetic material.
7. Identification of chromosomes in plant material. Carmine/orcein staining.
8. Determination of blood groups

Recommended Texts

1. Templeton, N.C. (2015). *Gene and cell therapy* (4th ed.). Germany: Taylor and Francis Publications.
2. Sybille, M., & Shoshan, M. (2015). *Tumor cell metabolism*. Germany: Springer Publications.

Suggested Readings

1. Verma P. S., & Agarwal, V. K. (2016). *Cell Biology (Cytology, Biomolecules and Molecular Biology)*. India: S. Chand Publishing.

2. Milo, R., & Phillips, R. (2015). *Cell biology by the numbers* (1st ed.). Germany: Taylor and Francis publications.
3. Bradshaw, R., & Stahl, P. (2015). *Encyclopedia of cell biology*. Amsterdam: Elsevier Publications.

Bioinorganic chemistry is a field that examines the role of metals in biology. Bioinorganic chemistry includes the study of both natural phenomena such as the behavior of metalloproteins as well as artificially introduced metals, including those that are non-essential, in medicine and toxicology. Interaction of various inorganic compounds with the biological species enables the scientist to design and formulate medicines for different diseases. 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.

Contents

1. Nature of metal-carbon bonds
2. Compounds with metal-carbon single bonds
3. Compounds with metal-carbon π - bonds
4. Bio-inorganic chemistry: introduction
5. Bio-inorganic chemistry: Environmental intrusion
6. Role of inorganic species in vivo
7. main group ions (Na^+ , K^+ , Ca^{++} , Mg^{++})
8. Trace elements: general roles, lanthanides & actinides, Zn, Cu, Cr, Mo, W, Co, Si, Se, Sn, I.
9. Storage and transport of iron
10. Metalloenzymes
11. Data Handling: introduction to analytical chemistry
12. Sampling; types of samples, techniques/ steps involved in sample preparation
13. Weighing, analytical balance, its construction working
14. Chemical concentration and preparation of solutions
15. Calibration and calibration curves (construction and interpretation), Standard addition and internal standard methods
16. Statistical treatment of analytical data; Precision, accuracy and types of errors, sample, population, mean, average, median, range, standard deviation, variance, significant figures
17. Separation techniques: chromatography (introduction, classification) TLC, column & ion exchange chromatography (with reference to principles & applications), electrophoresis & solvent extraction

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. Roat-Malone, R. M. (2007). *Bioinorganic chemistry: a short course*. New York: John Wiley & Sons.
2. Skoog, D.A., West, D.M., Holler, F.J., & Crouch S. R. (2014). *Fundamentals of analytical chemistry*. (9th ed.) Philadelphia: Saunders College Publishing.
3. Christian, G.D., Dasgupta, P.K., & Schug, K.A. (2013). *Analytical chemistry*. (4th ed.). New York, John Wiley & Sons.

This course introduces students with basic mathematics that is used in Biochemistry. This is the fundamental course of serving as the foundation of mathematics for its use in biochemistry and chemical calculation during the lab experiments and research. The course, equally, emphasizes basic concepts and skills needed for mathematical manipulation. It focusses 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. Students 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.

SEMESTER-IV

URCT-5115

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 wastewater 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

1. 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*. Obroonnosc. Zeszytl Naukowe. Turkey

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). *Small business handbook*. Prentice Hall Press.

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 York: 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

