OFFICE OF THE REGISTRAR
UNIVERSITY OF MALAKAND
(ACADEMIC SECTION)

Dated: **July 03, 2019**

NOTIFICATION

No. 741/Acad/31st Syndicate/9th AC./2019: It is notified for the information of all concerned that the Syndicate, in its 31th meeting held on April 19, 2019, on recommendations of the Academic Council, made in its 9th meeting held on February 13, 2019, vid item No.15 approved **Scheme of studies and Course of BS (4-Year) Chemistry**, recommended by the respective Board of Studies, Department of Chemistry duly endorsed by the 3rd Board of Faculty, Faculty of Sciences in its meeting held on December 21,2018 each page duly signed and stamped available in soft on University of Malakand Website(www.uom.edu.pk).

(Rahatullah)
Assistant Registrar

Copy for information/necessary action (if any) to:

1. Dean concerned
2. Chairperson/ Incharge of the Teaching Department concerned
3. Controller of Examinations with the request to acknowledge the receipt of Master copy of the above Scheme of Studies & Courses for safe custody and needful
4. Principals of all affiliated Colleges
5. Network Administrator with the request to approach the Controller of Examinations for needful accordingly
6. Deputy Registrar Admissions
7. PS to Vice-Chancellor
8. PA to Registrar
9. File

Assistant Registrar

Chakdara, Lower Dir, Khyber Pakhtunkhwa, Pakistan
Url: http://www.uom.edu.pk, **Tel:** +92 945 9250508, **Fax:** +92 945 9250505

MINUTES OF THE 3RD MEETING OF BOARD OF FACULTY OF SCIENCE

Friday, December, 21st 2018

FACULTY OF SCIENCE

UNIVERSITY OF MALAKAND

CHAKDARA

TABLE OF CONTENTS

Annexure-A

Constitution and Powers/Functions of the Board of Faculty

(2) There shall be a Board of each faculty which shall consist of –

(a) The dean to be appointed in the manner as may be prescribed;
(b) The professor and the Chairpersons of the Teaching Departments and director of Institutes comprising the faculty;
(c) One Lecturer, one Assistant professor and one Associate professor to be nominated by rotation in order of seniority from each Department or Institute constituted in the Faculty; and
(d) Three teachers to be nominated by Academic Council by reason of their specialized knowledge of subject which, though not assigned to the Faculty, have in the opinion of the Academic Council, important bearing on the subjects assigned to the Faculty.

(3) The members mentioned in clauses (c) and (d) of sub paragraph (2) shall hold office for two year.

(4) The quorum for a meeting of the Board of a Faculty shall be one half of the total number of members, a fraction being counted as one.

(5) The Board of each Faculty shall, subject to general control of the Academic Council and Syndicate, have the powers

(a) To co-ordinate the teaching, publication and research work in the subjects assigned to the Faculty;
(b) To scrutinize the recommendations of the Board of Studies comprised in the Faculty in regard to the appointment of paper setters and examiners except for research examinations and to forward the panels of suitable paper setters and examiners for each examination to the Vice Chancellor.
(c) To consider any other academic matter relating to report thereon to the Academic Council; and
(d) To perform such other functions as may be assigned to it.

Annexure-B

LIST OF MEMBERS OF BOARD OF FACULTY IN SCIENCE

S.No	Name	Institution/Department
1.	Prof. Dr. Rashid Ahmad	Dean of Science
2.	Prof. Dr. Mir Azam Khan	Dean of Biological Science
3.	Prof. Dr. Waqar Ahmad	Dean Faculty of Law
4.	Dr. Syed Muhammad Jamal	Associate Professor, Department of Biotechnology
5.	Dr. Manzoor Ahmad	Chairman Department of Chemistry
6.	Dr. Sultan Alam	Associate Professor, Department of Chemistry
7.	Dr. Mumtaz Ali	Assistant Professor, Department of Chemistry
8.	Ms. Sumaira Naz,	Lecturer, Department of Chemistry
9.	Dr. Imran Ahmad	Incharge Department of Geology
10.	Dr. Muhammad Asif	Incharge Department of Statistics
11.	Mr. Muhammad Ilyas	Lecturer, Department of Statistics
12.	Dr. Imtiaz Ahmad	Chairman, Department of Mathematics
13.	Dr. Muhammad Yousaf	Assistant Professor, Department of Mathematics
14.	Mr. Wajahat Ali	Lecturer, Department of Mathematics
15.	Dr. Arif Ullah	Incharge Department of Physics
16.	Dr. Imad Khan	Assistant Professor, Department of Physics
17.	Dr. Muhammad Irfan	Lecturer, Department of Physics
18.	Mr. Asad Muhammad	Lecturer, Department of Geology
19.	Dr. Mian Muhammad	Assistant Professor, Chemistry
20.	Dr. Amanullah	Assistant Professor, Mathematics
21.	Mr. Rahatullah	Assistant Registrar (Academics), UOM

Controller of Examination
University of Malakand

[BOF-5]

Annexure-C

OFFICE OF THE DEAN OF SCIENCES
UNIVERSITY OF MALAKAND, Chakdara,
Khyber Pukhtunkhwa, Pakistan
Phone: +92 945 9250529 Email: rashmad@gmail.com and rashidahmad@uom.edu.pk

No. UOM/Dean Sci./2018/616 Dated: Dec 31, 2018

Subject: **MINUTES OF THE 3rd MEETING OF BOARD OF FACULTY OF SCIENCE**

The meeting of the Board of Faculty of Science, University of Malakand was held on December 21, 2018 at committee room, University of Malakand. The meeting started with the recitation of the Holy Quran by Dr. M. Irfan, followed by welcome address by the Dean. He briefed the participants about the role of instructions in academic life. Furthermore, he stressed on the vibrant role of academics in the development of nations.

The curriculum of BS Chemistry (duly recommended by BOS Chemistry) and BS/MPhil/ PhD Mathematics (duly recommended by BOS mathematics) were presented to the participants for open house discussion for their suggestions/inputs regarding improvement of the curricula. After thorough deliberation, the Board unanimously recommended both the agenda items for the approval of Academic Council with the following remarks:

i. Course should be Coded according to University format (approved by Syndicate on the recommendation of Academic Council in its 5th meeting.
ii. The Board Unanimously decided that Prof. Rashid Ahmad will develop a general course on Occupational Safety and Environmental Health (OSEH) with a chapter on Drug abuse and will be adopted by the University.
iii. Reduce the numbers of reference books (max. 5) and try to go for text book including the latest version of reference books.
iv. Throughout the curriculum the course titles, course codes, course contents and references style must be of uniform format.
v. The title of each Program of the University of Malakand is registered in PQR. Therefore, the coordinator of PQR should circulate the same to the departments for consistency in nomenclature.
vi. The compulsory and general courses should be named and developed by the respective departments as decided (approved by Syndicate on the recommendation of Academic Council (5th meeting)) and the same should be circulated to all the departments.
vii. In BS the standard format of the university is 130-136 credit hours (approved by syndicate) and the department should follow the same.
viii. After considering the above mentioned remarks the Chemistry and Mathematics Curricula should be submitted to Dean of Science for further necessary action.

The meeting was adjourned with the vote of thanks to and from the Chair.

31/12/18

Prof. Rashid Ahmad *PhD*
Dean Faculty of Science

Controller of Examination
University of Malakand

[BOF-6]

Annexure-D

OFFICE OF THE DEAN OF SCIENCES

UNIVERSITY OF MALAKAND, Chakdara,

Khyber Pakhtunkhwa, Pakistan

Phone: +92 945 9250529 Email: rashmad@gmail.com and rashidahmad@uom.edu.pk

No. UOM/Dean Sci./2018/618 Dated: Dec 31, 2018

Subject: **DECISIONS OF THE BOARD OF FACULTY OF SCIENCE**

1. The meeting of the Board of Faculty of Science, University of Malakand was held on December 21, 2018 at Committee Room, University of Malakand. Beside the approval of the courses they concluded that;
   a. Approved Course Format approved by Syndicate recommended by Academic Council in its 8th meeting should be circulated to all the stake holders.
   b. Throughout the curriculum the course titles, course codes, course contents and references style must be in uniform format.
   c. The title of each Program of the University of Malakand is registered in PQR. Therefore, the coordinator of PQR should circulate the same to all the Departments for consistency in nomenclature.
   d. As approved by Syndicate on the recommendation of Academic Council (8th meeting) that the compulsory and general courses should be named and developed by the respective Departments and the same should be circulated to all the departments.
   e. In BS the standard format of the university is 130-136 credit hours (approved by syndicate) and the department should follow the same.
2. Para 1 (a-e) are submitted for further necessary action accordingly please.

Controller of Examination University of Malakand

31/12/18

Prof. Rashid Ahmad PhD
Dean Faculty of Science

Registrar

Copy in Even No. & Date:

1. Prof. Dr. Mir Azam Khan, Dean of Biological Science
2. Prof. Dr. Waqar Ahmad, Dean of Law
3. PSO to Vice Chancellor
4. Registrar
5. Chairman Department of Chemistry
6. Chairman Department of Mathematics
7. Director QEC
8. Incharge Department of Physics
9. Incharge Department of Statistics
10. Incharge Department of Geology
11. AR Academics
12. File

Controller of Examination University of Malakand

Annexure-E

CURRICULUM

BS (4-Year) CHEMISTRY

DEPARTMENT OF CHEMISTRY

UNIVERSITY OF MALAKAND

Introduction

The meeting of the Board of Studies, Department of Chemistry, University of Malakand was held at Department of Chemistry, University of Malakand on Sept 13, 2018 to review and modify the curriculum of B.S. (4 year) in Chemistry and to make recommendations for the promotion and development of the discipline.

The board of studies includes the following worthy members:

Dr. Manzoor Ahmad Chairman Department of Chemistry University of Malakand	Convener (Ex-Officio)
Prof. Dr. Rashid Ahmad Dean of Sciences University of Malakand	Member (Ex-Officio)
Dr. Sultan Alam Associate Professor Department of Chemistry, University of Malakand	Member (Ex-Officio)
Dr. Ezzat Khan Associate Professor Department of Chemistry, University of Malakand	Member (Ex-Officio)
Prof. Dr. Hamayun Khan Professor Islamia College University, Peshawar	Member
Dr. Anwar ul Haq Associate Professor Institute of Chemical Sciences, University of Peshawar	Member
Mr. Saeedullah Jan Assistant Professor GPGC Timergara	Member
Mr. Hanif Subhan Lecturer, GDC Gulabad, Dir (Lower)	Member
Ms. Musarat Jabeen Assistant Professor GGDC Thana	Member
Dr. Naveed Umar Assistant Professor Department of Chemistry, University of Malakand	Member
Ms. Sumaira Naz Lecturer Department of Chemistry, University of Malakand	Member

Contents

THE FOLLOWING SCHEME OF STUDIES WAS RECOMMENDED BY THE COMMITTEE

BS (4-YEAR) CHEMISTRY
SCHEME OF STUDIES

Definition of the course code numbers XYZ:

X= Year of Study; Y= Semester

Z= Specific Course

Code Number (Z)	Specific Course
1	Analytical Chemistry
2	Applied Chemistry
3	Biochemistry
4	Environmental Chemistry
5	Fuel Chemistry
6	Inorganic Chemistry
7	Organic Chemistry
8	Physical Chemistry

STANDARDIZED FORMAT/SCHEME OF STUDIES FOR FOUR-YEAR INTEGRATED CURRICULA FOR BACHELOR DEGREE IN BASIC, SOCIAL, NATURAL AND APPLIED SCIENCES

STRUCTURE

Sr.	Categories	No. of courses Min-Max	Credit Min-Max
1.	Compulsory Requirement (No Choice)	9-9	25 - 25
2.	General Courses to be chosen from other departments	7-8	21 - 24
3.	Discipline Specific Foundation Courses	9-10	30 - 33
4.	Major Courses including research project / Internship	11-13	36 - 42
5.	Electives within the major	4-4	12 - 12
	Total	**40-44**	**124 - 136**

- Total numbers of Credit hours 124-136
- Duration 4 years
- Semester duration 16-18 weeks
- Semesters 8
- Course Load per Semester 15-18 Cr hr.
- Number of courses per semester 4-6 (not more than 3 lab / practical courses)

LAYOUT

Compulsory Requirements (the student has no choice)		General Courses to be chosen from other departments		Discipline Specific Foundation Courses		Major courses including research project/internship		Elective Courses within the major	
9 courses		7-8 courses		9-10 courses		11-13 courses		4 courses	
25 Credit hours		21-24 Cr. hours		30-33 Credit hours		36-42 Credit hours		12 Credit Hours	
Subject	Cr. hr.	Subject	Cr. hr.	Subject	Cr. hr.	Subject	Cr. hr.	Subject	Cr. hr.
1. English I	3	1. Education-I	2	1.Physical Chem-I	3+1	1.Inorganic Chem-II	3	Environ.	3
2. English II	3	2. Functional Biology-I	3	2.Organic Chem-I	3+1	2.Organic Chem-II	3	Chem.-I	
3. English III	3	3. Functional Biology-II	3	3.Inorganic Chem-I	3+1	3.Physical Chem-II	3		
4. Physics-II *	3	4. Functional Biology-III	3	4.Analytical Chem-I	2+1	4.Inorganic Chem-III	3+1	Environ.	3
5. Pakistan Studies		5. Statistics-I	3	5.Biochem-I	2+1	5.Organic Chem-III	3+1	Chem.-II	
6. Islamic Studies /	2	6. Statistics-II	3	6.Applied Chem-I	2+1	6.Physical Chem-III	3+1		
Ethics	2	7. Physics-I	3	7.Fuel Chem.-I	2+1	**Specialization**			
7. Mathematics I		8. Occupational Safety &	3	8.Analytical Chem-II	3	7.Paper-I	3		
8. Mathematics II/Univ.	3	Environmental Health		9.Applied Chem-II	3	8.Paper-II	3		
Optional **	3			10.Biochem-II	3	9.Paper-III	3		
9. Introduction To						10.Paper-IV	3		
Computer	3					11.Paper-V	3		
						12.Paper-VI	3		
						13.Research Project-I	3		
						14.Research Project-II	3		
	25		23		34		45		06
TOTAL CREDIT HOURS: 132									

* University has the option to recommend any other course in lieu of English IV

** University may recommend any other course in lieu of Mathematics II

SCHEME OF STUDIES FOR BS (4-YEAR) CHEMISTRY

Semester/Year	Course Code	Name of Subject	Credits	Marks	Page
First	ELL-101	ENGLISH-I	3	100	2
	PS-111	PAKISTAN STUDIES	2	50	4
	MATH-111	MATH-I	3	100	6
	EDU-111	EDUCATION-I	2	50	7
	BOT-111	FUNCTIONAL BIOLOGY-I	3	100	8
	CHEM-118	PHYSICAL CHEMISTRY-I	3+1	125	10
	TOTAL		**17**	**525**	
Second	ELL-104	ENGLISH-II	3	100	13
	ISRA-100	ISLAMIC STUDIES / ETHICS	2	50	16
	MATH-121	MATH-II	3	100	17
	BOT-402	FUNCTIONAL BIOLOGY-II	3	100	18
	STAT-106	STATISTICS-I	3	100	20
	CHEM-127	ORGANIC CHEMISTRY-I	3+1	125	22
	TOTAL		**18**	**575**	
Third	ELL-202	ENGLISH-III	3	100	25
	BCS-114	INTRODUCTION TO COMPUTER	3	100	27
	STAT-107	STATISTICS-II	3	100	28
	PHY-231	PHYSICS-I	3	100	30
	CHEM-236	INORGANIC CHEMISTRY-I	3+1	125	32
	TOTAL		**16**	**525**	
Fourth	PHY-242	PHYSICS-II	3	100	35
	ZOO-126	FUNCTIONAL BIOLOGY-III	3	100	36
	CHEM-240	OCCUPATIONAL SAFETY & ENVIRONMENTAL HEALTH	3	100	39
	CHEM-241	ANALYTICAL CHEMISTRY-I	2+1	100	41
	CHEM-242	APPLIED CHEMISTRY-I	2+1	100	43
	CHEM-245	FUEL CHEMISTRY-I	2+1	100	44
	TOTAL		**18**	**600**	
Fifth	CHEM-352	APPLIED CHEMISTRY-II	2+1	100	47
	CHEM-353	BIOCHEMISTRY-I	2+1	100	49
	CHEM-356	INORGANIC CHEMISTRY-II	3	100	51
	CHEM-357	ORGANIC CHEMISTRY-II	3	100	53
	CHEM-358	PHYSICAL CHEMISTRY-II	3	100	55

	TOTAL		**15**	**500**	
Sixth	CHEM-361	ANALYTICAL CHEMISTRY-II	3	100	58
	CHEM-362	BIOCHEMISTRY-II	3	100	59
	CHEM-366	INORGANIC CHEMISTRY-III	3+1	125	61
	CHEM-367	ORGANIC CHEMISTRY-III	3+1	125	63
	CHEM-368	PHYSICAL CHEMISTRY-III	3+1	125	65
	TOTAL		**18**	**575**	
Seventh	CHEM-471	SPECIALIZATION PAPER-I	3	100	67-91
	CHEM-472	SPECIALIZATION PAPER-II	3	100	
	CHEM-473	SPECIALIZATION PAPER-III	3	100	
	CHEM-474	ENVIRONMENTAL CHEMISTRY-I	3	100	
	CHEM-475	RESEARCH PROJECT-I	3	100	
	TOTAL		**15**	**500**	
Eight	CHEM-484	SPECIALIZATION PAPER-IV	3	100	93-117
	CHEM-485	SPECIALIZATION PAPER-V	3	100	
	CHEM-486	SPECIALIZATION PAPER-VI	3	100	
	CHEM-487	ENVIRONMENTAL CHEMISTRY-II	3	100	
	CHEM-488	RESEARCH PROJECT-II	3	100	
	TOTAL		**15**	**500**	

TOTAL CREDIT HOURS: 132

*** 4 Cr Hr. must include LAB/Practical**

Controller of Examination
University of Malakand

DETAIL OF COURSES

BS 1st Year

Semester-I

Course Code	Course Title	Credits	Marks	Page
ELL-101	ENGLISH-I	3	100	2
PS-111	PAKISTAN STUDIES	2	50	4
MATH-111	MATH-I	3	100	6
EDU-111	EDUCATION-I	2	50	7
BOT-111	FUNCTIONAL BIOLOGY-I	3	100	8
CHEM-118	PHYSICAL CHEMISTRY-I	3+1	125	10
TOTAL		**17**	**525**	

BS 1st Year
Semester-I
Course Title: English I (Reading & Writing Skills)
Course Code: ELL-101
Credit Hours: 3; Marks:100

Course Description

The course is designed to help students take a deep approach in reading and writing academic texts which involve effective learning strategies and techniques aimed at improving the desired skills. The course consists of two major parts: the 'reading section' focuses on recognizing a topic sentence, skimming, scanning, use of cohesive devices, identifying facts and opinions, guess meanings of unfamiliar words. The 'writing section' deals with the knowledge and use of various grammatical components such as, parts of speech, tenses, voice, narration, modals etc. in practical contexts.

Course Objectives

- To enable students to identify main/topic sentences.
- To teach them to use effective strategies while reading texts.
- To acquaint them with cohesive devices and their function in the text.

Course Contents

Reading Skills

- Identify Main Idea / Topic sentences
- Skimming, Scanning, and Inference / Find Specific and General Information Quickly
- Distinguish Between Relevant and Irrelevant Information According to Purpose for Reading
- Recognize and Interpret Cohesive Devices
- Distinguish Between Fact and Opinion
- Guess the Meanings of Unfamiliar Words Using Context Clues
- Use the Dictionary for Finding out Meanings and Use of Unfamiliar Words
- Practice Exercises with Every Above-Mentioned Aspect of Reading

Writing Skills

- Parts of Speech
- Phrase, clause and sentence structure
- Combining sentences
- Tenses: meaning and use
- Modals
- Use of active and passive voice
- Reported Speech
- Writing good sentences
- Error Free writing
- Paragraph writing with topic sentence
- Summary writing

Note: Teachers need to include practice activities, exercises and worksheets on the provided topics.

Recommended Books

1. Howe, D. H, Kirkpatrick, T. A., & Kirkpatrick, D. L. (2004). Oxford English for undergraduates. Karachi: Oxford University Press.
2. Eastwood, J. (2004). English Practice Grammar (New edition with tests and answers). Karachi: Oxford University Press.
3. Murphy, R. (2003). Grammar in use. Cambridge: Cambridge University Press.

BS 1st Year
Semester-I
Course Title: Pakistan Studies (Compulsory)
Course Code: PS-111
Credit Hours: 2

Course 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.

Course Outline:

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:

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, Shahid Javed. State & Society in Pakistan, The Macmillan Press Ltd 1980.
2. Akbar, S. Zaidi. Issue in Pakistan's Economy. Karachi: Oxford University Press, 2000.

