INSTITUTE OF CHEMICAL SCIENCES

UNIVERSITY OF PESHAWAR

CURRICULUM

4-YEAR BS

IN

CHEMISTRY

2012 onward

A meeting of the Board of Studies of the Institute of Chemical Sciences (ICS) was held on February 28, 2009. The following members participated.

1. Prof: Dr. Muhammad Saeed Iqbal, Chairman Department of Chemistry, Govt College Univ. Lahore. (Member)
2. Prof: Dr. Humayun Pervez, Chairman Department of Chemistry, B.Z. University, Multan. (Member)
3. Dr. Khalid Khan, HEJ Research Institute of Chemistry, University of Karachi. (Member)
4. Prof. Dr. Muhammad Arfan, Institute of Chemical Sciences, University of Peshawar. (Member)
5. Prof: Dr. Imdad Ullah, Muhammadzai, Institute of Chemical Sciences, University of Peshawar. (Member)
6. Prof: Dr. Rafiullah Khan, Institute of Chemical Sciences, University of Peshawar. (Member)
7. Prof. Dr. Nazar ul Islam, Institute of Chemical Sciences, University of Peshawar. (Member)
8. Dr. Muhammad Shakirullah, Associate Prof., Institute of Chemical Sciences, University of Peshawar. (Member)
9. Dr. Habib-ur-Rehman, Associate Prof., Institute of Chemical Sciences, University of Peshawar. (Member)
10. Dr. Ikhtiar Khan, Associate Prof., Institute of Chemical Sciences, University of Peshawar. (Member)
11. Dr. Fazlullah Khan Bangash, Associate Prof., Institute of Chemical Sciences, University of Peshawar. (Member)
12. Dr. Yousaf Iqbal, Associate Prof., Institute of Chemical Sciences, University of Peshawar. (Member)
13. Dr. M. Ishaq, Associate Prof., Institute of Chemical Sciences, University of Peshawar (Member)
14. Dr. Jasmin Shah, Associate Prof., Institute of Chemical Sciences, University of Peshawar. (Member)
15. Dr. Khurshid Ali, Associate Prof., Institute of Chemical Sciences, University of Peshawar. (Member)
16. Dr. Imtiaz Ahmad, Assistant Prof., Institute of Chemical Sciences, University of Peshawar. (by Invitation)
17. Mrs. Raheela Taj, Lecturer., Institute of Chemical Sciences, University of Peshawar (by Invitation)
18. Dr. M. Nisar Ahmad, Director ICS, chaired the meeting

Agenda item Item 4. Curriculum for BS (4-Year Program)

Minutes: The Board decided that the HEC baseline will be followed for the curriculum of BS (4-Year). However, few modifications/additions/deletion were allowed in all the subjects. With such modifications that the sectional heads considers essential, the curriculum was approved. The Board also approved the courses of Fuel Chemistry to be included under "Institutional option" in the curriculum. The Board allowed increase of 2 credit hours for inclusion of Fuel Chemistry Courses.

MISSION STATEMENT

The common purpose is to achieve the highest possible standards of scholarship, teaching and research in chemistry and allied subjects.

1. The objectives of this curriculum are:

   i) To encourage intellectual development and scholarship in and through chemistry;

   ii) To impart a sound knowledge of chemistry to students and to help them to use this knowledge creatively and analytically.

   iii) To develop in students an awareness of the applications of chemistry including its practical, social and economic aspects such as health, agriculture, industry and defense.

   iv) To develop and improve students practical, written and oral communication, information retrieval, computer and problem solving skills.

   v) To encourage students to become effective independent learners.

   vi) To develop the curriculum which is need based and its continuous developments shall be made considering the changing global and national requirements.

   vii) To develop in students the ability to work in groups so as to acquire respect for human values.

   viii) To encourage students to broaden their knowledge, to develop their own capabilities and self-confidence, to respect learning and to participate in continuing education.

Courses Code Key:

i) The code will start alphabets as follows.

CHEM:	**Chemistry Courses**
GEN:	**General Courses***
MATH:	**Mathematics Course**
COMP:	**Computer Course**
STAT:	**Statistics Course**
BIO:	**Biology Course**

ii) The letter code will be followed by three digits; the first digit will denote level of the course.

iii) For the Chemistry Courses, Second digit specifying the subject identity will be as follows:

Analytical Chemistry	1
Applied / Industrial Chemistry	2
Biochemistry	3
Environmental Chemistry	4
Inorganic Chemistry	5
Organic Chemistry	6
Physical Chemistry	7
Fuel Chemistry	8

iv) The third digit may be used to indicate diversity within the specialty.

v) Codes for the special courses in 7^{th} and 8^{th} semester may be assigned in accordance with the above guidelines.

* List given in **Annexure "A"**

4-YEAR BS Program in Chemistry
Scheme of Studies, SEMESTER-I to SEMESTER-IIIV

Semester-I			**Credit Hours**		
Course Code	**Old #**	**Course Title**	**Theory**	**Laboratory**	**Marks**
ENG-311	ENG-100	English-I (Functional)	3	0	100
GEN-311	GEN-100	General-I (Logic & Critical Thinking)	3	0	100
GEN-312	GEN-101	General-II (History of Human Civilization)	3	0	100
MATH-311	MATH-00	Mathematics-I	3	0	100
BIOL-311	BIOL-100	Functional Biology-I			
GEN-313	GEN-102	Pakistan Studies	2	0	50
CHEM-311.5	CHEM-151	Inorganic Chemistry-I	3	1	100
		Total	**17**	**1**	**550**
Semester-II			**Credit Hours**		
Course Code	**Old #**	**Course Title**	**Theory**	**Laboratory**	**Marks**
ENG-321	ENG-200	English-II (Functional)	3	0	100
GEN-321	GEN-200	Islamic Studies/Ethics	2	0	50
GEN-322	GEN-201	General-III (Psychology)	3	0	100
MATH-321	MATH-200	Mathematics-II	3	0	100
BIO-321	BIOL-200	Functional Biology-II			
STAT-321	STAT-100	Statistics	3	0	100
CHEM-321.6	CHEM-161	Organic Chemistry-I	3	1	100
		Total	**17**	**1**	**550**

Semester-III			**Credit Hours**		
Course Code	**Old #**	**Course Title**	**Theory**	**laboratory**	**Marks**
ENG-431	ENG-300	English-III (Report Writing)	3	0	100
COMP-431	COMP-100	Introduction to Computer	3	0	100
GEN-431	GEN-301	General-IV (Philosophy of Science)	3	0	100
GEN-432	GEN-302	General-V (Principles of Management)	3	0	100
CHEM-431.4	CHEM-141	Environmental Chemistry	2	0	50
CHEM-432.7	CHEM-171	Physical Chemistry-I	3	1	100
		Total	**17**	**1**	**550**

Semester-IV			Credit Hours		
Course Code	**Old #**	**Course Title**	**Theory**	**Laboratory**	**Marks**
CHEM-441	CHEM-400	Mathematics & statistics for Chemists	3	0	100
GEN-441	GEN-400	General-VI	3	0	100
GEN-442	GEN-401	General-VII	3	0	100
CHEM-441.1	CHEM-111	Analytical Chemistry-I	2	0	60
CHEM-442.2	CHEM-121	Industrial Chemistry-I	2	0	60
CHEM-443.3	CHEM-131	Biochemistry-I	2	0	60
CHEM-444.8	CHEM-181	Fuel Chemistry-I	2	0	60
CHEM-445	CHEM-101	Combined Lab	0	1	60
		Total	**17**	**1**	**600**
Semester-V			**Credit Hours**		
Course Code	**Old #**	**Course Title**	**Theory**	**Laboratory**	**Marks**
CHEM-551.5	CHEM-251	Inorganic Chemistry-II	3	1	100
CHEM-552.6	CHEM-261	Organic Chemistry-II	3	1	100
CHEM-553.7	CHEM-271	Physical Chemistry-II	3	1	100
CHEM-554.1 CHEM-554.2 CHEM-554.3 CHEM-554.8	CHEM-211 CHEM-221 CHEM-231 CHEM-281	Analytical Chemistry-II Applied Chemistry-II Biochemistry-II Fuel Chemistry-II	3 each	1 Each	100 each
		Total	**12**	**4**	**400**
Semester-VI			**Credit Hours**		
Course Code	**Old #**	**Course Title**	**Theory**	**Laboratory**	
CHEM-561.5	CHEM-351	Inorganic Chemistry-III	3	1	100
CHEM-562.6	CHEM-361	Organic Chemistry-III	3	1	100
CHEM-563.7	CHEM-371	Physical Chemistry-III	3	1	100
CHEM-564.1 CHEM-564.2 CHEM-564.3 CHEM-564.8	CHEM-311 CHEM-321 CHEM-331 CHEM-381	Analytical chemistry-III Applied Chemistry-III Biochemistry-III Fuel Chemistry-III	3 Each	1 Each	100 each
		Total	**12**	**4**	**400**

Semester-VII					
Course Code	**Old #**	**Papers in specialization**	**Theory**	**laboratory**	**Marks**
Specialization In 7 disciplines Inorganic/Organic /Physical/Analytical /Applied/l/Bio / Fuel Chemistry		Specialization (Inorganic/Organic/ Physical/Analytical/ Applied/l/Bio /Fuel Chemistry)			
Paper-I CHEM-671.1 CHEM-671.2 CHEM-671.3 CHEM-671.5 CHEM-671.6 CHEM-671.7 CHEM-671.8	Paper-I CHEM-411 CHEM-421 CHEM-431 CHEM-451 CHEM-461 CHEM-471 CHEM-481	Paper-I each in Analytical Applied Biochemistry Inorganic Chemistry Organic Chemistry Physical Chemistry Fuel Chemistry	3	0	100
Paper-II CHEM-672.1 CHEM-672.2 CHEM-672.3 CHEM-672.5 CHEM-672.6 CHEM-672.7 CHEM-672.8	Paper-II CHEM-412 CHEM-422 CHEM-432 CHEM-452 CHEM-462 CHEM-472 CHEM-482	Paper-II, each in Analytical Applied Biochemistry Inorganic Chemistry Organic Chemistry Physical Chemistry Fuel Chemistry	3	0	100
Paper-III, CHEM-673.1 CHEM-673.2 CHEM-673.3 CHEM-673.5 CHEM-673.6 CHEM-673.7 CHEM-673.8	Paper-III CHEM-413 CHEM-423 CHEM-433 CHEM-453 CHEM-463 CHEM-473 CHEM-483	Paper-III, each in Analytical Applied Biochemistry Inorganic Chemistry Organic Chemistry Physical Chemistry Fuel Chemistry	3	0	100
Practical-I, CHEM-674.1 CHEM-674.2 CHEM-674.3 CHEM-674.5 CHEM-674.6 CHEM-674.7 CHEM-674.8	Practical-I CHEM-414 CHEM-424 CHEM-434 CHEM-454 CHEM-464 CHEM-474 CHEM-484	Practical-I, each in Analytical Applied Biochemistry Inorganic Chemistry Organic Chemistry Physical Chemistry Fuel Chemistry	0	1	25
Course code will depend on course selected from other specializations	Elective Course-I (Other than the field of specialization)	Elective Course-I (Other than the field of specialization) Title will be the same	3	0	100

	Title will be the same as offered in a particular specialization	as offered in a particular specialization			
THES/CHEM-679	Thesis /Advanced Special Practical/Review article (Literature Survey), CHEM-415 CHEM-425 CHEM-435 CHEM-455 CHEM-465 CHEM-475 CHEM-485	Thesis /Advanced Special Practical/Review article (Literature Survey)	0	2	50
	Total	**Total**	**12**	**3**	**475**
Semester-VIII					
Course Code	**Old #**	**Papers in Specialization**	**Theory**	**laboratory**	**Marks**
Course Code Specialization Inorganic/Organic/ Physical/Analytical/ Applied/Bio/Fuel Chemistry	Specialization Inorganic/Organic/ Physical/Analytical/ Applied/Bio/Fuel Chemistry	Specialization Inorganic/Organic/ Physical/Analytical /Applied//Bio/Fuel Chemistry			
Paper-IV CHEM-681.1 CHEM-681.2 CHEM-681.3 CHEM-681.5 CHEM-681.6 CHEM-681.7 CHEM-681.8	Paper-IV CHEM-416 CHEM-426 CHEM-436 CHEM-456 CHEM-466 CHEM-476 CHEM-486	Paper-IV, each in Analytical Applied Biochemistry Inorganic Chemistry Organic Chemistry Physical Chemistry Fuel Chemistry	3	0	100
Paper-V CHEM-682.1 CHEM-682.2 CHEM-682.3 CHEM-682.5 CHEM-682.6 CHEM-682.7 CHEM-682.8	Paper-V CHEM-417 CHEM-427 CHEM-437 CHEM-457 CHEM-467 CHEM-477 CHEM-487	Paper-V, each in Analytical Applied Biochemistry Inorganic Chemistry Organic Chemistry Physical Chemistry Fuel Chemistry	3	0	100
Paper-VI CHEM-683.1 CHEM-683.2 CHEM-683.3 CHEM-683.5	Paper-VI CHEM-418 CHEM-428 CHEM-438 CHEM-458	Paper-VI, each in Analytical Applied Biochemistry Inorganic Chemistry	3	0	100

CHEM-683.6 CHEM-683.7 CHEM-683.8	CHEM-468 CHEM-478 CHEM-488	Organic Chemistry Physical Chemistry Fuel Chemistry			
Practical-II CHEM-684.1 CHEM-684.2 CHEM-684.3 CHEM-684.5 CHEM-684.6 CHEM-684.7 CHEM-684.8	Practical-II CHEM-414 CHEM-424 CHEM-434 CHEM-454 CHEM-464 CHEM-474 CHEM-484	Practical-II, each in Analytical Applied Biochemistry Inorganic Chemistry Organic Chemistry Physical Chemistry Fuel Chemistry	0	1	25
Course code will depend on course selected from other specializations	Elective Course-II (Other than the field of specialization) Title will be the same as offered in a particular specialization	Elective Course-II (Other than the field of specialization) Title will be the same as offered in a particular specialization	3	0	100
THES/CHEM-689	Research Project/Advanced Special Practical/Review article (Write-up), CHEM-415 CHEM-425 CHEM-435 CHEM-455 CHEM-465 CHEM-475 CHEM-485	Research Project/Advanced Special Practical/Review article (Write-up)	0	2	50
	Total	**Total**	**12**	**3**	**475**

Semester	Theory Cr Hr	Laboratory Cr Hr	Total Cr Hr	Marks
I	17	1	18	550
II	17	1	18	550
III	17	1	18	550
IV	17	1	18	600
V	12	4	16	400
VI	12	4	16	400
VII	12	3	15	425
VIII	12	3	15	525
	116	**18**	**134**	**4000**

Course	Credit Hours (%)	Marks
General	21 (15.67)	700
Compulsory	28 (20.89)	900
Chemistry	85 (63.44)	2400
Total	134	4000

Compulsory Courses

Compulsory Courses				
10 Courses/28 Credit Hours				
#	**Course Code**	**Course Title**	**C. H**	**Marks**
1	ENG-311	English I (Functional)	3	100
2	ENG-321	English II (Functional)	3	100
3	ENG-431	English III (Report Writing)	3	100
4	CHEM-441	University Compulsory	3	100
5	GEN-313	Pakistan Studies	2	50
6	GEN-321	Islamic studies	2	50
7	MATH-311 BIOL-311	Mathematics- I (Algebra) Functional Biology-I	3	100
8	MATH-311 BIOL-311	Mathematics- II Functional Biology-II	3	100
9	COMP-431	Introduction to Computer	3	100
10	STAT-321	Introduction to Statistics	3	100
		Total	**28**	900

General Courses

General Courses				
7 Courses, 3 credit hour each/21Credit Hours				
#	**Course Code**	**Course Title**	**C. H**	**Marks**
1	Gen-311	Logic & Critical Thinking	3	100
2	Gen-312	History of Human Civilization	3	100
3	Gen-322	Psychology	3	100
4	Gen-431	Philosophy of Science	3	100
5	Gen-432	Principles of Management	3	100
6	Gen-441	Teaching & Learning	3	100
7	Gen-442	Sociology	3	100
		Total	**21**	**700**

CHEMISTRY COURSES

A	**Discipline Specific Foundation courses/9 courses of 23 credit hours**			
#	**Course Code**	**Course Title**	**Credit Hours**	**Marks**
1	CHEM-431.4	Environmental Chemistry	2	50
2	CHEM-311.5	Inorganic Chemistry-I	3+1	100
3	CHEM-321.6	Organic Chemistry-I	3+1	100
4	CHEM-432.7	Physical Chemistry-I	3+1	100
5	CHEM-441.1	Analytical Chemistry-I	2	60
6	CHEM-442.2	Applied Chemistry-I	2	60
7	CHEM-443.3	Biochemistry-I	2	60
8	CHEM-444.8	Fuel Chemistry-I	2	60
9	CHEM-445	Combined laboratory	1	60
		Total	**23**	**650**
B	**Major Courses in Respective Specializations**			
#	**Course Code**	**Course Title**	**C.H**	**Marks**
1	CHEM-551.5	Inorganic Chemistry-II	3+1	100
2	CHEM-552.6	Organic Chemistry-II	3+1	100
3	CHEM-553.7	Physical Chemistry-II	3+1	100
4	CHEM-554.1 CHEM-554.2 CHEM-554.3 CHEM-554.8	Analytical Chemistry-II Applied Chemistry-II Biochemistry-II Fuel Chemistry-II	3+1	100
5	CHEM-561.5	Inorganic Chemistry-III	3+1	100
6	CHEM-562.6	Organic Chemistry-III	3+1	100
7	CHEM-563.7	Physical Chemistry-III	3+1	100
8	CHEM-564.1 CHEM-564.2 CHEM-564.3 CHEM-564.8	***One paper to be selected from the following*** Analytical Chemistry-III Applied Chemistry-III Biochemistry-III Fuel Chemistry-III	3+1	100
		THEORY		
9	CHEM-671.1	***PAPER-I***	3	100
10	CHEM-671.2	Analytical Chemistry (Spectroscopic methods of analysis)		
11	CHEM-671.3			
12	CHEM-671.5	Applied Chemistry (Common Industries-I)		
13	CHEM-671.6			
14	CHEM-671.7	Biochemistry (general biochemistry related to biomedical sciences)		
15	CHEM-671.8	Inorganic Chemistry (Inorganic reaction mechanism)		

	THEORY	Organic Chemistry (Synthesis and mechanism-I)		
16	CHEM-672.1			
17	CHEM-672.2	Physical Chemistry (Statistical thermodynamics and electrochemistry)	3	100
18	CHEM-672.3			
19	CHEM-672.5	Fuel Chemistry (Chemistry of coal conversion processes-I)		
20	CHEM-672.6			
21	CHEM-672.7	***PAPER-II***		
22	CHEM-672.8	Analytical Chemistry (electroanlytical methods)		
	THEORY			
23	CHEM-673.1	Applied Chemistry (Agro-based industries-II)		
24	CHEM-673.2			
25	CHEM-673.3	Biochemistry (Physical techniques in biochemistry)	3	100
26	CHEM-673.5			
27	CHEM-673.6	Inorganic Chemistry (Organic reagents in inorganic chemistry)		
28	CHEM-673.7	Organic Chemistry (Synthesis and mechanism-II)		
29	CHEM-673.8	Physical Chemistry (Polymer chemistry)		
		Fuel Chemistry (Petroleum & petrochemicals-I)		
	Laboratory			
30	CHEM-674	***PAPER-III***		
	THEORY	Analytical Chemistry (Emission spectroscopy & radiochemical methods)		
31	CHEM-681.1			
32	CHEM-681.2	Applied Chemistry (Common industries-II)	1	25
33	CHEM-681.3			
34	CHEM-681.5	Biochemistry (Molecular biology)		
35	CHEM-681.6	Inorganic Chemistry (Spectroscopy and instrumental methods of analysis)	3	100
36	CHEM-681.7	Organic Chemistry (Hetrocyclic and interpretative organic spectroscopy)		
37	CHEM-681.8	Physical Chemistry (Quantum chemistry and molecular spectroscopy)		
	THEORY			
38	CHEM-682.1	Fuel Chemistry (Characterization of fossils fuels by advanced instrumental techniques-I)		
39	CHEM-682.2			
40	CHEM-682.3			
41	CHEM-682.5	Instrumental Practical-I		
42	CHEM-682.6			
43	CHEM-682.7	***PAPER-IV***	3	100
44	CHEM-682.8	Analytical Chemistry (Hyphenated techniques)		
	THEORY			
45	CHEM-683.1	Applied Chemistry (Organic based industries)		
46	CHEM-683.2			
47	CHEM-683.3	Biochemistry (Physiological chemistry and chemotherapy)		
48	CHEM-683.5			
49	CHEM-683.6			
50		Inorganic Chemistry (Organometallic		

