

ADP

Model LAYOUT (BIO COMBINATIONS)

Compulsory Courses		Foundation Courses		Major Courses		Elective Courses	
8 Courses		3 Courses		7		2 Courses	
22 Credit Hours		12 Credit Hours		27 Credit Hours		7 Credit Hours	
Subjects	C. hrs	Subjects	C. hrs	Subjects	C. hrs	Subjects	C. hrs
1- English-I (Functional English)	3	1- Subject A-I	4	1- Subject A-II	4	1-Subject A/C E-1*	3 4
2- English-II (Composition & Comprehension)	3	2- Subject B-I	4	2- Subject B-II	4	2- Subject A/C E-2*	
3- English-III (Communication Skills)	3	3- Subject C-I		3- Subject C-II	4		
4- Pakistan Studies	2			4- Subject A-III	3		
5- Islamic Studies	2			5- Subject B-III			
6- Introduction to Computer	3			6- Subject C-III			
7- Arabic	3			7- Subject B-IV			
8- Foundation of Mathematics							

*Elective can be chosen from the courses in subject B or C

Percentage of Each Category of Courses

Sr. No.	Categories	No. of Courses	Credit hours	% age of total credit hours
1	Compulsory Requirement (No Choice)	8	22	31.43
2	Discipline Specific Foundation Courses	3	12	17.14
3	Major Courses including project/Internship	7	27	38.57
4	Elective within the major	3	9	12.86
	Total	21	70	100%

Abbreviations in enclosed parenthesis used in below tables.

C1, C2....., for Compulsory Courses

F1, F2....., for Foundation Courses

M1, M2.....For Major Courses

E1, E2....., for Elective Courses

Associate Degree in Science
Combination (Botany, Zoology & Chemistry)

Semester-I

Sr.No	Course Code	Course Title	Crd. Hrs		
			Theory	Lab.	Total
1	ENG-1107	English-I (C1)	3	0	3
2	ISL-1112	Islamic Studies (C2)	2	0	2
3	CHEM-1104	Inorganic Chemistry (F1)	3	1	4
4	ZOL-1101	Principles of Animal Life-I (F2)	3	1	4
5	BOT-1101	Diversity of Plants (F3)	3	1	4
Total			14	3	17

Semester-II

Sr.No	Course Code	Course Title	Crd. Hrs		
			Theory	Lab.	Total
1	ENG-1207	English-II (Functional) (C3)	3	0	3
2	PS-1217	Pakistan Studies (C4)	2	0	2
3	CHEM-1204	Organic Chemistry (M1)	3	1	4
4	ZOL-1201	Principles of Animal Life-II (M2)	3	1	4
5	BOT-1201	Plant Systematics, Anatomy & Development (M3)	3	1	4
Total			14	3	17

Semester-III

Sr.No	Course Code	Course Title	Crd. Hrs		
			Theory	Lab.	Total
1	ENG-2307	English (REPORT WRITING) (C5)	3	0	3
2	MAT-2315	Mathematics (C6)	3	0	3
3	CHEM-2304	Physical Chemistry (M4)	3	1	4
4	ZOL-2301	Diversity of animal life-I (M5)	3	1	4
5	BOT-2301	Cell Biology, Genetics and Evolution (M6)	3	1	4

Total	15	3	18
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Semester-IV

Sr.No	Course Code	Course Title	Crd. Hrs		
			Theory	Lab.	Total
1	COM-2405	Computer Applications (C7)	3	0	3
2	ARA-2401	Arabic (C8)	3	0	3
3	CHEM-2481	Biochemistry (M7)	3	0	3
4	CHEM-2404	Analytical Chemistry (E1)	2	1	3
5	BOT-2401	Plant Physiology and Ecology (E2)	2	1	3
6	ZOL-2401	Animal Diversity-II (E3)	2	1	3
Total			15	3	18

OBJECTIVES:

Enhance language skills and develop critical thinking.

CONTENTS:

Basics of Grammar

Parts of speech and use of articles

Sentence structure, active and passive voice

Practice in unified sentence

Analysis of phrase, clause and sentence structure

Transitive and intransitive verbs

Punctuation and spelling

Comprehension: Answers to questions on a given text

Discussion: General topics and every-day conversation (topics for discussion to be at the discretion of the teacher keeping in view the level of students)

Listening: To be improved by showing documentaries/films carefully selected by subject teachers

Translation skills: Urdu to English

Paragraph writing: Topics to be chosen at the discretion of the teacher

Presentation skills: Introduction

Note: Extensive reading is required for vocabulary building

RECOMMENDED BOOKS:

1. Functional English

a) Grammar

1. Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 1. Third edition. Oxford University Press. 1997. ISBN 0194313492

2. Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 2. Third edition. Oxford University Press. 1997. ISBN 0194313506

b) Writing

1. Writing. Intermediate by Marie-Christine Boutin, Suzanne Brinand and Françoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 0 19 435405 7 Pages 20-27 and 35-4
- c) Reading/Comprehension
1. Reading. Upper Intermediate. Brain Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1992. ISBN 0 19 453402 2.
- d) Speaking

ISL-1112

Islamic Studies (C2)

Cr. 2

10 فیصد	قرآن مجید
10 فیصد	حدیث
10 فیصد	دین اسلام
15 فیصد	سیرة النبی ﷺ
15 فیصد	تہذیب انسانی کی تعمیر میں اسلام کا حصہ
15 فیصد	اسلام کی اخلاقی اقدار
10 فی صد	ہمارا مستقبل (ہمارے مسائل اور ان کا حل)
15 فیصد	معروضی سوالات
	تفصیل نصاب

1- مطالعہ قرآن

1- قرآن مجید کے مطالعہ کی ضرورت و اہمیت

فضائل قرآن مجید

- سورة فرقان کا تعارف
- آداب معاشرت (آیت 61 تا 77)
- سورة الحجرات کا تعارف
- نبی صلی اللہ علیہ وسلم کا مقام (آیت 1 تا 5)
- تحقیق احوال و ایمان یا اصلاح معاشرہ (آیت 6 تا 8)
- اخوت (آیت 9 تا 12)
- اعرابیوں کا دعویٰ ایمان کا جائزہ (آیت 13 تا 18)

2- مطالعہ حدیث

حدیث کی اہمیت و ضرورت، مطالعہ حدیث کی اہمیت و ضرورت

- ارکان اسلام
- کثرت سوال کی ممانعت
- متشابہات سے پرہیز
- فضولیات سے پرہیز
- اخوت
- اچھی بات اور ہمسایہ اور مہمان کی عزت
- غصہ نہ کرنا
- نیکی کی اہمیت
- حیا کی اہمیت
- ایمان باللہ
- جنت کی شرائط
- زہد
- ضرر رسانی کی ممانعت
- قانون شہادت
- برائی روکنے کا حکم
- احسانات خداوندی
- زندگی بسر کرنے کا طریقہ
- مومن کی نشانی
- مسلمان کی شناخت
- مومن کی نشانی