3. S.M. Burke and Lawrence Ziring. Pakistan's Foreign policy: An Historical analysis. Karachi: Oxford University Press, 1993.
4. Mehmood, Safdar. Pakistan Political Roots & Development. Lahore, 1994.
5. Wilcox, Wayne. The Emergence of Bangladesh., Washington: American Enterprise, Institute of Public Policy Research, 1972.

BS 1st Year
Semester-I
Course Title: Mathematics-I
Course Code: MATH-111
Credit Hours: 3; Marks:100

Course Objectives:

To prepare the students, not majoring in mathematics, with the essential tools of algebra to apply the concepts and the techniques in their respective disciplines.

Course Content:

Preliminaries: Real-number system, complex numbers, introduction to sets, set operations, functions, types of functions.

Matrices: Introduction to matrices, types, matrix inverse, determinants, system of linear equations, Cramer's rule.

Quadratic Equations: Solution of quadratic equations, qualitative analysis of roots of a quadratic equation, equations reducible to quadratic equations, cube roots of unity, relation between roots and coefficients of quadratic equations.

Sequences and Series: Arithmetic progression, geometric progression, harmonic progression.

Binomial Theorem: Introduction to mathematical induction, binomial theorem with rational and irrational indices.

Trigonometry: Fundamentals of trigonometry, trigonometric identities.

Recommended Books:

1. Kaufmann JE, College Algebra and Trigonometry, 1987, PWS-Kent Company, Boston
2. Swokowski EW, Fundamentals of Algebra and Trigonometry (6th edition), 1986, PWS-Kent Company, Boston

BS 1st Year
Semester-I
Course Title: Education ((Teaching and Learning))
Course Code: EDU-111
Credit Hours: 2

Course Description

The aim of course is to enable the learners to understand the m meaning, aims, nature, concept ad functions of education. The course also enables the learners to know the process of teaching, learning, learning theories and its applications in education, curriculum, its goals and types and also assessment, its meaning, types and applications in education.

Learning outcomes

At the end of course, the learners will be able to use the knowledge, concepts and theories of education in teaching and learning process in an innovative and creative manner.

Specific Objectives of course

The course will enable learners to:

1) Understand the meaning nature, types, aims and functions of education.
2) Know the meaning of teaching and learning and its process in education.
3) Know the concepts of approaches of teaching and learning in education.
4) Understand the concepts of curriculum, its meaning, types and importance.
5) Know the concepts of measurement and evaluation, its meaning types and applications in education.
6) Develop lesson plan and apply that in a classroom situation.

Course outline

a) Basics in education: Concepts, meaning, nature types and functions.
b) Teaching and learning: Concept of learning, approaches to learning and their applications in education, methods of teaching, teaching skills.
c) Curriculum and instructions: Concepts, meaning, types and functions.
d) Measurement and evaluation: concept difference between, measurement meaning types and applications in education.
e) Lesson planning and its applications in classroom situation.

Recommended Books:

1. Educational psychology (2012) S.K Mangal
2. Curriculum Development Karr and Kanirr (2004)
3. Assessment and evaluation - David A. 2002
4. Principles of curriculum (Prof. Arshad 2002)

BS 1st Year
Semester-I
Course Title: Functional Biology-I (Diversity of Plants)
Course Code: BOT-301
Credit Hours: 3; Marks:100

Course Objectives:

The course is aimed at developing the basic know how of the students about the classification of plants.

Course contents:

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

a) Viruses (RNA and DNA types) with special reference to TMV;

b) Bacteria and Cyanobacteria (Nostoc, Anabaena, Oscillatoria) with specific reference to biofertilizers, pathogenicity and industrial importance;

c) Algae (Chlamydomonas, Spirogyra, Chara, Vaucheria, Pinnularia, Ectocarpus, Polysiphonia)

d) Fungi (Mucor, Penicillium, Phyllactinia, Ustilago, Puccinia, Agaricus), their implication on crop production and industrial applications.

e) Lichens (Physcia)

f) Bryophytes

   i. Riccia
   ii. Anthoceros
   iii. Funaria

g). Pteridophytes.

   i. Fossils and fossilization
   ii. Psilopsida (Psilotum)
   iii. Lycopsida (Selaginella)
   iv. Sphenopsida (Equisetum)
   v. Pteropsida (Marsilea)
   vi. Seed Habit

h). Gymnosperms Cycas, Pinus, Ephedra.

Recommended Books:

1. Agrios, G.N. 2004. Plant pathology. 8th ed. Academic press London.
2. Alexopoulos, C.J., Mims, C.W. and Blackwell, M. 1996. Introductory Mycology. 4th ed. John Wiley and Sons Publishers.
3. Ingrouille, M. 1992. Diversity and Evolution of Land Plants. Chapman & Hall.
4. Lee, R.E. 1999. Phycology. Cambridge University Press, UK
5. Mauseth, J.D. 2003. Botany: An Introduction to Plant Biology 3rd ed., Jones and Bartlett Pub. UK
6. Prescott, L.M., Harley, J.P. and Klein, A.D. 2004. Microbiology, 3rd ed. WM. C. Brown Publishers.

BS 1st Year
Semester-I
Course Title: PHYSICAL CHEMISTRY
Course Code: CHEM-118
Credit Hours: 3+1; Marks:100+25

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.

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, half-lives of reactions, experimental techniques

for rate determination and methods for determination of order of reaction (integration, half-life, initial rate, and graphical methods), Arrhenius equation.

CHEM-118 Lab.

Determination of viscosity and refractive index of liquids.

Determination of percent composition of liquid solutions viscometrically.

Determination of refractive index and molar refractivity.

Determination of percent composition of liquid solutions by refractive index measurements.

Determination of molecular weight of a compound by elevation of boiling point (ebullioscopic method).

Determination of molecular weight of a compound by lowering of freezing point (cryoscopic method).

Determination of heat of solution by solubility method.

Determination of heat of neutralization of an acid with a base.

Kinetic study of acid catalyzed hydrolysis of ethyl acetate.

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., Atkin'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. Chaudhary, S. U., Ilmi Textbook of Physical Chemistry, 2nd ed., Ilmi Kitab Khana, Lahore, 2013).

BS 1st Year

Semester-II

Course Code	Course Title	Credits	Marks	Page
ELL-104	ENGLISH-II	3	100	13
ISRA-100	ISLAMIC STUDIES / ETHICS	2	50	16
MATH-121	MATH-II	3	100	17
BOT-402	FUNCTIONAL BIOLOGY-II	3	100	18
STAT-106	STATISTICS-I	3	100	20
CHEM-127	ORGANIC CHEMISTRY-I	3+1	125	22
TOTAL		**18**	**575**	

BS 1st Year
Semester-II
Course Title: English II (Composition Writing)
Course Code: ELL-104
Credit Hours: 3; Marks:100

Course Description:

The course focuses on the basic strategies of composition and writing skills. Good writing skills not only help students obtain good grades but also optimize their chances to excel in professional life. The course includes modes of collecting information and arranging it in appropriate manner such as chronological order, cause and effect, compare and contrast, general to specific etc. It enables the students to write, edit, rewrite, redraft and proofread their own document for writing effective compositions. Because of the use of a significant amount of written communication on daily basis, sharp writing skills have always been valued highly in academic as well as professional spheres.

Course Objectives:

This course aims to:

- Assist students identify the audience, message, and the purpose of writing
- Develop rhetorical knowledge and critical thinking
- Enable them express themselves in a variety of writing styles
- Help students write well organized academic texts including examination answers with topic/thesis statement and supporting details.
- Make students write argumentative essays and course assignments

Course outcome:

By the end of the course, students are expected to:

- Use different mechanics of writing to produce various types of compositions effectively keeping in view the purpose and the audience
- Demonstrate rhetorical knowledge
- Demonstrate critical thinking in well-organized forms of academic texts

Course Contents:

1. Writing Process

- Invention

✓ Generating Ideas (collecting information in various forms such as mind maps, tables, lists, charts etc.)

✓ Identifying Audience, Purpose, and Message

- Ordering Information

✓ Chronology for a narrative

✓ Stages of a process

✓ From general to specific and vice versa

✓ From most important to least important

✓ Advantages and disadvantages

✓ Comparison and contrast

✓ Problem solution pattern

- Drafting

✓ Free Writing

✓ Revising

✓ Editing

2. Paraphrasing

3. Cohesion and Coherence

✓ Cohesive Devices

✓ Paragraph unity

4. Summary and Precis Writing

5. Creative Writing

6. Essay Writing

✓ Developing a thesis

✓ Organizing an essay

✓ Writing effective introduction and conclusion

✓ Different types of essays

✓ Use of various rhetorical modes including exposition, argumentation and analysis

Recommended Books:

1. Goatly, A. (2000). Critical Reading and Writing: An Introductory Course. London:

Taylor & Francis

2. Hacker, D. (1992). A Writer's Reference. 2nd ed. Boston: St. Martin's
3. Hamp-Lyons, L. & Heasley, B. (1987). Study writing: A course in written English for academic and professional purposes. Cambridge: Cambridge University Press.
4. Howe, D. H, Kirkpatrick, T. A., & Kirkpatrick, D. L. (2004). Oxford English for Undergraduates. Karachi: Oxford University Press.
5. Kirszner, L.G & Mandell, S.R. (1989). Patterns for College Writing: Fourth Edition. USA: St. Martin's Press, Inc.
6. Smazler, W. R. (1996). Write to be Read: Reading, Reflection and Writing. Cambridge: Cambridge University Press.

BS 1st Year
Semester-II
Course Title: Islamic Studies/Ethics
Course Code: ISRA-100
Credit Hours: 3

Course Outlines:

Introduction to Quranic History and Uloom ul Quran.

Translation and Brief commentary of the selected part of the Holy Quran,

Seerat Studies: Life of Muhammad (SAW) before prophet hood, life in Makkah, life in Madina, Important events and lessons from the life of the Holy Prophet.

Hadith: Basic concepts, history, kinds, Uloom ul Hadith, Sunnah & Hadith and Legal position of Hadith

Selected study from texts of Hadith

Islamic law and jurisprudence: Basic concepts, history and importance, Sources and nature of differences.

Islamic culture and civilization: Basic concepts, Historical development it's Characteristics and its contemporary issues

Islam and science: Contributions of Muslims in science and development and Quran and science

Islamic Economic system: Means of distribution of wealth, Riba and Islamic ways of trade and commerce

Political system of Islam: Period of Khulafa- e- Rashida, Umayyads and Abbasids.

Social system of Islam: Basic concept, Elements of family and Ethical values in Islam.

Recommended books:

Ahmad Hassan	Principles of Islamic jurisprudence.
Bhatia H. S	Studies in Islamic law, religion and society.
Muhammad Zia ul Haq	Introduction to Al Sharaih Al Islamia.
Hameedullah Muhammad	Introduction to Islam
Hameedullah Muhhamad	Emergence of Islam
Hameedullah Muhhamad	Muslim Conduct of state
Dr. Saeed Ullah Qazi	Islamiyat (Comp) for BA/BSc
Dr. Mohammad Raza	Tareekh Musalmani Aalam

BS 2nd Year
Semester-II
Course Title: Mathematics-II
Course Code: MATH-121
Credit Hours: 3; Marks 100

Course Objectives:

To prepare the students, not majoring in mathematics, with the essential tools of calculus to apply the concepts and the techniques in their respective disciplines.

Course Outline:

Preliminaries: Real line, functions and their graphs, solution of equations involving absolute values, inequalities.

Limits and Continuity: Limit of a function, left-hand and right-hand limits, continuity, continuous functions.

Derivatives and their Applications: Differentiable functions, differentiation of polynomial, rational and transcendental functions, derivatives.

Integration and Definite Integrals: Techniques of evaluating indefinite integrals, integration by substitution, integration by parts, change of variables in indefinite integrals.

Recommended Books:

1. Anton H, Bevens I, Davis S, Calculus: A New Horizon (8th edition), 2005, John Wiley, New York
2. Stewart J, Calculus (3rd edition), 1995, Brooks/Cole (suggested text) Swokowski EW, Calculus and Analytic Geometry, 1983, PWS-Kent Company, Boston
3. Thomas GB, Finney AR, Calculus (11th edition), 2005, Addison-Wesley, Reading, Ma, USA

BS 1st Year
Semester-II
Course Title: Functional Biology-II (Ecology)
Course Code: BOT-402
Credit Hours: 3; Marks: 100

Course Objectives:

To make the students learn basics of ecology as well as become aware of the basic scientific facts about various ecological systems.

Course Contents:

1. Introduction, aims and applications of ecology.
2. Soil: Physical and Chemical properties of soil (soil formation, texture. pH, EC, organism and organic matter etc.) and their relationships to plants.
3. Light and Temperature. Quality of light, diurnal and seasonal variations. Ecophysiological responses.
4. Water: Field capacity and soil water holding capacity. Characteristics of xerophytes and hydrophytes. Effect of precipitation on distribution of plants.
5. Wind: Wind as an ecological factor and its importance.
6. Population Ecology: Introduction. A brief description of seed dispersal, seed bank, demography, density effects and reproductive strategy.
7. Community Ecology
    I. Ecological characteristics of plant community
    II. Methods of sampling vegetation (Quadrat and line intercept)
    III. Succession.
    IV. Major vegetation types of the local area.
8. Ecosystem Ecology
    I. Definition, types and components of ecosystem.
    II. Food chain and Food web.
    III. Biogeochemical cycles, definition, types with emphasis on
        1. Nitrogen and Hydrological cycles.
9. Applied Ecology
    I. Causes, effects and control of water logging and salinity with respect to Pakistan

II. Soil erosion: types, causes and effects (wind and water)

III. Brief concept of pollution types and effects (air, sediments and water pollution)

IV. Brief introduction to biodiversity and conservation with emphasis on Pakistan.

Recommended Books:

1. Barbour, M. G., J. H. Burke and W.D. Pitts. 1999. Terrestrial Plant Ecology, The Benjamin, Cumming Publishing Co. Palo Alto, California, USA.
2. Chapman, J.L. and Reiss, M.J. 1995. Ecology: Principles and Applications. Cambridge University Press.
3. Hussain F. 1989. Field and Laboratory Manual of Plan Ecology. National Academy of Higher Education, Islamabad.
4. Krebs, C. J. 1997. Ecology. Harper and Row Publishers.
5. Odum, E.P. 1985. Basic Ecology. W.B. Saunders.
6. Ricklefs, R.E. 2000. Ecology. W.H. Freeman and Co., UK.

BS 1st Year
Semester-II
Course Title: Statistics-I (Descriptive Statistics)
Course Code: STAT-106
Credit Hours: 3; Marks:100

Aims:

To give the basic knowledge of Statistics and prepare the students not majoring in Statistics

Objectives:

After completion of this course the student should be able to:

- Understand the use of the essential tools of basic Statistics;
- Apply the concepts and the techniques in their respective discipline and research work.

Course Contents:

What is Statistics? Definition of Statistics, Population and sample. Descriptive and inferential Statistics, Observations, Data, Discrete and continuous variables, Errors of measurement, Collection of primary and secondary data, Sources, Editing of Data. Exercises.

Presentation of Data: Introduction, basic principles of classification and Tabulation, Constructing of a frequency distribution, Relative and Cumulative frequency distribution, Diagrams, Graphs and their Construction, Bar charts, Pie chart, Histogram, Frequency polygon and Frequency curve, Cumulative Frequency Polygon or Ogive, Histogram, Ogive for Discrete Variable. Types of frequency curves. Exercises.

Measures of Central Tendency: Introduction, Different types of Averages, Quantiles, The Mode, Empirical Relation between Mean, Median and mode, Relative Merits and Demerits of various Averages. Properties of Good Average, Box and Whisker Plot, Stem and Leaf Display, definition of outliers. Exercises.

Measures of Dispersion: Introduction, Absolute and relative measures, Range, The semi-Inter-quartile Range, The Mean Deviation, The Variance and standard deviation,

Coefficient of variation, Properties of variance and standard Deviation, Standardized variables, Moments and Moments ratios. Skewness and Kurtosis. Exercises

Regression and Correlation: Introduction, cause and effect relationships, simple linear regression, estimation of parameters and their interpretation. r and R^2. Correlation. Coefficient of linear correlation, its estimation and interpretation. Multiple regression and interpretation of its parameters. Examples

Recommended Books

1. Johnson, R and Kuby, P. (2004) "Elementary Statistics" 9th Edition Brooks/Cole, a division of Thomson Learning, Inc. USA
2. Walpole, R.E., Myers, R.H and Myers, S.L. (1998), "Probability and Statistics for Engineers and Scientist" 6th edition, Prentice Hall, NY.
3. Chaudhry, S.M.and Kamal, S. (1996), "Introduction to Statistical Theory" Parts I & II, 6th ed, Ilmi Kitab Khana, Lahore
4. Spiegel, M.R., Schiller, J.L. and Sirinivasan, R.L. (2000) "Probability and Statistics", 2nd ed. Schaums outlines Series. McGraw Hill. NY.

BS 1st Year
Semester-II
Course Title: ORGANIC CHEMISTRY
Course Code: CHEM-127
Credit Hours: 3+1; Marks:100+25

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 Content:

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.

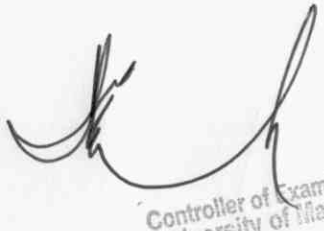
Chemistry of Functional Groups: Hydroxyl, ether and amino groups, preparation and properties of alcohols, phenols, ethers, and amines with focus on reaction mechanism and applications, carbonyl compounds, preparations and reaction mechanism of aldehydes and ketones and their applications, carboxylic 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.

CHEM-127 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).



BS 2nd Year

Semester-III

Course Code	Course Title	Credits	Marks	Page
ELL-202	ENGLISH-III	3	100	25
BCS-114	INTRODUCTION TO COMPUTER	3	100	27
STAT-107	STATISTICS-II	3	100	28
PHY-231	PHYSICS-I	3	100	30
CHEM-236	INORGANIC CHEMISTRY-I	3+1	125	32
TOTAL		**16**	**525**	

BS 2nd Year

Semester-III

Course Title: English-III (Communication and Presentation Skills)

Course Code: ELL-202

Credit Hours: 3

Course Description

For professional growth and future development, effective presentation skills and interactive and interpersonal communicative skills are very important. This course offers methods, techniques, and drills significant and useful in optimizing communication and presentation skills of the learners, enabling them to face divergent groups of audience with poise and confidence. The course has been divided into modules relating to the essentials, contents, gestures, technology, and variety associated with communication and presentations skills. The presentation skills part focuses on preparing students for long-life skill of preparing and giving presentations. Communication is a vital part of our daily routine. The communication skills part focuses on developing good communication skills among students.

Course Objectives

The course aims to:

Help students identify essential components of a presentation

Develop the awareness, knowledge, skills and attitudes required to deliver effective academic presentations and communicate clearly

Help students learn various presentation and communication styles and techniques

Provide techniques to facilitate effective interpersonal and interactive communication

Guide how to build stronger relationships through powerful communication

Course Contents

1. **Introduction**

   Understanding the purpose of Communication

   Analyze the Audience

   Communicating with words as well as with body language

   Writing with a Purpose

2. **Presentation skills**
3. **Delivering your presentation**

4. **Speaking with Confidence**
5. **Communicating Effectively**
6. **Job Interviews and Communicating Skills**
7. **Communicating with Customers**
8. **Communication in a Team**

Recommended Readings:

1. Carnegie, Dale. ( ). How to Win Friends & Influence People.
2. Giblin, Les. Skill with People.
3. Newton, Paul. How to communicate effectively.
4. Tracy, Brian. Speak to Win.

BS 2nd Year

Semester-III

Course Title: Introduction to Information and Communication Technologies (ICTs)

Course Code: BCS-114

Credit Hours: 3; Marks:100

Objectives:

This course focuses on a breadth-first coverage of computer science discipline, introducing computing environments, general application software, basic computing hardware, operating systems, desktop publishing, Internet, software applications and tools and computer usage concepts; Introducing Software engineering and Information technology within the broader domain of computing, Social issues of computing.

Course Outline:

Number Systems, Binary numbers, Boolean logic, History computer system, basic machine organization, Von Neumann Architecture, Algorithm definition, design, and implementation, Programming paradigms and languages, Graphical programming, Overview of Software Engineering and Information Technology, Operating system, Compiler, Computer networks and Internet, Computer graphics, AI, Social and legal issues.

Reference Material:

1. Computers: Information Technology in Perspective, 12/e: Larry Long and Nancy Long
2. An Invitation to Computer Science, 5/e: Schneider and Gersting, Brooks/Cole Thomson Learning, 2000.
3. Computer Science: An overview of Computer Science, Sherer.