51 52	CHEM-683.7 CHEM-683.8 ***Laboratory*** CHEM-684	chemistry) Organic Chemistry (Reaction mechanism, determination, bio-molecules and synthetic drugs) Physical Chemistry (Advanced chemical kinetics) Fuel Chemistry (Chemistry of coal conversion processes-II) ***PAPER-V*** Analytical Chemistry (Advanced chromatography) Applied Chemistry (Industrial products) Biochemistry (Microbiology and immunology) Inorganic Chemistry (Magnetochemistry) Organic Chemistry (natural product chemistry) Physical Chemistry (Radiation and photochemistry) Fuel Chemistry (Petroleum and petrochemical-II) ***PAPER-VI*** Analytical Chemistry (contents plz) Applied Chemistry (Metallurgy) Biochemistry (Nutrition) Inorganic Chemistry (Nuclear chemistry) Organic Chemistry (Synthesis and mechanism-III) Physical Chemistry (Solid state chemistry, surface chemistry and catalysis) Fuel Chemistry (Characterization of fossil fuels by advanced instrumental techniques-II) Instrumental Practical-II	3 1	100 25
		Total	**52**	**1450**

C	Elective Courses within the Major			
#	**Course Code**	**Course Title**	**C.H**	**Marks**
1	**Theory course** (On the recommendation of teacher, students will take one course other than the field of specialization)	**Elective Course-I** (Title will be the same as offered in a particular specialization	3	100
2	**Theory course** (On the recommendation of teacher, students will take one course other than the field of specialization)	**Elective Course-II** (Title will be the same as offered in a particular specialization	3	100
3	THES-679/689 CHEM-679/689	Thesis/Research/Review	2	50
4	THES-679/689 CHEM-679/689	Thesis/Research/Review	2	50
		Total	**10**	**300**

Semester	**Cr Hr Theory**	**Cr Hr Practical**	**Total Cr Hr**	**Marks**
I	17	1	18	550
II	17	1	18	550
III	17	1	18	550
IV	17	1	18	600
V	12	4	16	400
VI	12	4	16	400
VII	12	3	15	425
VIII	12	3	15	525
	116	**18**	**134**	**4000**

1st YEAR

SEMESTER-I

SCHEME OF COURSES

Course Title	Credit Hours		
Semester-I	**Theory**	**Practical**	**Marks**
ENG-311 English-I (Functional)	3	0	100
GEN-311 General-I	3	0	100
GEN-312 General-II	3	0	100
MATH-311 Mathematics-I	3	0	100
BIOL-311 Functional Biology-I			
GEN-313 Pakistan Studies	2	0	50
CHEM-311.5 Inorganic Chemistry	3	1	100
Total	**17**	**1**	**550**

1st year **Semester-I**

COMPULSORY COURSE
Course Title: English I (Functional)
Course Code: ENG-311
Credit Hours: 3
Marks: 100

Course Objectives: Enhance language skills and develop critical thinking.

Course Contents: Basics of Grammar, Parts of speech and use of articles, Sentence structure, active and passive voice, Practice in unified sentence, Analysis of phrase, clause and sentence structure, Transitive and intransitive verbs, Punctuation and spelling

Comprehension
Answers to questions on a given text

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

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

Translation skills

Urdu to English

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

Presentation skills
Introduction

Note: Extensive reading is required for vocabulary building

Recommended Books:

1. Functional English
a) Grammar

1. Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 1. Third edition. Oxford University Press. 1997. ISBN 0194313492 2.
2. Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 2. Third edition. Oxford University Press. 1997. ISBN 0194313506 b) Writing

b) Writing.

1. Intermediate by Marie-Christine Boutin, Suzanne Brinand and Francoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 0 19 435405 7 Pages 20-27 and 35-41.

c) Reading/Comprehension

1. Reading. Upper Intermediate. Brain Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1992. ISBN 0 19 453402 2.

d) Speaking

1st year **Semester-I**

GENERAL COURSE *
Course Title: General-I
Course Code: GEN-311
Credit Hours: 3
Marks: 100

Depending on the availability of teacher, General-I will be selected from Annexure "A"

* List given in **Annexure "A"**

1st year **Semester-I**

GENERAL COURSE*
Course Title: General-II (History of Human Civilization)
Course Code: GEN-312
Credit Hours: 3
Marks: 100

Depending on the availability of teacher, General-II will be selected from Annexure "A"

* List given in **Annexure "A"**

1st year **Semester-I**

COMPULSORY COURSE

Course Title: MATHEMATICS-I (ALGEBRA)
Course Code: MATH-311
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 Contents

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 equations, 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. Dolciani MP, Wooton W, Beckenback EF, Sharron S, Algebra 2 and Trigonometry, 1978, Houghton & Mifflin,
2. Boston (suggested text) Kaufmann JE, College Algebra and Trigonometry, 1987, PWS-Kent Company, Boston
3. Swokowski EW, Fundamentals of Algebra and Trigonometry (6^{th} edition), 1986, PWS-Kent Company, Boston

1st year **Semester-I**

COMPULSORY COURSE
Course Title: Functional Biology-I
Course Code: BIOL-311
Credit Hours: 3
Marks: 100

Course Objectives

Course Contents
Biological Methods

Principles of Cellular Life
Chemical Basis, Structure and Function, Principles of Metabolism, Energy Acquisition

Principles of Inheritance
Mitosis and Meiosis, Chromosomes, Observable Inheritance Patterns, DNA Structure and Function, RNA and Proteins, Genes, Genetic Engineering and Biotechnology

Biodiversity
Fundamental Concept of Biodiversity, One or two examples of each of the following from commonly found organism, Prions, Viruses, Bacteria, Protistans, Algae, Fungi, Plants, Crops Animals, Invertebrates, Vertebrates

Recommended Books

1 Roberts, M.M., Reiss and G.M onger. 2000. Advanced Biology, Nelson.
2 Starr, C, and R, Taggart, 2001. Biology: The Unity and Diversity of Life Brooks and Cole.
3 Campbell, N.A., J.B, Reece, L.G. Mitchell, M.R, Taylor. 2001. Biology: Concepts and Connections. Prentice-Hall.

1st year **Semester-I**

COMPULSORY COURSE
Course Title: Pakistan Studies
Course Code: GEN-313
Credit Hours: 2
Marks: 50

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 Contents
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.

Government and Politics in Pakistan
Political and constitutional phases:
   a. 1947-58
   b. 1958-71
   c. 1971-77
   d. 1977-88
   e. 1988-99
   f. 1999 onward

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 Banglades., Washington: American Enterprise, Institute of Public Policy Research, 1972.
6. Mehmood, Safdar. Pakistan Kayyun Toota, Lahore: Idara-e-Saqafat-e-Islamia, Club Road, nd.
7. Amin, Tahir. Ethno -National Movement in Pakistan, Islamabad: Institute of Policy Studies, Islamabad.
8. Ziring, Lawrence. Enigma of Political Development. Kent England: WmDawson & sons Ltd, 1980.
9. Zahid, Ansar. History & Culture of Sindh. Karachi: Royal Book Company, 1980.
10. Afzal, M. Rafique. Political Parties in Pakistan, Vol. I, II & III. Islamabad: National Institute of Historical and cultural Research, 1998.
11. Sayeed, Khalid Bin. The Political System of Pakistan. Boston: Houghton Mifflin, 1967.
12. Aziz, K.K. Party, Politics in Pakistan, Islamabad: National Commission on Historical and Cultural Research, 1976.
13. Muhammad Waseem, Pakistan Under Martial Law, Lahore: Vanguard, 1987.
14. Haq, Noor ul. Making of Pakistan: The Military Perspective. Islamabad: ational Commission on Historical and Cultural Research, 1993.

1st year **Semester-I**

CHEMSITRY COURSE
Course Title: INORGANIC CHEMISTRY
Course Code: CHEM-311.5
Credit Hours: 3
Marks:75

Course Objectives
After completing this course, students will have sufficient knowledge about;
the development of periodic law , properties of elements in a systematic way, principal of chemical bonding, concepts of acid and bases and the chemistry of p-block elements.

Course Contents
Periodic Law and Periodicity
Development of Periodic Table; classification of elements based on s, p, d and f orbitals, group trends, periodic properties i.e., atomic radii, ionic radii, ionization potential, electron affinities, electronegativities and redox potential in s, p, d and f block elements

Principles of Chemical Bonding
Types of chemical bonding; ionic bonding; the localized bond approach: valance bond (VB) theory, hybridization and resonance; the delocalized approach to bonding: molecular orbital theory as applied to diatomic and polyatomic molecules, three center bond, bonding theory of metals and intermetallic compounds; conductors, insulators and semiconductors; bonding in electron deficient compounds; hydrogen bonding.

Acids and Bases
Concepts of acids and bases including SHAB concept, relative strength of acids and bases, significance of $_pH$, $_pKa$, $_pKb$ and buffer solutions, theory of indicators, solubility, solubility product, common ion effect and their industrial applications.
Chemistry of p-block Elements
Chemistry and structure of p-block elements; main emphasis on the chemistry and structure of noble gases and their compounds, chemistry and structure of interhalogens, pseudohalogens and polyhalides. Prediction of shapes of molecules using VSEPR model and hybridization.

PRACTICAL
Course Code: CHEM-311.5
Credit Hour: 1
Marks: 25

Laboratory Work Illustrating Topics Covered in the Lectures of CHEM-311.5

Recommended Books

1 Miessler, G. L.; Tarr, D.A., *Inorganic Chemistry*, Prentice-Hall International, New Jersey, USA, **1991**.
2 Day, M.C.; Selbin, J., *Theoretical Inorganic Chemistry*, 2nd ed., Van Nostrand Reinhold Company, New York, USA, **1969**.
3 Shriver, D. F.; Atkins, P. W.; Langford, C. H., *Inorganic Chemistry*, 2nd ed., Oxford University Press, **1994**.

Supplementary Reading Material

1 Huheey, J. E.; Keiter, E. A.; Keiter, R. L., *Inorganic Chemistry: Principles of Structure and Reactivity*, 4th ed.., Harper and Row, New York, **2001.**
2 Cotton, F. A.; Wilkinson, G. *Basic Inorganic Chemistry*, 3rd ed., Wiley, New York, **1995**.
3 Lee, J.D., *Concise Inorganic Chemistry*, Chapman and Hall, 5th ed., **1996**.

1st Year

Semester-II

SCHEME OF COURSES

Course Title	**Credit Hours**		
Semester-II	**Theory**	**Practical**	**Marks**
ENG-321 English-II (Functional)	3	0	100
GEN-321 Islamic Studies/Ethics	2	0	50
GEN-322 General-III	3	0	100
MATH-321 Mathematics-II	3	0	100
BIOL-321 Functional Biology-II			
STAT-321 Statistics	3	0	100
CHEM-321.6 Organic Chemistry	3	1	100
Total	**17**	**1**	**550**

1st year **Semester-II**

COMPULSORY COURSE
Course Title: English II (Functional)
Course Code: ENG-321
Credit Hours: 3
Marks: 100

Objectives: Enable the students to meet their real life communication needs.

Course Contents
Paragraph writing
Practice in writing a good, unified and coherent paragraph
Essay writing
Introduction
CV and job application
Translation skills
Urdu to English
Study skills
Skimming and scanning, intensive and extensive, and speed reading, summary and précis writing and comprehension
Academic skills
Letter/memo writing, minutes of meetings, use of library and internet
Presentation skills
Personality development (emphasis on content, style and pronunciation)

Note: *documentaries to be shown for discussion and review*

Recommended Books:

Communication Skills

a) Grammar
   1. Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 2. Third edition. Oxford University Press 1986. ISBN 0 19 431350 6.

b) Writing
   1. Writing. Intermediate by Marie-Chrisitine Boutin, Suzanne Brinand and Francoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 019 435405 7 Pages 45-53 (note taking).
   2. Writing. Upper-Intermediate by Rob Nolasco. Oxford Supplementary Skills. Fourth Impression 1992. ISBN 0 19 435406 5 (particularly good for writing memos, introduction to presentations, descriptive and argumentative writing).

c) Reading
   1. Reading. Advanced. Brian Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1991. ISBN 0 19 453403 0.
   2. Reading and Study Skills by John Langan
   3. Study Skills by Riachard Yorky.

1st year **Semester-II**

COMPULSORY COURSE
Course Title: ISLAMIC STUDIES
Course Code: GEN-321
Credit Hours: 2
Marks: 50

Course Objectives
This course is aimed at:

1. To provide Basic information about Islamic Studies
2. To enhance understanding of the students regarding Islamic Civilization
3. To improve Students skill to perform prayers and other worships
4. To enhance the skill of the students for understanding of issues related to faith and religious life.

Course Contents

Introduction to Quranic Studies

1) Basic Concepts of Quran
2) History of Quran
3) Uloom-ul -Quran

Study of Selected Text of Holly Quran

1) Verses of Surah Al-Baqra Related to Faith(Verse No-284-286)
2) Verses of Surah Al-Hujrat Related to Adab Al-Nabi (Verse No-1-18)
3) Verses of Surah Al-Mumanoon Related to Characteristics of faithful (Verse No-1-11)
4) Verses of Surah al-Furqan Related to Social Ethics (Verse No.63-77)
5) Verses of Surah Al-Inam Related to Ihkam(Verse No-152-154)

Study of Selected Text of Holly Quran

1) Verses of Surah Al-Ihzab Related to Adab al-Nabi (VerseNo.6,21,40,56,57,58.)
2) Verses of Surah Al-Hashar (18,19,20) Related to thinking, Day of Judgment
3) Verses of Surah Al-Saf Related to Tafakar,Tadabar (Verse No-1,14)

Seerat of Holy Prophet (S.A.W) I

1) Life of Muhammad Bin Abdullah (Before Prophet Hood)
2) Life of Holy Prophet (S.A.W) in Makkah
3) Important Lessons Derived from the life of Holy Prophet in Makkah

Seerat of Holy Prophet (S.A.W) II

1) Life of Holy Prophet (S.A.W) in Madina
2) Important Events of Life Holy Prophet in Madina
3) Important Lessons Derived from the life of Holy Prophet in Madina

Introduction To Sunnah

1) Basic Concepts of Hadith
2) History of Hadith
3) Kinds of Hadith
4) Uloom –ul-Hadith
5) Sunnah & Hadith
6) Legal Position of Sunnah

Selected Study from Text of Hadith

Introduction To Islamic Law & Jurisprudence

1) Basic Concepts of Islamic Law & Jurisprudence
2) History & Importance of Islamic Law & Jurisprudence
3) Sources of Islamic Law & Jurisprudence
4) Nature of Differences in Islamic Law
5) Islam and Sectarianism

Islamic Culture & Civilization

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

Islam & Science

1) Basic Concepts of Islam & Science
2) Contributions of Muslims in the Development of Science
3) Quranic & Science

Islamic Economic System

1) Basic Concepts of Islamic Economic System
2) Means of Distribution of wealth in Islamic Economics
3) Islamic Concept of Riba
4) Islamic Ways of Trade & Commerce

Political System of Islam

1) Basic Concepts of Islamic Political System
2) Islamic Concept of Sovereignty
3) Basic Institutions of Govt. in Islam

Islamic History

1) Period of Khlaft-E-Rashida
2) Period of Ummayyads
3) Period of Abbasids

Social System of Islam

1) Basic Concepts of Social System Of Islam
2) Elements of Family
3) Ethical Values of Islam

Reference Books:

1. Hameed ullah Muhammad, “Emergence of Islam” , IRI,Islamabad
2. Hameed ullah Muhammad, “Muslim Conduct of State” .
3. Hameed ullah Muhammad, ‘Introduction to Islam
4. Mulana Muhammad Yousaf Islahi,”
5. Hussain Hamid Hassan, “An Introduction to the Study of Islamic Law” leaf Publication Islamabad, Pakistan.
6. Ahmad Hasan, “Principles of Islamic Jurisprudence” Islamic ResearchInstitute, International Islamic University, Islamabad (1993)
7. Mir Waliullah, “Muslim Jrisprudence and the Quranic Law of Crimes”Islamic Book Service (1982)
8. H.S. Bhatia, “Studies in Islamic Law, Religion and Society” Deep & Deep Publications New Delhi (1989)
9. Dr. Muhammad Zia-ul-Haq, “Introduction to Al Sharia Al Islamia” Allama Iqbal Open University, Islamabad (2001)

1st year **Semester-II**

GENERAL COURSE*
Course Title: General-III
Course Code: GEN-322
Credit Hours: 3
Marks: 100

Depending on the availability of teacher, General-II will be selected from Annexure "A"

1st year **Semester-II**

COMPULSORY COURSE
Course Title: Mathematics-II
Course Code: MATH-321
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 Contents
Preliminaries: Real-number 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:

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

1st year **Semester-II**

COMPULSORY COURSE
Course Title: Functional Biology-II
Course Code: BIOL-321
Credit Hours: 3
Marks: 100

Course Objectives

Course Contents
Myths and Realities of Evolution
- Microevolution
- Speciation
- Macroevolution

Level of Organization

Plants
- Tissues
- Nutrition and Transport
- Reproduction
- Growth and Development

Animals
- Tissue, Organ System and Homeostasis
- Information Flow and Neuron
- Nervous System
- Circulation and Immunity
- Nutrition and Respiration
- Reproduction and Development

Ecology and Behavior
- Ecosystems
- Biosphere
- Social Interactions
- Community Interactions
- Human Impact on Biosphere
- Environment Conservation

Reading

1 Roberts, M.M., Reiss and G.Monger. 2000. Advanced Biology, Nelson.
2 Starr, C, and R, Taggart, 2001. Biology: The Unity and Diversity of Life Brooks and Cole.
3 Campbell, N.A., J.B, Reece, L.G. Mitchell, M.R, Taylor. 2001.Biology: Concepts and Connections. Prentice-Hall.s

1st year **Semester-II**

COMPULSORY COURSE
Course Title: Introduction to Statistics
Course Code: STAT-321
Credit Hours: 3
Marks: 100

Course Objectives
After completing this course, students will know about the importance of statistics and its application in research. Students will be able to analyze data related to their field of specialization.

Course Contents
Unit 1. What is Statistics?
Definition of Statistics, Population, sample Descriptive and inferential Statistics, Observations, Data, Discrete and continuous variables, Errors of measurement, Significant digits, Rounding of a Number, Collection of primary and secondary data, Sources, Editing of Data. Exercises.

Unit 2. 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, Historigram, Ogive for Discrete Variable. Types of frequency curves. Exercises.

Unit 3. 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 and their detection. Exercises.

Unit 4.Measures of Dispersion
Introduction, Absolute and relative measures, Range, The semi-Inter-uartile Range, The Mean Deviation, The Variance and standard deviation, Change of origin and scale, Interpretation of the standard Deviation, Coefficient of variation, Properties of variance and standard Deviation, Standardized variables, Moments and Moments ratios. Exercises.

Unit 5. Probability and Probability Distributions.
Discrete and continuous distributions: Binomial, Poisson and Normal Distribution. Exercises

Unit 6. 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.

Unit 7. 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.