3- دین اسلام

(الف) عقائد

- توحید
- رسالت
- آخرت
- (ب) عبادات

- نماز
- زکوٰۃ
- روزہ
- حج
- جہاد

4- سیرۃ النبی صلی اللہ علیہ وسلم

- ولادت تابعث
- بعثت
- تبلیغ
- ہجرت
- میثاق مدینہ اور مواخات
- فتح مکہ

- حجة الوداع
 - وصال نبوی صلی اللہ علیہ وسلم
- 5- اسلام کی اخلاقی اقدار

- فضائل اخلاق
 - اخلاق کی اہمیت
 - تقویٰ
 - صدق (سچائی)
 - ایفائے عہد
 - عدل و انصاف
 - احسان
 - صبر
 - کسب حلال
 - والدین کا احترام
- 6- تہذیب انسانی کی تعمیر میں اسلام کا حصہ

- درمیانی امت (امت وسط)
- شرف انسانیت
- وحدت انسانیت
- اسلام کا تاریخی کردار
- اشاعت علوم
- مسلمانوں کی علمی خدمات
- تاریخی کردار: مسلمانوں کی علمی خدمات کا عالمی سطح پر اعتراف

7- ہمارا مستقبل (ہمارے مسائل اور ان کا حل)

- اسلامی تشخص
- سیاسی مسائل
- اقتصادی مسائل
- تعلیمی مسائل

8- معروضی سوالات (سلیبس میں سے)

مجوزہ کتب

اسلامیات لازمی (بی اے / بی ایس سی / بی کام) ، پروفیسر ڈاکٹر محمد خلیل ، پروفیسر ضیاء الرحمن قریشی ، علمی کتاب خانہ اردو بازار لاہور۔

CHEM-1104

Inorganic Chemistry (F1)

Cr. 3+1

Course Objectives:

Students will acquire knowledge about the key introductory concepts of chemical bonding, acid-

base chemistry, and properties of p-block elements as well as using this knowledge for qualitative and quantitative analysis of inorganic compounds during laboratory work.

Course Contents:

Chemical Bonding:

Types of chemical bonding, ionic and covalent bonding, localized bond approach, theories of chemical bonding, valence bond theory (VBT), hybridization and resonance, prediction of molecular shapes using Valence Shell Electron Pair Repulsion (VSEPR) model, molecular orbital theory (MOT) applied to diatomic molecules, delocalized approach to bonding, bonding in electron deficient compounds, hydrogen bonding.

Acids and Bases:

Brief concepts of chemical equilibrium, acids and bases including soft and hard acids and bases (SHAB), concept of relative strength of acids and bases, significance of pH, pKa, pKb and buffer solutions, theory of indicators, solubility, solubility product, common ion effect and their industrial applications.

p-Block Elements:

Physical and chemical properties of p-block elements with emphasis on some representative compounds, inter-halogens, pseudo-halogens and polyhalides.

Lab

Lab safety and good laboratory practices, knowledge about material safety data sheets (MSD), disposal of chemical waste and first-aid practices, qualitative analysis of salt mixtures, quantitative analysis, acid- base titrations, preparation and standardization of acid and alkali solutions, redox titrations, preparation and standardization of potassium permanganate solution and its use for the determination of purity of commercial potassium oxalate or oxalic acid, preparation and standardization of sodium thiosulfate solution and its use in determination of copper in a given sample, gravimetric analysis, determination of barium in a given sample, determination of chloride in a given solution.

Recommended Books:

1. Shriver, D. F., Atkins, P. W., Langford, C. H., *Inorganic Chemistry*, 2nd ed., Oxford University Press, (1994).
2. Cotton, F. A. and Wilkinson, G., *Advanced Inorganic Chemistry*, 6th ed., John-Wiley & Sons, New York, (2007).
3. Huheey, J. E., *Inorganic Chemistry: Principles of Structure and Reactivity*, 3rd ed., Harper International SI Edition, (2006).
4. House, J. E., *Inorganic Chemistry*, Academic Press. USA, (2008).
5. Lee, J. D., *Concise Inorganic Chemistry*, 5th ed., Chapman and Hall, (1996).
6. Miessler, G. L., Tarr, D. A., *Inorganic Chemistry*, 3rd ed., Pearson Education, India, (2008).
7. Huheey, J. E., Keiter E. A., Keiter L. R., *Inorganic Chemistry: Principles of Structure and Reactivity*, 4th ed., Benjamin-Cummings Pub Co., (1993).
8. Sharpe, A. G., *Inorganic chemistry*, 3rd ed., Pearson Education India, (1981).
9. Chaudhary S. U., *Ilmi Textbook of Inorganic Chemistry*, Ilmi Kitab Khana, Lahore, (2013).
10. Catherine E. House crdft, Alan G. Sharpe, *Inorganic Chemistry*, 3rd ed., Prentice Hall, (2008).
11. Kathleen A. H., James E. H., *Descriptive Inorganic Chemistry*, 2nd ed., Brooks Cole, (2010).
12. Wulfsberg G., *Principles of Descriptive Inorganic Chemistry*, 1st ed., University Science Books, (1991).
13. Hill, R. H. JR and Fister, D. C., *Laboratory Safety for Chemistry Students*, John-Wiley & Sons, Inc., (2010).
14. Mendham, J., Denny, R. C., Barnes, J. D., Thomas, M. and Sivasankar, B., *Vogel's Textbook of Quantitative Chemical Analysis*, 6th ed., Pearson Education, Ltd., (2000).
15. Svehla, G., *Vogel's Qualitative Inorganic Analysis*, 7th ed., (7th imp.), Pearson Education, Ltd., (2009).

ZOL-1101 Principles of Animal Life-I (F2)

Cr. 3+1

Aims and Objectives

The course aims to impart knowledge and understanding of:

1. The concept and status of Zoology in life sciences.
2. The common processes of life through its chemistry, biochemical and molecular processes.
3. The structure and function of cell organelles and how common animal cell diversified in various tissues, organs and organ systems.
4. Biochemical mechanisms eventually generating energy for animal work.

5. Animals and their relationship with their environment.

Course Contents

Scope of Zoology: Introduction; significance and applications of zoology; animal diversity; the scientific method; environment and world resources. **The Chemical Basis of Animal Life:** Brief introduction to biomolecules; carbohydrates, lipids, proteins, and nucleic acids. **Cellular Organization:** Structure of animal cells, cell membrane, cytoplasm and its organelles: ribosomes, endoplasmic reticulum, Golgi apparatus, lysosomes, mitochondria, cytoskeleton, cilia and flagella, centrioles and microtubules, and vacuoles; ribosomes, endoplasmic reticulum, the nucleus: nuclear envelope, chromosomes and nucleolus. **Animal tissues:** Types: epithelial, connective, muscle and nervous tissue; organs and organ systems. **Enzymes:** Structure, types; function and factors affecting their activity; cofactors and coenzymes. **Energy Harvesting:** Aerobic and anaerobic respiration: glycolysis, citric acid cycle and electron transport chain; fermentation, the major source of ATP. **Reproduction and Development:** Types; asexual and sexual, gametogenesis, fertilization, metamorphosis, zygote and early development. **Ecological Concepts:** Individuals and Populations: Animals and their abiotic environment; populations and limiting factors; Communities and Ecosystems: Community structure and diversity; interspecific interactions. Ecosystem, types, homeostasis, biomes, food chain, food web, energy flow and thermodynamics; biogeochemical cycles; Ecological problems; human population growth, pollution, resource depletion and biodiversity.