BS 2nd Year
Semester-III
Course Title: Statistics-II (Inferential Statistics)
Course Code: STAT-107
Credit Hours: 3; Marks:100

Aims:

To give the basic knowledge of Statistics and prepare the students not majoring in Statistics

Objectives:

After completion of this course the student should be able to:

- Understand the use of the essential tools of basic Statistics;
- Apply the concepts and the techniques in their respective discipline and research work.

Course Contents:

Probability and Probability Distributions: **Probability:** Random experiments,' sample space and events. Counting techniques. Definitions and axioms of probability. Basic laws of probability. Independence of events. Bayes Theorem (proof not required) and its application. **Discrete and continuous distributions:** Binomial, Poisson Geometric and Normal Distribution. Exercises

Sampling and Sampling Distributions: Introduction, sample design and sampling frame, bias, sampling and non-sampling errors, sampling with and without replacement, probability and non-probability sampling, Sampling distributions for single mean and proportion, Difference of means and proportions. Exercises.

Hypothesis Testing: Introduction, Statistical problem, null and alternative hypothesis, Type-I and Type-II errors, level of significance, Test statistics, acceptance and rejection regions, general procedure for testing of hypothesis. Exercises. **Testing of Hypothesis-Single Population:** Introduction, testing of hypothesis and confidence interval about the population mean and proportion for small and large samples, Exercises. **Testing of Hypotheses-Two or more Populations:** Introduction, Testing of hypothesis and confidence intervals about the difference of population means and proportions for small and large samples, Analysis of Variance and ANOVA Table. Exercises **Testing of Hypothesis-Independence of Attributes:** Introduction, Contingency Tables, Testing of

hypothesis about the Independence of attributes. Chi-square test of Independence, Chi square test of goodness of fit, Chi- square test of homogeneity, Introduction and application of F-distribution: Test of hypothesis for equality of two variance. Exercises.

Recommended Books

1. Johnson, R and Kuby, P. (2004) "Elementary Statistics" 9th Edition Brooks/Cole, a division of Thomson Learning, Inc. USA
2. Walpole, R.E., Myers, R.H and Myers, S.L. (1998), "Probability and Statistics for Engineers and Scientist" 6th edition, Prentice Hall, NY.
3. Chaudhry, S.M.and Kamal, S. (1996), "Introduction to Statistical Theory" Parts I & II, 6th ed, Ilmi Kitab Khana, Lahore
4. Spiegel, M.R., Schiller, J.L. and Sirinivasan, R.L. (2000) "Probability and Statistics", 2nd ed. Schaums outlines Series. McGraw Hill. NY.

BS 2nd Year
Semester-III
Course Title: Physics-I
Course Code: PHY-231
Credit Hours: 3

Course Objectives:

The course will make the students able to understand basic concepts of physics

Course Contents:

Vectors

Vectors and Scalars, Adding Vectors Geometrically, Components of Vectors, Unit Vectors, Adding Vectors by Components, Vectors and the Laws of Physics, Multiplying Vectors

Motion in Two and Three Dimensions

Position and Displacement; Average Velocity and Instantaneous Velocity; Average Acceleration and Instantaneous Acceleration; Projectile Motion; Projectile Motion Analyzed; Uniform Circular Motion; Relative Motion in One Dimension; Relative Motion in Two Dimensions

Force and Motion-1

Newtonian Mechanics; Newton's First Law; Force; Mass; Newton's Second Law; Some Particular Forces; Newton's Third Law; Applying Newton's Laws

Force and Motion-II

Friction; Properties of Friction; The Drag Force and Terminal Speed; Uniform Circular Motion

Kinetic Energy and Work

What Is Energy? Kinetic Energy; Work; Work and Kinetic Energy; Work Done by the Gravitational Force; Work Done by a Spring Force; Work Done by a General Variable Force; Power

Potential Energy and Conservation of Energy

Work and Potential Energy; Path Independence of Conservative Forces; Determining Potential Energy Values; Conservation of Mechanical Energy; Reading a Potential Energy Curve; Work Done on a System by an External Force; Conservation of Energy

Center of Mass and Linear Momentum

The Center of Mass; Newton's Second Law for a System of Particles; linear Momentum; The linear Momentum of a System of Particles; Collision and Impulse; Conservation of Linear Momentum; Momentum and Kinetic Energy in Collisions; Inelastic Collisions in One Dimension; Elastic Collisions in One Dimension; Collisions in Two Dimensions; Systems with Varying Mass: A Rocket

Recommended Book:

Halliday / Resnik / Walker, Fundamentals of Physics 7th Edition, Wiley International Edition

BS 2nd Year
Semester-III
Course Title: INORGANIC CHEMISTRY
Course Code: CHEM-236
Credit Hours: 3+1; Marks:100+25

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 Content:

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, pK_a, pK_b 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.

CHEM-236 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. Chaudhary S. U., *Ilmi Textbook of Inorganic Chemistry,* Ilmi Kitab Khana, Lahore, (2013).
8. Catherine E. House crdft, Alan G. Sharpe, *Inorganic Chemistry,* 3rd ed., Prentice Hall, (2008).
9. Kathleen A. H., James E. H., *Descriptive Inorganic Chemistry,* 2nd ed., Brooks Cole, (2010).
10. Wulfsberg G., *Principles of Descriptive Inorganic Chemistry,* 1st ed., University Science Books, (1991).
11. Hill, R. H. JR and Fister, D. C., *Laboratory Safety for Chemistry Students,* John-Wiley & Sons, Inc., (2010).
12. 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).
13. Svehla, G., *Vogel's Qualitative Inorganic Analysis,* 7th ed., (7th imp.), Pearson Education, Ltd., (2009).

BS 2nd Year

Semester-IV

Course Code	Course Title	Credits	Marks	Page
PHY-242	PHYSICS-II	3	100	35
ZOO-126	FUNCTIONAL BIOLOGY-III	3	100	36
CHEM-240	OCCUPATIONAL SAFETY & ENVIRONMENTAL HEALTH	3	100	39
CHEM-241	ANALYTICAL CHEMISTRY-I	2+1	100	41
CHEM-242	APPLIED CHEMISTRY-I	2+1	100	43
CHEM-245	FUEL CHEMISTRY-I	2+1	100	44
TOTAL		**18**	**600**	

BS 2nd Year
Semester-IV
Course Title: Physics-II
Course Code: PHY-242
Credit Hours: 3; Marks 100

Course Objectives:

The course will make the students able to understand basic concepts of physics related to thermodynamics and the theory of gases.

Course Contents:

Temperature, Heat and The First Law of Thermodynamics

Temperature; The Zeroth Law of Thermodynamics; Measuring Temperature; The Celsius and Fahrenheit Scales; Thermal Expansion; Temperature and Heat; The Absorption of Heat by Solids and Liquids; A Closer Look at Heat and Work; The First Law of Thermodynamics; Some Special Cases of the First Law of Thermodynamics

Heat Transfer Mechanisms

The Kinetic Theory of Gases

Avogadro's Number; Ideal Gases; Pressure; Temperature and RMS Speed; Translational Kinetic Energy; Mean Free Path; The Distribution of Molecular Speeds; The Molar Specific Heats of an Ideal Gas; Degrees of Freedom and Molar Specific Heats; A Hint of Quantum Theory; The Adiabatic Expansion of an Ideal Gas

Entropy and The Second Law of Thermodynamics

Irreversible Processes and Entropy; Change in Entropy; The Second Law of Thermodynamics; Entropy in the Real World: Engines; Entropy in the Real World: Refrigerators; The Efficiencies of Real Engines; A Statistical View of Entropy Course Objectives and course contents along with bibliography will be provided by the Department of Physics, University of Malakand.

Recommended Book:

Halliday / Resnik / Walker, Fundamentals of Physics 7th Edition, Wiley International Edition

BS 2nd Year
Semester-IV
Course Title: Functional Biology-III (Animal Diversity)
Course Code: ZOO-126
Credit Hours: 3

Aims and Objectives

The course is designed to provide students with:

a. Concepts of evolutionary relationship of animal kingdom.

b. Knowledge about animal kingdom, emphasizing their phylogenetic relationships and simple to complex mode of animal life.

Course Contents

1. Introduction

Classification of organisms; evolutionary relationships and tree diagrams; patterns of organization.

2. Animal-Like Protists: The Protozoa

Evolutionary perspective; life within a single plasma membrane; symbiotic life-styles. 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.

3. 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.

1. Triploblastics and Acoelomate Body Plan

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

5. Pseudocoelomate Body Plan: Aschelminths

Evolutionary perspective; general characteristics; classification up to phyla with external features; feeding and the digestive system; other organ systems; reproduction and

development of phylum rotifera and phylum nematoda; phylum kinorhyncha. Some important nematode parasites of humans; further phylogenetic considerations.

6. Molluscan Success

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

7. Annelida: The Metameric Body Form

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

8.Arthropods: Blueprint for Success

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

9. Hexapods and Myriapods: Terrestrial Triumphs

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

Recommended Books:

1. Campbell, N.A. Biology, 6th Edition. 2002. Menlo Park, California: Benjamin/Cummings Publishing Company, Inc.
2. Hickman, C.P., Roberts, L.S. and Larson, A. Integrated Principles of Zoology, 11th Edition (International), 2004. Singapore: McGraw Hill.
3. Kent, G.C. and Miller, S. Comparative Anatomy of Vertebrates. 2001. New York: McGraw Hill.

4. Miller, S.A. and Harley, J.B. Zoology, 5th Edition (International), 2002. Singapore: McGraw Hill.

5. Pechenik, J.A. Biology of Invertebrates, 4th Edition (International), 2000. Singapore: McGraw Hill.

BS 2nd Year

Semester-IV

Course Title: Occupational Safety & Environmental Health

Course Code: GEN-241

Credit Hours: 3

Course Objectives:

The course will make the students able to understand basic concepts of physics related to thermodynamics and the theory of gases.

Course Contents:

History and Importance of Safety and health in Laboratory

- Introduction to Occupational safety and environmental health (OSEH)
- Different Types of Hazards and risk in Chemical Laboratory
- Moral, Legal and Financial Reasons
- Importance of Safety and Security, Responsibility and Accounting for Safety

Housekeeping and Good Laboratory Practice (GLP) in Chemical Safety: Use of Appropriate Personal Protection Equipments (PPEs)

- Potential Health Hazards from Cleaning Chemicals
- Choosing Environmentally-safer Cleaning Chemicals
- Personal Protection Equipments; Aprons, Gloves Face, Eye and Foot Protection, Respiratory Protection
- Contaminated Work Environment
- Preventing Ergonomic Injuries
- Worker Training and Employer Responsibilities

Hazard Identification, Management and Control

- Introduction to Hazard Recognition and Evaluation
- Unrecognized hazards and their Consequences; Slips, Trips & Falls Hazards
- Understanding the safety Data Sheet (SDS) and Pictogram Communications
- Hazard Warning Signs, Labeling & Tagging System
- Hazard Communication Standard (HCS) and Globally Harmonized System (GHS)
- Ways of Protection and Control to Reduce Hazards Toxic Effects
- Examples of Hazards at the Work Place

- Hazards Reporting Procedures

Waste Management and Disposal

- Waste Management System for Laboratories
- Identification, Classification and Segregation of Laboratory Waste
- Storage of Laboratory Waste
- Recovery, Recycling and Reuse of Laboratory Chemicals
- Disposal of Chemicals in the Sanitary Sewer System
- Procedures for Laboratory Destruction of Chemical Waste
- Transportation of Hazardous Chemicals
- Incineration of Hazardous Chemicals
- Disposal of Hazardous Chemicals
- Disposal of Hazardous Chemicals in Landfill
- Disposal of Chemically Contaminated Waste from Life-Science Laboratories

Managing Chemicals

- Introduction
- Green Chemistry for Every Laboratory
- Purchasing Chemicals
- Inventory and Tracking of Chemicals
- Storage of Chemicals
- Transfer, Transport and Shipment of Chemicals

Recommended Books:

1. Fanning, Fred E. (2003). Basic Safety Administration: A Handbook for the New Safety Specialist, Chicago: American Society of Safety Engineers
2. Stephen K. Hall "Chemical Safety in the Laboratory" CRC Press
3. Anthony Fuscaldo, "Laboratory Safety Theory and Practice" Elsevier Science
4. Jay A. Young, "Improving Safety in the Chemical Laboratory: A Practical Guide", Wiley, 1991
5. Brinton Marshall Miller, "Laboratory safety: principles and practices", American Society for Microbiology, 1986
6. Stephen R. Rayburn The Foundations of Laboratory Safety: A Guide for the Biomedical Laboratory, Springer 1991

BS 2nd Year
Semester-IV
Course Title: ANALYTICAL CHEMISTRY-I
Course Code: CHEM-241
Credit Hours: 2+1

Course Objectives:

Students will acquire knowledge about sampling, sample 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 concepts, ISO standards.

Classical Analytical Methods:

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

CHEM-241 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 / $PbSO_4$).

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).

BS 2nd Year

Semester-IV

Course Title: APPLIED CHEMISTRY-I

Course Code: CHEM-242

Credit Hours: 2+1

Course Objectives:

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

Course Contents:

Fundamentals of Chemical Industry:

Basic principles and parameters for industrial plant unit operations and unit processes.

Chemical Industries:

Raw materials, flow sheet diagrams and unit operations and unit processes of sulphuric acid, nitric acid, hydrochloric acid, oxalic acid, formic acid, caustic soda and washing soda, cement industry, petroleum, textile, polymer and fuel industries, applications of these industries.

CHEM-242 Lab

Measurement of water hardness with EDTA Titrations.
Estimation of total solids in water.
Estimation of chloride in water.
Estimation of Ferrous and Ferric ions in drinking water by redox titration.
Extraction of capsicum oil (Soxhlet extraction).

Recommended Books:

1. Kent, J. A.,_Riegel's Handbook of Industrial Chemistry, 10th ed., Kluwer Academic/ Plenum Publishers, (2003).
2. Vermani, O. P. and Narula, A. K., Applied Chemistry; Theory and Practice, New Age International Pvt. Ltd. Publishers, (2008).
3. Hede, P. D., Bier. S.P., Inorganic and Applied Chemistry, Ventus publishing app., (2007).
4. Sharma, J., Ndi., Applied Industrial Chemistry, Arise publishers & Distributors, (2012).
5. Heaton, A., An introduction to Industrial Chemistry, 3rd ed., Chapman & Hall, (1996).

BS 2nd Year

Semester-IV

Course Title: FUEL CHEMISTRY-I

Course Code: CHEM-245

Credit Hours: 2+1

Course Objectives

After completing the course, the students will acquire knowledge about the chemistry of fossil fuels like coal, petroleum and natural gas and their conversion processes to get useful chemical products

Course Contents

Introduction and classification of fuels. Origin of coal, petroleum and natural gas. Constituents of coal, petroleum and natural gas. Varieties of crude oils. Coal ranks. Distillation of crude petroleum in to marketable products. Uses and properties of naphtha, gasoline, kerosene, diesel, gas oil and furnace oil. Lubricants from petroleum. Producer and water gas from coal. Petrochemicals from natural gas.

CHEM-245 Lab

Determination of moisture contents of coal mined in different parts of Pakistan. Determination of Ash contents of coal mined in different parts of Pakistan.

Determination of Volatile matter of coal. Determination of fixed carbon contents of coal.

Determination of hydrogen and nitrogen contents of the coal. Determination of chlorine and oxygen in coal.

Determination of various forms of sulfur in coal.

Determination of specific and API gravity of petroleum fractions. Estimation of carbon residue in petroleum products (Conradson method). Determination of ash content in petroleum products.

Determination of sulfated ash in lube oil.

Estimation of water, sediments and oil in crude oil by centrifuge method. Determination of cloud and pour point of Lube-oil.

Estimation of asphalt in road samples

Recommended Books:

1. Gyngell, E.S. "Applied Chemistry for Engineers". Edward Arnold Publisher, Ltd.

London. (1989).

2. Harker, J.H. and Backurst, J.R. "Fuel and Energy" Academic Press, London and New York (1988).

Supplementary Reading Materials:

1. Wilson, P.J. and Wells, J.H. "Coal Coke and Coal Chemicals" McGraw-Hill Book Company, London, (1980).
2. Hobson, G.D. "Modern petroleum technology" part-I. John Wily & Sons, Toronto, (1984).

BS 3rd Year

Semester-V

Course Code	Name of Subject	Credits	Marks	Page
CHEM-352	APPLIED CHEMISTRY-II	2+1	100	47
CHEM-353	BIOCHEMISTRY-I	2+1	100	49
CHEM-356	INORGANIC CHEMISTRY-II	3	100	51
CHEM-357	ORGANIC CHEMISTRY-II	3	100	53
CHEM-358	PHYSICAL CHEMISTRY-II	3	100	55
TOTAL		**15**	**500**	

BS 3rd Year
Semester-VI
Course Title: APPLIED CHEMISTRY
Code: CHEM-352
Credit Hours: 2+1

Course Objectives:

Students will gain understanding about the importance of water and its quality requirements for the industrial uses in addition to learning about water treatment techniques. They will also learn about the composite materials.

Course Contents:

Water Treatment, Steam Production and Scale Removal: Sources of water hardness, water treatment and conditioning for municipal and industrial purposes, steam production and its utilization for power and energy generation, boiler water treatment, chemistry involved in the formation of scale and its prevention.

Distillation: Vapor liquid equilibrium, methods of getting equilibrium data for binary systems, construction of equilibrium diagram, designing of distillation column, reflux ratio and its importance.

Composite Materials: Introduction to composite material, classification of composite on the basis of reinforcement (Particle–Reinforced composite, Fibre–Reinforced composite, structural composites) and classification of composites on the basis of matrix phase (Polymer–Matrix composite, Metal–Matrix composite, Ceramics–Matrix composite, Carbon-carbon composite, Hybrid-composite, Laminar composite, Sandwich panels), synthesis, properties and applications of composite materials.

CHEM-352 Lab

Extraction of clove oil from cloves.

Preparation of liquid detergents.

Study of the kinetics of dissolution of Magnesium metal in dilute HCl.

Estimation of Manganese in Steel.

Estimation of Ferric Iron in Cement.

Recommended Books:

1. Erwin D. L., Industrial Chemical Process Design, McGraw-Hill, (2002).

2. Chawla, K. K., Composite Materials: Science and Engineering, 3rd ed., Springer, (2012).
3. Methews, F. L., Rawlings, R. D., Composite Materials: Engineering and Sciences, CRC Press, (2003).
4. Deborah, D. L., Composite Materials: Science and Applications, 2nd ed., Springer, (2010).
5. Gay, D. and Hoa, S. V., Composite Materials: Design and Applications, 2nd ed., CRC Press, LLC, (2007).
6. Kister, H., Distillation Operation, 1st ed., McGraw-Hill Professional, (1990).
7. Kister, H., Distillation Design, 1st ed., McGraw-Hill Professional, (1992).
8. Tchobanoglous, G., Burton, F. L. and Stensel, H. D., Wastewater Engineering: Treatment and Reuse, 4th ed., McGraw-Hill, (2003).
9. Callister, W. D. Jr., Materials Science and Engineering: An Introduction, 7th ed., John-Wiley & Sons, Inc., (2007).
10. Roussak, O. V. and Gesser, H. D., Applied Chemistry: A Textbook for Engineers and Technologists, 2nd ed., Springer, (2013).
11. Mizrahi, J., Developing an Industrial Chemical Process: An Integrated Approach, CRC Press, (2002).
12. Vermani, O. P., Applied Chemistry: Theory and Practice, 2nd ed., New Age International, (2006).

BS 2nd Year
Semester-IV
Course Title: BIOCHEMISTRY-I
Course Code: CHEM-253
Credit Hours: 2+1

Course Objectives:

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

Course Contents:

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.

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

Definition and classification of lipids, chemistry and biological importance of fatty acids, waxes, glycerides, phospholipids, sphingolipids, glycolipids, sterols and prostaglandins.

Significance of lipids in biological membranes and transport mechanism.

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

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

CHEM-253 Lab.

Qualitative and quantitative analysis of carbohydrates, lipids and proteins.

Determination of pH, Preparation of buffers.

Enzyme catalysis, Progress curve for enzyme catalyzed reactions, Determination of K_m

values. To study the effect of different factors on the rate of enzyme catalyzed reactions.

Recommended Books:

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

BS 3rd Year

Semester-V

Course Title: INORGANIC CHEMISTRY

Course Code: CHEM-356

Credit Hours: 3

Course Objectives:

Students will acquire knowledge about the physical and chemical properties of d- & f-block elements on the basis of their electronic configurations and will be able to work out structures of coordination compounds through development of understanding of VBT, CFT and MOT.

Course Contents:

Chemistry of d-block elements and coordination complexes:

Back ground of coordination chemistry, nomenclature and structure of coordination complexes with coordination number 2-6, chelates and chelate effect, theories of coordination complexes, Werner's theory, valence bond theory (VBT), crystal field theory (CFT) and molecular orbital theory (MOT), Jahn-Teller theorem, magnetic properties, spectral properties, isomerism, stereochemistry, and stability constants of coordination complexes.