Unit 8.Testing of Hypothesis- Single Population

Introduction, Testing of hypothesis and confidence interval about the population mean and proportion for small and large samples, Exercises

Unit 9. 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

Unit 10. Testing of Hypothesis-Independence of Attributes

Introduction, Contingency Tables, Testing of hypothesis about the Independence of attributes. Exercises.

Unit 11. Regression and Correlation

Introduction, cause and effect relationships, examples, 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. Walpole, R. E. 1982. "Introduction to Statistics", 3rd Ed., Macmillan Publishing Co., Inc. New York.
2. Muhammad, F. 2005. "Statistical Methods and Data Analysis", Kitab Markaz, Bhawana Bazar Faisalabad.

1st Year **Semester-II**

CHEMISTRY COURSE
Course Title: Organic Chemistry-I
Course Code: CHEM-321.6
Credit Hours: 3
Marks: 75

Course Objectives
The objectives of Organic Chemistry offered in this semester are to provide the beginning student with the necessary knowledge and experience to be able to:

1. Realize the importance of organic chemistry in our daily life and learn the evolutionary historical developments of organic chemistry.
2. Draw proper chemical structures and ways in which organic structures may be drawn.
3. Get familiarized with the systematic nomenclature of hydrocarbons beside compounds having heteroatomic functional groups.
4. Understand the basic concepts of chemical bonding, molecular structure, inductive and field effects, resonance theory, aromaticity and tautomerism besides the Lewis and Bronsted–Lowry theories of acids and bases.
5. Identify centers of reactivity in organic structures, including the names, structures and basic chemical properties of the most important functional groups.
6. Learn characteristic reactions of basic organic functional groups and use this knowledge to predict products of reactions and distinguish related compounds.

Course Contents
Introduction to Organic Chemistry:
Organic Chemistry- the chemistry of Carbon compounds; Nature of organic chemistry-a historical perspective.
Basic Concepts in Organic Chemistry:
Localized and delocalized chemical bonding; concept of hybridization leading to bond angles, bond lengths, bond energies and shapes of organic molecules; dipole moment; inductive and field effects, resonance; aromaticity; tautomerism; hyperconjugation; hydrogen bonding, acids and bases; factors affecting the strengths of acids and bases.
Nomenclature of Organic Compounds:
Classification of organic compounds; development of systematic nomenclature of organic compounds; IUPAC nomenclature of hydrocarbons and heteroatom functional groups.
Functional Group Chemistry:
A brief introduction to the chemistry of hydrocarbons, alkyl halides, alcohols, phenols, ethers, aldehydes, ketones, amines, carboxylic acids and their derivatives.

Course Title: Organic Chemistry-I (Practical-I)
Course Code-321.6
Credit Hour: 1
Marks: 25

Laboratory Work Illustrating Topics Covered in the Lectures of CHEM-321.6

Recommended Books

(Latest available editions of the following books)

1. Clayden, J.; Greeves, N.; Warren, S.; Wothers, P., *Organic Chemistry*, Oxford University Press, New York.
2. Wade Jr., L. J., *Organic Chemistry*, Pearson Education, Delhi.
3. Younas, M., *A Text Book of Organic Chemistry*, Ilmi Kitab Khana, Lahore.
4. Morrison, R. T.; Boyd, R. N., *Organic Chemistry*, Prentice-Hall of India, New Delhi.
5. Panico, R.; Powell, W. H.; Richer, J. C., *A Guide to IUPAC Nomenclature of Organic Compounds*, Jain-Interscience Press, Delhi.

Supplementary Reading Material

1. Loudon, G. M., *Organic Chemistry*, Oxford University Press, New York. Sorrel, T. N., *Organic Chemistry*, Viva Books Private Ltd., New Delhi.
2. Finar, I. L., *Organic Chemistry*. Vol. 1, Pearson Education, Delhi.
3. Carey, F. A., *Organic Chemistry*, McGraw-Hill, New York.
4. Ahluwalia, V. K.; Goyal, M., *A Text Book of Organic Chemistry*, Narosa Publishing House, New Delhi.
5. March, J., *Advanced Organic Chemistry*, John Wiley & Sons, New York.
6. Bansal, R. K., *Organic Reaction Mechanisms*, Tata McGraw-hill Publishing Company Ltd., New Delhi.
7. Pine, S. H., *Organic Chemistry*, National Book Foundation, Islamabad.
8. Bailey Jr., P. S.; Bailey, C. A., *Organic Chemistry-A Brief Survey of Concepts ad Applications*, Prentice-Hall, New Jersey.
9. Morrison, R. T.; Boyd, R. N., *Organic Chemistry*, Prentice-Hall of India, New Delhi.
10. Carey, F. A.; Sundberg, R. J., *Advanced Organic Chemistry Part A: Structure and Mechanisms*, Kluwer Academic/Plenum Publishers, New York.
11. Sykes, P., *A Guide Book to Mechanism in Organic Chemistry*, Longman, London.
12. Hand, C. W.; Blewitt, H. L., *Acid-Base Chemistry*, Macmillan Publishing Company, New York.
13. McMurry, J., *Organic Chemistry*, Brooks/Cole Publishing Company, California.
14. Solomons, T. W. G.; Fryhle, C. B., *Organic Chemistry*, John Wiley & Sons, New York.
15. Panico, R.; Powell, W. H.; Richer, J. C., *A Guide to IUPAC Nomenclature of Organic Compounds*, Jain-Interscience Press, Delhi.
16. Streitwieser Jr., A.; Heathcock, C. H., *Introduction to Organic Chemistry*, Macmillan Publishing Company, New York.
17. Fox, M. A.; Whitesell, J. K., *Organic Chemistry*, Jones and Bartlett Publishers, London.

2nd Year

Semester-III

Semester-III	**Theory**	**Practical**	**Marks**
ENG-431 English-III (Report Writing)	3	0	100
COMP-431 Introduction to computer	3	0	100
GEN-431 General-IV (philosophy of Sci)	3	0	100
GEN-432 General-V (principles of management)	3	0	100
CHEM-431.4 Environmental Chemistry	2	0	50
CHEM-432.7 Physical Chemistry	3	1	100
Total	**16**	**1**	**550**

2nd year **Semester-III**

COMPULSORY COURSE
Course Title: English III (Technical Writing and Presentation Skills)
Course Code: ENG-431
Credit Hours: 3
Marks: 100

Course Objectives: Enhance language skills and develop critical thinking

Course Contents

Presentation skills

Essay writing
Descriptive, narrative, discursive, argumentative

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

Technical Report writing

Progress report writing

Note: *Extensive reading is required for vocabulary building*
Recommended Books:
Technical Writing and Presentation Skills

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

b) Presentation Skills

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

2nd year **Semester-III**

COMPULSORY COURSE
Course Title: Introduction to Computer
Course Code: COMP-431
Credit Hours: 3
Marks: 100

Course Objectives:

Course Contents:

Basic of Computer

Introduction and history of Computers
Types of Computer
Computer organization

Computer Software

Software Introduction
Types Software
PC Platform
Computer virus

Data processing and Storage

Data Processing Techniques
Data Storage (Bit, RAM, ROM, Cache Memory, Secondary
Storage (FDD, HDD, Tape, CD)
The Processor
Bus, Port
Computer Motherboard
Microprocessor
Math Co-processor
Memory Chip
Support Chips
Built-in-Programs
Expansion slots

INPUT and OUTPUT Devices

A. Input Devices
B. Keyboard and its types
C. Point and Draw devices
D. Scanner, Digital Camera, speech recognition system and multimedia

Output Deices

a. Monitor (Graphic Adopter, size, Resolution and types of monitors)
b. Printers and types (Dot matrix, inkjet and Laser)
c. Plotters (Raster and Pen)

d. Presentation Graphics and special function terminals (ATMs. POSs)

Windows

1. Windows introduction
2. Finding Files, Installing Printers
3. The Desktop and types of windows (application, documents, dialog)
4. Elements of an application window
5. Understanding folders, copying deleting and moving files
6. word Processing (MS word)
7. Basic concepts and features
8. Crating, saving, editing, formatting and printing documents
9. working with Tables
10. Electronic Spreadsheet (MS Excel)
11. Basic Concepts and Features
12. Creating, saving Excel sheet, editing the sheet
13. 'Managing formula, formatting the sheet and printing the sheet
14. working on workbook
15. Basic of Internet usage
16. Introduction
17. world wide web and web sites
18. Introduction to Internet based services and use of e-mail

Recommended Books

1 Using Information Technology (2nd Ed). By William Sawyer.

2 "Peter Norton's Introduction to computer", Published by Glencoe/McGraw-Hill, adivision of the Educational and Professional Publishing Group of The McGraw-Hill Companies New York.

3 Comprehensive computer studies.

4 Windows-XP2002 by Elizabeth Wells, University of Greenwich, 2001.

5 Seraching teaching material available on the www.

2nd year **Semester-III**

GENERAL COURSE*
Course Title: GENERAL-IV
Course Code: GEN-431
Credit Hours: 3
Marks: 100

Depending on the availability of teacher, General-I will be selected from Annexure "A"

* List given in **Annexure "A"**

2nd year **Semester-III**

GENERAL COURSE*
Course Title: GENERAL-V
Course Code: GEN-432
Credit Hours: 3
Marks: 100

Depending on the availability of teacher, General-I will be selected from Annexure "A"

* List given in **Annexure "A"**

2nd year **Semester-III**

CHEMISTRY COURSE
Course Title: Environmental Chemistry
Course Code: CHEM-431.4
Credit Hours: 2
Marks: 50

Course Objectives
From this course, the students should be able to:

- Understand the fundamental principles of environmental chemistry
- Apply these principles in pollution related subjects.
- Demonstrate the understanding of environmental chemistry principles via experimental exercises in the laboratory.

Course Contents

Atmospheric Chemistry
The air around us, atmospheric temperature and pressure profile, temperature inversion and photochemical smog, particulate matter in the atmosphere, industrial pollutants, radioactivity, atmospheric aerosols, Acid rain – major sources, mechanism, control measures and effects on buildings and vegetation, global warming – major green house gases, mechanism, control measures and global impact, the stratospheric ozone – the ozone hole, CFCs, ozone protection, biological consequences of ozone depletion.

Water Pollution and Water Treatment:
Sources of water pollution, industrial sources and agricultural sources, heavy metals contamination of water, eutrophication, detergents ad phosphates in water, water quality criteria, water purification – primary, secondary and advanced treatment, removal of nitrogen and phosphorous compounds from polluted water, organic matter in water and its decomposition.

Soil Pollution:
Soil and mineral resources, general principles of metal extraction, heavy metals contamination of soil, toxicity of heavy metals, bio-accumulation of heavy metals, organic matter in soil, macro and micro-nutrients in soil, ion-exchange in soil, soil pH and nutrients availability.

Green Revolution: Pest control, pesticides, toxicity of pesticides, integrated pests management.

Energy Production and Environment: Liquid and gaseous fuel, hydrogen economy.

Renewable Energy: Nuclear energy, solar energy, geothermal and tidal energy.

Recommended Books

Latest editions of the following books:

1. Collin Baird, Environmental Chemistry, W. H. Freeman and company, New York, 1995.
2. John W. Moore and Elizabeth A. Moore, Environmental Chemistry, Academic Press Inc., New York, 1976.
3. Anil Kumar De, Environmental Chemistry, Wiley Eastern Ltd. New Delhi, 1989.
4. R. W. Raiswell, P. Brimblecom be, D. L. Dent and P. S. Liss, Edward Arnold Ltd., London, 1980.
5. Staneley E. Manahan, Environmental Chemistry, Brooks, California.
6. Peter O. Neill, Environmental Chemistry, Chapman and Hall, London, 1993.
7. Derek M. Elsom, Atmospheric Pollution, Blackwell Publishers, Oxford, 1992.
8. Geoffrey Lean and Don Hinrichsen, Atlas of the Environment, Helicon Publishing Ltd., Oxford, 1992.

2nd year **Semester-III**

CHEMISTRY COURSES
2nd Year
Semester-III

Course Title: Physical Chemistry
Course Code: CHEM-432.7
Credit Hours: 3
Marks: 75

Course Objectives
To acquire the basic knowledge of physical states of matter, chemical thermodynamics, chemical kinetics, solution chemistry and surface chemistry. Completion of this course will enable students to study the more advanced physical chemistry courses.

Course Contents
Physical States of Matter
Ideal and real gases, equations of state, critical phenomenon and critical constants. Molecules in motion: collision diameter and mean free path. Physical properties of liquids: surface tension, viscosity, refractive index etc. and their applications. Brief account of interactions among the molecules in liquids. Packing of atoms in solids. Unit cells and crystal systems. Method of crystal structure analysis. Brief account of polymers and composite materials with special emphasis on superconductors, semi-conductors etc. Introduction to plasma.

Chemical Thermodynamics
Laws of thermodynamics and their applications. Thermodynamic functions: internal energy, enthalpy, entropy and free energy. Relation between thermodynamic functions. van't Hoff's equation. Heat capacities, concept of entropy and probability.

Chemical Kinetics
Rate of reaction and Rate law. Order and molecularity of the reactions. Zero, first and second order reactions. Determination of reaction order and its rate constant. Effect of temperature on the reaction rate. Concepts of chemical equilibrium. Le-Chatelier's principle and it s applications. Elementary concepts underlying complex and fast reactions.

Solution Chemistry
Ideal and non-ideal solutions. Raoult's and Henery's laws and their applications. Molecular interactions in solutions. Colligative properties. Distillation and concept of azeotropic mixture.

Surface Chemistry
Concept of interfaces. Adsorption and adsorption isotherms: Freundlich and Langmuir adsorption isotherms. Catalysis, colloids emulsion and their industrial applications.

Practical
Course Code: CHEM-432.7
Credit Hours: 1
Marks: 25

Laboratory Work Illustrating Topics Covered in the Lectures of CHEM-432.7

Recommended Books
Theory:

1. Alberty R. "Physical Chemistry" 17th ed., John Wiley and Sons (1987).
2. Atkins, P.W. "Physical Chemistry" 6th ed., W.H. Freeman and Co. New York (1998).
3. Barrow G.M. "Physical Chemistry" 5th ed., McGraw Hill (1992).
4. Laidler K.J., John H.M. and Bryan C.S. "Physical Chemistry" 4th ed., Houghton Mifflin Publishing Company Inc.(2003).

Practicals:

1. Jaffar M. "Experimental Physical Chemistry" University Grants Commission (1989).
2. Levitt B.P. "Findlay's Practical Physical Chemistry" 9th ed., Longman Group Limited (1978).
3. Shoemaker D. "Experiments in Physical Chemistry" 5th ed., McGraw Hill Publishing Company Limited (1989).

YEAR-II

SEMESTER-IV

SCHEME OF COURSES

Semester-IV	**Theory**	**Practical**	**Marks**
CHEM-441 Mathematics & statistical analysis for chemists	3	0	100
GEN-441 General-VI (education)	3	0	100
GEN-442 General-VII (sociology)	3	0	100
CHEM-441.1 Analytical Chemistry	2	0	60
CHEM-442.2 Industrial Chemistry	2	0	60
CHEM-443.3 Biochemistry	2	0	60
CHEM-444.8 Fuel Chemistry	2	0	60
CHEM-445Combined Lab	0	1	60
Total	**17**	**1**	**600**

2nd year **Semester-IV**

COMPULSORY COURSE

Course Title: Mathematics & statistical analysis for chemists
Course Code: CHEM-441
Credit Hours: 3
Marks: 100

Course Objective

To familiarize students majoring in chemistry with essential tools of statistics and mathematical concepts related to applications of statistics and mathematics in Chemistry

Course Contents:

1. Numbers and Functions: Real numbers, complex numbers, Functions of single variable, trigonometric function, exponential function, logarithmic function, inverse functions, graphical representation of functions, quadratic equation.
2. Differentiation: Rules of differentiation, differentiation of exponential function, trigonometric functions, logarithmic functions and complex functions, partial differentiation.
3. Integration: Rules of integration, integration by substitution, integration by parts, integration by partial fractions, definite integral, examples of definite integrals from chemistry text books.
4. Series: Arithmetic progression, geometric progression, convergence of infinite series, power series, Taylor and Maclaurin series, binomial expansion, sine and cosine series, exponential series, logarithmic series.
5. Measurement of central tendency and dispersion, its application to data evaluation, interpretation and presentation
6. Least square curve fitting

Recommended Books

1. Christian, G.D., Analytical Chemistry, 6th ed., John Wiley and Sons, Inc., NY (1999)
2. Frank Ayres, Theory and Problems of calculus, Shaum's outline series, McGraw Hill, Co. 1981, Singapore (1981)
3. D.M. Hirst, Mathematics for Chemists
   MacMillan press Ltd. (1976)
4. P.G Francis, , Mathematics for Chemists, Chapman and Hall New Year (1984)
5. R.E.S. Martin
   Essential Mathematics for Chemists, Longmans, Green and co. Ltd. London (1996)

2nd year **Semester-IV**

GENERAL COURSE

Course Title: General-VI
Course Code: GEN-441
Credit Hours: 3
Marks: 100

Depending on the availability of teacher, general-I will be selected from Annexure "A"

* List given in **Annexure "A"**

2nd year **Semester-IV**

GENERAL COURSE

Course Title: General-VII
Course Code: GEN-442
Credit Hours: 3
Marks: 100

Depending on the availability of teacher, General-I will be selected from Annexure "A"

* List given in **Annexure "A"**

2nd year **Semester-IV**

CHEMISTRY COURSE

Course Title: ANALYTICAL CHEMISTRY
Course Code: CHEM-441.1
Credit Hours: 2
Marks: 60

Course Objectives

To familiarize students with the concept of accuracy, manipulation and use of statistical analysis in data handling for quantitative determination.

Course Contents

Introduction to Analytical Chemistry:

Scope and applications of analytical chemistry, quantitative reactions, stoichiometric relationships, solution chemistry, expression of quantities and concentrations. Basic approach to equilibrium.

Sampling:

Types of sampling techniques, sampling of gas, liquid and solid, treatment of samples to obtain homogenous solutions.

Errors in chemical analysis and minimization:

Steps in analytical procedures, errors, precision, accuracy, types of errors, steps involved in minimization of errors.

Statistical evolution of data:

Ways of expressing accuracy, mean, median, mode, deviation, standard deviation, mean deviation, relative standard deviation. The confidence limit, confidence intervals, rejection of the results, limit of detection and quantification.

Quality control and quality assurance.

Recommended Books

1. Skoog, D.A.; West, P.M.; Holler, F.J.; Crouch, S. R., *Fundamentals of Analytical Chemistry*, 8th Edition, Holt, Rinehart and Winston, NY, USA, 2004.
2. Christian, G.D., *Analytical Chemistry*, 6th ed., John Wiley and Sons, Inc., NY, USA, 1999.

Supplementary Reading Material

1. Harris, D. C., *Quantitative Chemical Analysis*, 5th ed. W. H. Freeman and Company, NY, USA, 1999.
2. Braun, R.D., *Introduction to Chemical Analysis*, International Student Edition, 1985.
3. Vogel, A.I., *A Text Book of Quantitative Inorganic Analysis*, 3rd ed. The English Language Book Society, 1961.

4. Kolthoff, I.M.; Sandal, E.B., *Text Book of Quantitative Inorganic Analysis*, The MacMillan Company, NY, USA, 1943.
5. Miller, J.C.; Miller, J.N., *Statistics for Analytical Chemistry*, Ellis Horwood Limited, Chichester, England, 1984.
6. Woodget, B.W.; Cooper, D., *Samples and Standards*; Editor: Chapman, N.B., Analytical Chemistry by Open Book Learning, John Wiley and Sons, Inc., NY, USA,1987.

2nd year **Semester-IV**

PRACTICAL (Combined Lab)
Course Code: CHEM–445
Credit Hour: 1
Marks: 60

Laboratory work illustrating topics covered in the lectures of CHEM-441.1

Recommended Books

1. Skoog, D.A.; West, P.M.; Holler, F.J.; Crouch, S. R., *Fundamentals of Analytical Chemistry*, 8th Edition, Holt, Rinehart and Winston, NY, USA, 2004.
2. Christian, G.D., *Analytical Chemistry*, 6th ed., John Wiley and Sons, Inc., NY, USA, 1999.