Practical:

1. Tests for different carbohydrates, proteins and lipids.

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

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

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

3. Preparation of blood smears.

4. Plasmolysis and deplasmolysis in blood.

5. Protein digestion by pepsin.

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

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

Recommended Books

1. Hickman, C.P., Roberts, L.S. and Larson, A. Integrated Principles of Zoology, 12th Edition (International), 2004. Singapore: McGraw Hill.
2. Miller, S.A. and Harley, J.B. Zoology, 6th Edition (International), 2005. Singapore: McGraw Hill.
3. Campbell, N.A. Biology, 6th Edition. 2002. Menlo Park, California: Benjamin/Cummings Publishing Company, Inc.
4. Miller, S.A. General Zoology Laboratory Manual. 5th Edition (International), 2002. Singapore: McGraw Hill.
5. Hickman, C.P. and Kats, H.L., Laboratory Studies In Integrated Principles Of Zoology. 2000. Singapore: McGraw Hill.
6. Molles, M.C. Ecology: Concepts and Applications. 6th Edition. 2005. McGraw Hill, New York, USA.
7. Odum, E. P. Fundamentals of Ecology. 3rd Edition. 1994. W.B. Saunders. Philadelphia.

BOT-1101

Diversity of Plants (F3)

Cr. 3+1

Theory: a) Viruses: Introduction. Comparative study of life form, structure (RNA and DNA types), reproduction and economic significance with special reference to tobacco mosaic virus (TMV).

(b) Bacteria: Introduction. Study of life forms, structures and different types of reproduction in bacteria. Economic importance with specific reference to biofertilizers, pathogenicity and industrial importance. Introduction to structure and reproduction in Cyanobacteria (Anabaena).

(c) Algae: Introduction. Study of life forms, structures, classification, different types of reproduction and economic significance of algae with special reference to Spirogyra, Pinnularia and Chara.

(d) Fungi: Introduction. Study of structure, life cycles, classification, types of reproduction and economic significance of Fungi with special reference to Ustilago, Puccinia and Agaricus.

(e) Lichens: Study of structure, habitat, classification, types of reproduction and economic significance of lichens with special reference to Physcia.

(f) Bryophytes: Study of structure, habitat, mode of reproduction, classification and economic significance of bryophytes with special reference to Riccia, Anthoceros and Funaria.

(g) Pteridophytes: Study of structure, habitat, mode of reproduction, classification and economic significance of pteridophytes with special reference to Lycopside (Selaginella).

(h) Gymnosperms: Study of structure, habitat, mode of reproduction and economic significance of gymnosperms with special reference to Pinus.

(i) Angiosperms: Study of structure, habitat, mode of reproduction and economic significance of angiosperms with special reference to Monocot (Wheat), Dicot (Solanum nigrum).

Lab Outline:

- To visit lab to be familiar with instruments and learn operating methods, principles and calibration.
- Culturing and staining of bacteria.
- Culturing and staining of Fungi.
- Maintenance and preservation of cultures of microbes (Bacteria / Cyanobacteria / Algae / Fungi).
- To study anatomical differences between gram positive and gram negative bacteria by Gram staining Procedure.
- Study of morphology and reproductive structures of different Algal types mentioned in theory.
- Study of morphology and reproductive structures of different fungal types mentioned in theory.
- Study of morphology and reproductive structures of different Bryophytes mentioned in theory.
- Study of morphology and reproductive structures of different Pteridophytes mentioned in theory.
- Study of morphology and reproductive structures of different Gymnosperms mentioned in theory.
- Study of morphology and reproductive structures of different Angiosperms mentioned in theory.
- Identification of various types mentioned in theory from prepared slides and fresh collections.

Recommended Books:

- Iftikhar A. K. and R.U.H. Ramay. (2015). Textbook of Botany (Diversity of Plants). M. I. Publishers, Lahore, Pakistan.
- Vashishta, B. R. (1991). Botany for degree students (all volumes). S. Chand and Company. Ltd. New Delhi.
- B. P. Panday. (2006). College Botany. Vol 1 & II. S. 7th Edition. Chand & Co. New Delhi.

□ Ingrouille, M. (1992). Diversity and Evolution of Land Plants. Chapman & Hall.
Mauseth, J. D. (2003). Botany: An Introduction to Plant Biology 3rd Ed., Jones and Bartlett Pub. UK.

ENG-1207

English-II (Functional) (C3)

Cr. 3

OBJECTIVES:

Enable the students to meet their real life communication needs.

CONTENTS:

Paragraph writing

Practice in writing a good, unified and coherent paragraph

Essay writing

Introduction

CV and job application

Translation skills

Urdu to English

Study skills

Skimming and scanning, intensive and extensive, and speed reading, summary and précis writing and comprehension

Academic skills

Letter/memo writing, minutes of meetings, use of library and internet

Presentation skills

Personality development (emphasis on content, style and pronunciation)

Note: documentaries to be shown for discussion and review

RECOMMENDED BOOKS:

a) Grammar

1. Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 2. Third edition. Oxford University Press 1986. ISBN 0 19 431350 6.
- b) Writing
1. Writing. Intermediate by Marie-Christine Boutin, Suzanne Brinand and Françoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 019 435405 7 Pages 45-53 (note taking).
 2. Writing. Upper-Intermediate by Rob Nolasco. Oxford Supplementary Skills. Fourth Impression 1992. ISBN 0 19 435406 5 (particularly good for writing memos, introduction to presentations, descriptive and argumentative writing).
- c) Reading
1. Reading. Advanced. Brian Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1991. ISBN 0 19 453403 0.
 2. Reading and Study Skills by John Langan
 3. Study Skills by Richard Yorky.

PS-1217

Pakistan Studies (C4)

Cr. 2

OBJECTIVES:

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

CONTENTS:

1. *Historical Perspective:*
 - a. Ideological rationale with special reference to Sir Syed Ahmed Khan, Allama Muhammad Iqbal and Quaid-i-Azam Muhammad Ali Jinnah.
 - b. Factors leading to Muslim separatism
 - c. People and Land
 - i. Indus Civilization
 - ii. Muslim advent
 - iii. Location and geo-physical features.
2. *Government and Politics in Pakistan:*
Political and constitutional phases:
 - a. 1947-58
 - b. 1958-71

- c. 1971-77
 - d. 1977-88
 - e. 1988-99
 - f. 1999 onward
3. *Contemporary Pakistan:*
- a. Economic institutions and issues
 - b. Society and social structure
 - c. Ethnicity
 - d. Foreign policy of Pakistan and challenges
 - e. Futuristic outlook of Pakistan

RECOMMENDED BOOKS:

1. Burki, J. Shahid. 1980. *State & Society in Pakistan*, The Macmillan Press Ltd.
2. Zaidi, A. S. 2000. *Issue in Pakistan's Economy*. Karachi: Oxford University Press.
3. Burke, S.M. and L. Ziring. 1993. *Pakistan's Foreign policy: An Historical analysis*. Karachi: Oxford University Press.
4. Mehmood, S. 1994. *Pakistan Political Roots & Development*. Lahore.
5. Wilcox, W. 1972. *The Emergence of Banglades.*, Washington: American Enterprise, Institute of Public Policy Research.
6. Mehmood, S. *Pakistan Kayyun Toota*, Lahore: Idara-e-Saqafat-e-Islamia, Club Road.
7. Amin, T. *Ethno - National Movement in Pakistan*, Islamabad: Institute of Policy Studies, Islamabad.
8. Ziring, L. 1980. *Enigma of Political Development*. Kent England: WmDawson & sons Ltd.
9. Zahid, A. 1980. *History & Culture of Sindh*. Karachi: Royal Book Company.
10. Rafique, A. M. 1998. *Political Parties in Pakistan*, Vol. I, II & III. Islamabad: National Institute of Historical and cultural Research.
11. Sayeed, K. B. 1967. *The Political System of Pakistan*. Boston: Houghton Mifflin.
12. Aziz, K.K. 1976. *Party, Politics in Pakistan*, Islamabad: National Commission on Historical and Cultural Research.
13. Muhammad W. 1987. *Pakistan Under Martial Law*, Lahore: Vanguard.
14. Haq, N. 1993. *Making of Pakistan: The Military Perspective*. Islamabad: National Commission on Historical and Cultural Research.