Chemistry of f-block elements:

i. Lanthanides: General characteristics, occurrence, extraction and general principles of separation, electronic structure and position in the periodic table, lanthanides contraction, oxidation states, spectral and magnetic properties and uses.

ii. Actinides: General characteristics, electronic structure, oxidation state and position in the periodic table, half-life and decay law.

Recommended Books:

1. Cotton, F. A., Wilkinson, G., Murillo, C. A. and Bochmann, M., Advanced Inorganic Chemistry, 6th ed., Wiley-Interscience, (1999).
2. Housecraft, C. and Sharpe, A. G., Inorganic Chemistry, 4th ed., Prentice Hall, (2012).
3. Miessler, G. L. and Tarr, D.A., Inorganic Chemistry, 4th ed., Pearson- Prentice Hall International, (2010).

4. Douglas, B., McDanial, D., Alexander, J., Concepts and Models of Inorganic Chemistry, 3rd ed., John-Wiley & Sons, New York, (1994).
5. Shriver, D. and Atkins, P., Inorganic Chemistry, 5th ed., W. H. Freeman & Company, (2010).
6. Lee, J. D., Concise Inorganic Chemistry, 5th ed., Blackwell Science Ltd., (1996).
7. Atkins, P. and Jones, L., Chemicals Principles, 5th ed., W. H. Freeman & Company, (2010).
8. Huheey, J. E., Kieter, E. A. and Kieter, R. L., Inorganic Chemistry: Principles of Structure and Reactivity, 4th ed., Prentice Hall, (1997).
9. Müller, U., Inorganic Structural Chemistry, 2nd ed., John-Wiley & Sons, Ltd., (2006).
10. Marusak R. A., Doan K., Cummings S. D., Integrated Approach to Coordination Chemistry, 1st ed., John-Wiley & Sons, (2007).
11. Chaudhary, S. U., Ilmi Textbook of Inorganic Chemistry, Ilmi Kitab Khana, Urdu Bazar, Lahore, (2013).

BS 3rd Year

Semester-V

Course Title: ORGANIC CHEMISTRY

Course Code: CHEM-357

Credit Hours: 3

Course Objectives:

Students will gain knowledge about the stereochemical behavior of organic molecules and acquire an ability to propose mechanism of simple reactions.

Course Contents:

Stereochemistry:

Types of stereoisomers, RS and EZ notation, optical activity, stereoselectivity and stereospecificity, conformational analysis.

Organic Reactions and Mechanism:

Detailed mechanism of aliphatic reactions including addition, substitution (SN1, SN2, SNi, and SN2′), and elimination (E1, E2 and E1cB) reactions, concept of energy profile, transition state and intermediate.

Recommended Books:

1. Robert, T. M., and Robert, N. B., Organic Chemistry, 6th ed., Prentice Hall, New Jersey, (1992).
2. Younas, M., A Textbook of Organic Chemistry, Ilmi Kitab Khana, Urdu Bazar, Lahore, (2006).
3. Morris, D. G., Stereochemistry (Basic Concepts in Chemistry), Wiley-RSC, (2002).
4. Mislow, K., Introduction to Stereochemistry, Dover Publications Inc., (2003).
5. David M., Stereochemistry (Tutorial Chemistry Texts), Royal Society of Chemistry, (2002).
6. Seiler, J. P., Good Laboratory Practice: The Why and the How, 2nd ed., Springer, (2005).
7. Brown, W. H., Fotte, C. S., Iverson, B. L. and Anslyn, E. V., Organic Chemistry, 6th ed., Brooks/ Cole Cengage Learning, (2012).
8. Solomons, T. W. G. and Fryhle, C. B., Organic Chemistry, 10th ed., John- Wiley & Sons, Inc., (2011).

9. 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).
10. Eames, J. and Peach, J. M., Stereochemistry at a Glance, Blackwell Science, Ltd., (2003).
11. Eliel, E. L., Wilen, S. H. and Doyle, M. P., Basic Organic Chemistry, John- Wiley & Sons, Inc., (2001).

BS 3rd Year

Semester-V

Course Title: PHYSICAL CHEMISTRY

Course Code: CHEM-358

Credit Hours: 3

Course Objectives:

Students will be able to understand and acquire knowledge about the principles and theoretical background of quantum chemistry, kinetics theory of gases and phase equilibrium. The knowledge gained thus can be applied to study various aspects of quantum mechanics, gas kinetic behavior and thermodynamics and phase equilibrium.

Course Contents:

Quantum Chemistry: Black body radiation, photoelectric effect, line spectra of elements, Bohr atomic model, wave and particle nature of matter, de Broglie's equation, Young's double slit experiment, Heisenberg's uncertainty principle, wavefunctions and Born interpretation of wavefunctions, probability density, eigenfunctions and eigenvalues, Hamiltonian operator, Schrödinger wave equation, wavefunctions for hydrogen-like atomic orbitals, radial distribution functions, shielding and penetration, effective nuclear charge, orbital energies, periodic trends in the properties of the elements in the periodic table.

Kinetic Theory of Gases: Equation of states, ideal and real gases, the virial equation and the van der Waals equation for real gases, critical phenomena and critical constants, probability density for molecular speeds of gas molecules, Maxwell distribution of molecular speeds, average speeds, pressure of an ideal gas, calculation of molecular speeds, binary collisions, effusion and mean free paths, Maxwell Boltzmann's law of energy distribution, method for the determination of the Avogadro's number (NA), statistical probability and entropy.

Phase Equilibrium: Gibbs phase rule, Phase diagrams of one component and two component systems, Gibbs energy and the phase diagram of a substance, location of phase boundaries, Clausius-Clapeyron equation, vapor-liquid equilibrium of binary liquid mixtures, binary phase diagrams and lever rule.

Recommended Books:

1. Silbey, R. J., Alberty, R. A., and Bawendi, M. G., Physical Chemistry, 4th ed., Jojn-Wiley & Sons, (2005).
2. McQuarrie, D. A. and Simon, J. D., Physical Chemistry – A Molecular Approach, 1st ed., University Science Books, (1997).
3. Atkins, P. and Paula, J. D., Atkin's Physical Chemistry, 9th ed., Oxford University Press, (2010). 4. Moore. W. J., Physical Chemistry, 4th ed., Longman Publisher (1972).
4. Keeler. J. and Wothers, P., Chemical Structure and Reactivity: An Integrated Approach, 1st ed., Oxford University Press, (2008).
5. Helpern, A. M., Experimental Physical Chemistry: A Laboratory Textbook 2nd ed., Prentice Hall, (1997).
6. Garland, C. W., Nibler, J. W. and Shoemaker, D., P., Experiments in Physical Chemistry, 8th ed., McGraw-Hill, (2003).
7. Atkins, P., Jones, L., Chemical Principles: The Quest for Insight, 5th ed., W. H. Freeman, New York, (2010).

BS 3rd Year

Semester-VI

Course Code	Name of Subject	Credits	Marks	Page
CHEM-361	ANALYTICAL CHEMISTRY-II	3	100	58
CHEM-362	BIOCHEMISTRY-II	3	100	59
CHEM-366	INORGANIC CHEMISTRY-III	3+1	125	61
CHEM-367	ORGANIC CHEMISTRY-III	3+1	125	63
CHEM-368	PHYSICAL CHEMISTRY-III	3+1	125	65
TOTAL		**18**	**575**	

BS 3rd Year
Semester-VI
Course Title: ANALYTICAL CHEMISTRY-II
Course Code: CHEM-361
Credit Hours: 3

Course Objectives:

The main objectives of this course are to introduce the students to the basic principles, instrumental aspects and applications of thermal analysis, electrode phenomena and basic electroanalytical techniques

Course Contents:

Thermal Analysis

Basic principles, instrumentation and applications of Thermogravimetry (TGA) and Differential Thermal Analysis (DTA).

Electrode Phenomena

The electrochemical cell, Oxidation and reduction potentiometric methods, various types of electrodes and their use, over potentials, membrane potentials, some well-known Redox reactions of analytical importance, ion-selective electrodes

Electroanalytical techniques

Basic principles, instrumentation and application of potentiometry, voltammetry, polarography, conductometry, electrogravimetry, amperometry and coulometry

Recommended Books:

1. Analytical Chemistry by Gary D. Christian; 6th ed. 2004; John Wiley & Sons, Inc.
2. Douglas A. Skoog, Donald M. West, F. James Holler, Stanley R. Crouch, "Fundamentals of Analytical Chemistry" 8th ed. 2003; Saunders College Publishing, Philadelphia.
3. Instrumental Methods of Analysis by Hobert H. Willard D.L. Merrit & J.R.J.A. Dean, Frank A. Settle; 7th Sub edition 1988; Wadsworth Publishing Company.
4. Laboratory Manual of Analytical Chemistry by C. Reilly; Allyn and Bacon, London.
5. Quantitative Analysis by W. J. Blaedal and V. W. Medloche; Harper & Row, N.Y.

BS 3rd Year
Semester-VI
Course Title: BIOCHEMISTRY-II
Course Code: CHEM-362
Credit Hours: 3

Course Objectives:

Students will acquire knowledge about the fundamental concepts of the mechanisms of major macromolecules (amino acids, proteins, carbohydrates, nucleic acids and lipids), and the metabolism and regulation and inhibition of the metabolic pathways.

Course Contents:

Metabolism of Carbohydrates: Digestion, Absorption and Transport of sugars into cell, Glycolysis, Citric Acid Cycle, HMP pathway and its significance, Uronic acid pathway, Gluconeogenesis, Glycogenesis, Glycogenolysis, Photosynthesis.

Metabolism of Lipids: Digestion of Lipids, absorption and transport of lipids and fatty Acids, Oxidation saturated and unsaturated, odd chain and branched chain fatty acids, Biosynthesis of fatty acids and eicosanoids, Biosynthesis of triglycerides, phosphides, steroid and Bitter acids, Biosynthesis and utilization of Ketone bodies.

Metabolism of Proteins: Digestion of proteins, absorption and transport of amino acids to the cell, Biochemical reaction of amino acids: decarboxylation, deamination, transamination and transmethylation etc., metabolism of essential amino acids, metabolic disorders, urea cycle, Creatine and uric acid synthesis, inter- relationship between carbohydrate, lipid and protein metabolism.

Metabolism of Nucleic Acids: Biosynthesis and catabolism of purines and pyrimidines and their regulation, synthesis, catabolism of nucleosides, DNA polymerases and other enzymes involves in metabolism.

Recommended Books:

1. Voet, D. and Voet, J. D., Biochemistry, 4th ed., illustrated. Publisher: John- Wiley & Sons Canada, Limited, (2011). ISBN: 0470917458, 9780470917459.
2. Nelson, D. L. and Cox, M. M., Lehninger's Principles of Biochemistry, 6th ed., Freeman, (2012).
3. Murray, R., Bender, D., Botham, K.M., Kennely, P. J., Rodwall, V. and Weil, P.A.,

Harper's Biochemistry, 29th ed., (2012).

4. Zubay, G. L., Biochemistry, 4th ed., illustrated. Publisher: WMC. Brown Publishers, (1998), digitized, (2008). ISBN: 0697219003. 9780697219008.
5. Guyton, A. C. & Hall, J. E., Guyton & Hall Text Book of Medical Physiology, 12th ed., Publishers: Saunders Elsevier, (2011).
6. Plummer, D.T., An Introduction to Practical Biochemistry, 3rd ed., TATA MCGraw-Hill Publishing Company LTD, (2010).
7. Sawhney, S. K. and Sing, R., Introductory Practical Biochemistry, 2nd ed., Narosa Publishing House, New Delhi, (2005).
8. Robert A. Copeland, Enzymes: A Practical Introduction to Structure, Mechanism, and Data analysis, 2nd ed., Publishers: John-Wiley & Sons, (2000) ISBN: 0-471-35929-7

BS 3rd Year
Semester-VI
Course Title: INORGANIC CHEMISTRY
Course Code: CHEM-366
Credit Hours: 3+1

Course Objectives:

Students will acquire knowledge about various types of inorganic materials, their structure, synthesis, characterization and applications in various fields

Course Contents:

Introduction to inorganic materials, crystalline and amorphous states, bonding in solids, non-stoichiometric compounds, binary solid solutions, mechanical, electrical, magnetic, dielectric, optical, and chemical (corrosion) properties of advanced materials, synthesis (e.g., sol-gel, hydrothermal techniques, etc.) and design of inorganic materials and characterization, doping and purification of silicone, chemical vapor deposition and sputtering, introduction to nano materials.

CHEM-366 Lab

1. Estimation of anions in-mixtures:

Chloride-phosphate, chloride-nitrate, oxalate-chloride, sulphate- phosphate, bromide-nitrate, borate-acetate, iodide-nitrate.

2. Iodometric titration with potassium iodate.
3. Gravimetric estimation of oxalate.
4. Precipitation Titrations.

a) Determination of strength of NaCl given solution by AgNO3 using Fluorescein as indicator.

b) Determination of % age purity of KBr using Fluorescein as indicator.

c) Determination of % composition of mixture of KI & KNO3 using Eoscein as indicator.

5. Spectrophotometric determination of cerium.
6. Separation of heavy metals using solvent extraction technique.

Recommended Books:

1. Xu, R., Pang, W., Huo, Q., Modern Inorganic Synthetic Chemistry, 1st ed., Elsevier, (2011).
2. Mendham, J., Denney, R. C., Barnes, J. D. and Thomas, M. J. K., Vogel's Quantitative

Chemical Analysis, 6th ed., Prentice Hall, (2000).

3. Cotton, F. A., Wilkinson, G., Murillo, C. A. and Bochmann, M., Advanced Inorganic Chemistry, 6th ed., Wiley-Interscience, (1999).
4. Huheey, J. E., Keiter, E. A. and Keiter, R. L., Inorganic Chemistry: Principles of Structure and Reactivity, 4th ed., Prentice Hall, (1997).
5. Housecraft, C. and Sharpe, A. G., Inorganic Chemistry, 4th ed., Prentice Hall, (2012).
6. Rodgers G. E., Descriptive Inorganic, Coordination, and Solid-State Chemistry, 3rd ed., Brooks- Cole, (2012).
7. Smart L. E., Moore E. A., Solid State Chemistry: An Introduction, 4th ed., CRC Press, (2012).
8. Müller, U., Inorganic Structural Chemistry, 2nd ed., John-Wiley & Sons, (2006).
9. Schwarzenbach D., Crystallography, 1st ed., John-Wiley & Sons, (1996).

BS 3rd Year
Semester-VI
Course Title: ORGANIC CHEMISTRY
Course Code: CHEM-367
Credit Hours: 3+1

Course Objectives:

Students will acquire knowledge and understanding about aromatic substitution reactions and oxidation and reduction as well as pericyclic reactions.

Course Contents:

Aromatic Substitution Reactions:

Mechanisms of aromatic reactions including electrophilic and nucleophilic substitutions, effect of substituents on orientation and reactivity.

Oxidation-reductions Reactions:

Common oxidizing and reducing reagents, reactions involving elimination of H, cleavage of C-C bond, replacement of hydrogen by oxygen, and addition of oxygen to substrates, reaction involving replacement of oxygen by hydrogen, removal of oxygen from the substrates and reduction with cleavage.

Pericyclic Reactions:

Introduction to pericyclic reactions, frontier orbital theory, mechanisms of electrocyclic, cycloaddition and sigmatropic reactions.

CHEM-367 Lab.

Experiments involving aromatic substitution, oxidation/reduction reactions and pericyclic reactions, nitration of nitrobenzene to meta-dinitrobenzene, reduction of meta-dinitrobenzene to meta-nitroaniline, sulphonation of aniline, oxidation of benzaldehyde, oxidation of cyclohexanol to cyclohexanone. Preparation of benzoic acid and benzyl alcohol from benzaldehyde using Cannizzaro's reaction.

Recommended Books:

1. Robert, T. M. and Robert, N. B., Organic Chemistry, 6th ed., Prentice Hall, New Jersey, (1992).
2. Tse-Lok, H., Symmetry: A Basis for Synthesis Design, John-Willey & Sons, Inc., New York, (1995).
3. Pine, S. H., Organic Chemistry, 5th ed., Tata McGraw-Hill, India, (1987).
4. Sykes, P., A Guide Book to Mechanism in Organic Chemistry, 6th ed., Pearson Education, (1986).

5. Mayo, D. W., Pike, R. M. and Forbes, D. C., Microscale Organic Laboratory with Multistep and Multiscale Syntheses, 5th ed., John-Wiley & Sons, Inc., (2011).
6. Gilbert, J. C. and Martin, S. F., Experimental Organic Chemistry: A Miniscale and Microscale Approach, 5th ed., Brooks/ Cole Cengage Learning, (2010).
7. Solomons, T. W. G. and Fryhle, C. B., Organic Chemistry, 10th ed., John- Wiley & Sons, Inc., (2011).
8. Carey, F. A. and Giuliano, R. M., Organic Chemistry, 9th ed., McGraw-Hill Education, (2013).
9. Bruice, P. Y., Organic Chemistry, 7th ed., Perason Education, Ltd., (2013).
10. Smith, M. B., March's Advanced Organic Chemistry: Reactions, Mechanisms, and Structure, 7th ed., John-Wiley & Sons, Inc., (2013).
11. Kürti, L. and Czakó. B., Strategic Applications of Named Reactions in Organic Synthesis: Background and Detailed Mechanisms, Elsevier Inc., (2005).

BS 3rd Year
Semester-VI
Course Title: PHYSICAL CHEMISTRY
Course Code: CHEM-368
Credit Hours: 3+1

Course Objectives:

Students will acquire knowledge and understanding about the theoretical and instrumental as well as application related aspects of conductometric, and electrochemical techniques and surface chemistry. They will also acquire information regarding nuclear binding energy, nuclear instabilities and decay mechanisms as well as the fission and fusion processes.

Course Contents:

Conductometry: Ions in solution, measurement of conductance and Kohlrausch's law, mobility of ions and transport number, conductometric titrations, Debye-Hückel theory and activity coefficient, determination of activities, application of conductance measurement.

Electrochemistry: Redox reactions, spontaneous reactions, electrochemical cells, standard electrode potentials, liquid junction potential, electrochemical series, Nernst's equation, thermodynamic of redox reactions, measurement of pH and pKa, dynamic electrochemistry, Latimer Diagram, Frost Diagram, electrolytic cells, potentiometry, reference and indicator electrodes, voltammetry, fuel cells, corrosion and its prevention, fuel cell and hydrogen economy.

Surface Chemistry: Adsorption and absorption, adsorption isotherms, Freundlich and Langmuir adsorption isotherms, Gibbs adsorption isotherm, application of adsorption, characteristics of catalyst, type of catalysis, theories of catalysis, industrial applications of catalysis.

Nuclear Chemistry: Atomic nucleus, nuclides, nuclear stability, modes of decay, nuclear energetics, nuclear models (shell + liquid drop model), fusion and fission, nonspontaneous nuclear processes, nuclear reactors, beta decay systematic.

CHEM-368 Lab.

Spectroscopic determination of Cu percentage in the given sample.
Conductometric determination of Cu (II)- EDTA mole ratio in the complex.
To determine the effectiveness of an extraction of I_2 solution by using Solvent Extraction method.
Determination of molecular weight of a polymer by viscosity method.
Determination of percentage composition of $KMnO_4$/ $K_2Cr_2O_7$ in a given solution by spectrophotometry.
Evaluation of pKa value of an indicator by spectrometric method.
Conductometric determination of hydrolysis constant (K_h) of conjugate base of a weak acid.

Recommended Books:

1. Silbey, R. J., Alberty, R. A. and Bawendi, M. G., Physical Chemistry, 4th ed., John-Wiley & Sons, (2005).
2. Ball D. W., Physical Chemistry, Brooks/Cole Co. Inc., (2003).
3. Vertes, A., Nagy, S. and Klencsar, Z., Handbook of Nuclear Chemistry. Volume 1: Basics of Nuclear Science, 1st ed., Springer, (2003).
4. Choppin, G., Liljenzin, J-. O. and Rydberg, J., Radiochemistry and Nuclear Chemistry, 3rd ed., Butterworth- Heinemann, (2002).
5. Loveland, W., Morrisey, D. J. and Seaborg, G. T., Modern Nuclear Chemistry, John-Wiley & Sons, Inc., (2006).
6. Atkins, P. and Paula, J. D., Atkin's Physical Chemistry, 9th ed., Oxford University Press, (2010). 7. Somorjai, G. A. and Li, Y., Introduction to Surface Chemistry and Catalysis, 2nd ed., John-Wiley & Sons, Inc., (2010).
7. Laidler. K. J., "Chemical Kinetics" 3rd ed., Prentice Hall, (1987).
8. Atkins, P., Jones, L., Chemical Principles: The Quest for Insight, 5th ed., W. H. Freeman, New York, (2010).