Supplementary Reading Material

7. Harris, D. C., *Quantitative Chemical Analysis*, 5th ed. W. H. Freeman and Company, NY, USA, 1999.
8. Braun, R.D., *Introduction to Chemical Analysis*, International Student Edition, 1985.
9. Vogel, A.I., *A Text Book of Quantitative Inorganic Analysis*, 3rd ed. The English Language Book Society, 1961.
10. Kolthoff, I.M.; Sandal, E.B., *Text Book of Quantitative Inorganic Analysis*, The MacMillan Company, NY, USA, 1943.
11. Miller, J.C.; Miller, J.N., *Statistics for Analytical Chemistry*, Ellis Horwood Limited, Chichester, England, 1984.
12. Woodget, B.W.; Cooper, D., *Samples and Standards*; Editor: Chapman, N.B., Analytical Chemistry by Open Book Learning, John Wiley and Sons, Inc., NY, USA,1987.

2nd Year **Semester-IV**

CHEMISTRY COURSE
Title of the Course: Industrial Chemistry
Code: CHEM-442.2
Credit Hours: 02
Marks: 60

Course Objectives
After successful completion of the course the students will acquire the knowledge about basic unit operation such as filteration, size reduction, filteration, distillation, crystallization and drying etc. The students will understand the basic and heavy chemical industries such as production of sulphuric acid, nitric acid and hydrochloric acid etc.They will also acquire the knowledge about silicate industries.

Course Contents
Fundamentals of Chemical Industries
Basic principles and parameters for industrial plant location; Elementary treatment of general unit operations commonly used in industries such as size reduction; evaporation, filtration, distillation, crystallization and drying; Chemical unit processes like carbonation, sulfiation, defecation, nitration, etc. in chemical process industries.

Basic and Heavy Chemical Industries
Raw materials and chemicals; Flow sheet diagrams and commercial production of sulphuric acid, nitric acid, hydrochloric acid, oxalic acid, formic acid, caustic soda and washing soda; Applications of these chemicals in chemical industries.

Glass Industry
Raw materials and manufacture of glass; Chemistry involved in the production of glass; Types of glass; Glassy state phenomena and annealing of glass; Photo chromic and photographic lasses; Production of safety glasses.

Ceramics Industry
Raw material used for ceramics; Chemistry involved in the production of ceramics articles and wares; Types and classification of ceramic products; Manufacture of ceramics products.

Recommended Books
Coulson & Richardson., Chemical Engineering, 1st Ed., (1985).
Walter. L. Badger & Julius T. Banchero, Introduction to Chemical Engineeing, (1955).
George T. Austin., Shreve's Chemical Process Industries, 5th Edition., McGraw Hill Book Company Inc. New York, (1984).
Riegel, E. R., Industrial Chemistry, 5th Ed., Reinhold Publishing Corporation NewYork, (1997).
Wyatt, Metal Ceramics & Polymers, (1974).

Supplementary Reading Materials
Google/topic/book/publication /search., http://en.wikipedia.org., http://www.sciencedirect.com.

CHEM-445Combined Lab

2nd year **Semester-IV**

Course Title: Biochemistry
Course Code: CHEM-443.3
Credit Hours: 2
Marks: 60

Title of the course: Basic chemistry and functions of Biomolecules

Course Objectives

This course provides fundamental concepts in biochemistry, which focuses upon the major macromolecules and chemical properties of living systems. Primary topics include 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
Definition, 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.

Lipids
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.

Proteins
Chemistry and classification of Amino acids, physical and chemical properties of amino acids. Biological significance of amino acids and peptides. Proteins; their classification, properties and biological significance. Primary, secondary, tertiary and quaternary structure of proteins. Denaturation of proteins. Protein sequencing.

Nucleic Acids
Chemical composition, 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.

Recommended Books

1. Nelson, D. L.; Cox, M. N., *Lehninger principles of biochemistry*, 4th ed. Worth Publisher, New York, 2004.
2. Murray, R. K.; Mayes P. A.; Granner, D. K.; and Rodwell, V. W., *Harper's Biochemistry*, Appleton & Lange, 2000.
3. West, W. R.; Todd, H. S., *Text Book of Biochemistry*, 4th ed. Macmillan, London, 1968.

Supplementary Reading Material

1. Voet, D.; Voet J. G., *Biochemistry*, 3rd ed. John Wiley & Sons, New York, 2004.
2. Zubay, G., *Biochemistry*, 4th ed. Macmillan Publishing Co, 1999.
3. www.bio.mtu.edu/campbell/401sch1.html

CHEM-445 Combined Lab

2nd year **Semester-IV**

CHEMISTRY COURSE

Course Title: Fuel Chemistry
Course Code: CHEM-444.8
Credit Hours: 2
Marks: 60

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.

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. "Modren petroleum technology" part-I. John Wily & Sons, Toronto, (1984).

CHEM-445Combined Lab

YEAR-III

SEMESTER-V

SCHEME OF COURSES

Course Title		**Credit Hours**		
Semester-V		**Theory**	**Practical**	**Marks**
CHEM-551.5	Inorganic Chemistry	3	1	100
CHEM-552.6	Organic Chemistry	3	1	100
CHEM-553.7	Physical Chemistry	3	1	100
CHEM-554.1 CHEM-554.2 CHEM-554.3 CHEM-554.8	Analytical/ Applied/ Bio/ Fuel Chemistry	3 3 3 3	1 1 1 1	100/ 100/ 100/ 100
	Total	**12**	**4**	**400**

3rd year **Semester-V**

CHEMISTRY COURSE

Course Title: Inorganic Chemistry
Course Code: CHEM-551.5
Credit Hours: 3
Marks: 75

Course Objectives

After completing this course students will know about;
the historical development of transition element chemistry, the importance and applications of the transition elements, coordination chemistry, various theories developed to explain the structure and properties of coordination compounds, and reactions in non aqueous solvents.

Course Contents

Coordination Compounds

Historical back ground of coordination compounds, geometry of complexes having coordination number 2 to 6, nomenclature, theories of coordination compounds; Werner's theory, valence bond theory, crystal field and; molecular orbital theory; Jahn-Teller theorem; magnetic properties; spectrochemical series, isomerism and stereochemistry, stability constants, techniques for studying structure of complexes, and uses/applications of coordination compounds.

Non Aqueous Solvents

Classification of solvents, types of reactions in non-aqueous solvents, effects of physical and chemical properties of non-aqueous solvents, detailed study of liquid NH_3, liquid H_2SO_4, liquid HF, and liquid SO_2, and liquid BrF_3 and reactions in molten salts systems.

PRACTICAL (CHEM-551.5) (1-Cr. Hr.) Marks: 25

Laboratory Work Illustrating Topics Covered in the Lecture of CHEM-551.5

Recommended Books

1 Miessler, G. L.; Tarr, D.A., *Inorganic Chemistry*, Prentice-Hall International, New Jersey, USA, **1991**.
2 Day, M.C.; Selbin, J., *Theoretical Inorganic Chemistry*, 2nd ed., Van Nostrand Reinhold Company, New York, USA, **1969**.
3 Shriver, D. F.; Atkins, P. W.; Langford, C. H., *Inorganic Chemistry*, 2nd ed., Oxford University Press, **1994**.

Supplementary Reading Material

1 Huheey, J. E.; Keiter, E. A.; Keiter, R. L., *Inorganic Chemistry: Principles of Structure and Reactivity*, 4th ed., Harper and Row, New York, **2001.**
2 Cotton, F. A.; Wilkinson, G. *Basic Inorganic Chemistry*, 3rd ed., Wiley, New York, **1995**.
3 Lee, J.D., Chapman and Hall, *Concise Inorganic Chemistry*, 5th ed., Chapman and Hall, **1996**.

3rd Year **Semester-V**

CHEMISTRY COURSE
Course Title: Organic Chemistry-II
Course Code: CHEM-552.6
Credit Hours: 3
Marks: 7

Course Objectives
As a result of successful completion of this course, a student will be able to:

1. Give IUPAC and common names to the classes of compounds as well as be able to determine the optical configurations of stereo-chemical compounds using the R,S convention, and give proper names to the geometric isomers using the E,Z convention;
2. Apply the concepts and principles in structure elucidation of simple organic compounds.
3. Compare and contrast the mechanisms for nucleophilic substitution reactions in terms of nucleophile, substrate and reaction solvent.
4. Compare and contrast the mechanism for β-elimination reaction in terms of substrate, base, reactant, solvent and the stereochemistry of the reaction.

Course Contents

Isomerism:
Introduction; classification of isomerism; optical isomerism: optical activity, chirality and optical activity, symmetry elements and optical inactivity, relative and absolute configuration, R,S notation, method of determining configuration, racemic mixtures and their resolution, asymmetric synthesis, optical activity in biphenyls, allenes and Spiro-compounds, stereo-specific and stereo-selective reactions; geometrical isomerism: determination of configuration of geometrical isomers, Z,E convention and *cis- trans* isomerism in cyclic systems; conformational isomerism: conformational analysis of mono-substituted cyclohexanes, di-substituted cyclohexanes and decalin systems.
Introductory Organic Spectroscopy:
Introduction to IR, UV, ^{1}H-NMR and Mass spectrometric methods, and their usage for structure elucidation of some simple organic compounds.

Aliphatic Substitution Reactions

Aliphatic Nucleophilic Substitution Reactions:
Mechanisms ─ study of SN_2, SN_1, SNi, $SN_{2'}$, $SN_{1'}$, $SN_{i'}$ mechanisms; neighbouring group participation─intramolecular displacement by neighbouring oxygen, nitrogen, sulphur and halogen; structure and reactivity─effects of the substrate structure, entering group, leaving group and reaction medium on the mechanisms and rates of substitution reactions.
Aliphatic Electrophilic Substitution Reactions:
Mechanisms─study of SE_1, SE_2 (front), SE_2 (back) and SE_i mechanisms; structure and reactivity effects of substrate, leaving group and medium on the rates of these reactions

Elimination Reactions:
Eliminations Proceeding by Polar Mechanisms:

Study of E_1, E_1cB and E_2 mechanisms; orientation- Saytzeff and Hofmann rules; structure and reactivity, the effects of substrate structure, attacking base, leaving group and the reaction medium on the rates and mechanisms of elimination reactions; competition between elimination and substitution reactions.

Eliminations by Non-polar Mechanisms:

Pyrolytic eliminations─study of E_i and free-radical mechanisms; orientation in pyrolytic eliminations

Course Title: Organic Chemistry-II (Practical-II)
Course Code: CHEM-552.6
Credit Hour: 01
Marks: 25

Laboratory work illustrating topics covered in the lectures of CHEM-552.6

Recommended Books

(Latest available editions of the following books)

1. Wade Jr., L. J., *Organic Chemistry*, Pearson Education, Delhi.
2. Sykes, P., A Guide Book to Mechanism in Organic Chemistry, Longman, London.
3. Pavia, D. L., Lampman, G. M.; Kriz, G. S.; *Introduction to Spectroscopy: A Guide for Students of Organic Chemistry*, Saunders Golden Sunburst Series, London.
4. Morrison, R. T.; Boyd, R. N., *Organic Chemistry*, Prentice-Hall of India, New Delhi.
5. McMurry, J., *Organic Chemistry*, Brooks/Cole Publishing Company, California.

Supplementary Reading Material

1. Eliel, E. L.; Wilen, S. H.; Doyle, M. P., *Basic Organic Stereochemistry*, Wiley Interscience, New York.
2. Loudon, G. M., *Organic Chemistry*, Oxford University Press, New York.
3. March, J., *Advanced Organic Chemistry*, John Wiley & Sons, New York.
4. Sykes, P., *A Guide Book to Mechanism in Organic Chemistry*, Longman, London.
5. Norman, R. O.C.; Coxon, J. M., *Principles of Organic Synthesis*, Nelson Thornes, Cheltenham.
6. Kalsi, P.S., *Spectroscopy of Organic Compounds*, Wiley Eastern Ltd., New Delhi.
7. Pavia, D. L.; Lampman, G. M.; Kriz, G. S., *Introduction to Spectroscopy*: *A Guide for Students of Organic Chemistry*, Saunders Golden Sunburst Series, London.
8. Carey, F. A., *Organic Chemistry*, McGraw-Hill, New York.
9. Solomons, T. W. G.; Fryhle, C. B., *Organic Chemistry*, John Wiley & Sons, New York.

3rd year **Semester-V**

Course Title: Physical Chemistry
Course Code: CHEM-553.7
Credit Hours: 3
Marks: 75

Course Objectives
To acquire more knowledge of the kinetic theory of gases, chemical thermodynamics, and chemical kinetics and the basic knowledge of quantum chemistry.

Course Contents
Kinetic Theory of Gases
Virial equations. Maxwell's law of molecular velocities. Calculation of molecular velocities and binary collisions. Maxwell-Boltzmann's law of energy distribution. Method for the determination of the Avogadro number (NA).

Chemical Thermodynamics
Relation of entropy and energy with equilibrium constant, and their dependence on temperature. Clausius-Clapeyron's equation. Chemical potential. Partial molar quantities. Free energy change. Fugacity of gases. Phase diagram and stability of a single component system.

Chemical Kinetics
Integrated rate laws: Third order reactions with same and different initial concentrations of reactants. Effect of temperature on the reaction rate. Elementary and complex reactions: opposing, parallel, consecutive bimolecular reactions and chain reactions. Steady state approximation, Lindemann's theory of unimolecular reactions. Bimolecular collision theory, transition state theory, kinetics of thermal and photochemical reactions.

Quantum Chemistry
Limitation of classical mechanics, Wave and particle nature of matter, de Broglie's equation, Heisenberg's uncertainty principle. Schroedinger wave equation and its solution for particle in 1-dimentional and 3-dimentional boxes. Concept of quantization of energy, introduction to spectroscopy of molecules, spectra of hydrogen and hydrogen like atoms.

PRACTICALS (CHEM-553.7) (1Cr. Hr.) Marks: 25
Laboratory work illustrating topics covered in the lectures of CHEM-553.7
Recommended Books
Theory:

1. Alberty, R. A., Robert J.S. and Moungi G. B. "Physical Chemistry". 4th ed, John Wiley and Sons (2004).
2. Ball, D W., "Physical Chemistry" 1st ed., Brooks/Cole Co. Inc. (2003).

Practicals:

1. Daniel, F., "Experimental Physical Chemistry" McGraw Hill (1962).
2. Shoemaker, D., "Experimental Physical Chemistry" McGraw Hill (1989)

3rd year **Semester-V**

CHEMISTRY COURSE

Course Title: ANALYTICAL CHEMISTRY
Course Code: CHEM-554.1
Credit Hours: 3
Marks: 75

Course Objectives
By taking this course, students will learn how to prepare buffer solutions and how to use gravimetric and different titrimetric methods of analysis for quantitative determination.

Course Contents

Gravimetric methods of analysis:
Solubility and solubility product of sparingly soluble salts, separation by precipitation, formation and size of precipitates, types of precipitates, impurities in precipitates, quantitative calculations, stoichiometric reactions.

Neutralization titration:
Theory of neutralization titration, titration curve, theories of indicator, choice of indicator, buffer, preparation of buffer, buffer capacity and buffer mechanism. Application of neutralization titration. Hydrolysis of salt and pH calculation.

Complexometric and precipitation titration:
Complex formation reaction, titration with chelating agents, indicators used in complexometric titration. Precipitation titration, endpoint location in precipitation titration, Applications of complexometric and precipitation titration.

Oxidation Reduction titrations:
Oxidizing and reducing agents, titration curve, choice of indicator and colour change mechanism, applications of redox titrations.

PRACTICAL
Course Code: CHEM-554.1
Credit Hour: 1
Marks: 25

Laboratory work illustrating topics covered in the lectures of CHEM-554.1

Recommended Books

1. Skoog, D.A.; West, P.M.; Holler, F.J.; Crouch, S. R., *Fundamentals of Analytical Chemistry*, 8th ed. Holt, Rinehart and Winston, NY, USA, 2004.
2. Vogel, A.I., *A Text Book of Quantitative Inorganic Analysis*, 3rd ed. The English

Language Book Society, 1961.

3. Harris, D. C., *Quantitative Chemical Analysis*, 5th ed. W. H. Freeman and Company, NY, USA, 1999.

Supplementary Reading Material

1. Barun, R.D., *Introduction to Chemical Analysis*, International Student Edition, 1985.
2. Kolthoff, I.M.; Sandell, E.B., *Text Book of Quantitative Inorganic Analysis*, The MacMillan Company, NY, USA, 1943.
3. Chistian, G.D., *Analytical Chemistry*, 6th ed. John Wiley and Sons, Inc., NY, USA, 1999.
4. Fifield, F. W.; Kealey, D., *Principle and Practice of Analytical Chemistry*, 2nd ed. International Text Book Company Limited, London, 1983.
5. Dick, J.G., Analytical Chemistry, McGraw-Hill Kogakusha, Limited, Tokyo, Japan, 1973.

3rd Year **Semester-V**

CHEMISTRY COURSE
Title of the Course: Applied Chemistry
Course Code: CHEM-554.2
Credit Hours: 03
Marks: 75

Course Objectives
The objectives of the course are
To cater the students about the raw material, manufacturing and chemistry involved in the cement industry. To understand the various water softening processes ,chemisty involed in scale formation and its prevention.
To understand the i.e;that is its raw material chemistry involved in processing of pulp and in manufacturing of paper.The students will also acquire the knowledge about the size separation paper and pulp technology, principles of evaporation, types construction of evaporators and heat and material balances equation.

Course Contents
Cement Industry
Raw materials used for cement production; chemistry involved in the production of cement; manufacture of cement by wet and dry processes; types of cement and composition to clinker. Chemical phenomena and chemistry involved in the hardening and setting of cement.
Water Treatment, Steam Production and Scale Removal
Sources of water; hardness of water; 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; prevention of scale formation.
Paper and Pulp Technology
Raw materials for pulp and paper industries, classification of paper products. Chemistry involved in the processing of craft pulp, sulphites and semi chemical pulp. Manufacture of paper and regeneration of spent liquor.
Grinding and Separation
Principal of communition, Communiting equipments. Energy Requirements for Size reduction.
Evaporation
Principles of evaporation. Types of evaporation. Construction and wsorking principal of evaporators. Heat and mass transfer in evaporation. Methods of feeding multiple effect evaporators. Improved efficiency in evaporators

Recommended Books

1 George T. Austin., Shreve's Chemical Process Industries, 5th Edition., McGraw Hill Book Company , New York, (1984).
2 Riegel, E. R., Industrial Chemistry, 5th Ed., Reinhold Publishing Corporation New York, (1997).
3 Jain .P. C., A Textbook of Applied Chemistry, (1993).
4 Bye .G. C., Portland Cement, (1983).
5 Walter. L. Badger & Julius T. Banchero, Introduction to Chemical Engineeing, (1955).

6 Wiseman, P., Industrial Organic Chemistry, 2nd Ed., Applied Science Publisher Ltd., London, (1979).
7 Coulson & Richardson., Chemical Engineering, Vol I and II., (1985).
8 James P. Casey, Pulp & Paper Chemistry and Chemical Technology, 3rd Ed., Vol.II, (1980).

Supplementary Readings materials

Google/topic/book/publication /search.
http://www.sciencedirect.com.
http://en.wikipedia.org..

PRACTICALS CHEM-554.2 (1 Cr. Hr) **Marks: 25**

Laboratory work illustrating topics covered in the lectures of CHEM-554.2

3rd year **Semester-V**

Course Title: Biochemistry (Bioenergetics and Metabolism of Biomolecules)
Course Code: CHEM-554.3
Credit Hours: 3
Marks: 75

Course Objectives
This course provides fundamental concepts about the energy production and the mechanisms of the major macromolecules metabolism. Regulation and inhibition of the metabolic pathways are also addressed. This course will also integrate knowledge of bioenergetics and the metabolic pathways of amino acids, proteins, carbohydrates, nucleic acids and lipids to solve biological problems.