CHEM-1204

Organic Chemistry (M1)

Cr. 3+1

Course Objectives:

Students will acquire knowledge about basic concepts of organic chemistry, chemistry of hydrocarbons and functional groups and the mechanism of organic reactions. Such information will

be useful for qualitative analysis and synthesis of organic compounds.

Course Contents:

Basic Concepts of Organic Chemistry:

Bonding and hybridization, localized and delocalized bonding, structure-aromaticity, inductive effect, dipole moment, resonance and its rules, hyperconjugation, classification and nomenclature of organic compounds including IUPAC system, types of organic reactions (an overview).

Chemistry of Hydrocarbons:

Saturated, unsaturated and aromatic hydrocarbons with emphasis on synthesis and free radical, electrophilic addition and electrophilic substitution reactions.

Chemistry of Functional Groups:

Hydroxyl, ether and amino groups, preparation and properties of alcohols, phenols, ethers, and amines with focus on reaction mechanism and applications, carbonyl compounds, preparations and reaction mechanism of aldehydes and ketones and their applications, carboxylic acids and their derivatives, acidity of carboxylic acids and effect of substituents on their acidity, preparation and reactions of carboxylic acids and their derivatives including esters, amides, acid halides and acid anhydrides.

Lab

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

Recommended Books:

1. Brown, W. and Poon, T., *Introduction to Organic Chemistry*, 3rd ed., John-Wiley & Sons, Inc., (2005).
2. John, E. M. *Organic Chemistry*, 8th ed., Brooks/Cole Publishing Co, USA, (2012).

3. Robert, T. M. and Robert, N. B., *Organic Chemistry*, 6th ed., Prentice Hall, New Jersey, (1992).
4. Younus, M., *A Textbook of Organic Chemistry*, Ilmi Kitab Khana, Urdu Bazar, Lahore, Pakistan, (2006).
5. Sykes, P., *A Guide Book to Mechanism in Organic Chemistry*, 6th ed., Pearson Education Limited, England, (1986).
6. Solomons, T. W. G. and Fryhle, C. B., *Organic Chemistry*, 10th ed., John-Wiley & Sons, Inc., (2011).
7. Furniss, B. S., Hannaford, A. J., Smith, P. W. G., Tatchell, A. R., *Vogel's Textbook of Practical Organic Chemistry*, 5th ed., Longman, UK, (1989).
8. Pavia, D. L., Kriz, G. S., Lampman, G. M. and Engel, R. G., *A Microscale Approach to Organic Laboratory Techniques*, 5th ed., Brooks/ Cole Cengage Learning, (2013).
9. Mayo, D. W., Pike, R. M. and Forbes, D. C., *Microscale Organic to Laboratory with Multistep and Multisacle Syntheses*, 5th ed., John-Wiley & Sons, Inc., (2011).
10. Gilbert, J. C. and Martin, S. F., *Experimental Organic Chemistry: A Miniscale and Microscale Approach*, 5th ed., Brooks/ Cole Cengage Learning, (2010).
11. Brown, W. H., Fotte, C. S., Iverson, B. L. and Anslyn, E. V., *Organic Chemistry*, 6th ed., Brooks/ Cole Cengage Learning, (2012).

ZOL-1201

Principles of Animal Life-II (M2)

3+1

Aims and Objectives

The course will imparts knowledge and understanding of:

1. Cell division and its significance in cell cycle.
2. Concepts and mechanisms of inheritance pattern, chromosome and gene linkage and molecular basics of genetics.
3. Animal behaviour and communication.
4. Theories of evolution, gene flow and mechanism of evolution with reference to animals and diversity.

Course Contents

Cell Division: Cell cycles: Mitosis and meiosis; control of the cell cycle. **Inheritance Patterns:** Mendelian genetics; inheritance patterns; gene, structure, chemical composition and types. **Chromosomes and Gene Linkage:** Eukaryotic chromosomes; linkage and crossing over; chromosomal aberrations. **Molecular Genetics: Cellular Control: DNA:** the genetic material; DNA replication in prokaryotes and eukaryotes; control of gene expression in eukaryotes; gene mutation; recombinant DNA and applications of genetic technologies. **Animal Behaviour:** Behaviour and its types, proximate and ultimate causes; anthropomorphism; development of behavior; learning; factors controlling animal behavior; communication; behavioral ecology; social behavior. **Evolution:** A Historical Perspective: Theories of evolution: Lamarckism and natural

selection, neo larmarckism, Darwinism, and neo Darwinian. **Evolution and Gene Frequencies:** Hardy-Weinberg principle; evolutionary mechanisms: population size, genetic drift, gene flow, de Vries mutation theory and rates of evolution, polymorphism; species and speciation; molecular evolution; mosaic evolution.

Recommended Books

1. Hickman, C.P., Roberts, L.S. and Larson, A. Integrated Principles of Zoology, 11th Edition (International), 2004. Singapore: McGraw Hill.
2. Miller, S.A. and Harley, J.B. Zoology, 5th Edition (International), 2002. Singapore: McGraw Hill.
3. Pechenik, J.A. Biology of Invertebrates, 4th Edition (International), 2000. Singapore: McGraw Hill.
4. Kent, G.C. and Miller, S. Comparative Anatomy Of Vertebrates. 2000. New York: McGraw Hill.
5. Campbell, N.A. Biology, 6th Edition. Menlo Park, California: 2002. Benjamin/Cummings Publishing Company, Inc.

Practical:

1. Study of mitosis in onion root tip.
2. Study of meiosis in grasshopper testis (students should prepare the slide).
3. Problem based study of Mendelian ratio in animals.
4. Multiple alleles study in blood groups.
5. Survey study of a genetic factor in population and its frequency.
6. Study of karyotypes of *Drosophila*, mosquito.
7. Study of cytochemical detection of DNA in protozoa and avian blood cell.
8. Study to demonstrate nervous or endocrine basis of behaviour (conditioned reflex or aggression or parental behavior).
9. Study to demonstrate social behaviour (documentary film be shown, honey bee, monkey group in a zoo).

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

Recommended Books

1. Miller, S.A. General Zoology Laboratory Manual. 5th Edition (International), 2002. Singapore: McGraw Hill.
2. Hickman, C.P. and Kats, H.L. Laboratory Studies In Integrated Principles Of Zoology. 2000. Singapore: McGraw Hill.