BS 4th Year

Semester-VII

Course Code	Name of Subject	Credits	Marks	Page
CHEM-471	SPECIALIZATION PAPER-I	3	100	67-91
CHEM-472	SPECIALIZATION PAPER-II	3	100	
CHEM-473	SPECIALIZATION PAPER-III	3	100	
CHEM-474	ENVIRONMENTAL CHEMISTRY-I	3	100	
CHEM-500	RESEARCH PROJECT-I	3	100	
TOTAL		**15**	**500**	

BS 4th Year

Semester-VII (ANALYTICAL CHEMISTRY)

Paper-I

Course Title: ATOMIC SPECTROSCOPY

Course Code: CHEM-471

Credit Hours: 3

Course Objectives:

Students will acquire knowledge about theoretical aspects and instrumentation of different atomic spectroscopic methods as well as learn about the applications of these techniques in the field of chemical sciences.

Course Contents:

Flame Photometry: Origin and classification of atomic spectroscopic methods, origin of atomic spectrum, position of the signal, intensity of the signal, spectral line width, principle of flame photometry, fate of the sample in the flame, flame and its characteristics, instrumentation for flame photometry, merits and limitations.

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

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

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

Recommended Books:

1. Christian, G. D., *Analytical Chemistry*, 6th ed., John-Wiley & Sons, New York, (2006).
2. Harris, D. C., *Quantitative Chemical Analysis*, 8th ed., W. H. Freeman and Company, New York, (2011).
3. Kealey, D. and Haines, P. J., *BIOS Instant Notes in Analytical Chemistry*, Bios Scientific Publishers Limited, Oxford, UK, (2002).
4. Sharma, B. K., *Instrumental Methods of Chemical Analysis*, 24th ed., Goel Publishing House, Meerut, India, (2005).
5. Skoog, D. A. and West., D. M., *Fundamentals of Analytical Chemistry*, 8th ed., Hot Reinehart Inc., London, (2008).
6. Ebdon, L., Evaus, E.H, Fischer, A., and Hill, S.J., *An Introduction to Analytical Atomic Spectrometry,* John Wiley & Sons, England. (1998).
7. Bernhard Wels, Michael Sperling, *Atomic Absorption Spectrometry,* 3rd ed., Wiley-VCH, Germany, (1998).
8. Farrukh, M. A., *Atomic Absorption Spectroscopy,* In Tech, (2012).
9. Kellner, R., Mermet, J. M, Otto, M., Valcarcel, M., Widmer, H.M., *Analytical Chemistry: A Modern Approach to Analytical Science*, Wiley-VCH, (2004)

BS 4th Year

Semester-VII (ANALYTICAL CHEMISTRY)

Paper-II

Course Title: ELECTROANALYTICAL TECHNIQUES

Course Code: CHEM-472

Credit Hours: 3

Course Objectives:

Students will acquire sound knowledge regarding the theoretical, instrumental as well as application related aspects of different electroanalytical techniques

Course Contents:

Potentiometry: Electrode potential, Nernst equation and its use for measuring half-cell potential, different kinds of electrodes including glass and calomel electrodes, working of potentiometer and its applications including pH measurements, Ion selective electrode systems, Ion exchange membrane electrode, solid state membrane electrodes, and bio-membrane electrodes, Potentiometric titrations.

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

Voltammetry and Polarography: Basic principle, voltammogram, polarizable and non-polarizable electrodes, solid electrodes, their scope and limitations, cyclic voltammetry, anodic stripping voltammetry. voltammetric equation, basic concept of polarography and interpretation of various polarographic curves, measurement of decomposition potential, diffusion and limiting currents, derivation of Ilkovic equation, logarithmic analysis of polarographic wave, advantages and limitation of dropping mercury electrode.

Recommended Books:

1. Christian, G. D., Analytical Chemistry, 6th ed., John-Wiley & Sons, New York, (2006).
2. Harris, D. C., Quantitative Chemical Analysis 8th ed., W.H. Freeman and Company, New York, (2009).
3. Kealey, D. and Haines, P. J., BIOS Instant Notes in Analytical Chemistry,
4. Bios Scientific Publishers Limited, Oxford, UK, (2002).
5. Sharma, B. K., Instrumental Methods of Chemical Analysis, 24th ed., Goel Publishing House, Meerut, India, (2005).

BS 4th Year

Semester-VII (ANALYTICAL CHEMISTRY)

Paper-III

Course Title: ADVANCED SEPARATION TECNIQUES

Course Code: CHEM-473

Credit Hours: 3

Course Objectives:

Students will acquire knowledge about the principles and instrumentation of advanced chromatographic techniques namely GLC, HPLC and capillary electrophoresis along with their applications in different fields such as food, pharmaceuticals, petroleum, environmental and other industrial sectors.

Course Contents:

Introduction: Classifications of chromatographic techniques, the chromatographic processes, rate theory of chromatography, Van-Deemter equation and its significance in evaluating column efficiency.

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

HPLC: General principle, sample preparation, separation process (normal phase and reverse phase separation), instrumentation, method development and applications.

Capillary electrophoresis: Theory and principle of CE, mobility, electro-osmotic flow separation by CE, instrumentation, modes of operation, applications.

Recommended Books:

1. Skoog, D. A., West, P. M., Holler, F. J. and Crouch, S. R., Fundamentals of Analytical Chemistry, 9th ed., Cengage Learning, (2013).
2. Christian, G. D., Analytical Chemistry, 6th ed., John-Wiley & Sons, New York, (2004).
3. Kealey, D. and Haines, P. J., BIOS Instant Notes in Analytical Chemistry, 1st ed., Taylor & Francis, (2002).
4. Sharma, B.K. Instrumental Methods of Chemical Analysis, 24th ed., Goel Publishing House, Meerut, India, (2005).
5. Kellner, R., Mermet, J-. M., Otto, M., Valcarcel, M. and Widmer, H. M., Analytical Chemistry: A Modern Approach to Analytical Science, Wiley- VCH, (2004).
6. Meyer, V. R., Practical High-Performance Liquid Chromatography, 5th ed., John-Wiley & Sons, Ltd., (2010).

BS 4th Year
Semester-VII (APPLIED CHEMISTRY)
Paper-I
Course Title: COMMON INDUSTRIES-I
Course Code: CHEM-471
Credit Hours: 3

Course Objectives:

Students will acquire knowledge and technical know-how about sugar manufacturing industry, starch production industry and leather tanneries.

Course Content

Sugar Industry: Scope of sugar industry, Manufacture of raw sugar from cane and beet, refining of raw sugar, Methods of clarification of cane juice and chemistry involved in the clarification processes, Defecation Remelt Carbonation (DRC), Defecation Remelt Sulphitation (DRS), Defecation Remelt Phosphitation (DRP) and Double Carbonation Double Sulphitation (DCDS), Utilization of by- products of sugar industry.

Starch Industry: Scope of starch industry, Raw materials for starch production, Manufacture of starch from various raw materials such as corn, rice, wheat, potatoes, Industrial applications of starch, Chemistry involved in the conversion of starch, Synthesis of d-glucose and dextrin from starch.

Leather Industry: Leather, gelatin and adhesives, Preparation of hides, Methods of tanning, vegetable and chrome tanning processing of leather, Production of glue and gelatin.

Recommended Books:

1. Rao, G. P., Mogarey, R. C., Solomn, S., Rewal, S. S. and Li, Y-., Sugar Cane: Production Managemnet and Agro-Industrial Imperatives, Ibdc Publisher, (2005).
2. Covington, A. D., Tanning Chemistry: The Science of Leather, Royal Society of Chemistry, (2009).
3. Kent, J. A., Riegel's Handbook of Industrial Chemistry, 10th ed., Kluwer Academic/ Plenum Publishers, (2003).

BS 4th Year

Semester-VII (APPLIED CHEMISTRY)

Paper-II

Course Title: AGRO BASED INDUSTRIES AND POLLUTION CONTROL

Course Code: CHEM-472

Credit Hours: 3

Course Objectives:

Students will acquire knowledge about various fertilizers, pesticides and herbicides used in agriculture sector as well as know about the environmental pollution and its protection.

Course Contents:

Fertilizers: Importance of chemical fertilizers, classification of chemical fertilizers, manufacture and chemistry involved in the production of various fertilizers i.e. Urea, Single Super phosphate (SSP), Triple superphosphate (TSP), Nitrophos (NP), Diammonium phosphate (DAP), Calcium ammonium nitrate (CAN), Ammonium nitrate (AN), Ammonium sulphate (AS), Zinc sulphate (ZS) and Complex fertilizers.

Agrochemicals: Classification of pesticides, formulation and toxicity of pesticides, future trends of pest control, control of weeds, household agrochemicals, plant growth regulators and background chemistry, hazards associated with the use of agrochemicals and environmental aspects.

Industrial Pollution and Its Abatement: Sources of air, water and soil pollution, Industrial waste control for the protection of environment, modern trends of waste management.

Recommended Books:

1. Afonso, C. A. M. Crespo, J. P. G. and Anastas, P. T., *Green Separation Process: Fundamentals and Applications,* Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim, (2005).
2. Manahan, S. E., *Fundamentals of Environmental Chemistry*, 2nd ed., CRC Press, (2001).
3. Lister, J. and Ennis, B., *The Science and Engineering of Granulation Processes,* Kluwer Academic Publishers, (2004).
4. Park, M., *The Fertilizer Industry,* Woodhead Publishing Limited, (2001).
5. Anastas, P. T. and Warmer, J. C., *Green Chemistry: Theory and Practice,* Oxford University Press, (2000).
6. Kumar, A., *Industrial Pollution: Problems and Solution,* Daya Publishing House, India, (2006).

BS 4th Year
Semester- VII (APPLIED CHEMISTRY)
Paper-III
Course Title: COMMON INDUSTRIES-II
Course Code: CHEM-473
Credit Hours: 3

Course Objectives:

Students will acquire knowledge for extraction, production and processing oil, fats and waxes. They will also gain knowledge about soap and detergent industries as well as surface coating industries.

Oils and Fats: Oils, Fats and Waxes, extraction of oils such as soya bean and cotton seed oils, purification and refining of oils, chemistry involved in the production of vegetable ghee, selective hydrogenation of oil and fats during the manufacture of vegetable ghee, inter-esterification of crude fats.

Soaps and Detergents: Raw materials for the manufacture of soap and detergents, chemistry involved in the production of soap and detergents, action of builders, additives brighteners and surfactants, cleansing action of soaps, effect of acidic species and hard water on soap, Production of transparent soap.

Paints: Raw materials for paints and pigments, classification and properties of surface-coating constituents, classification and manufacture of pigments, production of paints, varnishes, distempers, enamels and lacquers, chemistry involved in the drying phenomena of paints, drying oils for paint and classification of drying oils.

Recommended Books:

1. Vermani, O. P, Narula, A.K, Applied Chemistry, Theory and Practice, 2nd ed., New Age International. Publisher, India, (1995).
2. Balasaraf, V. M, Applied Chemistry, I. K. International House Pvt. Ltd, India, (2009).
3. P. K. Chattopadyay, Modern Technology of Soaps, Detergents and Toilries: with formulae and project profile, 2nd ed., National Institute of Industrial Research, India, (2003).
4. Bockisch M., Fats and Oils Handbook, American oil Chemists and Society, (1998).
5. Gunstone F., Oils and Fats in Food Industry, Wiley Black Well, (2008).
6. Gunstone F., Vegetable Oil in Food Technology: Composition, Properties and Uses, John-Wiley & Sons, (2011).
7. Lambourme, R., Strivens, T.A., Paint and Surface Coatings: Theory and Practice, 2nd ed., Woodhead Publishing Limited, (1999).

BS 4th Year
Semester-VII (BIOCHEMISTRY)
Paper-I
Course Title: BIOMEDICAL CHEMISTRY
Course Code: CHEM-471
Credit Hours: 3

Course Objectives:

Students will acquire knowledge about the fundamental biochemical and molecular aspects of endocrinology and chemistry of blood and other extracellular fluids.

Course Contents:

Endocrinology: General introduction, chemical nature of hormones, common characteristics, mode of action of hormones, hormones receptors, chemistry, biosynthesis, metabolism and biological functions of pituitary, adrenal, thyroid, parathyroid, pancreatic and gonadal hormones, hormones of GIT, renal and pineal Glands.

Blood and Other Body Fluids: General composition of blood, function of blood plasma, plasma protein, composition and functions, composition, development and functions of red blood cells, white blood cells and platelets, Hemoglobin, chemistry properties, synthesis, functions and derivatives, degradation of hemoglobin, respiration and gas transport, blood coagulation and clotting of blood, blood pressure, blood groups, composition of urine, extracellular fluids like: cerebrospinal fluid, lymph, sweat, tears, synovial and interstitial fluid.

Recommended books:

1. Nelson, D. L. and Cox, M. M., Lehninger's Principles of Biochemistry, 6th ed., W. H. Freeman, (2012).
2. Voet, D. and Voet, J. D, Biochemistry, 4th ed., illustrated. John Wiley & Sons, (2011).
3. Hall, J. E., Guyton & Hall Textbook of Medical Physiology, 12th ed., Elsvier Health Sciences, (2011).
4. Orten, James. M. and Neuhaus, O. W., Human Biochemistry, 10th ed., Mosby, Incorporated, (1982),
5. Devlin, T. M., Textbook of Biochemistry with Clinical Correlations, 7th ed., Wiley, (2010).
6. Frisell, W. R., Human Biochemistry, 1st ed., Macmillan Publication Company, (1982).
7. Hadley, M. and Levine, J. E., Endocrinology, 6th ed., Pearson, (2006).

BS 4th Year
Semester- VII (BIOCHEMISTRY)
Paper-II
Course Title: MOLECULAR BIOLOGY
Course Code: CHEM-472
Credit Hours: 3

Course Objectives:

Students will acquire knowledge about the structural and functional features of DNA and RNA.

Course Contents:

DNA: the primary genetic material, structure, replication in prokaryotes and comparison with eukaryotes, DNA sequencing, chemical synthesis of polynucleotides, DNA repair and recombination. Different types of RNA and their role in protein synthesis, transcription and its regulation, genetic code, post transcriptional processing, structure of transfer RNA, protein synthesis inhibitors, control of translation, post translational modification, plasmids, bacteriophage and cosmids, *invitro* mutagenesis, deletion, insertion and substitution, recombinant DNA and genetic diseases.

Recommended Books:

1. Watson, J. D., Baker, A. T., Bell, S. P., Gann A., Levine, M. and Losick, M. R., *Molecular Biology of the Gene,* 7th ed., Benjamin Cummings, (2013).
2. Watson, J. D., Myers, R. M., Caudy A. A., and Witkowski, J. A., *Recombinant DNA: Genes and Genome. A Short Course,* 3rd ed., W. H. Freeman, (2006).
3. Krabs, J., *Genes X* 10th ed., Jones and Bartlett Learning, (2011).
4. Alberts, B., *Molecular Biology of the Cell,* 5th ed., Publisher: Garland Science, (2008). ISBN: 0815341113, 9780815341116.
5. Brown, T.A., *Genomes 3,* 3rd ed., Publisher: Garland Science Publishing, (2007). ISBN: 0815341385, 9780815341383.

BS 4th Year
Semester- VII (BIOCHEMISTRY)
Paper-III
Course Title: PHYSICAL TECHNIQUES IN BIOCHEMISTRY
Course Code: CHEM-473
Credit Hours: 3

Course Objectives:

Students will gain knowledge and in depth understanding about the fundamental biochemical techniques such as extraction, purification, fractionation and centrifugation being applicable for macromolecules separation as well as those techniques which are used for characterization of biomolecules.

Course Contents:

Extraction, Fractionation and Purification of Macrobiomolecules: Homogenization, solubilization and concentration including ultrasonication, lyophilization and ultradecantation, purification based on differential solubility techniques, ion-exchange chromatography, gel chromatography, affinity chromatography, paper & thin layer chromatography and HPLC.

Electrophoresis: Paper and gel electrophoresis, two-dimensional electrophoresis, capillary electrophoresis.

Electrofocusing: Preparative and analytical electrofocusing.

Centrifugation: Principle, preparative centrifugation, application of density gradient and differential centrifugation, ultracentrifugation sedimentation equilibrium and sedimentation velocity methods, application of analytical centrifugation.

Tracer techniques: Detection and measurement of radioactivity, application of radioisotopes in biological system.

U.V. and Visible Spectroscopy: Basic principles, instrumentation and applications.

Enzyme linked immunosorbent assay (ELISA): Basic principle, instrumentation and applications.

Recommended Books:

1. Cooper, T. C., *The Tools of Biochemistry,* 2nd ed., John Wiley, (2007).
2. Wilson, K. and Golding, K. H., *A Biologist's Guide to Principles and Techniques of Practical Biochemistry*, 3rd ed., Edward Arnold, (1986).
3. Dawes, E. A., *Quantitative Problems in Biochemistry,* 5th ed., Williams & Wilkins, (1972).
4. Scopes, R. K., *Protein Purification: Principles and Practice,* 3rd ed., Springer (1994).

BS 4th Year

Semester: VII (FUEL CHEMISTRY)

Paper-I

Title of the Course: CHEMISTRY OF COAL CONVERSION PROCESSES-I

Course Code: CHEM-471

Credit Hours: 3

Course Objectives:

The students will acquire knowledge about environmentally friendly utilization of coal and how to extract maximum energy and convert coal in to a variety of highly demanding chemicals used as feed stock in a number of Industries.

Course Contents:

Coal: Composition, structure, coalification and classification of coal, ASTM international and coal Standards. Use of coal in different industries like power generation, steel and other metallurgical operations. Coal exploration, mining and mining risk handling, pretreatment and preparation of coals. Innovations in coal using industry.

Environmental Aspects: Pollution problems associated with coal combustion, mining and flue gases.

Gasification: Thermodynamics, kinetics and catalytic aspects of coal gasification, fixed bed gasifier, fluidized bed gasifier, transport reactor, liquid medium gasifier and underground gasification. Gas upgrading by carbon monoxide shift, gas purification, methanation and dehydration, properties and processing of gaseous fuels, environmental consideration.

Recommended Books:

1. Wen, C.Y. and Stanley, E. Coal conversion Technology, Addison-Wesley, New York. (1979).
2. Probstein, R.F and Hicks, R.E. Synthetic Fuels, McGraw Hill, New York. (1982).
3. Francis, W. Fuels and Fuel Technology, Pergamon Press, London. (1980).
4. Merick, D. Coal Combustion and Conversion Technology, McMillan Ltd., London (1984).
5. Berkowitz, N. The Chemistry of Coal, Elsevier Amsterdam. (1985).

BS 4th Year
Semester-VII (FUEL CHEMISTRY)
Paper-II
Title of the Course: PETROLEUM AND PETROCHEMICALS-I
Course Code CHEM-472
Credit Hours: 3

Course Objectives:

The students will acquire knowledge about the modern refining operations for maximum recovery of petroleum products and to get knowledge using crude petroleum and its distillate products in commercial manufacture of highly demanding petrochemicals.

Course Contents:

Petroleum: Composition, properties and classification of crude oils, oil shale and tar sands. Preparation, structure and properties of cracking and reforming catalysts. Mechanism of cracking and reforming. Effect of operating conditions on cracking and reforming products. Hydroforming and desulphurization of petroleum products.

Petrochemicals: Ethylene production by thermal cracking from ethane. Propane and naphtha. Petrochemicals from oxidation processes. Production of petrochemicals from halogenation processes. Hydrogenation of benzene, fats, and adiponitrile, nitration of benzene and toluene, sulphonation of benzene and toluene, alkylation of aromatics.

Recommended Books:

1. Hobson, G.D. Modern Petroleum Technology, Part 2, John Wiley and Sons, New York. (1984).
2. Gates, B.C, Katzer, J.R and Schuit, G.C.A. Chemistry of Catalytic Processes, McGraw Hill Book company, London (1979).
3. List, H.L. Petrochemical Technology, Printice-Hall Englewood Cliffs, New Jersey. (1986).
4. Goodger, E.M. Hydrocarbon Fuels, Union Brothers Ltd, London. (1985).
5. Maleev, V.L. Internal Combustion Engines, McGraw Hill Book Company London, (1985).
6. Hughes, J.R., and Swindells, N.S. Storage and Handling of Petroleum Liquids, Charless Griffin and Company Ltd, London. (1987).
7. Wiseman, P. An Introduction to Industrial Organic Chemistry, Wiley Interscience, New York (2001)

BS 4th Year

Semester-VII (FUEL CHEMISTRY)

Paper-III

Title of the Course: CHARACTERIZATION OF FOSSIL FUELS

Course Code: CHEM-473

Credit Hours: 3

Course Objectives:

The students will acquire knowledge of the physicochemical and instrumental analysis of fuels

Course Contents:

Physicochemical Determination and data interpretation using ASTM methods of API Gravity, Flash Point, Pour Point, Analine Point, Distillation behaviors, Octane no. Cetane number and RVP.

Analytical Methods: Analytical methods in the production of analytes and quality assurance of fuels using GC-FID, GC-MS, Calorimetry, Atomic absorption, ICP.