Course Contents

Intermediary Metabolism and Bioenergetics
Biological oxidation—Reduction including respiratory carriers. Cell bioenergetics. Oxidative Phosphorylation.

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.

Metabolism of Lipids
Digestion of Lipids, absorption and transport of lipids and fatty Acids. Oxidation of saturated, unsaturated, odd chain and branched chain fatty acids. Biosynthesis of Fatty Acids and eicosanoids. Biosynthesis of triglycerides, phospholipids, steroids and bile 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 and catabolism of nucleic acids and nucleotide. DNA Polymerases and other enzymes involved in metabolism.

Recommended Books

1. Berg, J. M.; Tymoczko, J. L.; Stryer, L., *Biochemistry*, 6th ed. W. H. Freeman, 2006.
2. Murray, R. K.; Mayes P. A.; Granner, D. K.; and Rodwell, V. W., *Harper's Biochemistry*, Appleton & Lange, 2000.
3. West, W. R.; Todd, H. S., *Text Book of Biochemistry*, 4th ed. Macmillan, London, 1968.

Supplementary Reading Material

1. Pankajanaik., *Biochemistry*, 2nd ed. Jaypee brothers medical publishers Ltd., New Delhi, 2007.
2. http://www.wiley.com/college/voetfundamentals
3. www.worthington-biochem.com/best

PRACTICALS (CHEM-554.3) (1-Cr. Hr.) Marks: 25

Laboratory work illustrating topics covered in the lectures of CHEM-554.3

Recommended Books

1. Plummer, D.T.; *An Introduction to practical Biochemistry*, TATA McGraw-Hill Publishing Company LTD.
2. Sawhney, S. K.; and R. Sing (Editors), *Introductory Practical Biochemistry*, Narosa Publishing House, New Delhi, 2005
3. Oser, B. L., *Hawks physiological chemistry*, 14th ed. McGraw-Hill Book Company, 1965.

3rd year **Semester-V**

CHEMISTRY COURSE

Course Title: Fuel Chemistry
Course Code: CHEM-554.8
Credit Hours: 3
Marks: 75

Course Objectives

After completing the course, the students will acquire knowledge about coal beneficiation, storage, briquetting, and coke oven gas conditioning. They will learn about economical and environmentally friendly utilization of coal and coke.

Course Contents

Coke oven gas conditioning (Chemicals from Coal):

Separation of tar from coke oven gas, Hydrogen sulphide removal from coke oven gas: Oxide boxe process, Seaboard process, Hot-actification process, and Thylox sulphur recovery process. Recovery of ammonia from coke oven gas: Semi direct sulphate process, Indirect process. Separation of light oil from coke oven gas.

Coal beneficiation: Gravity separation; Wet Launder washers, Wet Jig washers, Wet classifiers, Wet tables, Air cleaning tables, Air Launder, Air cleaning jig. Float and sink process; Chance sand flotation process, Air sand process, Froth flotation.

Storage of Coal: Spontaneous heating factors, Precautions in coal storage.

Coal briquetting: Objectives of briquetting, Binder less briquetting, Briquetting with binder.

Classification of coal: Ranks of coal, Parr's, Ralston's, Seyler's,, ASTM, NCB and International (E.C.E) classifications.

Petrology of coal: Thiessen U.S Bureau of mines nomenclature, Stopes nomenclature, International committee for coal petrography (ICCP) nomenclature, Bright coal, Splint coal, and Semi-splint coal.

Carbonization of coal: Low temperature and high temperature carbonization, Coking and non coking coals, Giesceler plastometer, Audibert-Arnu dilatometer, Free swelling index, Gray King assays

PRACTICALS CHEM-554.8 (1 Cr. Hr) Marks: 25

Laboratory work relating to course CHEM-554.8

Recommended Books:

1. Berkowitz. N. “An Introduction to Coal Technology” Academic Press, London, New York (1981).
2. Wilson, P.J. and Wells, J.H. “Coal Coke and Coal Chemicals” McGraw-Hill Book Company, London, (1980).

Supplementary Reading Materials:

1. Harker, J.H. and Backurst, J.R. “Fuel and Energy” Academic Press, London and New York, (1988).
2. Karr, C. “Analytical methods for Coal and Coal Products” Academic Press, London, (1978).
3. Hessley, R.K, Reasoner, J.W. “Coal science” John wily & Sons, New York, (1986).

YEAR-III

SEMESTER-VI

SCHEME OF COURSES

Semester-VI	**Theory**	**Practical**	**Marks***
CHEM-561.5 Inorganic Chemistry	3	1	100
CHEM-562.6 Organic Chemistry	3	1	100
CHEM-563.7 Physical Chemistry	3	1	100
CHEM-564.1 Analytical/ CHEM-564.2 Applied/ CHEM-564.3 Bio/ CHEM-564.8 Fuel Chemistry	3 3 3 3	1 1 1 1	100 100 100 100
Total	**12**	**4**	**400**

3rd Year **Semester-VI**

CHEMISTRY COURSE

INORGANIC CHEMISTRY
Course Title: Inorganic Chemistry
Course Code: CHEM-561.5
Credit Hours: 3
Marks: 75

Course Objectives

After taking this course , students will know about ;
the chemistry of Lanthanides, their purification and properties, the chemistry of actinide and their characteristics, and the chemistry of metal carbonyls their synthesis structure and properties.

Course Contents

Chemistry of f-Block Elements

(i) Lanthanides: Electronic structure and position in the periodic table, Lanthanide's contraction, oxidation states, spectral and magnetic properties, general characteristics, occurrence, extraction and general principles of separation, complexes and uses.
(ii) Actinides: Electronic structure and position in the periodic table, oxidation states, general characteristics, half life and decay law.

Pi-Acceptor Complexes

Mononuclear and polynuclear metal carbonyls: the eighteen electron rule (EAN) as applied to metal carbonyls; rationalization of molecular structure; evaluation of structures based on spectroscopic evidences; chemistry of metal carbonyls and their derivatives (nitrosyls, halides and hydrides).

PRACTICAL (CHEM-561.5) (1 Cr. Hr.) Marks:25

Laboratory work illustrating topics covered in the lectures of CHEM-561.5

Recommended Books

1 Miessler, G. L.; Tarr, D.A., *Inorganic Chemistry*, Prentice-Hall International, New Jersey, USA, **1991**.
2 Day, M.C.; Selbin, J., *Theoretical Inorganic Chemistry*, 2nd ed., Van Nostrand Reinhold Company, New York, USA, **1969**.
3 Shriver, D. F.; Atkins, P. W.; Langford, C. H., *Inorganic Chemistry*, 2nd ed.., Oxford University Press, **1994**.

Supplementary Reading Material

1 Huheey, J. E.; Keiter, E. A.; Keiter, R. L., *Inorganic Chemistry: Principles of Structure and Reactivity*, 4th ed., Harper and Row, New York, **2001.**
2 Cotton, F. A.; Wilkinson, G. *Basic Inorganic Chemistry*, 3rd ed., Wiley, New York, **1995**.
3 Lee, J.D., *Concise Inorganic Chemistry*, 5th ed., Chapman and Hall, **1996**.

BS 3rd Year **Semester-VI**

CHEMISTRY COURSE (ORGANIC CHEMISTRY)
Course Title: Organic Chemistry-III
Course Code: CHEM-562.6
Credit Hours: 3
Marks: 75

Course Objectives
At the conclusion of this course, the student should be able to:

1. Apply fundamental chemical principles of addition of various types of nucleophiles and electrophiles to electron rich centers such as carbon-carbon and carbon-heteroatom multiple bonds.
2. Describe, in general, the structure and bonding in organometallics.
3. Describe the reactivity order of the Grignard reagent, organo-lithium, organo-cadmium, organo-zinc and organo-copper with carbon-heteroatom multiple bonds.
4. Acquire the knowledge of generating stabilized carbanions and their reactions with soft electrophiles selectively and specifically. Predict the effect of a substituent on p*K*a.
5. Outline the completed electrophilic aromatic substitution reactions.
6. Predict the effect; a substituent will have on the regioselectivity of an electrophilic and nucleophilic substitution reaction. Recognize and be able to write the mechanism of nucleophilic/electrophilic aromatic substitution.

Course Contents
Addition Reactions:
Electrophilic and Nucleophilic Addition to C=C: Their mechanisms, orientation and stereochemistry; electrophilic addition of halogens and hydrogen halides to C=C; electrophilic addition to conjugated dienes; nucleophilic addition to C=C and C=C-C=O linkage.
Nucleophilic Addition to C=O:
Structure and reactivity of carbonyl group; simple addition reactions i.e.addition of water, alcohol, hydrogen cyanide and bisulphite; addition/elimination reactions: addition of derivates of ammonia; stereoselectivity in carbonyl addition reactions.
Organometallic Compounds:
Principles; organo-magnesium, organo-sodium, organo-lithium, organo-copper, organo-cadmium, organo-mercury and organo-zinc compounds: their structure and reactivity, methods of preparation and synthetic applications.
Chemistry of Enols and Enolate Ions:
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.

Aromatic Substitution Reactions:

Electrophilic Substitution Reactions: Mechanisms of substitution; orientation and reactivity; electrophilic substitution reactions i.e. nitration, halogenation, sulphonation, Friedel-Craft's reaction, diazocoupling, formylation and carboxylation.
Nucleophilic Substitution Reactions:

Mechanisms - study of SNAr, SN_1 and benzyne mechanisms; structure and reactivity - the effects of substrate structure, leaving group and the attacking nucleophile on the rates of substitution reactions.

Course Title: Organic Chemistry-III (Practical-III)
Course Code: CHEM-562.6
Credit Hour: 01
Marks: 25

Laboratory work illustrating topics covered in the lectures of CHEM-562.6

Recommended Books
(Latest available editions of the following books)

1. Clayden, J.; Greeves, N.; Warren, S.; Wothers, P., *Organic Chemistry*, Oxford University Press, New York.
2. Sykes, P., *A Guide Book to Mechanism in Organic Chemistry*, Longman, London.
3. March, J., *Advanced Organic Chemistry*, John Wiley & Sons, New York.
4. Bruckner, R., *Advanced Organic Chemistry-Reaction Mechanisms*, Harcourt Science & Technology Company, New York.

Supplementary Reading Material

1. Carroll, F. A., *Perspectives on Structure and Mechanism in Organic Chemistry*, Brooks/Cole Publishing Company, New York.
2. Loudon, G. M., *Organic Chemistry*, Oxford University Press, New York.
3. Carey, F. A., *Organic Chemistry*, McGraw-Hill, New York.
4. Morrison, R. T.; Boyd, R. N., *Organic Chemistry*, Prentice-Hall of India, New Delhi.
5. Solomons, T. W. G.; Fryhle, C. B., *Organic Chemistry*, John Wiley & Sons, New York.
6. Pine, S. H., *Organic Chemistry*, National Book Foundation, Islamabad.
7. Ege, S., *Organic Chemistry*, A.I.T.B.S. Publishers & Distributors, Delhi.
8. Parkins, A. W.; Poller, R. C., *An Introduction to Organometallic Chemistry*, Macmillan, London.
9. Norman, R. O.C.; Coxon, J. M., *Principles of Organic Synthesis*, Nelson Thornes, Cheltenham.

3rd Year **Semester-VI**

CHEMISTRY COURSE

Course Title: Physical Chemistry
Course Code: CHEM-563.7
Credit Hours: 3
Marks: 75

Course Objectives

To acquire basic knowledge of electrochemistry, nuclear chemistry, group theory and photochemistry.

Course Contents

Electrochemistry

Basic concepts of electrochemistry. Chemical reactions and redox potentials, electrochemical cells and types of electrodes. Application of electrode potential. Nernst's equation and its application. Predicting reactions and stability of oxidation states. Cell potential and thermodynamics. Theory of metallic conduction. Measurement of conductance. Application of conductance measurement. Electrode potential, liquid junction potential, transference number. Ions in aqueous solution. Ionic activity and Debye Hūckel theory.

Nuclear Chemistry

Atomic nucleus, nuclides, nuclear stability, modes of decay, nuclear energetic, nuclear models (shell + liquid drop model), fusion and fission, non-spontaneous nuclear processes, nuclear reactors, beta decay systematic, nuclear spins.

Group Theory

Symmetry and symmetry operations. Point groups. Properties of groups, matrices, transformation of matrices, character tables and their applications in molecular spectroscopy.

Photochemistry

Principles of photochemistry. Laws of photochemistry. Einstein's law of photochemical equivalence. Rates of intramolecular processes. Chemical reactions and their quantum yields. Hydrogen – bromine and hydrogen – chlorine reactions.

PRACTICALS (CHEM-563.7) (1 CR. HR.) Marks: 25

Laboratory work illustrating topics covered in the lectures of CHEM-563.7

Recommended Books

Theory:

1. Cotton F.A. "Chemical Applications of Groups Theory" Inter Science Publishers (1963).
2. Lowell Hall H. "Group Theory and Symmetry in Chemistry" McGraw Hill Book Company (1969).
3. Albert R.A., Robert J.S. and Moungi G.B. "Physical Chemistry". 4th ed., John Wiley and Sons (2004).

4. Ball D.W. “Physical Chemistry” 1st ed., Brooks/Cole Co. Inc. (2003).
5. Calvert J.G. and Pitts J.N. “Photochemistry” John Wiley, New York (1966).

Practicals:

1. Halpern, Arthur M. “Experimental Physical Chemistry: A Laboratory Textbook” 2nd ed., Prentice Hall (1962).
2. Shoemaker D. “Experimental Physical Chemistry” McGraw Hill (1989).

3rd year **Semester – VI**

CHEMISTRY COURSE (ANALYTICAL CHEMISTRY)
Course Title: ANALYTICAL CHEMISTRY
Course Code: CHEM-564.1
Credit Hours: 3
Marks: 75

Course Objectives
To apply the knowledge of separation techniques in chemistry and to realize its significance in instrumental methods.

Course Contents

Separation Techniques
Introduction and classification of separation techniques:
Precipitation, volatilization, distillation, masking, solvent extraction, chromatography and electrophoresis.
Solvent Extraction:
Principle of solvent extraction, the distribution coefficient, the distribution ratio, solvent extraction of metals. Analytical separation, multiple batch extraction, solid phase extraction. Applications of solvent extraction.
Classical Chromatographic Techniques:
Principles of chromatography, classification of chromatographic techniques; adsorption, partition, ion exchange, affinity and size exclusion chromatography. Separation techniques of column chromatography, column efficiency in chromatography. Ion exchange chromatography, size exclusion chromatography, paper chromatography and thin layer chromatography
Electrophoresis:
Capillary zone electrophoresis. Low voltage electrophoresis. High voltage electrophoresis. Analytical applications of electrophoresis.
Thermal Analysis:
Thermogravimetric and differential thermal analysis. Basic principle, instrumentation and applications.

PRACTICAL

Course Code: CHEM-564.1 (ANALYTICAL CHEMISTRY)

Credit Hour: 1
Marks: 25

Laboratory work illustrating topics covered in the lectures of CHEM-564.1

Recommended Books

1. Barun, R.D., *Introduction to Chemical Analysis*, International Student Edition, 1985.
2. Stock, R.; Rice, C.B.F., *Chromatographic methods*, 2nd ed. Chapman and Hall Limited, 1967.
3. Chistian, G.D., *Analytical Chemistry*, 6th ed. John Wiley and Sons, Inc., NY, USA, 1999.
4. Miller, J.M., *Chromatography Concepts and Contrasts*, John Wiley and Sons, NY, USA, 1988.

Supplementary Reading Material

1. Kolthoff, I.M.; Sandell, E.B., *Text Book of Quantitative Inorganic Analysis*, The MacMillan Company, NY, USA, 1943.
2. Skoog, D.A.; West, P.M.; Holler, F.J., Crouch, S. R., *Fundamentals of Analytical Chemistry*, 8th ed. Holt, Rinehart and Winston, NY, USA, 2004.
3. Dodd, J. W.; Tonge, K.H., *Thermal Methods*, Analytical Chemistry by Open Book Learning, John Wiley and Sons, NY, USA, 1987.
4. Daniels, T., *Thermal Analysis*, John Wiley and Sons, Inc., 1973.
5. Vogel, A.I., *A Text Book of Quantitative Inorganic Analysis*, 3rd ed. The English Language Book Society, 1961.
6. Fifield, F. W.; Kealey, D., *Principle and Practice of Analytical Chemistry*, 2nd ed. International Text Book Company Limited, London, 1983.

3rd Year **Semester-VI**

CHEMISTRY COURSE (APPLIED CHEMISTRY)
Title of the Course: Applied Chemistry
Course Code: CHEM-564.2
Credit Hours: 3
Marks: 75

Course Objectives
The course introduces fermentation and biotechnology, photography, coal cleaning and its utilization. The course will also provide the knowledge about the filtration and distillation used in industrial processes.

Course Contents
Fermentation and Biotechnology
Micro-organisms, conditions for their growth and biochemical activity. Production of ethanol, acetic acid, citric acid, penicillin and amylase; Microbial growth rate and its modeling.
Photography
Introduction:, Black and color photography, reactions involved in Photography, Dye Bleach process, Image Diffusion process, Development of Film and printing of photographyss
Coal cleaning and utilizations
Origin and types of coal; Coal cleaning and its utilization; Coal combustion, carbonization and gasification; Production of various fuel gases from coal such as water gas, producer gas etc.
Filtration
Filtration Theory. Filtration equipments. Filter auxiliaries
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.

Recommended Books
1 George T. Austin., Shreve's Chemical Process Industries, 5th Edition., McGraw Hill Book Company Inc. New York, (1984).
2. Riegel, E. R., Industrial Chemistry, 5th Ed., Reinhold Publishing Corporation New York, 1997).
3. Walter. L. Badger & Julius T. Banchero, Introduction to Chemical Engineeing, (1955).
4. Wiseman, P., Industrial Organic Chemistry, 2nd Ed., Applied Science Publisher Ltd., London, (1979).
5. Coulson & Richardson., Chemical Engineering, Vol I and II.,(1985).
6.. Jain,. P. C., A Textbook of Applied Chemistry, (1993).
7. Berkowitz, N. "The Chemistry of Coal" Elsevier Amsterdam.(1985).
8. Gyngell, E. S., Applied Chemistry for Engineers, 3rd Ed. Edward Arnold, Ltd London,

Supplementary Reading Materials
Google/topic/book/publication /search.
http://en.wikipedia.org.

http://www.sciencedirect.com.

PRACTICALS CHEM-564.2 (1 Cr. Hr) **Marks: 25**

Laboratory work illustrating topics covered in the lectures of CHEM-564.2sss

3rd Year **Semester-VI**

CHEMISTRY COURSE (BIOCHEMISTRY)

Course Title: Biocatalysts and Acid-Base Regulation
Course Code: CHEM-564.3
Credit Hours: 3
Marks: 75

Course Objective

Course will emphasize on all the aspects of the chemistry of enzymes. Importance of coenzyme and cofactors will also be covered. This course will also emphasize on the acid-base regulation in human body.

Course Contents

Enzymes

Chemical nature, nomenclature and classification of Enzymes and Cofactors. Substrate specificity, enzyme-substrate interactions and nature of active site. Mechanism of enzyme action with specific reference to chymotrypsin and ribonuclease. Kinetics of single substrate reactions. Effect of different factors on enzyme activity. Bisubstrate reactions. Quantitative assays of enzyme activity. Enzyme Inhibition. Regulatory enzymes; Allosteric enzymes, Multienzyme system, Zymogens, and Isozymes. Enzymatic control of metabolic pathways, Immobilized enzymes; synthesis, properties and uses.