BOT-1201 Plant Systematics, Anatomy & Development (M3) Cr. 3+1

Theory: Introduction to plant systematic, its aims, history and importance. Classification: Importance brief history, introduction various systems of classification, Engler and Prantels System, Bentham and Hooker's System. Brief introduction to nomenclature; Importance of Latin names, systems with an introduction to international code of Botanical Nomenclature (ICBN). Morphology and Phytography – a detailed account of various morphological characters of root, stem, leaf, inflorescence, flower, placentation and fruit types. Diagnostics characters, economic importance and distribution pattern of the following families: Brassicaceae (Cruciferae), Leguminosae, Rosaceae, Cucurbitaceae, Solanaceae, Lamiaceae (Labiatae), Asteraceae, Moraceae, Meliaceae, Acanthaceae, Liliaceae and Poaceae.

Anatomy and Development: Cell wall; structure and chemical composition. Tissue and Tissue System: Concept; structure and function of various tissues. e.g, Parenchyma, Chlorenchyma, Collenchyma, Sclerenchyma, Xylem and phloem. Primary Structure of root, stem and leaf. Definition and various type of meristems. Primary and secondary growth of dicot stem. Early development of plant body (embryology) Capsela bursa-pastoris or Arabidopsis.

Lab Outline:

- Identification of families given in syllabus with the help of keys
- Technical description of root, stem and leaves
- Technical description of flower
- Technical description inflorescence
- Technical description of fruit & placentation
- Field trips shall be undertaken to study and collect local plants. Students shall submit 50 fully identified herbarium specimens.
- Study of cross section of monocot and dicot stem.
- Study of simple and compound tissue in macerated and sectional material.
- Study of cross section of bifacial leaf
- To study the prepared slides of secondary growth in dicot stem

- Study of pollen grains by acetolysis method
- Study of L.S of monocot leaf.
- Study of pollen grains.
- Study of fleshy plant specimen.
- Study of herbarium preparation

Recommended Books:

- Bold, H.C., (1997). Morphology of Plants. Harper & Row, N.Y.
- Dickison, W.C. (2000). Integrative Plant Anatomy, Academic Press, UK.
- Fahn, A. (1990) Plant Anatomy. Pergamon Press, UK.
- Malik, T.A. (1996). Principles of Botany. The Carvan Press Darbar Market, Lahore.
- Mauseth, J.D. (1998). An Introduction to Plant Biology: Multimedia Enhanced. Jones and Bartlett Pub. UK
- Moore, R.C., W.D. Clarke and Vodopich, D.S. (1998) Botany. McGraw Hill Company, USA.
- Pullaiah, T (2007). Taxonomy of Angiosperms 3rd Ed. Regency Publication, New Delhi.
- Raven, P.H., Evert, R.E. and Eichhom, S.E. (1999). Biology. Saunders College Publishing, USA.
- Sharma, O.P. (1993). Plant Taxonomy. Tata McGraw-Hill 7 Patel Nagar, New Delhi.
- Stuessy, T.F. (1990). Plant Taxonomy. Columbia University Press.

ENG-2307

English (REPORT WRITING) (C5)

Cr. 3

OBJECTIVES:

Enhance language skills and develop critical thinking.

CONTENTS:

Presentation skills

Essay writing

Descriptive, narrative, discursive, argumentative

Academic writing

How to write a proposal for research paper/term paper

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

Technical Report writing

Progress report writing

Note: Extensive reading is required for vocabulary building

RECOMMENDED BOOKS:

Technical Writing and Presentation Skills

a) Essay Writing and Academic Writing

1. Writing. Advanced by Ron White. Oxford Supplementary Skills. Third Impression 1992. ISBN 0 19 435407 3 (particularly suitable for discursive, descriptive, argumentative and report writing).
2. College Writing Skills by John Langan. Mc=Graw-Hill Higher Education. 2004.
3. Patterns of College Writing (4th edition) by Laurie G. Kirszner and Stephen R. Mandell. St. Martin's Press.

a) Presentation Skill

b) Reading: The Mercury Reader. A Custom Publication. Compiled by norther Illinois University. General Editors: Janice Neulib; Kathleen Shine Cain; Stephen Ruffus and Maurice Scharton. (A reader which will give students exposure to the best of twentieth century literature, without taxing the taste of engineering students).

MAT-2315

Mathematics (C6)

Cr. 3

OBJECTIVES:

This course aims to provide students with the essential concepts of biomathematics and how these can be employed for analyzing real data.

CONTENTS:

Preliminaries: Real-number line, functions and their graphs, solution of equations involving absolute values, inequalities, binomial theorem and its use. *Limits and Continuity:* Limit of a function, left-hand and right-hand limits, continuity, continuous functions. *Derivatives and their Applications:* Differentiable functions, differentiation of polynomial, rational and transcendental functions, derivatives.

Integration and Definite Integrals: Techniques of evaluating indefinite integrals, integration by substitution, integration by parts, change of variables in indefinite integrals. Application and importance of calculus for biotechnology; the exponential growth curve and growth equation.

RECOMMENDED BOOKS:

1. Helfgott, M., and D. Moore. 2011. Introductory Calculus for the Natural Sciences. Create Space Independent Publishing Platform, USA.
2. Neuhauser, C. 2010. Calculus for Biology and Medicine. Prentice Hall.
3. Anton, H., et al., 2005. Calculus: A New Horizon. John Wiley, New York.
4. Thomas, G. B. and A. R. Finney. 2005. Calculus. Addison-Wesley, Reading, USA.
5. Kumar, A. 2011. Mathematics for biologist. First Edition; Alpha science international.

CHEM-2304

Physical Chemistry (M4)

Cr. 3+1

Course Objectives:

Students will acquire knowledge to enable themselves to understand the fundamental principles and laws of thermodynamics and 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.

Course Contents

Chemical Thermodynamics

Equation of states, ideal and real gases, the virial equation and the van der Waals equation for real gases, critical phenomena and critical constants, four laws of thermodynamics and their applications, thermochemistry, calorimetry, heat capacities and their dependence on temperature, pressure and volume, reversible and non-reversible processes, spontaneous and non-spontaneous processes, relations of entropy and Gibbs free energy with equilibrium constant, Gibbs Helmholtz equation, fugacity and activity.

Chemical Equilibrium

General equilibrium expressions, reaction quotients, examples of equilibrium reactions in solid, liquid and gas phases, extent of reactions and equilibrium constants, Gibbs energies of formation and calculations of equilibrium constants, effect of temperature and pressure on the equilibrium constants/compositions, van't Hoff equation, Le-Chatelier's principle.

Solution Chemistry

Physical properties of liquids, surface tension, viscosity, refractive index, dipole moment etc. and

their applications, brief account of interactions among the molecules in liquids, ideal and non-ideal solutions, Raoult's law and its applications, lowering of vapor pressure, elevation of boiling point, depression of freezing point, osmotic pressure, vapor pressure of non-ideal solutions and Henry's law, abnormal colligative properties, degrees of association and dissociation of solutes, osmotic pressure and its measurement, fractional distillation and concept of azeotropic mixtures.

Chemical Kinetics

The rates of reactions, zero, first, second and third order reactions with same and different initial concentrations techniques for rate determination and methods for determination of order of reaction (integration, half-life, initial rate, and graphical methods), Arrhenius equation.