Recommended Books:

1. Ewing, G.W. Instrumental Methods of Chemical Analysis, McGraw Hill, London. (1985).
2. Chrisition, G.D. Instrumental Analysis, Allyn and Bacon, Inc, Boston, London. (1986).
3. Kagler, S.H. Spectroscopic and Chromatographic Analysis of Mineral Oils, John, Wiley and Sons, New York. (1983).
4. Karr. C. Analytical Methods for Coal and Coal Products, Academic Press, New York. (1978).
5. Harker, J.H. and Backurst, J.R. Fuel and Energy, Academic Press, London and New York (1988).
6. Skooge, D.A. Instrumental Analysis, Sanat Printer, Indian Edition, 2009.

BS 4th Year

Semester-VII (INORGANIC CHEMISTRY)

Paper-I

Course Title: INORGANIC REACTION MECHANISM

Course Code: CHEM-471

Credit Hours: 3

Course Objective:

Students will acquire know-how and understanding about different mechanisms of inorganic reactions and their applications towards understanding different types of complexes.

Course Contents:

Classification of reaction mechanisms; rate laws; steady state approximation; inert and labile complexes; substitution reactions in octahedral complexes and square planar complexes, acid hydrolysis, base hydrolysis, steric effects of inert ligands, nucleophilic reactivity, trans-effect, *cis*-effect, racemization reactions. Mechanism of electron transfer reactions, oxidation reduction reactions of metal ions, outer and inner sphere mechanisms, factors affecting rate of electron transfer reactions, two electrons transfer reactions, complementary or non-complementary electron transfer reactions, oxidative addition, addition of oxygen, hydrogen, HX, organic halides and bimetallic species, Reductive Elimination Reactions.

Recommended Books:

1. Huheey, J. E., Keiter, E. A., Keiter, R. L., Inorganic Chemistry: Principles of Structure and Reactivity, 4th ed., Prentice Hall, (1997).
2. Shriver, D. F., Atkins, P. W., Inorganic Chemistry, 3rd ed., Oxford University Press, (2001).
3. Wilkins, R. G., Kinetics and Mechanism of Reactions of Transition Metal Complex, 2nd ed., (Rev.), Wiley-VCH, (1991).
4. Jolly, W. L., Modern Inorganic Chemistry, 2nd ed., McGraw-Hill Company, (1991).
5. Jordan, R. B., Reaction Mechanisms of Inorganic and Organometallic Systems, 2nd ed., Oxford University Press, New York, (1998).
6. Atwood, J. D., Inorganic and Organometallic Reaction Mechanisms, 2nd ed., Wiley-VCH, Inc., (1997).
7. Sharma, S. K., Inorganic Reaction Mechanisms, Discovery Publishing House, (2007).

BS 4th Year

Semester-VII (INORGANIC CHEMISTRY)

Paper-II

Course Title: π- ACEPTOR LIGANDS AND INORGANIC POLYMERS

Course Code: CHEM-472

Credit Hours: 3

Course Objective:

Student will acquire sound knowledge about π--acceptor ligands and different types of inorganic polymers.

Course Contents:

π-Acceptor Ligands: Introduction to π-acceptor ligands, effective atomic number (EAN) rule and chemistry of metal carbonyls, nitrosyls, and isocyanides, structure elucidation based on spectroscopic evidences, applications and uses of metal carbonyls and their derivatives for catalysis and organic synthesis.

Inorganic Polymers: Introduction to homoatomic and heteroatomic inorganic polymers, chains and cages of boron, silicon, nitrogen, phosphorous and sulphur, synthesis and applications, Polyionic species, Isopoly and heteropoly, anions of transition metals, silicates, borates, condensed phosphates, zeolites.

Recommended Books:

1. Brady, J. E., and Sense, F., Chemistry-The Study of Matter and Its Changes, 5th ed., Wiley Plus, (2009).
2. Miessler, G. L., Tarr, D. A., Inorganic Chemistry, 4th ed., Prentice-Hall International, New Jersey, USA, (2010).
3. Douglas, B., McDanial, D., Alexander, J., Concepts and Models of Inorganic Chemistry, 3rd ed., John-Wiley & Sons, New York, (1994).
4. Huheey, J. E., Keiter, E. A., Keiter, R. L., Inorganic Chemistry: Principles of Structure and Reactivity, 4th ed., Prentice Hall, (1997).
5. Shriver, D. F., Atkins, P. W., Langford, C. H., Inorganic Chemistry, 2nd ed., Oxford University Press, (1994).
6. Cotton, F. A., Wilkinson, G., Murillo, C. A. and Bochmann, M., Advanced Inorganic Chemistry, 6th ed., Wiley-Interscience, (1999).
7. Atkins, P. and Jones, L., Chemicals Principles: The Quest for Insight, 5th ed., W. H. Freeman, (2010).
8. Mandelkern, L., An Introduction to Macromolecules, 2nd ed., Springer Verlag, New York, (1983).
9. Ravve, A., Principles of Polymer Chemistry, 2nd ed., Plenum Publishers, (2000).
10. Crabtree, R. H., The Organometallic Chemistry of the Transition Metals, 5th ed., John-Wiley and Sons, New Jersey, (2011).
11. Yamamoto, A., Organotransition Metal Chemistry, Prentice Hall, (1992).

BS 4th Year

Semester-VII (INORGANIC CHEMISTRY)

Paper-III

Course Title: INORGANIC SPECTROSCOPY

Course Code: CHEM-473

Credit Hours: 3

Course Objectives:

Students will acquire understanding about various types of transitions (e. g. d- d transition, charge transfer) occurring in transition metal compounds and to characterize new compounds by application of electronic spectroscopy.

Course Contents:

Electronic States of transition metal complexes, Russel-Sander's coupling scheme, derivation of term symbols for d1-d10 systems, d-d transitions, connecting atomic states and molecular states, correlation diagrams, Tanabe - Sugano diagrams, calculation of 10Dq values, High-spin and low-spin molecules, Jahn-Teller effect, applications of subgroups, selection rules for electronic transitions in molecules, LMCT and MLCT transitions, some examples involving different geometries.

Recommended Books:

1. Yarwood, J., Bazin, P., and Douthwaite, R., Spectroscopic Properties of Inorganic and Organometallic Compounds, Volume 42, The Royal Society of Chemistry, UK, (2011).
2. Lever, A. B. P., Inorganic Electronic Spectroscopy, 2nd ed., Elsevier, UK, (1984).
3. Brisdon, A. K., Inorganic Spectroscopic Methods, Oxford University Press, UK, (1998).
4. Solomon, E.I., Inorganic Electronic Structure and Spectroscopy: Methodology, Volume 2, Wiley, New York, (1999).

BS 4th Year

Semester-VII (ORGANIC CHEMISTRY)

Paper-I

Course Title: HETEROCYCLIC AND ORGANOMETALLIC COMPOUNDS

Course Code: CHEM-471

Credit Hours: 3

Course Objectives:

Students will acquire knowledge about C-Hetero atom bond with emphasis on how it is formed and how it reacts. The importance and applications of compounds containing hetero atom should also be discussed.

Course Contents:

Aromatic Heterocycles: Structure, classification and nomenclature; aromaticity; basicity and acidity of the nitrogen heterocycles; synthesis and reactions, chemistry of furan, pyrrole and thiophene, pyridine;

Organometallic Compounds: Principles, organomagnesium, organolithium, organocopper, organocadmium, organomercury and organozinc compounds: their structure and reactivity, methods of preparation and synthetic applications.

Chemistry of organic compounds containing sulfur, phosphorus, boron and silicon: synthesis, reactions and application.

Recommended Books:

1. Claydem, J., Greeves, N. and Warren, S., Organic Chemistry, 2nd ed., Oxford University Press, (2012).
2. Coxon, J. M. Norman, R. O. C., Principles of Organic Synthesis, 3rd ed., CRC Press, (1993).
3. Joule, J. A., Mills, K., Heterocyclic Chemistry, 5th ed., John-Wiley & Sons, UK, (2010).
4. Crabtree, R. H., The Organometallic Chemistry of the Transition Metals, 5th ed., John-Wiley & Sons, New Jersey, (2009).

BS 4th Year
Semester-VII (ORGANIC CHEMISTRY)
Paper-II
Course Title: REACTIVE INTERMEDIATES
Course Code: CHEM-472
Credit Hours: 3

Course Objectives:

Students will acquire knowledge regarding the rearrangement reactions and their types including some name reactions, and different intermediates involved in organic reactions. Students are expected to learn the underlying concepts and synthetic applications.

Course Contents:

Reactive Intermediates: Carbocations, carbanions, free radicals, carbenes, nitrenes, and arynes, their generation, stability, reactions and synthetic applications. Chemistry of Enolates and Enols: Acidity of carbonyl compounds, enolization of carbonyl compounds, α-halogenation of carbonyl compounds; aldol-addition and aldol- condensation, condensation reactions involving ester enolate ions, alkylation of ester enolate ions.

Rearrangement Reactions: Types of rearrangements, general mechanisms of nucleophilic, free radical and electrophilic rearrangements, hydrogen and/or carbon migration to electron-deficient carbon, nitrogen and oxygen, carbon migration to electron-rich carbon, aromatic rearrangements, inter- and intra-molecular carbon migration from oxygen to carbon.

Recommended Books:

1. Clayden, J., Greeves, N. and Warren, S., Organic Chemistry, 2nd ed., Oxford University Press, (2012).
2. Coxon, J. M. and Norman, R.O.C., Principles of Organic Synthesis, 3rd ed., Chapman and Hall, UK, (1993).
3. Brown, W. H., Fotte, C. S., Iverson, B. L. and Anslyn, E. V., Organic Chemistry, 6th ed., Brooks/Cole Learning, (2012).
4. John, E. M., Organic Chemistry, 8th ed., Brooks/Cole Publishing Co., USA, (2012).
5. Robert, T. M. and Robert, N. B., Organic Chemistry, 6th ed., Prentice Hall, New Jersey, (1992).

BS 4th Year

Semester-VII (ORGANIC CHEMISTRY)

Paper-III

Course Title: ORGANIC SPECTROSCOPY

Course Code: CHEM-473

Credit Hours: 3

Course Objectives:

Students will acquire an adequate knowledge about fundamental and instrumental aspects of different spectroscopic techniques and will be able to perform structural elucidation of organic compounds using spectral data.

Course Contents:

UV-Visible: Basic concepts, electronic transitions, Lambert-Beer's law, factors influencing the lambda max (λ_{max}) values, Woodward rules for calculation of wavelength values.

IR spectroscopy: Basic concepts, absorption mechanisms, functional group determination and factors affecting the absorption frequencies.

^{1}H-NMR and ^{13}C-NMR: Chemical shift, factors affecting chemical shift, spin relaxation, spin-spin coupling, coupling constants, nuclear overhauser effect, 2-D NMR, COSY and HETCOR.

Mass Spectrometry: Basic concepts; mass spectrometers, ionization techniques, different fragmentation patterns and structure elucidation, combined usage of IR, UV, NMR and Mass spectrometric data for structure elucidation of organic compounds having medium complexity.

Recommended Books:

1. Mohan, J., Organic Analytical Chemistry: Theory and Practice, 1st ed., Alpha Science Int. Ltd., (2003).
2. Kalsi, P. S., Spectroscopy of Organic Compounds, 6th ed., New Age International, New Delhi, India, (2007).
3. Yadav, L. D. S., Organic Spectroscopy, Springer, UK, (2005).
4. Kemp, W., Organic Spectroscopy, 3rd ed., W. H. Freeman & Company, New York, USA, (1991).
5. Younas, M., Organic Spectroscopy, Ilmi Kitab Khana, Urdu Bazar Lahore, Pakistan, (2006).
6. Hollas, J. M., Modern Spectroscopy, 4th ed., John-Wiley & Sons, Inc., (2004).
7. Pavia, D. L., Lampman, G. M., Kriz, G. S. and Vyvyan, J. R., Introduction to Spectroscopy, 4th ed., Brooks/ Cole Cengage Learning, (2009).
8. Silverstein, R. M., Webster, F. X. and Kiemle, D., Spectrometric Identification of Organic Compounds, 7th ed., John-Wiley & Sons, Inc., (2005).
9. Williams, D. H. and Flemming, I., Spectroscopic Methods in Organic Chemistry, 6th ed., McGraw-Hill Higher Education, (2008).

BS 4th Year

Semester-VII (PHYSICAL CHEMISTRY)

Paper-I

Course Title: ELECTROCHEMISTRY & STATISTICAL THERMODYNAMICS

Course Code: CHEM-471

Credit Hours: 3

Course Objectives:

Students will develop understanding of the electrochemical processes, thermodynamic principles and mechanisms involved in aqueous salt solutions as well as colloidal solutions. In the second part of the course, students will acquire knowledge about the molecular level treatment of the thermodynamic functions/properties using partition functions and Boltzmann statistics.

Electrochemistry: Electrical double layer, interface, Outer Helmholttz Plane and Inner Helmholttz Plane , contact adsorption, Gibbs Surface Excess, potential differences across metal solution interfaces, outer and surface potential differences, galvanic potential difference, electrochemical potential difference, interfacial tension, electro-capillary thermodynamics, Lippmann's equation, Helmholtz-perrin model, Gouy Chapmann model, Stern model of electrical double layer, differential capacitance, the Capacitance hump. Electrochemical devices, charge transfer processes in the absence and presence of electrical field, the over potential, the symmetry factor, high field and low field approximation, cyclic voltammetry and its applications,

Statistical Thermodynamics: Description of various systems, Concepts of states, accessible states and distribution, Probability concepts, Maxwell-Boltzmann's statistics for the systems of independent particles, Partition functions, The relationship of partition function to the various thermodynamic functions, Transitional, vibrational and rotational partitional functions and equilibrium constant, Statistical thermodynamics, Applications to equilibrium and chemical kinetics, Bose-Einstein's and Fermi-Dirac's statistics.

Recommended Books:

1. Gasser, R. P. H., Entropy and Energy Level, Rev. ed., Oxford University Press, New York, (1986).
2. Bockris J. O. M., and Reddy, A. K. N., Modern Electrochemistry: Ionics, Vol. I, 2nd ed., Plenum Press, London, (1998).
3. Seddon, J. M. and Gale, J. D., Thermodynamics and Statistical Mechanics, Royal Society of Chemistry, (2001).
4. Engel, T., Reid, P., Thermodynamics, Statistical Thermodynamics, and Kinetics, 3rd ed., Prentice Hall, (2012).
5. Bard, A. J. and Faulkner, L. R., Electrochemical Method: Fundamentals and Applications 2nd ed., John-Wiley & Sons, New York, (2001).
6. Kondepudi D., Introduction to Modern Thermodynamics, John-Wiley & Sons, (2008).
7. Hamann, C. H., Hamnett, A. and Veilstich, W., Electrochemistry, 2nd ed., Wiley-VCH Verla Gnb H and Co. KGaA, (2007).
8. Braun R. D. and Walters F., Application of Chemical Analysis, McGrawHill, (1982)

BS 4th Year
Semester-VII (PHYSICAL CHEMISTY)
Paper-II
Course Title: POLYMER CHEMISTRY
Course Code: CHEM-472
Credit Hours: 3

Course Objectives:

Students will learn the fundamental principles of polymerization, synthesis methods and reaction mechanisms, thermodynamic and kinetic aspects of the polymerization, and physical and mechanical properties of polymers. Students will also know about the polymer characterization techniques and various applications of polymers.

Polymer Chemistry: Introduction to Polymers, Application of polymers in Chemical Industries, Properties of polymers. Classification of polymers-classification based on sources (Natural and inorganic), classification based on the structure, classification based on mode of polymerization (Addition or chain reaction, condensation or step growth polymerization), Classification based on molecular forces (elastomers, fibers, thermoplastic and thermosetting polymers), Kinetics of polymer chain growth. Co-polymerization and its types-Alternating, Random, Block and periodic co-polymers, form of copolymers.

Introduction to surfactants-Classification and its uses, Manufacture, micelle and its formation. Emulsion polymerization-ingredients, stages of emulsion polymerization, Applications.

Physical aspects of polymers-molecular weight of polymers and methods of determination by viscosity, optical rotation method. Chain isomerism, stereochemistry, configurations, conformation, amorphous state of polymers, dynamics in the amorphous state, mechanical models of polymer behavior, polymer rheology.

Recommended Books:

1. Sperling, L. H. *Introduction to Physical Polymer Science,* 4th ed., Wiley- Interscience, New York, USA, (2006).
2. Boyd, R. H. and Phillips, P. J., *The Science of Polymer Molecules,* Cambridge, UK, (1993).
3. Odian, G., *Principles of Polymerization,* 4th ed., Wiley Interscience, (2004).
4. Carraher Jr, C. E., *Carraher's, Polymer Chemistry,* 8th ed., CRC Press, Inc., (2010).
5. Ravve, A., *Principles of Polymer Chemistry,* 3rd ed., Springer, (2012).
6. Stevens, M. P., *Polymer Chemistry: An Introduction,* 3rd ed., Oxford University Press, (1998).
7. Allcock, H., Lampe, F. and Mark, J., *Contemporary Polymer Chemistry,* 3rd ed., Prentidl Hall, (2003).

BS 4th Year

Semester-VII (PHYSICAL CHEMISTRY)

Paper-II

Course Title: QUANTUM CHEMISTRY AND MOLECULAR SPECTROSCOPY

Course Code: CHEM-473

Credit Hours: 3

Course Objectives:

Students will acquire knowledge about quantum chemistry including Schrödinger wave equation and its applications to define the behavior and properties of different systems. In addition, they will learn about different molecular spectroscopic techniques.

Course Contents:

Quantum Chemistry: Operators and their properties, Schrödinger wave equation, particle in a box and a ring, quantum mechanical tunneling, angular momentum, postulates of quantum mechanics, central field problem, approximate methods, perturbation methods and variation principle, many electron systems, treatment of simple harmonic oscillator, diatomic rigid rotor, valence bond and molecular orbital theories, Hũckel method for pi-electron approximation in aromatic compounds.

Molecular Spectroscopy: Interaction of electromagnetic radiation with matter, symmetry properties of molecules, microwave and infrared spectroscopy, rotational, vibrational and rotational-vibrational spectra of diatomic and polyatomic molecules, electronic spectra of simple molecules, nuclear magnetic resonance spectroscopy.

Recommended Books:

1. Fayer, M. D., Elements of Quantum Mechanics, Oxford University Press, London, UK, (2001).
2. Becker, E. D., High Resolution NMR; Theory & Chemical Application, 3rd ed., Academic Press, New York, USA, (2000).
3. Graybeal, J. D., Molecular Spectroscopy, 1st ed., McGraw-Hill, New York, (1988).
4. Hayward, D. O., Quantum Mechanics for Chemists, Royal Society of Chemistry, (2002).
5. House, J. E., Fundamentals of Quantum Mechanics 2nded., Elsevier Academic Press, New York, USA, (2004).
6. Kirsten, H. J. W. M., Introduction to Quantum Mechanics: Schrodinger Equation and Path Integral 1st ed., World Scientific Publishing Co. Pvt. Ltd., (2006).
7. Barrow, G. M., Physical Chemistry, 6th ed., McGraw-Hill Book Company, (1996).
8. Straughan, B. P., and Walker, S., Spectroscopy, Vol. 1 and 2., Chapman and Hall Ltd., (1976).

BS 4th Year
Semester-VII
Course Title: Elective Course-I (Environmental Chemistry)
Course Code: CHEM-474
Credit Hours: 3

Course Objectives:

This course will enable the students to understand various types of energy sources and the types of air pollution. They will also understand the soil and mineral resources.

Course Contents:

1. Fossil Fuels and Energy Sources:

Origin and development of coals: Origin and reserves of petroleum and natural gas, composition and classification of petroleum, refining, environmental problems associated with petroleum, nuclear fission reactors, solar energy, power synthesis, tidal and geothermal energy, synthetic chemical fuels, the H economy, electrochemical energy conversion, conversion of free energy, the energy balance of the earth.

2. The Atmosphere and Air Pollution:

Structure and properties of the atmosphere, temperature inversion and air pollution, atmospheric photochemistry, possible depletion of stratospheric ozone, natural Vs. polluted air, particulate matter, analysis and control of particulates, Sulphur oxides, effects of Sulphur oxides and particulates, other industrial air pollutants, carbon monoxide, oxides of nitrogen, photochemical smog, airborne lead, control of automobile emissions.

3. Soil and Mineral Resources:

Estimating reserves of mineral resources of earth. Extraction of metal-general principles, iron, steel, aluminum, copper and other metals, Sulphur and nitrogen. Organic matter in soil, soil nutrients, ion exchange in soils, solid pH and nutrients availability.

Recommended Books:

1. Anil Kumar, Environmental Chemistry, Wiley Eastern, New Delhi.
2. J.W. Moore & E.A. Moore, Environmental Chemistry, Academic Press, New York.
3. S.K. Banerji, Environmental Chemistry, Prentice Hall, Delhi.
4. S.K. Banerji, Environmental Chemistry, Tata Publisher, Delhi.
5. Staneley E. Manahan, Environmental Chemistry, Brooks, California.