Acid – Base and Electrolyte Chemistry

Intracellular and Extracellular Electrolytes. Body fluids as electrolyte solutions, pH, Henderson-Hasselbalch Equation and Buffers. Acids and bases, Actual and titratable acidities, Equilibrium reactions of acids, bases and protons. Buffer action. Effect of other ions on acid-base equilibria. Amino acids, peptides and proteins as acids and bases. Acid and base production in human metabolism. Regulation of Acid-Base Balance; Control of acidity and physiologic buffer action. Buffer capacity. Buffers of body fluids. Respiratory regulation of acid-base balance. Haemoglobin as an acid-base system. Renal control of Acid-base balance. Acid- Base disorders; Acidosis, Alkalosis. Effect of acid-base disturbances on electrolytes. Homeostasis, Variation of Na^+, K^+ and Cl^- in acid-base disturbances.

Recommended Books

1. Berg, J. M.; Tymoczko, J. L.; Stryer, L., *Biochemistry*, 6th ed. W. H. Freeman, 2006.
2. Guyton, A.C.; and Hall, J. E., *Text Book of Medical Physiology*, 9th ed. W. B. Saunders Company, Tokyo, 1996.
3. Jain. J. L., *Fundamentals of Biochemistry*, 5th ed. S. Chand and Company Ltd., New Delhi, 2003.
4. West, W. R.; Todd, H. S., *Text Book of Biochemistry*, 4th ed. Macmillan, London, 1968.

Supplementary Reading Material

1. Voet, D.; Voet J. G., *Biochemistry*, 3rd ed. John Wiley & Sons, New York, 2004.
2. Murray, R. K.; Mayes P. A.; Granner, D. K.; and Rodwell, V. W., *Harper's Biochemistry*, Appleton & Lange, 2000.
3. www.bio.mtu.edu/campbell/401sch1.html

PRACTICALS (CHEM-564.3) (1-Cr. Hr.) Marks: 25

Laboratory work illustrating topics covered in the lectures of CHEM-564.3

Recommended Books

1. Plummer, D.T.; *An Introduction to practical Biochemistry*, TATA McGraw-Hill Publishing Company LTD.
2. Sawhney, S. K.; and R. Sing (Editors), *Introductory Practical Biochemistry*, Narosa Publishing House, New Delhi, 2005
3. Oser, B. L., *Hawks physiological chemistry*, 14th ed. McGraw-Hill Book Company, 1965.

Supplementary Reading Material

1. Boyer, R. F., *Modern Experimental Biochemistry*, 2nd ed. The Benjamin Cumming Publishing Company, USA, 2006.
2. Chawla, R., *Practical Clinical Biochemistry*, 2nd ed. Jaypee Brothers medical publishers, New Delhi.
3. Baldwin, E.; Bell. D. J., *Coles practical physiological chemistry*, 10th ed. W. Heffer & Sons Ltd., Cambridge, 1955.

3rd Year **Semester-VI**

CHEMISTRY COURSE (FUEL CHEMISTRY)

Course Title: Biocatalysts and Acid-Base Regulation
Course Code: CHEM-564.8
Credit Hours: 3
Marks: 75

Course Objectives

After successful completion of the course, the students will be able to achieve real depth of understanding in fuel chemistry particularly petroleum based oils ranging from gaseous fuels to the heavy residual fuel oils. The student will also get knowledge about alternative fuels to be used in case of non availability of petroleum based oils

Course Contents

Chemistry of hydrocarbon fuels: Occurrence and exploration of crude petroleum. Preliminary treatment of crude petroleum .Classification of crude petroleum Fractionation column, fractionation of crude petroleum and its theory. Thermal cracking, catalytic cracking .Catalytic reforming, steam reforming . Basic properties of petroleum products i.e. CNG, LPG, gasoline, kerosene, diesel fuels, lubricating oils and heavy residue. Lubricating grasses and petroleum waxes

Alternate Sources of energy: Biomass Resources: Biomass conversion processes, Bio gas technology. Alcohols: Alcohols and its uses as alternative fuel. Hydrogen: Hydrogen production, storage, handling and its uses as alternative fuel. Fuel cells: Fuel Cells and its application, Phosphoric acid, molten carbonate and solid oxide fuel cells. Solar Energy: Photovoltaic power conversion & solar energy collectors. Nuclear fuels: Nuclear fuels processing, fission and fusion, nuclear reactors.

PRACTICALS CHEM-564.8 (1 Cr.Hr) Marks: 25

Laboratory work relating to course CHEM-564.8

Recommended Books:

1. Wiseman, P. "An Introduction to Industrial Organic Chemistry" Applied Science Publishers Ltd., London, (1979).
2. Goodger E.M. "Alternative fuels (chemical energy resources)" The Macmillan press Ltd, London, (1980).
3. Twidell, J. and Weir, T. "Renewable Energy Resources" Sopn London, New York, (1986).

Supplementary Reading Materials:

1. Penner, S.S, and Icreman, L. "Non nuclear energy technology" Vol-II pergaman press, New York, (1984).
2. Probstein R.F. and Hicks, R.E. "Synthetic fuels" Mc Graw Hill, New York, (1982).
3. Hobson, G.D. "Modren petroleum technology" part-I. John Wily & Sons, Toronto, (1984).
4. Mashall, W. "Nuclear power technology" vol-I, II, III, Clarendon press, Oxford, (1983).
5. "Methods for Analysis and Testing, IP standards for petroleum and its products". Part-I & II, Heyden and Sons, London, (1987).

YEAR-IV
SEMESTER-V11
SCHEME OF COURSES

Semester-VII: Specialization (Inorganic/Organic/Physical/ Analytical/Applied/Bio/Fuel Chemistry)	**Theory**	**Practical**	**Marks**
Paper-I, CHEM-671.1 CHEM-671.2 CHEM-671.3 CHEM-671.5 CHEM-671.6 CHEM-671.7 CHEM-671.8	3	0	100
Paper-II, CHEM-672.1 CHEM-672.2 CHEM-672.3 CHEM-672.5 CHEM-672.6 CHEM-672.7 CHEM-672.8	3	0	100
Paper-III, CHEM-673.1 CHEM-673.2 CHEM-673.3 CHEM-673.5 CHEM-673.6 CHEM-673.7 CHEM-673.8	3	0	100
Practical-I, CHEM-674.1 CHEM-674.2 CHEM-674.3 CHEM-674.5 CHEM-674.6 CHEM-674.7 CHEM-674.8	0	1	25
Course code will depend on course selected	3	0	100

from other specialization			
Research Project/Advanced Special Practical/Review Article (literature Survey) THESIS/CHEM-679	0	2	
Total	**12**	**3**	**425**

INORGANIC CHEMISTRY

4th Year **Semester-VII**

CHEMISTRY COURSE (INORGANIC CHEMISTRY)

Course Title: Inorganic reaction mechanism
Paper-I
Course Code: CHEM-671.5
Credit Hours: 3
Marks: 100

Course Objective

After completing this course, students will know about;
the periodic anomalies, bonding in electron deficient compounds, kinetics and mechanism of inorganic reactions, and electron transfer reaction

Course Contents

Periodic Anomalies and Bonding in Electron deficient Compounds

First and second row anomalies; the use of d-orbitals by non-metals; reactivity and d-orbital participation; pπ-dπ bonds; the use of p-orbitals in π-bonding; periodic anomalies of non-metals and post-transition metals. Multicentered bonding in electron deficient molecules, three centre two electron bond (3c-2e) and three-centered, four electron (3c-4e) bond model.

Kinetic and Mechanism of Inorganic Reactions

Classification of reaction mechanisms; rate laws; steady state approximation; inert and labile complexes; substitution reactions in octahedral complexes: acid hydrolysis, acid catalyzed aquation, anation reactions, base hydrolysis, attack on ligands, steric effects of inert ligands; square planar complexes: nucleophilic reactivity, trans-effect, cis-effect, racemization reactions.

Electron Transfer Reactions

Electron transfer reactions in co-ordination compounds, mechanism of electron transfer reactions, outer sphere or tunneling mechanism, inner sphere or ligand bridge mechanism, factors effecting the rate of electron transfer reactions, two electrons transfer reactions, complementary or non complementary electron transfer reactions, oxidation reduction reactions of metal ions.

Recommended Books

1 Basolo, F.; Pearson, R. G., *Mechanism of Inorganic Reactions*, Wiley, New York, **1982**.
2 Huheey, J. E.; Keiter, E. A., Keiter, R. L., *Inorganic Chemistry: Principles of Structure and Reactivity*, 4th ed., Harper & Row, New York, **2001**.
3 Benson, D., *Mechanisms of Inorganic Reactions in solution*, McGraw Hill, **1968**.
4 Purcell, K.F., Kotz, J.C., *Inorganic Chemistry* ,W.B.Saunders Company Holt-Saunders Internal editions , **1977**.
5 Shirve D.F., Atkins P.W., Langford C.H., *Inorganic Chemistry*, Oxford University Press , **1990**.

6 Wilkins R.G., *Kinetics and Mechanism of Reactions of Transition Metal Complex*, VCH Publishers, Inc, **1991**.
7 William. J., *Modern Iinorganic Chemistry* ,2nd ed., McGraw Hill Company, **1991**.
8 Porterfield, W.W., *Inorganic chemistry, Unified approach*, Elsevier Company, Delhi, **2005.**
9 Jordan, R.B., *Reaction Mechanisms of Inorganic and Organomettalics Systems*. Oxford University Press, New York, **1991**.
10 Wilkins, R.G., *The study of kinetics and Mechanisms of Reactions of transition metal complexes*, 2nd ed., VCH Publishers, New York, **1991.**

4th Year **Semester-VII**

CHEMISTRY COURSE (INORGANIC CHEMISTRY)

Course Title: Organic reagents in inorganic chemistry
Paper-II
Course Code: CHEM-672.5
Credit Hours: 3
Marks: 100

Course Objective

After completing this program students will have a sound knowledge of;
organic reagents used in inorganic analysis, their selectivity, specificity etc., and polymer chemistry

Course Contents

Organic Reagents Used in Inorganic Analysis

Types of reagent, specificity and sensitivity of the reagents, methods of application with specific examples, complexometric and gravimetric methods involving various reagents, chelates and chelate-effect.

Polymer Chemistry

Molecular species: Introduction, homoatomic and heteroatomic inorganic polymers, chains and cages of boron, silicon, nitrogen, phosphorous and sulphur; their synthesis, reactivity and applications, metal clusters. Polyionic species: Isopoly and heteropoly anions of transition metals, Silicates, borates, condensed phosphates, zeolites.

Recommended Books

1. Malcoim, P.S., *Polymer Chemistry*, Oxford University Press, **2005**.
2. Mandelkern, L .,*An Introduction to Macromolecules* ,2nd ed., Springer Verlag, NY **1983.**
3. Ravue, A., *Principles of Polymer Chemistry*, 2nd ed., Plenum Publishers, **2000**.
4. Emeléus, H.J**.,** Sharpe. A.G., *Modern Aspects of Inorganic Chemistry*, 4th ed., Wiley, New York, **1973**.
5. Huheey, J. E., Keiter, E. A., Keiter, R. L., *Inorganic Chemistry: Principles of Structure and Reactivity*, 4th ed., Harper & Row, New York, **2001**.
6. Billmeyer, F.W., *A Text book of Polymer Science*, John Willey & Sons, New Delhi, **2002**.
7. Powell, P., *Non Metal Chemistry*, Chopman & Hall., **1974.**
8. Miessler, G.L., Donald, A.T., *Inorganic Chemistry*, Prentice Hall Int. edition, **1991**.
9. Daniel, D.M., Alexander, A., Concepts and Models of Inorganic Chemistry, John Willey and Sons, **1994**.

4th Year **Semester-VII**

CHEMISTRY COURSE (INORGANIC CHEMISTRY)

Course Title: Spectroscopy and instrumental methods of analysis
Paper-III
Course Code: CHEM-673.5
Credit Hours: 3
Marks: 100

Course Objectives

After completing this course, students will know about the principles and applications of different spectroscopic techniques used in inorganic analysis and synthesis. Spectroscopic techniques will include; atomic/molecular spectroscopy, nuclear magnetic resonance spectroscopy (NMR), UV, IR, MS, separation science techniques, hyphenated techniques, and thermal analysis.

Course Contents

Instrumental Methods of Analysis

Physical methods in inorganic chemistry, principles, instrumentation, and applications of atomic/molecular absorption, uv-visible, ir, nmr, mass spectrometry, and thermal analysis.

Recommended Books

1. Vogel, A. I., *A Text book of Quantitative Inorganic Analysis*, English language Book Society, 4th ed., **1978**.
2. Daniels, T., *Thermal Analysis*, John Wiley & Sons, Inc., **1973.**
3. Pavia, D. L., Lampman, G. M., Kriz, G.S., *Introduction to Spectroscopy*, Saunders College Publishing, **1980**
4. Silverstein, R. M., Barler, C. G., Mogrill, T. C., *Spectrometric Identification of Organic Compounds*, 5th ed., John Wiley and Sons Inc., **1991.**
5. Kemp, W., *NMR in Chemistry A Multi Nuclear Introduction*, McMillan Press Ltd, **1986**.
6. Drago, R. S., *Physical Method in Inorganic Chemistry*, W.B. Saunders Company, **1997**.
7. Bassetta, J., Denney, C., Jeffery, G. H., Mendham, J., *Vogel's Textbook of Quantitative Inorganic Analysis including Elementary Instrumental Analysis*, English language book society, 4th ed., **1978**.
8. Douglas, A., Skoog, F., James Holler, Trmothy, A., *Principles of Instrumental Analysis*, 5th ed., Saunders College Publishing, New York, **1997**.
9. Ewing, G.W., *Instrumental Methods of Chemical Analysis*, 5th ed., McGraw Hill, New York, **1985**.

4th Year **Semester-VII**

CHEMISTRY COURSE (INORGANIC CHEMISTRY)

Course Title: Inorganic Chemistry
Practical-I
Course Code: CHEM-673.5
Credit Hours: 1
Marks: 25

Laboratory work illustrating topics covered in the lectures of Paper I, II, and III

4th Year **Semester-VII**

CHEMISTRY COURSE (INORGANIC CHEMISTRY)

Elective Course-I (other than the field of Specialization)
Course Code:
Credit Hours: 3
Marks: 100

4th Year **Semester-VII**

CHEMISTRY COURSE (INORGANIC CHEMISTRY)

Course Code: (CHEM-672.5)
Course Title: Inorganic Chemistry
Paper-II
Credit Hours: 3
Marks: 100

Title of Course: Special Practicals/Research Project/Position Paper (Literature Survey)

ORGANIC CHEMISTRY

BS 4th Year **Semester – VII**

CHEMISTRY COURSE (ORGANIC CHEMISTRY)
Course Title: Synthesis and mechanism–I
Paper-I
Course Code: CHEM-671.6
Credit Hours: 3
Marks: 100

Course Objectives
The objectives of the course are:

- To acquire basic Knowledge of all aspects of oxidations and reductions in organic chemistry.
- To become acquainted with approaches to the synthesis of organic molecules.
- To develop an understanding of the processes of synthesis and mechanism of the reactions and to apply them in a practical context by designing syntheses.

Course Contents
Oxidation:
Introduction; reactions involving elimination of hydrogen, cleavage of C-C bond, replacement of hydrogen by oxygen and addition of oxygen to the substrate; oxidative coupling.
Reduction:
Introduction; reactions involving replacement of oxygen by hydrogen, removal of oxygen from the substrate and reduction with cleavage; reductive coupling.
Protective Groups:
Use of hydroxyl-, amino-, carboxyl- and carbonyl- protecting groups in organic synthesis.
Pericyclic Reactions:
Principles; cycloadditions; electrocyclic reactions; cheletrophic reactions; sigmatropic rearrangements; the ene-reaction and related reactions.

Recommended Books
(Latest available editions of the following books)

1. Norman, R. O.C.; Coxon, J. M., *Principles of Organic Synthesis*, Nelson Thornes, Cheltenham.
2. Rinehart Jr., K. L., *Oxidation and Reduction of Organic Compounds*, Prentice-Hall, London.
3. March, J., *Advanced Organic Chemistry*, John Wiley & Sons, New York.
4. Clayden, J., Greeves, N.; Warren, S.; Wothers, P., *Organic Chemistry*, Oxford University Press, New York.
5. Bruckner, R., *Advanced Organic Chemistry-Reaction Mechanisms*, Harcourt Science & Technology Company, New York.
6. House, H.O., *Modern Synthetic Reactions*, The Benjamin/Cummings Publishing Company, California.
7. Greene, T. W., *Protective Groups in Organic Synthesis*, John Wiley & Sons, New York.

Supplementary Reading Material

1. Loudon, G. M., *Organic Chemistry*, Oxford University Press, New York.
2. Smith, M. B., *Organic Synthesis*, McGraw-Hill, New York.
3. Sykes, P., *A Guide Book to Mechanism in Organic Chemistry*, Longman, London.
4. Carey, F. A.; Sundberg, R. J., *Advanced Organic Chemistry Part B: Reactions and Synthesis*, Plenum Press, New York.
5. Morrison, R. T.; Boyd, R. N., *Organic Chemistry*, Prentice-Hall of India, New Delhi.
6. March, J., *Advanced Organic Chemistry*, John Wiley & Sons, New York.
7. Finar, I. L., *Organic Chemistry*, Vol. 1, Pearson Education, Delhi
8. Greene, T. W., *Protective Groups in Organic Synthesis*, John Wiley & Sons, New York.

BS 4th Year **Semester – VII**

CHEMISTRY COURSE (ORGANIC CHEMISTRY)
Course Title: Synthesis and mechanism-II
Paper-II
Course Code: CHEM-672.7
Credit Hours: 3
Marks: 100

Course Objectives
The objectives of the course are:

1. To provide an introduction to selected topics in modern synthetic organic chemistry.
2. To bring the students to a good knowledge on structure and reactivity of the most important reactive intermediates as well as on remarkable reactions and their mechanism, and make them able to design synthetic procedures for simple organic compounds.
3. To develop an understanding of the role of a chemist in the synthesis of new compounds and study of their reactions.
4. To develop an understanding of the role of a chemist in the synthesis of new compounds and study of their reactions on the basis of molecular rearrangements and free radicals.

Course Contents
Molecular Rearrangements:
Types of rearrangements; general mechanisms of nucleophilic, free radical and electrophilic rearrangement reactions; 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.
Free Radicals:
Introduction; radical generation; radical detection; radical shape and stabilization; radical reactions: addition reactions – addition of halogens, hydrogen halides, halomethanes, other carbon radicals and S-H compounds; substitution reactions-halogenations, oxidations and substitution involving aryl radicals.
Reactive Intermediates:
Carbenes, nitrenes, and arynes: Their generation, stability, reactions and synthetic applications.

Recommended Books
(Latest available editions of the following books)

1. March, J., *Advanced Organic Chemistry*, John Wiley & Sons, New York.
2. Norman, R. O.C.; Coxon, J. M., *Principles of Organic Synthesis*, Nelson Thornes, Cheltenham.
3. Bruckner, R., *Advanced Organic Chemistry-Reaction Mechanisms*, Harcourt Science & Technology Company, New York.
4. Clayden, J.; Greeves, N.; Warren, S.; Wothers, P., *Organic Chemistry*, Oxford University Press, New York.
5. Gilchrist, T. L.; Rees, C. W., *Carbenes, Nitrenes and Arynes*, Nelson, London.

6. Smith, M. B., *Organic Synthesis*, McGraw-Hill, New York.
7. Lwowski, W., *Nitrenes*, Interscience Publishers, New York.

Supplementary Reading Material

1. Morrison, R. T.; Boyd, R. N., *Organic Chemistry*, Prentice-Hall of India, New Delhi.
2. Carey, F. A.; Sundberg, R. J., *Advanced Organic Chemistry Part A: Structure and Mechanisms*, Kluwer Academic /Plenum Publishers, New York.
3. Sykes, P., *A Guide Book to Mechanism in Organic Chemistry*, Longman, London.
4. Pine, S. H., *Organic Chemistry*, National Book Foundation, Islamabad.
5. Loudon, G. M., *Organic Chemistry*, Oxford University Press, New York.
6. McMurry, J., *Organic Chemistry*, Brooks/Cole Publishing Company, California.
7. Finar, I. L., *Organic Chemistry*, Vol. 1, Pearson Education, Delhi.