Lab

1. Determination of viscosity and refractive index of liquids.
2. Determination of percent composition of liquid solutions viscometrically.
3. Determination of refractive index and molar refractivity.
4. Determination of percent composition of liquid solutions by refractive index measurements.
5. Determination of molecular weight of a compound by elevation of boiling point (ebullioscopic method).
6. Determination of molecular weight of a compound by lowering of freezing point (cryoscopic method).
7. Determination of heat of solution by solubility method. of heat neutralization of an acid with a base. Kinetic study of acid catalyzed hydrolysis of ethyl acetate.
8. Determination of partition coefficient of a substance between two immiscible liquids.

Recommended Books:

1. McQuarrie, D. A. and Simon, J. D., Physical Chemistry – A Molecular Approach, 1st ed., University Science Books, (1997).
2. Atkins, P. and Paula, J. D., Atkins's Physical Chemistry, 9th ed., Oxford University Press, (2010).
3. Shoemaker, D., Experiments in Physical Chemistry, 8th ed., McGraw Hill Publishing Company Limited, (2003).
4. Silbey, R., Alberty, R. and Bawendi, M., Physical Chemistry, 4th ed., (2005).

5. Glasstone, S., *Textbook of Physical Chemistry*, Macmillan London (1960).
6. James, A. M., Prichard, F. E., *Practical Physical Chemistry*, 3rd ed., Longman Group Limited, New York, (1974).
7. Chaudhary, S. U., *Ilmi Textbook of Physical Chemistry*, 2nd ed., Ilmi Kitab Khana, Lahore, (2013).
8. Atkins, P., Jones, L., *Chemical Principles: The Quest for Insight*, 5th ed., W. H. Freeman, New York, (2010).
9. Linder, B., *Elementary Physical Chemistry*, World Scientific Publishing Co. Pvt. Ltd., (2011).
10. Davis, W. M., Dykstra, C. E., *Physical Chemistry: A Modern Introduction*, 2nd ed., CRC Press, (2011).

ZOL-2301

Diversity of animal life-I (M5)

Cr. 3+1

(Classification, Phylogeny and Organization of Invertebrates)

Aims and Objectives

The course is designed to provide students with:

1. Concepts of evolutionary relationship of animal kingdom.
2. Knowledge about animal kingdom, emphasizing their phylogenetic relationships and simple to complex mode of animal life.

Course Contents

Introduction: Architectural pattern of an animal, taxonomy and phylogeny, major subdivisions of animal kingdom. **Animal-Like Protists:** The Protozoa Evolutionary perspective; life within a single plasma membrane; symbiotic life-styles. Protozoan taxonomy: (up to phyla, subphyla and super classes, wherever applicable). Pseudopodia and amoeboid locomotion; cilia and other pellicular structures; nutrition; genetic control and reproduction; symbiotic ciliates; further phylogenetic considerations. **Multicellular and Tissue Levels of Organization** Evolutionary perspective: origins of multicellularity; animal origins. Phylum porifera: cell types, body wall, and skeletons; water currents and body forms; maintenance functions; reproduction. Phylum cnidaria (coelenterata) the body wall and nematocysts; alternation of generations; maintenance functions; reproduction and classification up to class. Phylum ctenophora; further phylogenetic considerations. **Triploblastics and Acoelomate Body Plan:** Evolutionary perspective; phylum platyhelminthes: classification up to class; the free-living flatworms and the tapeworms; phylum nemertea; phylum gastrotricha; further phylogenetic considerations. **Pseudocoelomate Body Plan:** Aschelminths Evolutionary perspective; general characteristics; classification up to phyla with external features; feeding and the digestive system; other organ systems; reproduction and development of phylum rotifera and phylum nematoda; phylum kinorhyncha. Some important nematode parasites of humans; further phylogenetic considerations. **Molluscan Success:** Evolutionary perspective: relationships to other animals; origin of the coelom; molluscan characteristics; classification up to class. The characteristics of shell and associated structures, feeding, digestion, gas exchange, locomotion,

reproduction and development, other maintenance functions and diversity in gastropods, bivalves and cephalopods; further phylogenetic considerations. **Annelida:** The Metameric Body Form Evolutionary perspective: relationship to other animals, metamerism and tagmatization; classification up to class. External structure and locomotion, feeding and the digestive system, gas exchange and circulation, nervous and sensory functions, excretion, regeneration, reproduction and development, in polychaeta, oligochaeta and hirudinea; further phylogenetic considerations. **Arthropods:** Blueprint for Success Evolutionary perspective: classification and relationships to other animals; metamerism and tagmatization; the exoskeleton; metamorphosis; classification up to class; further phylogenetic considerations. Crustaceans, Hexapods and Myriapods, general nature, classification, phylogeny and adaptive diversification. **Echinoderms:** Evolutionary perspective: relationships to other animals; echinoderm characteristics; classification up to class. Maintenance functions, regeneration, reproduction, and development in asterozoa, ophiurozoa, echinozoa, holothurozoa and crinozoa; further phylogenetic considerations; some lesser-known invertebrates: the lophophorates, entoprocts, cycliophores, and chaetognaths.

Recommended Books

1. Hickman, C.P., Roberts, L.S. and Larson, A. Integrated Principles Of Zoology, 15th Edition (International), 2011. Singapore: McGraw Hill.
2. Miller, S.A. and Harley, J.B. Zoology, 8th Edition (International), 2011. Singapore: McGraw Hill.
3. Pechenik, J.A. Biology Of Invertebrates, 4th Edition (International), 2000. Singapore: McGraw Hill.
4. Campbell, N.A. Biology, 6th Edition. 2002. Menlo Park, California: Benjamin/Cummings Publishing Company, Inc.

Practical

1. Museum study of representative phyla, permanent slide preparations
2. Study of *Euglena*, *Amoeba*, *Entamoeba*, *Plasmodium*, *Trypanosoma*,
3. *Paramecium* as representative of animal like protists. (Prepared slides).
4. Study of sponges and their various body forms.
5. Study of principal representative classes of phylum Coelenterata.
6. Study of principal representative classes of phylum Platyhelminthes.
7. Study of representative of phylum Rotifera, phylum Nematoda.
8. Study of principal representative classes of phylum Mollusca.
9. Study of principal representative classes of phylum Annelida.
10. Study of principal representative classes of groups of phylum Arthropoda.
11. Brief notes on medical/economic importance of the following:
12. *Plasmodium*, *Entamoeba histolytica*, *Leishmania*, Liverfluke, Tapeworm, Earthworm,
13. Silkworm, Citrus butterfly.

Recommended Books

1. Hickman, C.P. and Kats, H.L. Laboratory Studies In Integrated Principles Of Zoology. 2000. Singapore: McGraw Hill.
2. Miller, S.A., General Zoology Laboratory Manual. 5th Edition (International), 2002. Singapore: McGraw Hill.

BOT-2301

Cell Biology, Genetics and Evolution (M6)

Cr. 3+1

Theory: a). Cell biology: Introduction to cell biology, brief history and scope. Structure and Function of Bio-molecules, Carbohydrates, Lipids, Proteins, Nucleic Acids. Cell: Cell theory, cell types (prokaryotes, eukaryotes), basic properties of cell. Brief description of following cell organelles; Cell wall, Cell membrane, Nucleus, Endoplasmic reticulum, Plastids, Mitochondria, Dictyosomes, Vacuoles. Reproduction in somatic and embryogenic cell, mitosis, meiosis and cell cycle. b). Genetics: Introduction, scope and brief history of genetics. Mendelian inheritance; introduction to Mendelian inheritance, shortcomings. Laws of segregation and independent assortment. Back cross, test cross, Reciprocal cross, dihybrid cross, monohybrid cross, exception to Mandel's laws. Dominance and incomplete dominance, hetreodominance and over dominance. c). Evolution: Definition and history and

scope. The nature of evolutionary forces, adaptive radiations, differential reproductive potential. First plant cell, origin of organized structures, early aquatic and terrestrial ecosystem. First vascular plant, origin and characters.