BS 4th Year

Semester-VIII

Course Code	Name of Subject	Credits	Marks	Page
CHEM-484	SPECIALIZATION PAPER-IV	3	100	93-117
CHEM-485	SPECIALIZATION PAPER-V	3	100	
CHEM-486	SPECIALIZATION PAPER-VI	3	100	
CHEM-487	ENVIRONMENTAL CHEMISTRY-II	3	100	
CHEM-501	RESEARCH PROJECT-II	3	100	
TOTAL		**15**	**500**	

BS 4th Year
Semester-VIII (ANALYTICAL CHEMISTRY)
Paper-IV
Course Title: LUMINESCENCE SPECTROSCOPY AND THERMAL ANALYSIS
Course Code: CHEM-484
Credit Hours: 3

Course Objectives:

Students will acquire knowledge about the theoretical and instrumental aspects of luminescence spectroscopy and thermal techniques of analysis in addition to learning about their applications.

Course Contents:

Luminescence Spectrophotometry: Introduction, origin of fluorescence and phosphorescence spectra, Jablonski diagram, activation, deactivation, fluorescence spectrum, fluorescent and phosphorescent species; photoluminescence and structure, factors affecting fluorescence and phosphorescence, fluorescence quenching, quantum yield, instrumentation for fluorescence measurement, sources, wavelength selectors, sampling, detectors, read out devices, instrumentation for phosphorescence measurement, sampling, recording procedure, applications of fluorescence and phosphorescence.

Thermal Methods of Analysis: Introduction, instrumentation, sources of errors, interpretation of data, Factors affecting curve, applications of TGA, DTA and DSC.

Recommended Books:

1. Christian, G. D., Analytical Chemistry. 6th ed., John-Wiley & Sons, New York, (2006).
2. Harris, D. C., Quantitative Chemical Analysis, 8th ed., W. H. Freeman and Company, New York, (2011).
3. Braun, R. D., Introduction to Chemical Analysis, International Student Edition, (1985).
4. Haines, P. J., Whitby, On Canada Mcgraw Hill Ltd., Thermal Methods of Analysis Principles, Applications and Problems, 1st ed., Springer, (1995).
5. Lakowicz, J. R., Principles of Fluorescence Spectroscopy, 3rd ed., Springer (2006).
6. Gabbot, P., Principles & Applications of Thermal Analysis, Wiley-Blackwell, (2007).
7. Brown, M. E., Introduction to Thermal Analysis: Techniques and Applications, 2nd ed., Kluwer Academic Publishers, (2001).
8. Skoog, D. A., West, D. M. and Holler, F. J. and Crouch, S. R., Fundamentals of Analytical Chemistry, 8th ed., (Int.), Cengage Learning, (2004).

BS 4th Year

Semester-VIII (ANALYTICAL CHEMISTRY)

Paper-V

Course Title: NUCLEAR ANALYTICAL TECHNIQUES

Course Code: CHEM-485

Credit Hours: 3

Course Objectives:

Students will acquire knowledge about different nuclear analytical techniques with special emphasis on the theoretical, instrumental and applications

Course Contents:

Radiotracer techniques, choice of radiotracers, factors affecting choice of radiotracers, isotope dilution analysis (IDA), principle and equation, instrumentation, applications, advantages and limitations, sub-stoichiometric isotope dilution analysis (SIDA), activation analysis (AA), principle of NAA, neutron sources, interferences, sensitivity and detection limits, classification, instrumentation, applications, advantages and limitations, comparison of NAA and IDA with other methods, radiometric titrations (RT), procedure, advantages and limitations, radio chromatography and radioimmunoassay.

Recommended Books:

1. Friedlander, G., Kennedy, J. W., Macias, E. S. and Miller. M. J., Nuclear and Radiochemistry, 3rd ed., Wiley, New York, (1981).
2. Arnikan, H. J., Essentials of Nuclear Chemistry, 4th ed., New Age International Pvt. Ltd. (1995)
3. Naqvi, I. I., Farrukh, M. A, Radiotracers in Chemical Applications: Radiochemistry, VDM Verlog Dr. Muller, (2010).

BS 4th Year
Semester-VIII (ANALYTICAL CHEMISTRY)
Paper-VI
Course Title: FOOD AND DRUG ANALYSIS
Course Code: CHEM-486
Credit Hours: 3

Course Objectives:

Students will acquire knowledge about sample preparation, derivations and analysis of different types of foods, pharmaceuticals and forensics.

Course Contents:

Food Products: Introduction to food analysis, sampling of food, general methods of analysis. Analysis of milk, butter, wheat flour, meat, beverages, tea, coca, honey and soft drinks.

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

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

Recommended Books:

1. Skoog, D. A., West, D. M. and Holler, F. J., Fundamentals of Analytical Chemistry, 7th ed., Saunders College Publishing, (1995).
2. Christian, G. D., Analytical Chemistry, John-Wiley & Sons, Inc., 6th ed., (2004).
3. Eckert, W. G., Introduction to Forensic Science, 2nd ed., CRC Press, (1997).
4. Nielsen, S. S., Food Analysis, 4th ed., Springer, (2010).
5. Thomas, G., Medicinal Chemistry: An Introduction, 2nd ed., John-Wiley & Sons, (2007).
6. Kobilinsky, L. F., Forensic Chemistry Handbook, 1st ed., John-Wiley & Sons, USA, (2012).
7. Watson, D. G., Pharmaceutical Analysis: A Textbook for Pharmacy Students and Pharmaceutical Chemists, Elsevier, (2012).
8. Stuart H. Barbara, "Forensic Analytical Techniques", 1st ed., John-Wiley & Sons, (2013).
9. Jackson, A. R. W. and Jackson, J. M., Forensic Science, 2nd ed., Pearson Education, (2008).

BSc 4th Year
Semester-VIII (APPLIED CHEMISTRY)
Paper-VI
Course Title: ORGANIC BASED INDUSTRIES
Course Code: CHEM-484
Credit Hours: 3

Course Objectives:

Students will acquire knowledge to understand the structure, mechanism, properties and synthesis of various polymers. The course will also provide technical know- how about perfumes and cosmetics and surface coating industries.

Course Contents:

Paper and Pulp: Raw materials for pulp and paper industries, classification of paper products, chemistry involved in the processing of Kraft pulp, sulphite pulp and semi-chemical pulp, manufacture of paper and regeneration of spent liquor.

Polymers: General classification and characterization of polymers, mechanism and chemistry of polymerization, thermoplastic and thermosetting polymerization, A brief outline for the production and applications of polymers i.e. polyethylene, polystyrene, polyurethanes, polyesters and urea phenol formaldehyde resins, and production of drug delivery polymers.

Cosmetics and Perfumes: Chemistry and production of hair products and shampoos, chemistry involved in hair curling and styling products, hair tonics and depilatory products, production of cold cream, vanishing cream, bleach cream and shaving creams, tooth paste and face powders, production of nail polish, lipsticks and mascaras.

Recommended Books:

1. Odian, G., Principles of Polymerization, 4th ed., John-Wiley & Sons, Inc., (2004).
2. Carraher, C. E. Jr., Polymer Chemistry, 6th ed., Marcel Dekker Incorporation, New York, (2003).
3. Roussak, D. V., Gesser, H. D., Applied Chemistry; A Textbook of Engineers and Technologists, 2nd ed., Springer, (2013).
4. Bajpai, P., Environmentally Friendly Production of Pulp and Paper, John- Wiley & Sons, Inc., (2010).
5. Schueller, R. and Romanowski, P., Beginning Cosmetic Chemistry: Practical Knowledge for the Cosmetic Industry, 3rd ed., Allured Publishing Corporation, (2009).
6. Barel, A. O., Paye, M. and Maibach, H. I., Handbook of Cosmetic Science and Technology, 3rd ed., Informa Healthcare, (2009).

BS 4th Year
Semester-VIII (APPLIED CHEMISTRY)
Paper-V
Course Title: INDUSTRIAL PROCESSES
Course Code: CHEM-485
Credit Hours: 3

Course Objectives:

Students will acquire knowledge about pharmaceutical industries and nuclear industry as well as about oil refinery and production of various petrochemicals.

Course Contents:

Pharmaceuticals: Classification of pharmaceutical products and pharmaceutical processing, manufacture of paracetamol and aspirin, chemistry involved in the production and manufacture of various antibiotics such as streptomycin, erythromycin, penicillin etc.

Petroleum and Petrochemicals: Origin of petroleum, constituents and classification of petroleum, cracking and distillation of various fractions in distillation towers, control of distillation tower in refinery, manufacture of monomers such as acetylene, ethylene, propylene, separation and purification of benzene, toluene and xylene.

Recommended Books:

1. Austin, G. T., Nelson, W. L., Petroleum Refinery Engineering, 4th ed., Aukland. Mcgraw Hill, (1985).
2. Shreve, R. M., George, T. A., Shreve's Chemical Process Industries, 5th ed., McGraw-Hill Book Company Inc., New York, (1984).
3. Kent, J. A., Riegel's Handbook of Industrial Chemistry, 10h ed., Kluwer Academic/Plenum publishers, (2003).
4. Vermani, O. P., Narula. A. K, Applied Chemistry, Theory and Practice, 2nd ed., New Age International Publisher, India, (1995).
5. D. G. Watson, Pharmaceutical Chemistry, Churchill Living Stone, (2007).
6. Cairms, D., Essentials of Pharmaceutical Chemistry, Pharmaceutical Press, (2003).
7. Loveland, W. D., Morrisey, D. J, Modern Nuclear Chemistry, Wiley Interscience, (2005).
8. Speight, J. G., The Chemistry and Technology of Petroleum, 3rd ed., Taylor & Francis, (2013).

BS 4th Year

Semester-VIII (APPLIED CHEMISTRY)

Paper-VI

Course Title: METALLURGY AND EXPLOSIVES

Course Code: CHEM-486

Credit Hours: 3

Course Objectives:

The course is designed to give sufficient knowledge about iron, steel and its alloys. The course also provides the knowledge about corrosion and its preventions. The course will also give the knowledge about organic Dyes industries, different lubricants used in industrial processes.

Course Contents:

Iron, Steel and Alloys: Iron ores, constituents and their classification, manufacture of iron and steel, types of iron and steel, metal extractions and production of Alloys.

Explosives and Propellants: Raw materials, manufacture of industrial explosives and propellants, types of explosives and their safety measures, chemistry involved in production of military explosives.

Nuclear Materials: Extraction of uranium from rocks, importance of nuclear technology, nuclear energy and its peaceful applications, production of nuclear energy and control of nuclear reactors, chemistry of fission and fusion reactions, reprocessing of nuclear spent fuel, industrial application of nuclear radiations.

Recommended Books:

1. Akhawan, J., The Chemistry of Explosives, 2nd ed., Royal Chemical Society, (2004).
2. Campball, F. C., Elements of Metallurgy and Engineering Alloys, ASM. International, (2008).
3. Davis, T. L., The Chemistry of Powder and Explosives, Angriff Press, (2012).
4. Reddy, L. K., Principles of Engineering Metallurgy, 2nd ed., New Age Publishers, (2009).
5. Loveland, W., Morrissey, D. J. and Seaborg, G. T., Modern Nuclear Chemistry, John-Wiley & Sons, Inc., (2006).
6. Choppin, G., Liijenzin, J-O. and Rydberg, J., Radiochemistry and Nuclear Chemistry, 3rd ed., Butterworth-Heinemann, (2002).
7. Vermani, O. P, Narula, A. K, Applied Chemistry, Theory and Practice, 2nd ed., New Age Publishing House, India, (1995).
8. Balsaral, V. M, Applied Chemistry, I.K. International House Pvt. Ltd., India, (2009).

BS 4th Year
Semester-VIII (BIOCHEMISTRY)
Paper-IV
Course Title: MICROBIOLOGY AND IMMUNOLOGGY
Course Code: CHEM-484
Credit Hours: 3

Course Objectives:

Students will learn about fundamentals of microbiology and immunology as well as the related disorders such as microbial borne infectious diseases, allergy, inflammation, and hypertension and their control.

Course Contents:

Fundamentals of Microbiology: Prokaryotic cell structure and function, Prokaryotic growth and nutrition, prokaryotic genetics. Virus and eukaryotic microorganisms, virus, bacteria, fungi and parasites. Bacterial diseases, airborne, foodborne and waterborne bacterial diseases. Industrial microbiology and biotechnology, microorganism in industry, alcoholic beverages, other important microbial products.

Immunology: Chemistry of immunoglobulins, myeloma and hybridoma immunoglobulins, immune system and its abnormalities, allergy and inflammation, complement system, Peripheral leucocytes and macrophages, Type I lgE-mediated hypersensitivity, other types of hypersensitivity autoimmune disorders, immunodeficiency disorders.

Recommended Books:

1. Nester, E., Nester, M., Anderson, D. and Roberts, C. E. Tr., Microbiology: A Human Perspective, 7th ed., McGraw-Hill, (2011).
2. Duan, T., Melvold, R., Viselli, S. and Waltenbaugh, C., Lippincott's Illustrated Reviews, Immunology, 2nd ed., Lippincott William & Wilkins, (2012).
3. Harvey, R. A., Cornelissen, C. N. and Fischer, B. D., Lippincott's Illustrated Reviews: Microbiology, 3rd ed., Lippincott William & Wilkins, (2012).
4. Wiley, J. M., Sherwood, L. M. and Woolnerton, C. J., Prescott's Microbiology, 7th ed., McGraw-Hill Education, (2011).
5. Male, D., Brostoff, J., Roth, D. B. and Roitt, I. M., Immunology, 8th ed., Elsevier, (2012).

BS 4th Year
Semester- VIII (BIOCHEMISTRY)
Paper-V
Course Title: BIONANOTECHNOLOGY
Course Code: CHEM-485
Credit Hours: 3

Course Objectives:

The aim of the course is to acquire knowledge about bionanotechnology in general and its potential applications in particular. Bionanotechnology aims to exploit attributes of new materials like biosensors for medical applications. Understanding of the structure and assembly of nanoparticles opens some exciting possibilities to construct artificial structures in applied nanotechnology, which will mimic the functions of the biological systems.

Course Contents:

Introduction to nanoparticles, overview of nanoscale materials, effect of length scale on properties, introduction to bionanotechnology, bionanotechnology systems, protein-based nanostructures, nanobiosensors, challenges and opportunities associated with biology on the nanoscale, green nanoparticle production, self-assembly and templating, surface patterning and functionalization, characterization techniques of nanostructures.

Recommended Books:

1. Ratner, M.A. and Ratner, D., Nanotechnology: A Gentle Introduction to the Next Big Idea, Prentice Hall Professional, upper saddle river, New Jersey (2003).
2. Goodsell, D.S., Bionanotechnology: Lessons from Nature, Wiley-Liss, Inc., Hoboken, New Jersey (2004).
3. Papazoglou, E. S., Bionanotechnology, Morgan & Claypool Publishers, California, USA (2007).
4. Renugopalakrishnan V., Lewis, R. V., Bionanotechnology: Proteins to Nanodevices, Springer (2006).
5. Iqbal, S., Bionanosensors, Morgan & Claypool Publishers, California USA (2008).
6. Kotov, N. A., Nanoparticle Assemblies and Superstructures, CRC press, USA (2006).
7. Dinh, T.V., Nanotechnology in Biology and Medicine: Methods, Devices and Application CRC press, USA (2007).
8. Kumar, C., Nanomaterials for Biosensors, Wiley-VCH, Germany (2007).
9. Niemeyer, C.M., and Mirkin, C.A., Nanobiotechnology: Concepts, Applications and Perspectives, Wiley-VCH, Germany (2004).

BS 4th Year

Semester- VIII (BIOCHEMISTRY)

Paper-VI

Course Title: NUTRITIONAL CHEMISTRY

Course Code: CHEM-486

Credit Hours: 3

Course Objectives:

Students will acquire knowledge about dietary components; energy needs based nutritional requirements of different age groups as well as the importance of minerals and vitamins.

Course Contents:

Major Dietary Constituents: Nutritional importance of carbohydrates, proteins and amino acids, lipids, and dietary fiber.

Energy Needs: Assessment and requirement of energy in different age groups nutrition in growth and aging, nutritional requirement during infancy and childhood, diet, nutrition and adolescence, nutrition in the elderly minerals, biochemical role of Calcium, Chromium, Copper, Iron, Iodine, Magnesium, Phosphorous, Selenium and Zinc, their dietary source daily requirements and deficiency diseases.

Vitamins: Role of vitamins as coenzymes structure, physiological functions, deficiency diseases and recommended dietary allowances of the following vitamins, fat soluble vitamins: A, D, E, and K, water soluble vitamins: Thiamine, Riboflavin, Niacin, Pantothenic acid, Folic acid, Blotin and Ascorbic acid.

Recommended Text Books:

1. Wilson, K. and Walker, J., Principles and Techniques of Biochemistry, 5th ed., Cambridge University Press, (2000)
2. Belitz, H. D., Grosch, W. and Schieberle, P., Food Chemistry, 4th ed., Springer-Verlag Berlin, Germany, (2009).
3. Spallholz, J. E., Boylan, L. M. and Driskell, J. A., Nutrition: Chemistry & Biology, 2nd ed., CRC Press Inc., USA, (1999).
4. Ross, A. C., Caballero, B., Cousins, R. J., Tucker, K. L. and Ziegler, T. R., Modern Nutrition in Health and Disease, 11th ed., Lippincott Williams & Wilkins, (2012).
5. McDowell, L. R., Vitamins in Animal and Human Nutrition, 2nd ed., Iowa State University Press, (2000).
6. Zempleni, J., Rucker, R. B., McCormick, D. B. and Suttie, J. W., Handbook of Vitamins, 4th ed., CRC Press, (2007).
7. Nelson, D. L. and Cox, M. M., Lehninger's Principles of Biochemistry, 6th ed., W. H. Freeman, (2012).

BS 4th Year
Semester-VIII (FUEL CHEMISTRY)
Paper-IV
Course Title: CHEMISTRY OF COAL CONVERSION PROCESSES-II
Course Code: CHEM-484
Credit Hours: 3

Course Objectives:

The students will acquire knowledge about the coal conversion processes like solvent extraction, hydrogenation, and importance of catalysis in such reactions, product up gradation and analysis and environmental problems relating to synthetic fuels obtained from coal.

Course Contents:

Liquefaction of Coal: Historical Developments: Historical developments of coal liquefaction, earlier coal liquefaction processes; (a) Pott and Broch Process (b) Bergius process.

Solvent Extraction: Solvent extraction of coal, some experiments on solvent extraction, mechanism of solvent extraction, types of solvent extraction, solvent systems, super critical gas extraction, commercial processes of solvent extraction like SRC-I, SRC-II, EDS, Super critical gas extraction.

Direct Liquefaction: Direct liquefaction of coal through catalytic hydrogenation, mechanism, catalysts' system, catalyst poisoning, catalytic role of coal minerals, commercial processes of catalytic hydrogenation like H-coal and Synthoil process.

Indirect Liquefaction: Indirect liquefaction through Fischer Tropsch synthesis, methanol synthesis and MTG (Methanol to Gasoline) processes.

Effect of Parameters: Effect of coal properties, catalyst and solvent on liquefaction behavior of coal, effect of coal properties like rank, maceral components and mineral matter on liquefaction, effect of operating condition like temperature, pressure, residence time, solvent, catalyst, etc.

Processing of Coal Liquids: Purification of liquefaction products, solid- separation, fractionation, upgrading and characterization of coal derived liquids, properties of coal derived liquids.

Liquefaction Reactor: Description of high-pressure coal liquefaction reactor and auxiliary devices, ebulated bed reactor, fluidization.

Environmental Aspects: Environmental consideration, aerial emissions, water effluents, solid waste disposal.

Recommended Books:

1. Wen, C. Y. and Stanley, E. Coal Conversion Technology. Addison-Wesley, New York. (1979).

2. Probstein, R. F and Hicks, R. E. Synthetic Fuels. McGraw Hill, New York. (1982).
3. Francis, W. Fuels and Fuel Technology. Pergamon Press, London (1980).
4. Merick, D. Coal Combustion and Conversion Technology. McMillan Ltd., London (1984).
5. Berkowitz, N. The chemistry of Coal. Elsevier Amsterdam (1985).

BS 4th Year
Semester-VIII (FUEL CHEMISTRY)
Paper-V
Course Title: PETROLEUM AND PETROCHEMICALS-II
Course Code: CHEM-485
Credit Hours: 3

Course objectives:

The students will acquire knowledge about the modern thermodynamics and combustion of hydrocarbons fuels. The students will also be able to learn about the safe storage and transportation of hydrocarbons fuels.