BS 4th Year **Semester – VII**

CHEMISTRY COURSE (ORGANIC CHEMISTRY)
Course Title: Heterocyclics and Interpretative Organic Spectroscopy
Paper-III
Course Code: CHEM-673.6
Credit Hours: 3
Marks: 100

Course Objectives:
On completing this course the student should be able to:

1. Determine the structures of simple and medium size organic compound by spectroscopic methods.
2. Have reasonable understanding of the chemistry of heterocyclic aromatic compound, and correlates these with their aromatic hydrocarbons compounds.

Course Contents
Organic Spectroscopy:
IR and UV-Vis Spectroscopy:
Brief description of the instrumentation, brief account of the theoretical basis of IR and UV-Vis., application of IR to functional groups and finger print regions. Survey of the IR of various classes of compounds. UV-Vis; application to conjugated systems, including various empirical rules in the calculation of λ_{max}.
^{1}H-NMR and ^{13}C-NMR Spectroscopy:
Brief description of the instrumentation, Chemical shift; factors affecting the chemical shift; coupling constants; factors affecting coupling constants; simple and complex splitting patterns, 2-D NMR. C-13 NMR, brief treatment of the theoretical aspects, use of correlation tables.
Mass Spectrometry:
Introduction; brief instrumentation. Main Objective**:** Structure elucidation of simple organic compounds by the combined use of the spectroscopic methods.
Aromatic Heterocycles:
Introduction; nomenclature; structure and aromaticity; basicity and acidity of the nitrogen heterocycles; chemistry of furan, pyrrole and thiophene; synthesis of indoles and isoindoles; chemistry of pyridine, quinoline and isoquinoline; occurrence of heterocyclic compounds.

Recommended Books
(Latest available editions of the following books)

1. Kemp, W., *Organic Spectroscopy*, Palgrave, New York.
2. Silverstein, R. N.; Barrler, G. C.; Morrill, T. C., *Spectrometric Identification of Organic Compounds*, John Wiley & Sons, New York.
3. Williams D. H.; Fleming, I., *Spectroscopic Methods in Organic Chemistry*, Athlone Press, London.
4. Bansal, R. K., *Heterocyclic Chemistry*, Wiley Eastern Ltd., New Delhi.
5. Gilchrist, T. L., *Heterocyclic Chemistry*, Longman, Singapore.
6. Joule, J. A.; Mills, K., *Heterocyclic Chemistry*, Blackwell Science, Tokyo.

Supplementary Reading Material

1. Atta-ur-Rehman., *Nuclear Magneti Resonance Spectroscopy*, UGC, Islamabad.
2. Davis, R.; Freason, M., *Mass Spectrometry*, John Wiley & Sons, New York.
3. Loudon, G. M., *Organic Chemistry*, Oxford University Press, New York.
4. Lambert, J. B.; Shurvell, H. F.; Lightner, D. A.; Cooks, R. G., *Introduction to Organic Spectroscopy*, Macmillan Publishing Company, New York.
5. Anderson, R. J.; Bendell, D.; Groundwater, P., *Organic Spectroscopic Analysis*, The Royal Society of Chemistry, Cambridge.

BS 4th Year **Semester – VII**

CHEMISTRY COURSE (ORGANIC CHEMISTRY)
Course Title: Laboratory work illustrating topics covered in the lectures of papers I, II & III.
Practical-I
Course code: CHEM-673.6
Credit Hours: 01
Marks: 25

4th Year **Semester-VII**

CHEMISTRY COURSE (ORGANIC CHEMISTRY)
Elective Course-I (other than the field of Specialization)
Course Code:
Credit Hours: 3
Marks: 100

BS 4th Year **Semester-VII**

CHEMISTRY COURSE (ORGANIC CHEMISTRY)
Course Title: Special Practical/Research Project/Position Paper (Literature Survey)
Special Practical-I/Research-I
Course code: CHEM-679
Credit Hours: 02
Marks:

PHSICAL CHEMISTRY

4th Year **Semester-VII**

CHEMISTRY COURSE

Course Title: Physical Chemistry
Paper-I
Course Code: CHEM-671.7
Credit Hours: 3
Marks: 100

Course Objectives
To acquire advanced knowledge about statistical thermodynamics and electrochemistry.
Course Contents

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. Translational, vibrational and rotational partitional functions and equilibrium constant. Statistical thermodynamics. Applications to equilibrium and chemical kinetics. Bose-Einstein's and Fermi-Dirac's statistics.

Electrochemistry
Electrical double layer: Interface: A look into the interface; OHP and IHP. Contact adsorption Gibbs Surface Excess. Potential differences across metal solution interfaces. Outer and surface potential differences. Galvani potential difference. Electrochemical potential difference. Interfacial tension. Electro capillary thermodynamics. Lippmann's equation. Helmholtz-perrin model, Gouy-Chapmann model. Stern model, and BDM (Bockris-Devanathan-Muller) model. Charge density. Differential capacitance. Shape of capacitance-charge curve. The Capacitance hump.

Electrode kinetics: Electrochemical devices. Charge transfer processes in the absence and presence of electrical field. The Over potential. Butler-Volmer's equation. The Idea of equilibrium exchange current density. The Symmetry factor. High field and low field approximation. Tafel's equation. Cyclic voltammetry and its applications. Fuel cell, corrosion and its prevention. Electrochemical impedance spectroscopy.

Recommended Books

1. Gasser R.P.H. and Richards W.G. "Entropy and Energy Levels" Oxford University Press (1974).
2. Wayatt P.A.H. "The Molecular Basis of Entropy and Chemical Equilibrium" Royal Institute of Chemistry London (1971).
3. Bockris J.O.M. and Reddy A.K.N. "Modern Electrochemistry" Vol-I and II, 4th ed. Plenum Press, London (2003).
4. Muhammad M. and Amjad M. "Principles of Electrode Kinetics" Rooha Printers, Lahore (2001).
5. Albery J., Electrode Kinetics, Clarendon, Oxford (1975).

6. Engel, Thomas and Philip Reid, “Thermodynamics, Statistical Thermodynamics”, and Kinetics 1st ed., Benjamin Cummings (2006).
7. Bard A.J. and Faulkner L.R. “Electrochemical Methods” John Wiley & Sons (2001).

4th Year **Semester-VII**

CHEMISTRY COURSE

Course Title: Physical Chemistry
Paper-II
Course Code: CHEM-672.8
Credit Hours: 3
Marks: 100

Course Objectives

To acquire knowledge about the physical properties and structure of polymers.

Course Contents

Polymer Chemistry

Introduction to Polymers. Step-growth Polymerizations. Polymer chain growth. Kinetics of polymer chain growth. Copolymerization. Emulsion Polymerization. Natural and Inorganic Polymers. Physical Aspects of polymers. Molecular Weight of Polymers: Distribution, averages, and methods of determination. Viscosity. Osmometry. Light scattering method. Diffusion. Sedimentation. Optical rotation method. Structure of Polymer Chain: Introduction to chain isomerism, stereochemistry, configurations, and conformations. (not in Hiemenz). Amorphous State of Polymers: In depth examination of polymer conformation, microstructure, and dynamics in the amorphous state. Polymer viscoelasticity: Stress relaxation, mechanical models of polymer behavior, time-temperature superposition, perhaps rheology. Crystalline State of Polymers: crystallization and kinetics, crystalline structures, experimental methods. Polymer Solutions and Blends:

Recommended Books

1. Hiemenz P.C. "Polymer Chemistry: The Basic Concepts" Marcel Dekker (1984).
2. Stevens M.P. "Polymer Chemistry: An Introduction" Oxford University Press (1999).
3. Sperling L.H. "Introduction to Physical Polymer Science" Wiley Interscience (1992).
4. Boyd R.H. and Phillips P.J. "The Science of Polymer Molecules" Cambridge (1993).
5. Malcolm P.S. "Polymer Chemistry" Oxford University Press (2005).

4th Year **Semester-VII**

CHEMISTRY COURSE

Course Title: Physical Chemistry
Paper-III
Course Code: CHEM-673.7
Credit Hours: 3
Marks: 100

Course Objectives

To acquire advanced knowledge about quantum chemistry and molecular spectroscopy.

Course Contents

Quantum Chemistry

Operators and their properties. Angular momentum. 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. pi-electron calculations.

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. Micheal D.F. "Elements of Quantum Mechanics" Oxford University Press (2005).
2. Atkin P., Friedman R. "Molecular Quantum Mechanics", 4th ed., Oxford Univ. Press (2005)
3. Barrow G. "Molecular Spectroscopy" McGraw Hill (1962).
4. Becker E. D. "High Resolution NMR; Theory & Chemical Application", New York, Academic Press (1980).
5. Graybal J.D. "Molecular Spectroscopy", New York, McGraw-Hill (1988).
6. Griffiths, David J., "Introduction to Quantum Mechanics" 2nd ed., Prentice Hall (2004).

4th Year **Semester-VII**

CHEMISTRY COURSE

Course Title: Physical Chemistry
Practical-I
Course Code: CHEM-673.7
Credit Hours: 1
Marks: 25

Laboratory work illustrating topics covered in the lecture of papers I, II & III.

4th Year **Semester-VII**

CHEMISTRY COURSE

Elective Course-I (other than the field of Specialization)
Course Code:
Credit Hours: 3
Marks: 100

4th Year **Semester-VII**

CHEMISTRY COURSE

Course Title: Physical Chemistry
Special Practicals/Research
Course Code: CHEM-679
Credit Hours: 2
Marks:

Title of the Course: Special Practicals/Research Project/Position Paper (Literature Survey)

ANALYTICAL CHEMISTRY

4th year **Semester – VII**

CHEMISTRY COURSE (ANALYTICAL CHEMISTRY)
Specialization: ANALYTICAL CHEMISTRY
Course Title: SPECTROSCOPIC METHODS OF ANALYSIS
Paper: I
Course Code: CHEM-671.1
Credit Hours: 3
Marks: 100

Course Objectives
To provide thorough background in theoretical knowledge of spectrochemical methods and practical knowledge of instrumental analysis.

Course Contents

Molecular absorption Spectroscopy:

Electromagnetic radiation, electronic excitation, absorption by molecules, magnitude of absorption of radiation. Instrumentation, various sources of light, filters and monochromators and their efficiency, detectors. Single beam and double beam spectrophotometers. Sources of errors and optimum conditions. Analytical applications in quantitative analysis of organic, inorganic and bioanalytical compounds.

Photoluminescence Spectroscopy:

Principle of photoluminescence, spectrofluorimetry and spectrophosphorimetry. Excitation and deexcitation processes, variables affecting fluorescence and phosphorescence, measurement of fluorescence. Components of the equipment. Analytical applications.

Atomic Absorption Spectroscopy:

Basic principle of atomic absorption phenomena. Instrumentation, different light-sources, atomizers, flame and flameless atomizers, photometric system and detectors. Modulation. Analytical applications.

Recommended Books

1. Braun, Robert D., *Introduction to Instrumental Analysis*, McGraw-Hill Book Company, Singapore, 1987.
2. Christian, G. D.; O.Reilly, J. E., *Instrumental Analysis*, Allyn and Bacon, 1986.
3. Skoog, D.A.; West, D.M., *Principles of Instrumental Analysis*, Holt, Rinehart and Winston Inc, 1971.
4. Welz, B., *Atomic Absorption Spectroscopy*, Verlag Chemie, Weinheim, NY, USA, 1976.

Supplementary Reading Material

1. Christian, G. D., *Analytical Chemistry*, 5th ed. John Wiley and Sons, Inc NY, USA, 1994.
2. Ewing, G. W., *Instrumental Methods of Chemical Analysis*, 5th ed. McGraw-Hill International Editions1985.
3. Thompson, K.C.; Reynolds, R.J., *Atomic Absorption, Fluorescence and Flame Emission Spectroscopy*, 2nd ed. Charles Griffin and Co, Ltd, London, 1978.
4. Robinson, J. W., *Atomic Absorption Spectroscopy*, 2nd ed. Marcel Dekker, NY, USA, 1975.
5. Willard, H.H.; Merit, D.L.; Dean, J.R.J.A.; Settle, F.A., *Instrumental Methods of Analysis*, 7th ed. Wadsworth Publishing Company, 1988.
6. Dean, J.R., *Atomic Absorption and Plasma Spectroscopy*, 2nd ed. John Wiley and Sons, Inc NY, USA, 1997.

4th year **Semester – VII**

CHEMISTRY COURSE (ANALYTICAL CHEMISTRY)
Course Title: ELECTROCHEMICAL METHODS
Paper: II
Course Code: CHEM-672.1
Credit Hours: 3
Marks: 100

Course Objectives
To visualize the significance of potentiometric and voltammetric techniques as electroanalytical tools for chemical analysis.

Course Contents

Introduction to Electrochemical Methods.
The Electrochemical cells, oxidation – reduction reactions, Nernst equation, standard potentials.

Potentiometric Techniques.
Standard electrodes and reference electrodes. Ion selective electrodes and its applications. Direct potentiometric measurement and potentiometric titration.

Voltammetric Techniques.
Classification of voltammetric techniques. Polarography, basic principles and instrumentation, different modes of polarography, applications of polarography in organic and inorganic analysis. Stripping voltammetry, types of stripping voltammetry and its applications. Cyclic voltammetry and its applications. Amperometry.

Recommended Books

1. Braun, R. D., *Introduction to Instrumental Analysis*, McGraw-Hill Book Company, Singapore, 1987.
2. Christian, G. D.; O.Reilly, J. E., *Instrumental Analysis*, Allyn and Bacon, 1986.
3. Skoog, D.A.; West, D.M., *Principles of Instrumental Analysis*, Holt, Rinehart and Winston Inc, 1971.
4. Kapoor, R.C.; Aggarwal, B.S., *Principles of Polarography*, Wiley Eastern Limited, New Delhi, India, 1991.

Supplementary Reading Material

1. Christian, Gary D., *Analytical Chemistry*, 5th ed. John Wiley and Sons, Inc NY, USA, 1994.
2. Ewing, Galen W., *Instrumental Methods of Chemical Analysis*, 5th ed. McGraw-Hill International Editions 1985.
3. Willard, H.H.; Merit, D.L.; Dean, J.R.J.A.; Settle, F.A., *Instrumental Methods of Analysis*, 7th Edition Wadsworth Publishing Company, 1988.
4. Crew, D.R., *Principles and Applications of Electrochemistry*, 4th ed. Stanley Thornes Publishers, 1994.
5. Bard, A.J.; Faulkner, L.R., *Electrochemical Methods: Fundamentals and Applications*, 2nd ed. John Wiley and Sons, Inc NY, USA, 1998.
6. Meites, L, *Polarographic Techniques*, Interscience Inc. NY, USA, 1955.

4th year **Semester – VII**

CHEMISTRY COURSE (ANALYTICAL CHEMISTRY)
Course Title: EMISSION SPECTROSCOPY AND RADIOCHEMICAL METHOD
Paper: III
Course Code: CHEM-673.1
Credit Hours: 3
Marks: 100

Course Objectives
To provide sound knowledge of atomic spectroscopic techniques and radiochemical methods for the analyte of interest for chemical and biological analysis.

Course Contents

Atomic emission spectroscopic methods
Types of emission spectroscopic techniques. Flame emission spectroscopy: basic principle, instrumentation and application. Atomic fluorescence spectroscopy: basic principle, instrumentation and applications. Plasma emission spectroscopy: inductively coupled plasma (ICP) and DC plasma, applications of plasma emission spectroscopy. Comparison of atomic spectroscopic techniques.

Radiochemical methods
Nuclear emission: alpha particles, β particles, γ-rays. Detectors: gas ionization, scintillation and semiconductor. Radiochemical analysis: neutron activation analysis, isotope dilution method, radiometric titrations, radioactive tracers.

Recommended Books

1. Braun, R. D., *Introduction to Instrumental Analysis*, McGraw-Hill Book Company, Singapore, 1987.
2. Christian, G. D.; O.Reilly, J. E., *Instrumental Analysis*, Allyn and Bacon, 1986.
3. Skoog, D.A.; West, D.M., *Principles of Instrumental Analysis*, Holt, Rinehart and Winston Inc, 1971.
6. Willard, H.H.; Merit, D.L.; Dean, J.R.J.A.; Settle, F.A., *Instrumental Methods of Analysis*, 7th ed. Wadsworth Publishing Company, 1988.

Supplementary Reading Material

1. Christian, G. D., *Analytical Chemistry*, 5th ed. John Wiley and Sons, Inc NY, USA, 1994.

2. Ewing, G. W., *Instrumental Methods of Chemical Analysis*, 5th ed. McGraw-Hill International Editions 1985.
3. Thompson, K.C.; Reynolds, R.J., *Atomic Absorption, Fluorescence and Flame Emission Spectroscopy*, 2nd ed. Charles Griffin and Co, Ltd, London, 1978.
4. Rubeska, I.; Svoboda, V.; Sychra, V., Atomic *Fluorescence Spectroscopy*, Van Nostrand Reinhold Company, London, 1975.
5. Fifield, F.W.; Kealey, D., *Principle and Practice of Analytical Chemistry*, 2nd ed. 1983.
6. Strobel, H.A.; Heineman, W.R., Chemical Instrumentation; A Systematic Approach, 3rd ed. Johnn Wiley and Sons, NY, USA, 1999.

4th Year **Semester –VII**

CHEMISTRY COURSE (ANALYTICAL CHEMISTRY)
Practical-I
Course Code: CHEM-673.1
Credit Hours: 2
Mark:

Experiments based on theory topics covered in Paper I, II, and III.

4th Year **Semester-VII**

CHEMISTRY COURSE (ANALYTICAL CHEMISTRY)
Special Practical/Research –I
Course Code: CHEM-679
Credit Hours: 2
Marks:
Title of Course: Special Practical/Research Project/Position Paper (Literature Survey)

4th Year **Semester-VII**

CHEMISTRY COURSE (ANALYTICAL CHEMISTRY)
Elective Course-I (other than the field of Specialization)
Course Code:
Credit Hours: 3
Marks: 100

APPLIED CHEMISTRY

4th Year **Semester-VII**

CHEMISTRY COURSE (APPLIED CHEMISTRY)
Title of Course: Common Industries-I
Paper-I
Course Code: CHEM-671.2
Credit Hours: 03
Marks: 100

Course Objectives:
To cater the students about the sugar manufacturing industry, starch production industry and leather tannery.

Course Contents
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, gelatine and adhesives; Preparation of hides; Methods of tanning, Vegetable and chrome tanning processing of leather; Production of glue and gelatine.
Recommended Books
Chittararjan Kumar., Sugar Industry Management, (1994).
Birch, G. G.; Parker,K. J., Sugar Science & Technology (1979).
George T. Auston., Shreve's Chemical Process Industries, 5th Edition., McGraw Hill Book Company Inc. New York, (1984).
Riegel, E. R., Industrial Chemistry, 5th Ed., Reinhold Publishing Corporation NewYork, (1997).

Supplementary Reading Materials

Google/topic/book/publication /search.
http://en.wikipedia.org.
http://www.sciencedirect.com.

BS 4th Year **Semester-VII**

CHEMISTRY COURSE (APPLIED CHEMISTRY)
Title of Course: Agro based Industries
Paper-II
Course Code: CHEM-672.2
Credit Hours:03
Marks: 100

Course Objectives
The course is designed to give the knowledge about the various fertilizers used in agriculture sector. the course will also provide the knowledge about the agrochemicals used against pests .It will also give understanding 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.
Agrochemical Industry
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 Environmental Protection
Sources of air, water and soil pollution; Industrial waste and its control for environmental protection; Modern trends for waste treatment; Industrial gases and pollution control methods; Role and production of free radicals and atmospheric chemistry.
Recommended Books
George T. Austin., Shreve's Chemical Process Industries, 5th Edition., McGraw Hill Book Company Inc. New York, (1984).
Riegel, E. R., Industrial Chemistry, 5th Ed., Reinhold Publishing Corporation NewYork, (1997).
Jain. P. C., A Textbook of Applied Chemistry, (1993).
K. Wark Cecil F. Warner, Air Pollution its origin & Control.(1976).
Henry C. Perkin, Air Pollution, (1974).
Glele Mamantov W. D. Shults, Determination of Air Quality, (1974).
Nelson L. Nemerow, Industrial Water Pollution, (1978).