Lab Outline:

- Rules of Lab use and lab biosafety and bioethics.
- To visit Lab to be familiar with instruments and learn operating methods, principles and calibration
- Study of cell structure using compound microscope.
- Elucidation of ultrastructure of cell from electron microphotographs.
- Measurement of cell size.
- Preparation of temporary and permanent slides.
- Staining techniques simple and differential staining.
- Study of mitosis using onion root tips and comparison with prepared slides.
- Study of meiosis by smear/squash method and from prepared slides.
- Study of chromosome morphology and variation in chromosome number.
- Extraction and estimation of carbohydrate, protein, from plant sources.
- Tests for reducing and non-reducing sugars.
- Genetics
- Genetical problems related to transmission and distribution of genetic material.
- Identification of chromosomes in plant material. Carmine/orcein staining.
- Determination of blood groups.

Recommended Books:

- Daniel, L. H. (2000). Essential Genetics. Jones and Bartlett Publishers. .
- Dyonsager, V. R. (1999). Cytology and Genetics. Tata and McGraw-Hill Publication Co. Ltd, New Delhi.
- Lodish. H. (2001). Molecular Cell Biology. W. H. Freeman and Co.
- Sinha, U. and Sinha, S. (1998). Cytogenesis Plant Breeding and Evolution, Vini

OBJECTIVES:

To familiarized students with the basics of computer.

CONTENTS:

Introduction and History of Computers, Computer Characteristics, Major components of computer, Introduction to operating system, Hardware and software concepts, Computer applications in modern ages, Categories of computers, Introduction to networks, Introduction to Internet and usage of web browsers, Introduction to e-mail and web documents searching, Presentation skills, Introduction to formatting documents, Introduction to information systems, Software development life cycle.

PRACTICALS:

Word processing, Windows operating systems, Graphics software, Network introduction LANs, WANs, MANs, Presentation software practice, Excel software practice, Formatting documents

ARA-2401

Arabic (C8)

Cr. 3

الأسماء الإشارة

الضمائر المتصلة

المركب الإضافي

المركب التوصيفي

الضمائر المنفصلة /حروف الجر

الجمع

الفعل الماضي

الفعل المضارع

الفعل المضعف / الضمائر المتصلة بالأفعال

الفعل الصحيح / الفعل المعتل

المذكر والمؤنث / الأسماء الخمسة

الأعداد

الإستفهام

اسم الفاعل

أعضاء الجسم / الألوان

لقاء في المطار / الحروف والأسماء مع ضمائر المتصلة

الجملة الإسمية / الجملة الفعلية

حروف الهجاء وطريقة النطق بها / حروف المد / حروف القمرية والشمسية

الأنشيد المختارة / القصة (قوة الإخلاص)

الأحاديث النبوية الأحاديث النبوية

الكتب المختارة:

• اللسان العربي جامعة علامة إقبال المفتوحة إسلام آباد

CHEM-2481

Biochemistry (M7)

Cr. 3

Course Objectives:

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

Introduction to Biochemistry:

Brief introduction to the scope and history of Biochemistry, molecular logic of the living organism, cell structures and their functions, origin and nature of biomolecules.

Acid–Base and Electrolyte Chemistry:

Intracellular and extracellular electrolytes, body fluids as electrolyte solutions, pH, Henderson-Hasselbalch equation and buffers, amino acids, peptides and proteins, buffer capacity, buffers of body fluids, haemoglobin as an acid-base system, renal control of acid-base, balance, acid-base disorders: acidosis, alkalosis. haemoglobin and omeostasis, variation of Na^+ , K^+ , Cl^- in acid-base disturbances.

Carbohydrates, Lipids and Proteins:

Definition and classification, chemistry, physical and chemical properties of various classes of carbohydrates, biological functions of starch, glycogen, cellulose, and cell wall polysaccharides, acid mucopolysaccharides and proteoglycans.

Definition and classification of lipids, chemistry and biological importance of fatty acids, waxes, glycerides, phospholipids, sphingolipids, glycolipids, sterols and prostaglandins. Significance of lipids in biological membranes and transport mechanism.

Chemistry and classification of amino acids, physical and chemical properties of amino acids, biological significance of amino acids, peptides, proteins, their classification, properties and biological significance, primary, secondary tertiary and quaternary structure of proteins, denaturation of proteins.

Nucleic Acids:

Chemical composition of nucleic acids, structure and biological significance of nucleic acids, chemical synthesis of oligonucleotides, nucleic acids hydrolysis, isolation and separation of nucleic acids, introduction to recombinant DNA technology.

CHEM-2404

Analytical Chemistry (E1)

Cr. 2+1

Course Objectives:

Students will acquire knowledge about sampling and their handling and preparation and results calculation and data reporting. In addition they will learn and develop understanding about the classical techniques of analytical chemistry and quality control and quality assurance

Course Contents:

Chemometrics: Sampling, significant figures, stoichiometric calculations, measurement errors, analysis of variance (ANOVA), arithmetic mean, median, mode, standard deviation/relative standard deviation, confidence limits, Gaussian distribution, least square method, tests for significance, outliers

Quality Control and Quality Assurance:

Definitions, seven tools for quality control, the concept of quality assurance, quality assurance techniques, validations based on design qualification (DQ), installation qualification (IQ), operational qualification (OQ) and performance qualification (PQ), calibrations, monitoring and quality reviews, periodical trainings, six sigma concept, ISO standards.

Classical Analytical Methods:

Acid-base, complexometric and redox titrations, gravimetric analysis.

Lab

Calibration of volumetric glassware, electronic and analytical equipment, statistical evaluation of analytical data including linear regression analysis, constructing a calibration curve from a given analytical data using spread sheet software, determination of hardness of water using EDTA, determination of chloride in tap water sample, estimation of copper, arsenic, hydrogen peroxide and vitamin C using iodometry, gravimetric analysis, determination of barium in barium nitrate, determination of nickel in a given steel sample, determination of bicarbonates in a clinical sample using back-titration, determination of cation in a mixture by complexometric titration, studying the effect of common ions on solubility of sparingly soluble salts (e. g. AgCl / PbSO₄).

Recommended Books:

1. Skoog, D. A., West, P. M., Holler, F. J., Crouch, S. R., *Fundamentals of Analytical Chemistry*, 9th ed., Brooks Cole Publishing Company, (2013).
2. Christian, G. D., *Analytical Chemistry*. 6th ed., John-Wiley & Sons, New York, (2006).
3. Harris, D. C., *Quantitative Chemical Analysis*, 8th ed., W. H. Freeman and Company, New York, USA, (2011).
4. Kealey, D. and Haines, P. J., Instant Notes., *Analytical Chemistry*, Bios Scientific Publishers Limited, Oxford, UK, (2002).
5. Matthios, Otto, *CHEMOMETRICS-Statistics and Computed applications in Analytical Chemistry*, 2nd ed., Wiley-VCH, Germany, (2007).
6. Mitra A., *Fundamentals of Quality Control and Improvement*, 3rd ed., John-Wiley & Sons, (2008).
7. Miller, J. and Miller, J., *Statistics and Chemometrics for Analytical Chemistry*, 5th ed., Prentice Hall, (2005).