Suggested Readings

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

<p>Course Contents:</p>	<p>ایمانیات اور عبادات 0 بلا پر ایمان، فرشتوں پر ایمان، رسولوں پر ایمان، آسمانی کتابوں پر ایمان یوم آخرت پر ایمان، تقدیر پر ایمان نماز، روزہ، زکوٰۃ، حج، جہاد 0 معاشرے کے حقوق خاندان کی تکوین حق مہر رضاعت و حمل والد کو قتل کرنے کے ممانعت شوہر کی 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 والد کے بیچ عداوت 0 خاندان کے حقوق مہمان کی عزت اجازت طلب کرنے کے اصول مجلس کے آداب تعاون اور بھائی چارہ گروہ بندی محبت لوگوں کے درمیان صلح عفو و درگزر، غصہ پر قابو اور معاف کرنا شعوب و قبائل لوگوں کے بیچ اختلافات حمایت و نگہبانی</p>
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Grammar:	<p>قرآنی عربی گرامر کے اصول اور انکے اطلاقات (متن قرآنی پر اطلاق سے توضیحات)</p>
<p>Details of Chapters and verse Numbers:</p>	<ul style="list-style-type: none"> ▪ منتخب آیات مع ترجمہ و تجوید ▪ البقرہ ((۱۱۷، ۲۳۸، ۴۵، ۱۱۸، ۲۷۸، ۱۷۷، ۴۵، ۳۴۷، ۱۵۸، ۷۱۸، ۴۲۸، ۵۳، ۴۲۸، ۴۷، ۲۸۷، ۳۴۸، ۲۲، ۸۲، ۲۸۷، ۴۲۸، ۲۴۸، ۱۱۷، ۲۳۷، ۲۲۷، ۱۱۸، ۵۲۷، ۳۲۷، ۲۷۸، ۲۴۷، ۷۵۸، ۲۲۷، ۱۸۸، ۲۸۸، ۱۳۸، ۲۸۸، ۲۸۸، ۷۳۸، ۱۳۸، ۴۳۸، ۱۳۸، ۸۲، ۵۲۷، ۳۳۸، ۸۲۷، ۱۲۷، ۳۲)) ▪ النساء (۴۲، ۸۲، ۲۴، ۲۳۷، ۲۲، ۱۲، ۳۷، ۲۲، ۲۲، ۱۲، ۲۳، ۲۲، ۲۱۷، ۸۷، ۴۳، ۲۸۷، ۵۳، ۷۷، ۵، ۲۱۷، ۵۸، ۴۸، ۷۷، ۷۷، ۲۸۷، ۷۲۷، ۴۳، ۱۸، ۴۳، ۷۲۷، ۲، ۷، ۱۸، ۷، ۲۷، ۲۵۷، ۵۴، ۲۸۷، ۷۲) ▪ النعام (۸۸، ۸۲، ۵۷، ۱۳۷، ۷۴۷، ۲۵، ۵۴) ▪ آل عمران (۱۲، ۲۳، ۴۲، ۴۸۷، ۵۲، ۵۵۷، ۲۷، ۷) ▪ المائدہ (۵۴، ۸، ۸۲، ۲۳، ۲۷، ۸۲، ۸، ۴) ▪ العراف (۴۳، ۲۲۷، ۲۲۷) ▪ التوبہ (۱۸، ۲۷، ۷۱) ▪ ہود (۸۷) ▪ الزمر (۲) ▪ النور (۵۴، ۸۴، ۲۸، ۱۸، ۱۲، ۲۸) ▪ محمد (۳۳) ▪ انفال (۸۲، ۱۸) ▪ الرعد (۳) ▪ الطالق (۵) ▪ الحج (۴) ▪ ابراہیم (۵۵، ۳۸) ▪ السراء (۳۸، ۵۸) ▪ الحقاف (۴۷) ▪ المؤمنون (۱۸) ▪ العنکبوت (۲۵، ۴۸، ۲) ▪ النحل (۸۸) ▪ لقمان (۵، ۴۷، ۵۷) ▪ الحزاب ((۴۳، ۲۳، ۱۴، ۲۵)) ▪ الشعراء (۱) ▪ الروم (۷۸) ▪ مریم (۲۸، ۵۷) ▪ المجادلہ (۸۷، ۷۷)

This course provides a basic understanding of microorganisms, types, classification and functions. Students will get hands on experience in the microbial production of biopolymer, enzymes, bioactive compounds, and biomass. This course introduces the basic principles of microbiology examining the microbes that inhabit our planet and their effect on the biosphere. Introduction to Microbiology explores this impact through the lens of all areas of microbiology. Students will assess the influence of microbiology and 21st century challenges and opportunities that arise from our changing relationship with and understanding of microbes. Through short lectures, cases studies, in-class group work, and homework projects, students will probe the science of microbes and the social issues and concerns relevant to the field of microbiology including emerging infectious disease, antibiotic resistance, the anti-vaccine movement, and dual-use biological research.

Contents

1. Definitions and Scope of Microbiology
2. Introduction and brief History of Microbiology
3. Structure and Function
4. Microbial Metabolism
5. Microbial Growth and Biofilms
6. Genetics – Overview
7. Replication, Transcription, Translation
8. Mutations and Genetic Control
9. Applications of Microbial Genetics
10. Microbial Evolution and Taxonomy
11. Microbial Ecosystems
12. Microbial Interactions – The Build Environment, The Human Microbiome
13. Microbial Diversity – Prokaryotes and Eukaryotes
14. Microbial Diversity – Viruses
15. Epidemiology
16. Pathogenicity, Immunity, Immune disorders
17. Control of Microbes
18. Clinical Microbiology
19. Food Microbiology