Course Contents:

Thermo chemistry and Combustion of Hydrocarbon Fuels: Basic thermodynamics principles, standard enthalpy of formation, standard enthalpy of reaction, enthalpy of combustion products, mechanism of combustion of gaseous and liquid hydrocarbon, theory of flame propagation, method of measuring flame speed, fuel performances in reciprocating piston engines, environmental pollution from hydrocarbon fuel utilization.

Storage and Handling of Hydrocarbon Fuels: Various types of storage tanks, different methods of transportation of crude and refined petroleum products. Health hazards associated with petroleum handling, volatility losses, fire hazards and its prevention. Extinguishing of oil fire methods.

Recommended Books:

1. Hobson, G. D. Modern Petroleum Technology. Part 2, John Wiley and Sons, New York. (1984).
2. Gates, B. C, Katzer, J. R, and Schuit, G. C. A. Chemistry of Catalytic Processes. McGraw Hill Book company, London (1979).
3. List, H. L. Petrochemical Technology. Printice-Hall Englewood Cliffs, New Jersey. (1986).
4. Goodger, E. M. Hydrocarbon Fuels. Union Brothers Ltd, London. (1975).
5. Maleev, V. L. Internal Combustion Engines. McGraw Hill Book Company London, (1985).
6. Hughes, J.R., and Swindells, N. S. Storage and Handling of Petroleum Liquids. Charless Griffin and Company Ltd, London (1987).

BS 4th Year
Semester-VIII (FUEL CHEMISTRY)
Paper-VI
Course Title: ALTERNATE ENERGY RESOURCES
Course Code: CHEM-486
Credit Hours: 3

Course objectives:

This course will enable students to know about the challenging sources of alternate sources of energy. The students will also be able to learn about the safe uses of natural resources.

Course Contents:

Biomass Resources: Biomass conversion processes, bio gas technology. Various traditional methods of alcohol production. Alcohols and its uses as alternative fuel.

Biofuels: Production of Bio-ethanol and biodiesel, uses of bioethanol as supplement with petroleum gasoline as E10 and E20 etc.

Hydrogen: Hydrogen production, storage, handling and its uses as alternative fuel. Fuel cells: Fuel Cells and its application,

Solar Energy: Photovoltaic power conversion & solar energy collectors.

Nuclear fuels: Nuclear fuels processing, fission and fusion, nuclear reactors.

Hydel Energy: introduction to Hydel energy. Prospecting of hydel powers in Pakistan.

Recommended Books:

1. Gyngell, E. bS. Applied Chemistry for Engineers. Edward Arnold Publisher, Ltd. London. (1989).
2. Harker, J.b. and Backurst, J.R. Fuel and Energy. Academic Press, London and New York (1988).
3. Goodger E. M. Alternative fuels (chemical energy resources). The Macmillan press Ltd, London, (1980).
4. Twidell, J. and Weir, T. Renewable Energy Resources. John Wiley and Sons, London, New York, (1986).

BS 4th Year

Semester-VIII (INORGANIC CHEMISTRY)

Paper-IV

Course Title: ORGANOMETALLICS

Course Code: CHEM-484

Credit Hours: 3

Course Objectives:

Students will acquire knowledge about chemistry of organometallics especially with reference to their types and bonding, and reactivity of organometallic compounds in homogeneous catalysis.

Course Contents:

Fundamentals of organometallic compounds, types of bonding in organometallics, single, double and triple bonds to carbon (compound types, acyls, alkylidene complexes and alkylidyne complexes), delocalized hydrocarbon systems (alkenes, olefins, allyl and butadienes), alkyne complexes, cyclic π-complexes (five and six membered rings). Homogeneous catalytic hydrogenation, dimerization, oligomerization, polymerization, hydroformylation of olefins, catalytic polymerization of acetylenes. Insertion reactions and uses of organometallic compounds in organic synthesis.

Recommended Books:

1. Powell, P., Principles of Organometallics Chemistry, 2nd ed., Springer, (1998).
2. Yamamoto A., Organotransition Metal Chemistry: Fundamental Concepts and Applications, 1st ed., John-Wiley & Sons, Inc., (1986).
3. Cotton, F. A., Wilkinson, G., Murillo, C. A., Bochmann M., Advanced Inorganic Chemistry, 6th ed., Wiley-Intersceince, New York, (1999).
4. Miessler, G. L., Fisher, P. J. and Tar, D, A., Inorganic Chemistry, 5th ed., Prentice Hall, (2013).
5. Douglas, B., McDaniel, D. and Alexander, J., Concepts and Models of Inorganic Chemistry, 3rd ed., John-Wiley & Sons, Inc., (1994).
6. Haiduc, I. and Zuckerman, J. J., Basic Organometallic Chemistry, Walter De Gruyter Inc., (1985).
7. Jolly, W. L., Modern Inorganic Chemistry, 2nd ed., McGraw-Hill Company, (1991).
8. Porterfield, W. W., Inorganic Chemistry: A Unified Approach, 2nd ed., Academic Press, (1993).
9. Vincet, A., Molecular Symmetry and Group Theory: 2nd ed., John-Wiley & Sons, Ltd., (2001).
10. Malik, W. U., Tuli, G. D., Madan, R. D., Selected Topics in Inorganic Chemistry, S. Chand and Co. Ltd., (2010).

BS 4th Year
Semester-VIII (INORGANIC CHEMISTRY)
Paper-V
Course Title: SYMMETRY AND MAGNETOCHEMSITRY
Course Code: CHEM-485
Credit Hours: 3

Course Objectives:
Students will acquire knowledge about magnetic properties from chemistry point of view and group theory.

Course Contents:
Symmetry and Group Theory: Symmetry and group theory, point groups, multiplication tables, group representation and development of character tables. Introduction to the interpretation of spectra and structure elucidation.
Magnetochemistry: Theory of magnetism, diamagnetism, paramagnetism, ferro, ferri and antiferromagnetism, magnetic susceptibility, magnetic moments, Faraday's & Gouy's methods, effect of temperature on magnetic properties of complexes. Electron spin resonance spectroscopy, Magnetic moment of lanthanides.

Recommended Books:
1. Douglas, B., McDaniel, D., Alexander, J., Concepts and Models of Inorganic Chemistry, 3rd ed., John-Wiley & Sons Inc., (1997).
2. Huheey, J. E, Keiter, E. A., Keiter, R. L., Inorganic Chemistry: Principles of Structure and Reactivity", 4th ed., Prentice Hall, (1997).
3. Mackay, K. M., Mackay, R. A. and Henderson, W., Introduction to Modern Inorganic Chemistry, 6th ed., CRC Press, (2002).
4. Miessler, G. L., Fisher, P. J. and Tar, D, A., Inorganic Chemistry, 5th ed., Prentice Hall, (2013).
5. Purcell, K. F., Kotz, J. C., An Introduction to Inorganic Chemistry, W. B. Saunders, Company Holt-Saunders, International ed., (1980).
6. Cotton, F. A., Wilkinson, G., Murillo, C. A., Bochmann, M., Advanced Inorganic Chemistry, 6th ed., Wiley-Intersceince, New York, (1999).
7. Jolly, W. L., Modern Inorganic Chemistry, 2nd ed., McGraw-Hill Company, (1991).
8. Carter, R. L., Molecular Symmetry and Group Theory, 1st ed., John-Wiley & Sons, Inc., New York, (1997).
9. Orchin, M., Jaffe, H. H., Symmetry, Orbitals, and Spectra, John-Wiley & Sons, Inc., New York, (1971).
10. McWeeny, R., Symmetry: An Introduction to Group Theory and its Applications, Dover Publications, Inc., (2002).

BS 4th Year

Semester-VIII (INORGANIC CHEMISTRY)

Paper-VI

Course Title: RADIO AND NUCLEAR CHEMISTRY

Course Code: CHEM-486

Credit Hours: 3

Course Objectives:

Students will acquire knowledge about radio and nuclear chemistry and nuclear reactions.

Course Contents:

Fundamentals and applied aspects of radioactivity and nuclear chemistry. types and characteristics of nuclear radiation, structure of nucleus, half-life, nuclear binding energy, and artificial radioactivity, fission and fusion reactions, acceleration of charged particles and applications of radioisotopes.

Recommended Books:

1. Friedlander, G., Kennedy, J. W., Miller, J. M. and Maciuas, E. S., Nuclear and Radiochemistry, 3rd ed., John-Wiley & Sons, Inc., (1981).
2. Choppin, G. R., Rydberg, J., Liljenzin, J., Radiochemistry and Nuclear Chemistry, 3rd ed., Butterworth-Heinemann Ltd., (2002).
3. Arnikar, H. J., Essentials of Nuclear Chemistry, 4th ed., New Age International Pvt. Ltd. Publishers, (1996).
4. Naqvi, I. I. and Farrukh, M. A., Radiotracers in Chemical Applications VDM Verlag Dr. Müller, Germany, (2010).
5. Loveland, W., Morrissey, D. J. and Seaborg, J. T., Modern Nuclear Chemistry, John Wiley and Sons, Inc., (2006).

BS 4th Year
Semester-VIII (ORGANIC CHEMISTRY)
Paper-IV
Course Title: NATURAL PRODUCTS
Course Code: CHEM-484
Credit Hours: 3

Course Objectives:
Students will acquire knowledge about different types of natural products with emphasis on their structure, synthesis and applications.

Course Contents:
Alkaloids: Introduction, classification, isolation methods, structure elucidation and discussion with particular reference to structure and synthesis and biosynthesis of typical alkaloids such as ephedrine, nicotine, atropine, quinine, papaverine and morphine.
Terpenoids: Introduction, classification, isolation techniques and discussion with particular reference to structure and synthesis and biosynthesis of typical terpenoids such as citral, α-terpineol, α-pinene, camphor and α-cadinene.
Steroids: Study of cholesterol and steroidal hormones with emphasis on their structure and biosynthesis.
Flavonoids: Introduction and classification of flavonoids, general biosynthetic pathway, synthesis of flavone, flavonol and cyanidin.

Recommended Books:
1. Dewick, P. M., Medicinal Natural Products: A Biosynthetic Approach, 3rd ed., Medicinal Natural Products, John-Wiley & Sons, Ltd., (2009).
2. Sell, C. S., A Fragrant Introduction to Terpenoid Chemistry, The Royal Society of Chemistry, UK, (2003).
3. De la Rosa, L. A., Parrilla, E. A. and Aguitar, G. A. G., Fruit and Vegetable Phytochemicals: Chemistry, Nutritional Value and Stability, Wiley-Blackwell, (2009).
4. Shahidi, F. and Naczk M., Phenolics in Food and Nutraceuticals, CRC Press, (2004).
5. Oyvind, M. A., and Kenneth, R. M., Flavonoids: Chemistry, Biochemistry and Applications, CRC, Taylor & Francis, New York, (2010).
6. Finar, I. L., Organic Chemistry, Vol. 2, Stereochemistry and the Chemistry of Natural Products, 5th ed., Pearson Education Ltd., Delhi, (2008).
7. Hesse, M., Alkaloid Chemistry, John-Wiley & Sons, New York, (1981).

BS 4th Year

Semester-VIII (ORGANIC CHEMISTRY)

Paper-V

Course Title: ORGANIC SYNTHESIS

Course Code: CHEM-485

Credit Hours: 3

Course Objectives:

Students will acquire knowledge and understanding to design protocols for synthesis of small to medium sized organic compounds and be able to carry out retrosynthetic analysis and propose alternative reactions to synthesize a compound.

Course Contents:

Principles and importance of organic synthesis: Introduction to reterosynthesis and disconnection approach, synthesis of aromatic compounds; one and two group carbon C-X disconnections, donor and acceptor synthons, C-C disconnections and 1,2-, 1,3-, 1,4-, 1,5- and 1,6- difunctionalized compounds, synthesis of cyclic compounds (3-6 membered), chemo-, regio- and stereoselectivity.

Synthetic strategies: Functional group protection: hydroxyl, amino, carbonyl, carboxylic, sulfanyl, C=C, solid phase synthesis, phase-transfer catalysis and metal catalyzing reactions.

Recommended Books:

1. Warren, S. and Wyatt, P., Workbook for Organic Synthesis: The Disconnection Approach, 2nd ed., John-Wiley & Sons, Inc., (2010).
2. Fox, M. A. and Whitsell, J. K., Organic Chemistry, 3rd ed., Jones & Bartlett Publishers (1997).
3. Clayden, J., Greeves, N., and Warren, S., Organic Chemistry, 2nd ed., Oxford University Press, New York, (2012).
4. Loudon, M., Organic Chemistry, 5th ed., Roberts Company Publishers, (2009).
5. Smith, J. G., Organic Chemistry, 3rd ed., McGraw-Hill, (2010).
6. Norman, R. O. C. and Coxon, J. M., Principles of Organic Synthesis, 3rd ed., CRC Press, (1993).

BS 4th Year
Semester-VIII (ORGANIC CHEMISTRY)
Paper-VI
Course Title: MEDICINAL CHEMISTRY
Course Code: CHEM-486
Credit Hours: 3

Course Objectives:

Students will acquire knowledge and learn about the nature, types and properties of drugs and medicines, and the role of an organic chemist in drug designing and drug discovery.

Course Contents:

Chemistry of biomolecules; introduction to drugs and drug discovery, sources of therapeutic agents, structure activity relationship (SAR), drug-receptor interaction, drug formulation and its methods, different types of drugs; chemistry and modes of action of some common drugs.

Recommended Books:

1. Paul, M. D., Medicinal Natural Products: A Biosynthetic Approach, 3rd ed., Medicinal Natural Products, John-Wiley & Sons, Ltd, (2009).
2. Wolff, M. E., Burger's Medicinal Chemistry, 4th ed., Part III, John-Wiley & Sons, New York, (2006).
3. Williams, D. A. and Lemke, T. L., Foye's Principles of Medicinal Chemistry, 6th ed., Lippincott Williams & Wilkins, New York, (2008).
4. D. Sriram, P. Vogeeswari, Medicinal Chemistry, 2nd ed., BITS Pilani, Pearson, Publisher: Darling Kindernley, India, (2010).
5. Carins D., Essential of Pharmaceutical Chemistry, 3rd ed., Pharmaceutical Press, London, (2008).

BS 4th Year
Semester-VIII (PHYSICAL CHEMISTRY)
Paper-IV
Course Title: REACTION DYNAMICS
Course Code: CHEM-484
Credit Hours: 3

Course Objectives:

Students will acquire knowledge and learning about reaction dynamics and kinetic theories. They will also know about the factors which can influence the rates of reactions under different reaction conditions.

Course Contents:

Reaction Dynamics: Correlation between physical properties and concentration, Kinetics of the complex reactions, reversible, parallel, consecutive bimolecular reactions, Theory of absolute reaction rate, Lindemann's theory of unimolecular reactions, bimolecular collision theory, transition state theory, comparison of collision and absolute reaction theories, Potential energy surfaces, Thermodynamic formulation of reaction rates, Calculation of entropy and enthalpy changes, Thermal decomposition of nitrogen pentaoxide.

Reactions in solutions: Influence of ionic strength on the reaction rate, effect of dielectric constant of the medium on the rate of the reaction, single sphere activated complex model, double sphere activated complex model, complex reactions, chain reactions, single chain carrier with second order breaking, one chain carrier with first order breaking, two chain carriers with second order breaking, experimental techniques for fast reactions.

Recommended Books:

1. Espenson, J. H., Chemical Kinetics and Reaction Mechanism 2nd ed., McGraw-Hill, London (2002).
2. Connors, K. A., Chemical Kinetics: The Study of Reaction Rates in Solution, VCH Publishers, Inc., (1990). 3. Silbey, R. J., Alberty, R. A. and Bawendi, M. G., Physical Chemistry, 4th ed., John-Wiley& Sons, (2005). 4. Atkins, P. and Paula, J. D., Atkin's Physical Chemistry, 9th ed., Oxford University Press, (2010).

BS 4th Year

Semester-VIII (PHYSICAL CHEMISTRY)

Course Title: RADIATION AND PHOTOCHEMISTRY

Paper-V

Course Code: CHEM-485

Credit Hours: 3

Course Objectives:

Students will learn about the mechanisms of radiation induced chemical changes in molecules, radiation dosimetery and applications of the radiation chemistry. They will also learn about radioactive decays, and how radioisotopes are produced and applied in Mössbauer spectroscopy. Students will be able to understand the principles of fluorescence, phosphorescence and other photochemical processes, and their applications.

Course Contents:

Radiation Chemistry: Development and advancement in radiation chemistry, radiation dosimetry, Fricke dosimeter, dosimetry in pulse radiolysis, energy states in radiation chemistry, excited states, fragmentation, pre-dissociation, photochemical decay, ions and electrons, radiolysis of gases, liquids, solids, frozen liquids and ions in radiation chemistry, recent application of radiation chemistry.

Photochemistry: Principles of photochemistry, laws of photochemistry, Einstein's law of photochemical equivalence, rates of intramolecular processes, chemical reactions and quantum yields with examples, energy transfer in photochemical reaction, quantum yield of emission process radiation and nonradiation process, kinetics and quantum yields of radiative and nonradiative process (fluorescence, phosphorescence, inter-system crossing, internal conversion, quenching) and Stern-Volmer reactions, photosensitized reactions.

Recommended Books:

1. Spinks, J. W. T. and Woods, R. J., An introduction to Radiation Chemistry, 3rd ed., Wiley Inter Si. Pub., USA, (1990).
2. Aziz, F. and Rodgers, M. A. J., Radiation Chemistry Principles and Applications, 1sted., VCH Publishers, Inc., (1987).
3. Choppin, G., Liljenzin, J-O., Rydberg, J., Radiochemistry and Nuclear Chemistry, 3rd ed., Butterworth-Heinemann, (2002).

4. Mostafavi, M., Douki, T., Radiation Chemistry: From Basic to Applications in Material and Life Sciences, EDP Science, (2008).

5. Dunkin, I., Photochemistry, Vol. 36, RSC Publishing, (2007).

BS 4th Year

Semester-VIII (PHYSICAL CHEMISTRY)

Paper-VI

Course Title: COLLOID AND SURFACE CHEMISTRY

Course Code: CHEM-486

Credit Hours: 3

Course Objectives:

Students will acquire knowledge about the important colloidal system and Nano Size materials with applications. The solid surface will be characterized and will be used for the process of surface phenomenon. The Thermodynamic study of the solid-liquid interfaces will also be explored.

Course Contents:

Colloidal solutions: Introduction, Classification of colloidal system, Structural characteristics, Preparation of colloidal system. Optical Properties: Optical and electron microscopy, Light scattering. Composition and structure of solid surfaces. Colloid with special reference to surfactants and emulsions.

Introduction to Nano sized materials: Classification of NSM, Synthesis of NSM, properties of NSM. Case studies of NSM. Charged films and Langmuir-Blodgett layers, Applications.

Characterization of Colloidal and Nano sized materials: Experimental probes techniques for the surface chemistry of adsorbent: scanning probe techniques (SEM/TEM, low energy electron diffraction (LEED), other surface analysis techniques like EDS, Zeta Potential, FTIR, TGA/DTA).

Adsorption on the surface: Solid–liquid interfaces: Adsorption equilibration, Adsorption kinetics, adsorption isotherms, factors affecting the process of adsorption, adsorption mechanism and thermodynamics of adsorption. Usefulness of surface chemistry to colloidal solution and NSM surfaces.

Recommended Books:

1. Hunter, R. J., Introduction to Modern Colloid Science, Oxford University Press, Oxford, (1994).
2. Poole, C. P. and Owens, F. J., Introduction to Nanotechnology, 1st ed., Wiley-Interscience, (2003).

3. Klabunde, K. J., Nanoscale Materials in Chemistry, John-Wiley & Sons, Inc., (2003).
4. Atkins, P. and Paula, J. D., Atkin's Physical Chemistry, 8th ed., Oxford University Press, (2006).
5. Christian, G. D., Analytical Chemistry, 6th ed., John-Wiley & Sons, (2004).

BS 4th Year

Semester-VIII

Course Title: Elective Course-II (Environmental Chemistry)

Course Code: CHEM-487

Credit Hours: 3

Course Objectives:

This course will enable the students to understand the basic concepts of water pollution and water treatment and the green revolution

Course Contents:

Water and Water Treatment:

Unique physical and chemical properties of water, criteria of water quality, natural water-eutrophication, detergents and phosphates, importance of microorganisms in water purification, primary and secondary treatment of water, advanced waste water treatment, removal of nitrogen and phosphorus, sources of industrial water pollution, heavy metals and mercury.

The Green Revolution:

Pest control, pesticides, toxicity of pesticides, pest management.

Recommended Books:

1. Anil Kumar, Environmental Chemistry, Wiley Eastern, New Delhi.
2. J.W. Moore & E.A. Moore, Environmental Chemistry, Academic Press, New York.
3. S.K. Banerji, Environmental Chemistry, Prentice Hall, Delhi.
4. S.K. Banerji, Environmental Chemistry, Tata Publisher, Delhi.
5. Stanley E. Manahan, Environmental Chemistry, Brooks, California.

THE END