BOT-2401

Plant Physiology and Ecology (E2)

Cr. 2+1

Theory: (a) Plant Physiology; Water relations: Introduction to water potential terminologies. Mechanism of absorption and translocation of water in plants. Transpiration, Theories regarding stomatal regulation.

Mineral nutrition: Introduction to macro and micro nutrients. Soil as a source of minerals. Passive and active transport of nutrients. Essential mineral elements, role and deficiency symptoms of macronutrients.

Photosynthesis: Introduction, Oxygenic and non-oxygenic photosynthesis, Mechanism: light reactions and dark reactions. Differences between C₃ and C₄ plants. Factors affecting this process.

Respiration: Definition and respiratory substrates, mechanism of Glycolysis, Krebs cycle. Electron transport and oxidative phosphorylation. Anaerobic respiration. Energy balance in aerobic and anaerobic respiration, Respiratory quotients.

(b) Ecology; Introduction, aims and applications of ecology. Soil: Physical and Chemical properties of soil (soil formation, texture, pH, EC, organism and organic matter etc) and their relationships to plants. Light and Temperature. Quality of light, diurnal and seasonal variations. Ecophysiological responses. Water: introduction. Characteristics of xerophytes and hydrophytes. Effect of precipitation on distribution of plants. Wind: Wind as an ecological factor and its importance. Population Ecology: Introduction. A brief description of seed dispersal and seed bank. Community Ecology. Introduction to communities. Ecological characteristics of plant community Methods of sampling vegetation (Quadrat and line intercept) Major vegetation types of the local area. Ecosystem Ecology. Definition, types and components of ecosystem, Food chain and Food web. Applied Ecology: Causes, effects and control of water logging and salinity with respect to Pakistan.

Lab Outline:

a) Plant Physiology

- Preparation of solutions of specific normality of acids/bases, salts, sugars, molal and molar solutions and their standardization.
- Determination of uptake of water by swelling seeds when placed in sodium chloride solution of different concentrations.
- Measurement of leaf water potential by the dye method.
- Determination of the effects of environmental factors on the rate of transpiration of a leafy shoot by means of a potometer/cobalt chloride paper method.
- Extraction of chlorophyll from the leaves and separation of component pigments on a paper chromatogram.
- Study of Absorption Spectra using Spectrophotometer

- Estimation of oxygen utilized by a respiring plant by Winkler's method.
- Determination of the temperature at which beetroot cells lose their permeability.
- Extraction of Amylase from Germinating Wheat Seeds and study of its effect on Starch Break Down.
- Measurement of Carbon Dioxide Evolution during Respiration of Germinating Seeds by the Titration Method.

b) Ecology

- Determination of physical and chemical characteristics of soil.
- Measurement of vegetation by Quadrat and line intercept methods.
- Measurements of various population variables
- Effect of light and temperature on seed germination.
- Determination of carbonates and bicarbonates in water
- Measurements of Wind Velocity

Recommended Books:

- Iftikhar, A. K. and R.U.H. Ramay. (2015). Textbook of Botany (Plant Physiology and Ecology). M. I. Publishers, Lahore, Pakistan.
- Jain, V. K. and Chand, S. (2008). Fundamentals of plant Physiology. Rajendra Ravindra printers, New Delhi.
- Taiz, L. and Zeiger, E. (2006). Plant Physiology. 4th. Ed. Sinauers Publ. Co. Inc.

Calif.

- Salisbury F. B. and Ross C. B. (1992). Plant Physiology. 5th Edition. Wadsworth Publishing Co. Belmont CA.
- Schultz, J. C. (2005). Plant Ecology. Springer-Verlag, Berlin.

ZOL-2401

Animal Diversity-II (E3)

Cr. 2+1

Aims and Objectives

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

Course Contents

Hemichordates and Invertebrate Chordates: Evolutionary Perspective: Phylogenetic Relationships; Classification up to subphylum or class where applicable; Further Phylogenetic Considerations. **Fishes:** Vertebrate Success in Water: Evolutionary perspective: phylogenetic relationships; survey of super class agnatha and gnathostomata; evolutionary pressures:

adaptations in locomotion, nutrition and the digestive system, circulation, gas exchange, nervous and sensory functions, excretion and osmoregulation, reproduction and development; further phylogenetic considerations. **Amphibians:** The First Terrestrial Vertebrates Evolutionary perspective: phylogenetic relationships; survey of order caudata, gymnophiona, and anura. Evolutionary pressures: adaptations in external structure and locomotion, nutrition and the digestive system, circulation, gas exchange, temperature regulation, nervous and sensory functions, excretion and osmoregulation, reproduction, development, and metamorphosis; further phylogenetic considerations. **Reptiles:** The First Amniotes Evolutionary perspective: cladistic interpretation of the amniotic lineage; survey of order testudines or chelonia, rhynchocephalia, squamata, and crocodilia; evolutionary pressures: adaptations in external structure and locomotion, nutrition and the digestive system, circulation, gas exchange, and temperature regulation, nervous and sensory functions, excretion and osmoregulation, reproduction and development; further phylogenetic considerations. **Birds:** Feathers, Flight, and Endothermy Evolutionary perspective: phylogenetic relationships; ancient birds and the evolution of flight; diversity of modern birds; evolutionary pressures: adaptation in external structure and locomotion, nutrition and the digestive system, circulation, gas exchange, and regulation, nervous and sensory systems, excretion and osmoregulation, reproduction and development; migration and navigation. **Mammals:** Specialized Teeth, Endothermy, Hair, and Viviparity: Evolutionary perspective: diversity of mammals; evolutionary pressures: adaptations in external structure and locomotion, nutrition and the digestive system, circulation, gas exchange, and temperature regulation, nervous and sensory functions, excretion and osmoregulation, behavior, reproduction and development.

Recommended Books

1. Hickman, C.P., Roberts, L.S. and Larson, A. Integrated Principles Of Zoology, 15th Edition (International), 2011. Singapore: McGraw Hill.
2. Miller, S.A. and Harley, J.B. Zoology, 8th Edition (International) 2010. Singapore: McGraw Hill.
3. Kent, G.C. and Miller, S. Comparative Anatomy Of Vertebrates. Latest Edition 2002. New York: McGraw Hill.
4. Campbell, N.A. BIOLOGY, 9th Edition. 2011. Menlo Park, California: Benjamin/Cummings Publishing Company, Inc.

Practical

1. Museum study of representative phyla
2. Study of a representative of Hemichordate and Chordate.
3. Study of representative groups of class Fishes.
4. Study of representative groups of class Amphibia.
5. Study of representative groups of class Reptilia.
6. Study of representative groups of class Aves.
7. Study of representative groups of class Mammalia.
8. Field trips to study animal diversity in an ecosystem.

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

Recommended Books

1. Hickman, C.P. and Kats, H.L. Laboratory Studies In Integrated Principles Of Zoology. 2000. Singapore: McGraw Hill.
2. Miller, S.A. General Zoology Laboratory Manual. 5th Edition (International), 2002. Singapore: McGraw Hill.