Labs

1. Sterilization techniques
2. Culturing of bacteria in liquid and solid medium
3. Isolation and identification of microbes from different samples
4. Colony morphology and colony count
5. Preservation of culture
6. Microbial cell/spore count and growth curves
7. Gram-staining of bacteria
8. Endospore staining
9. Determination of sensitivity of isolates to different antibiotics

Recommended Texts

1. Willey, J. Sherwood, L. & Woolverton, C. J. (2017). *Prescott's microbiology*. (10th ed.). New York, USA: Prescott Publishers.
2. Dawis, B. D., Dulbecco, R., Eisen, H. N., & Ginsberg, H. S. (2002). *Microbiology*. New York, USA: Harper & Row.

Suggested Readings

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.

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
19. Chi Square for Association.
20. Statistics by using Software GraphPad Prism and MS Excel

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.

To provide concept of metabolism and regulation of carbohydrates and lipids. The students will be able to understand glycolytic and energy generating pathways and other intermediary pathways for carbohydrates. This course will enhance knowledge about biosynthesis and degradative pathways of fatty acids and lipids. On successful completion of this course the students will be able to Acquire the knowledge about intermediary biochemical processes. They will be able to demonstrate the metabolic pathways of carbohydrates and lipids - the energy yielding and energy requiring reactions in life and understand the diversity of metabolic regulation of two macromolecules, and how this is specifically achieved in different cells.

Contents

1. Carbohydrate metabolism: Digestion and absorption of carbohydrates
2. Role of glucose in metabolism of plants, animals and microorganisms
3. Glycolysis: reactions of glycolysis and energy calculation, anaerobic fate of pyruvate, fermentation, control of metabolic flux. Regulation of glycolytic pathway. Metabolism of other monosaccharides (Feeder pathways).
4. Conversion of Pyruvate to acetyl CoA
5. TCA cycle: Overview of TCA, Metabolic sources of Acetyl Coenzyme A, Regulation of TCA Cycle, Reactions of Electron Transport chain, Energetics, Shuttle systems.
6. Other pathways of carbohydrate metabolism: Gluconeogenesis, cori cycle, glycogenesis, glycogenolysis, Glyoxalate Cycle reactions, Pentose phosphate Pathway.
7. Carbohydrate synthesis: Synthesis of starch, cellulose and peptidoglycan, glycoproteins. □ Glycogen metabolism: Synthesis and breakdown, glycogen synthetase and phosphorylase and their regulation, Glycogen storage diseases. Lipid metabolism:
8. Introduction to lipid digestion, absorption and transport
9. Lipolysis and utilization of glycerol
10. β -oxidation of fatty acids and various modes of oxidations
11. Ketogenesis, ketolysis and regulation
12. Biosynthesis of fatty acids, Elongase and Desaturase systems
13. Biosynthesis of triacylglycerols, Phospholipids, Cardiolipins, Glycolipids and sphingolipids
14. Prostaglandins: Prostacyclins, Thromboxanes and leukotrienes
15. Lipoproteins: metabolism of plasma lipoproteins.
16. Metabolism of cholesterol, steroid hormones and bile acids.
17. Protein metabolism Digestion and pathways
18. Nucleic Acid metabolism

Labs

1. Isolation of serum and plasma from human blood
2. Estimation of fasting/random glucose levels in human serum by colorimetric methods (DNS method, glucose peroxidase method).
3. Estimation of Hemoglobin in human blood.
4. Estimation of total protein serum/urine proteins by Colorimetric method.
5. Estimation of urea, creatinine triglycerides Glutathione, ammonia and cholesterol
6. Liver function tests and lipid profiles from human serum
7. Estimation of Sodium (Na⁺), Potassium (K⁺) and Chloride (Cl⁻) from serum using flame photometer.
8. Estimation of heavy metals in human serum using atomic absorption.
9. Isolation and enzymatic hydrolysis of Glycogen from Liver
10. Sterilization and Preparation of culture media i.e use of autoclave
11. Streak, pour and spread plate methods.
12. Testing sensitivity to antimicrobial substances, Preparing serial dilutions of cultures
13. Use of microscope and differential staining: Gram's staining method
14. Online resources for metabolic pathways i.e. KEGG, MetaCyc

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. Swaminathan, R. (2011). *Handbook of clinical biochemistry*. (2nd ed.). Singapore: World Scientific Publishing Company.
2. Walker, J. M. (1994). *The basic protein and peptide protocols*. New Jersey, USA: Humana Press.