Supplementary Reading Materials

Google/topic/book/publication /search.
http://en.wikipedia.org.
http://www.sciencedirect.com.

BS 4th Year **Semester-VII**

CHEMISTRY COURSE (APPLIED CHEMISTRY)
Title of the Course: Common Industries-II
Paper-III
Course Code: CHEM-673.2
Credit Hours: 03
Marks: 100

Course Objectives
To acquire the following knowledge
a) About the extraction of Oil, Fats and waxes, its production and refining. Hydrogenation of vegetable oils, chemistry involved in vegetable ghee.
b) To cater the knowledge about soap and detergent industries as well as surface coating industries.

Course Contents
Oils, Fats, Waxes and Vegetable Ghee Industry
Oils, Fats and Waxes; Extraction of oils such as soybean 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; Interesterification 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.
Surface Coating Industry
Raw materials for paints and pigments; Classification and properties of surface-coating constituents; Classification and manufacture of pigments; Production of paints, varnishes, distempers, enamals and lacquers; Chemistry involved in the drying phenmena of paints; Drying oils for paint and classification of drying oils.
Recommended Books
George T. Austin., Shreve's Chemical Process Industries, 5th Edition., McGraw Hill Book Company Inc. New York, (1984).
Riegel, E. R., Industrial Chemistry, 5th Ed., Reinhold Publishing Corporation New York, (1997).
Jain, P. C., A Textbook of Applied Chemistry, (1993).
Deb, P. C., Modern Trends in Formulating Soaps and Detergents, (1996).
Deb, P. C., Soaps and Detergents, 1st Edition, C. B. S. Publisher and distributes, (1996).

Supplementary Reading Materials

Google/topic/book/publication /search.
http://en.wikipedia.org.
http://www.sciencedirect.com.

4th Year **Semester-VII**

CHEMISTRY COURSE (APPLIED CHEMISTRY)
PRACTICAL-1
Course code : CHEM-673.2
Credit Hours: 2
Marks:

Laboratory work illustrating topics covered in the lecture of papers I, II & III.

4th Year **Semester-VII**

CHEMISTRY COURSE
APPLIED CHEMISTRY
Title of the Course: Special Practical/Research Project/Review Paper (Literature Survey)
Course code : CHEM-679
Credit Hours:2
Marks:

BIOCHEMISTRY

4th Year **Semester-VII**

CHEMISTRY COURSE (BIOCHEMISTRY)

Title of the Course: General Biochemistry Related to Biomedical Sciences
Paper-I
Course Code: CHEM-671.3
Credit Hours: 3
Marks: 100

Prerequisites: Course I and concept of basic human physiology

Course Objectives
This course provides fundamental concepts. Biochemical and molecular aspects of endocrinology and chemistry of blood and other extra cellular fluids. Emphasis is on relation of the above topics to medicine.

Course Contents

Endocrinology:

General introduction, chemical nature, common characteristics and mode of action of hormones. Hormone receptors. Chemistry, Biosynthesis, Metabolism and biological functions of pituitary, adrenal, thyroid, parathyroid, pancreatic and gonadal hormones. Hormones of GIT and Pineal glands.

Blood and Other Body Fluids

General composition of blood. Functions of blood. Blood plasma. Plasma proteins; composition and functions. Composition, development and functions of red blood cells, white blood cells and platelets. Haemoglobin; chemistry, properties, synthesis, functions and derivatives. Degradation of haemoglobin. Blood Coagulation and clotting factors. Blood pressure. Blood groups. Composition of Urine, Extracellular Fluids Like: cerebrospinal fluid, lymph, sweat, tears, synovial and interstitial fluid.

Recommended Books:

1. Smith, E.L.; Hill, R.L.; Lehman, I.R.; Lefkowitz, R.J.; Handler, P.; White, A., *Principles of Biochemistry (Mammalian Biochemistry)*, 7th ed. McGraw-Hill Companies Inc., New York, 1984.
2. Guyton, A.C.; and Hall, J. E., *Text Book of Medical Physiology*, 9th ed. W. B. Saunders Company, Tokyo, 1996.
3. Murray, R. K.; Mayes P. A.; Granner, D. K.; and Rodwell, V. W., *Harper's Biochemistry*, Appleton & Lange, 2000.

Supplementary Reading Material

1. Zia.T., *Lecture Notes on Blood Physiology*, 2nd ed. Multi color publisher, Lahore, 2005.
2. West, W. R.; Todd, H. S., *Text Book of Biochemistry*, 4th ed. Macmillan, London, 1968.
3. Devlin, T. M., *The Text Book of Biochemistry with Clinical Correlation*, Wiley- Liss, New York, 1997.

4th Year **Semester-VII**

CHEMISTRY COURSE (BIOCHEMISTRY)

Title of the Course: Physical Techniques in Biochemistry
Paper-II
Course Code: CHEM-672.3
Credit Hours: 3
Marks: 100

Course objectives: This course is designed to impart a fundamental understanding of biochemical techniques used to isolate and characterize various macromolecules.

Course Contents

Extraction, Fractionation and Purification of macromolecules

Homogenization, Solubilization and Concentration including ultrasonication, lyophilization and ultra decantation. 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.

Electro focusing

Preparative and Analytical electro focusing.

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.

ELISA Techniques

Recommended Books

1. Cooper, T. G., *The tools of Biochemistry*, John Wiley & Sons, New York, 1977.
2. Bryan, L. W.; Keith, W.; Arnold, E., *A Biologists guide to principles and techniques of practical biochemistry*, London, 1981.
3. Scope, R. K., *Protein purification: principle and practice*, 3rd ed., Springer-Verlag, New York, 1994.

Supplementary Reading Material

1. Dawes, E.A., *Quantitative problems in biochemistry*, 6th ed., Livingstone, 1980.
2. www.bio.mtu.edu/campbell/401sch1.html

4th Year **Semester-VII**

CHEMISTRY COURSE (BIOCHEMISTRY)

Title of the Course: Molecular Biology
Paper-III
Course Code: CHEM-673.3
Credit Hours: 3
Marks: 100

Course Objectives

The contents of the course mainly covers the fundamental concepts of molecular biology, molecular manipulations and associated applications. Focus is placed on understandings of the chemistry, and relations between structure and properties of the nucleic acids.

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. In vitro mutagenesis: Deletion, Insertion and Substitution. Recombinant DNA and genetic diseases.

Recommended Books

1. Karp. G., *Cell and Molecular Biology*, John Wiley & Sons, 1996.
2. Doonan. S., *Nucleic Acids*, Royal Society of Chemistry, Cambridge, 2004.
3. Watson, J.D.; Baker, T.A.; Bell, S.P., et al, *Molecular Biology of the Gene*, 5th ed. Pearson Benjamin Cummings, 2004.

Supplementary Reading Material

1. Watson, J.D.; Tooze, J.; Kurtz, D.T., *Recombinant DNA*, Scientific American Books, W.H. Freeman, New York, 1983.
2. Lewin B., *Gene VII*, Oxford University Press, New York, 2000.
3. Alberts, B.; Johnson, A.; Lewis, J.; Raff, M.; Roberts, K.; Walter, P., *Molecular Biology of the Cell*, 5th ed. Taylor &Francis, 2008.
4. Brown, T. A.,*Genomes*, 3rd ed. Taylor &Francis, 2006.

4th Year **Semester-VII**

CHEMISTRY COURSE (BIOCHEMISTRY)

Practical-I
Course Code: CHEM-674
Credit Hours: 1
Marks: 25

Experiments based on theory topics covered in Paper I, II, and III.

4th Year **Semester-VII**

CHEMISTRY COURSE (BIOCHEMISTRY)

Elective Course-I (other than the field of Specialization)
Course Code:
Credit Hours: 3
Marks: 100

4th Year **Semester-VII**

CHEMISTRY COURSE (BIOCHEMISTRY)

Title of Course: Special Practicals/Research Project/Position Paper (Literature Survey)
Practical-II
Course Code: CHEM-679/689
Credit Hours: 2
Marks:

FUEL CHEMISTRY

4th Year **Semester-VII**

CHEMISTRY COURSE (FUEL CHEMISTRY)

Title of the Course: Chemistry of Coal Conversion Processes-I
Fuel Chemistry
Paper-I
Course Code: CHEM-671.8
Credit Hours: 3
Marks: 100

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
Combustion of Coal
Burning System for Coal Combustion: Combustion general, chemical reactions, system functions, Combustion furnaces and boilers, externally heated, internally heated, mixed furnaces. Water tube boilers, shell boilers.

Grate firing: Stokers, type of stokers, their merits and demerits, sketching a burning bed.

Fluid bed firing: Fluidization, characteristics of fluidized bed, atmospheric pressure, fast and pressurized Fluidization / fluidized bed combustion.

Entrained firing system: Unit system, bin and feeder system, burners for entrained firing system.

Heat rates and firing densities. Rosin equation, elementary design equation and constraints on design equation,

Coal Flames. Coal behaviour in combustion system, flames, types of coal flames, their propagation and stabilization, combustion products analysis.

Environmental Aspects: Pollution problems in coal combustion and its control, flue gas desulphurisation by dry and wet methods.

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).

Supplementary Reading Materials:

1. Merick, D. “Coal Combustion and Conversion Technology” McMillan Ltd., London (1984).
2. Berkowitz, N. “The Chemistry of Coal” Elsevier Amsterdam. (1985).

4th Year **Semester-VII**

CHEMISTRY COURSE (FUEL CHEMISTRY)

Title of the Course: Petroleum and Petrochemicals-I
Paper-II
Course Code: CHEM-672.8
Credit Hours: 3
Marks: 100

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

Cracking and Reforming of Petroleum Fractions: Preparation, structure and properties of cracking and reforming catalysts. Mechanism of cracking and reforming. Effect of operating conditions on cracking and reforming products. Construction and operation of thermal and catalytic cracking and reforming units. Hydro forming and desulphurisation of petroleum products.

Petroleum and 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 adiponitrite, 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).

Supplementary Reading Materials:

a. List, H.L. "Petrochemical Technology" Printice-Hall Englewood Cliffs, New Jersey. (1986).

b. Smith, M.L, Stinson. K.W. "Fuels and Combustion" McGraw Hill Book Company. Reprint by National Book Foundation in (1972).

c. Goodger, E.M. "Hydrocarbon Fuels" Union Brothers Ltd, London. (1975).

d. Maleev, V.L. "Internal Combustion Engines" McGraw Hill Book Company London, (1985).

e. Hughes, J.R., and Swindells, N.S. "Storage and Handling of Petroleum Liquids" Charless Griffin and Company Ltd, London. (1987).

4th Year **Semester-VII**

CHEMISTRY COURSE (FUEL CHEMISTRY)

Title of the Course: Characterization of Fossil Fuels by Advanced Instrumental Techniques-I
Paper-III
Course Code: CHEM-673.8
Credit Hours: 3
Marks: 100

Course Objectives

The students will acquire knowledge of the advanced spectroscopic techniques currently used in modern refineries and research organizations for characterization and identification of various fossil fuels.

Course Contents

UV-Visible Spectroscopy: Spectral region and types of molecular spectroscopy, Molecular absorption, Molecular fluorescence, Molecular phosphorescence, Jablonski energy-level diagram, Beer-Lambert law, Deviation from Beer-Lambert law, Electronic transitions, Selection rules, Franck-Condon principle, Chromophores, Sources of radiation, Monochormater, Detectors, Single and double beam spectrophotometer, General applications and applications in characterization of fossil fuels.

Infra-Red Spectroscopy: Molecular vibrations, Hook's law, Selection rules, Group frequencies and factors influencing vibrational frequencies, Sources of I.R radiations, Detectors, Infra-red spectrophotometer, General application and applications in characterization of fossil fuels.

Atomic Absorption: General theory, Flame atomization and laminar flow premix burner, Graphite furnace atomizers, Hollow-cathode lamp, Atomic absorption spectrophotometer, Background correction, Application in characterization of fossil fuels.

Recommended Books:

1. Ewing, G.W. "Instrumental Methods of Chemical Analysis" McGraw Hill, London. (1985).
2. Crisition, 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).

Supplementary Reading Materials:

1. Karr. C. "Analytical Methods for Coal and Coal Products" Academic Press, New York. (1978).

2. Kemp, W. “Organic Spectroscopy” The MancMillan Press Ltd London (1994).
3. Skooge, D.A.“Instrumental Analysis”. Sanat Printer, Indian Edition, 2009.

4th Year **Semester-VII**

CHEMISTRY COURSE (Fuel Chemistry)

Elective Course-I (other than the field of Specialization)
Course Code:
Credit Hours: 3
Marks: 100

4th Year **Semester-VII**

CHEMISTRY COURSE (Fuel CHEMISTRY)
PRACTICAL-1
Course code : CHEM-674
Credit Hours: 1
Marks: 25

Laboratory work illustrating topics covered in the lecture of papers I, II & III.

4th Year **Semester-VII**

CHEMISTRY COURSE
FUEL CHEMISTRY
Title of the Course: Special Practical/Research Project/Review Paper (Literature Survey)
Course code : CHEM-679/689
Credit Hours:2
Marks:

YEAR-IV
SEMESTER-VIII
Scheme of Courses

Semester-VIII: Specialization (Inorganic/Organic/Physical/ Analytical/Applied/Bio/Fuel Chemistry)	**Theory**	**Practical**	**Marks**
Paper-IV, CHEM-681.1 CHEM-681.2 CHEM-681.3 CHEM-681.5 CHEM-681.6 CHEM-681.7 CHEM-681.8	3	0	100
Paper-V, CHEM-682.1 CHEM-682.2 CHEM-682.3 CHEM-682.5 CHEM-682.6 CHEM-682.7 CHEM-682.8	3	0	100
Paper-VI, CHEM-683.1	3	0	100

CHEM-683.2 CHEM-683.3 CHEM-683.5 CHEM-683.6 CHEM-683.7 CHEM-683.8			
Practical-II, CHEM-684	0	1	25
Elective Course-II (Other than the field of Specialization)	3	0	100
Research Project/Advanced Special Practical/Review Article (Write-up), THES-679/689 CHEM-679/689	0	2	100
Total	**12**	**3**	**525**

INORGANIC CHEMISTRY

4th Year **Semester-VIII**

CHEMISTRY COURSE

INORGANIC CHEMISTRY
Course Title: Organometallic Chemistry
Paper-IV
Course Code: CHEM-681.5
Credit Hours: 3
Marks: 100

Course Objectives

After completing this course, students will know about;
the chemistry of organometallics especially with reference to their types and bonding, and reactivity of organometallic compounds in homogenous catalysis.

Course Contents

Chemistry of Organometallics

History and introduction to organometallic compounds, types of bonding.
Transition metals; 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).

Organometallic Compounds in Homogenous Catalytic Reactions

Homogenous catalytic hydrogenation, dimerization, oligomerization, polymerization, oxidation, hydrosilation, hydroformylation of olefins. Catalytic polymerization of acetylenes, insertion reactions, use of organometallic compounds in organic synthesis.

Recommended Books

1. Powell, P., *Principles of Organometalics Chemistry*, 2nd ed., London, **1995**.
2. Akio Yamamoto., *Organotransition Metal Chemistry*, Printice Hall, **1992**.
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., Tar D, A., *Inorganic Chemistry*, Prentice Hall Int, **1991**.
5. Douglas., M., John A., *Concepts and Models of Inorganic Chemistry*, John Willey and Sons, **1994**.
6. Zuckerman, H., *Basic Organometallic Chemistry*, 2nd ed., **1985**.
7. William. J., *Modern Inorganic Chemistry*, 2nd ed., McGraw Hill Company, **1991**.
8. Porter Field. W.W., *Inorganic Chemistry a Unified Approach*, 2nd ed., Elsevier Publishers**, 2005**

4th Year **Semester-VIII**

CHEMISTRY COURSE

INORGANIC CHEMISTRY
Course Title: Magnetochemistry
Paper-V
Course Code: CHEM-682.5
Credit Hours: 3
Marks: 100

Course Objectives

After completing this course, students will have knowledge about;
magneto-chemistry, oxidative addition and reductive elimination reactions.

Course Contents

Magnetochemistry

Theory of magnetism, diamagnetism, paramagnetism, ferro-, ferri- and antiferromagnetism, magnetic susceptibility, magnetic moments, Faraday's & Gouy's methods,orbital contribution to magnetic moment, Russell-Sanders coupling scheme, derivation of term symbols for p1- p6 and d1 - d10 systems, pigeon holes diagram, effect of temperature on magnetic properties of complexes. Magnetic moment of lanthanides..

Oxidative Addition and Reductive Elimination Reactions

Oxidative Addition: one electron oxidative addition, addition of oxygen, addition of bimetallic species, hydrogen addition, HX addition, organic halides, Reductive Elimination Reactions.

Recommended Books

1. Douglas, B., McDaniel, D., Alexander, J., *Concepts of Models of Inorganic Chemistry*, 3rd ed., John Wiley & Sons Inc., **1994**
2. Huheey, J. E, Keiter, E. A., Keiter, R. L., *Inorganic Chemistry: Principles of Structure and Reactivity*", 4th ed., Harper & Row, New York, **2001**.
3. Mackay, K. M., Mackay, R. A., Henderson, W., *Introduction to Modern Inorganic Chemistry*, 5th ed., Stanley Thomas Publisher Ltd,**1996**
4. Miessler, G. L.,Tarr D.A., *Inorganic Chemistry*, Prentice Hall International, **1991**.
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. William. J., *Modern Inorganic Chemistry*, 2nd ed., McGraw Hill Company, **1991**.

4th Year **Semester-VIII**

CHEMISTRY COURSE

INORGANIC CHEMISTRY
Course Title: Nuclear Chemistry
Paper-VI
Course Code: CHEM-683.5
Credit Hours: 3
Marks: 100

Course Objectives

After completing this course, students will have enough knowledge about;
radiochemistry, nuclear reactions, radioisotopes, properties & function of nuclear radiation, harmless and harmful factors associated with the use of nuclear radiation, the chemistry of radio isotopes, their reactions and applications and nuclear reactions

Course contents

Nuclear Chemistry

Introduction, theory of radioactive decay, positive ray analysis, mass spectrograph, Astam mass spectrograph, Dempster mass spectrograph, Jordan double focusing mass spectrograph, Bain bridge mass spectrograph, structure of the nucleus, half life, nuclear binding energy, artificial radioactivity. Fission and Fusion reactions, Acceleration of charged particles, applications of Radioisotopes

Recommended Books

1. Friedlandler, G.; Kennedy, J.W., Miller, J.M.; *Nuclear and Radiochemistry*, 2nd ed., John Willey and Sons, Inc., **1964.**
2. Choppin, G. R.; Rydberg, J.; Libjenzin, J.; *Radiochemistry and Nuclear Chemistry*, 2nd ed.; Butterworth-Heinemann Ltd. **1995**.
3. Arnikar, H. J., *Essentials of Nuclear Chemistry*, 4th ed., John Willey Eastern Ltd., **1988.**
4. Harvey, B.G.,*Introduction to Nuclear Physics and Chemistry*, Prentice-Hall Inc, **1990**.

4th Year **Semester-VIII**

CHEMISTRY COURSE

INORGANIC CHEMISTRY
Course Title: Inorganic Chemistry
Practical-II
Course Code: CHEM-684
Credit Hours: 1
Marks: 25

Experiments based on theory topics covered in Paper IV, V, and VI.

4th Year **Semester-VIII**

CHEMISTRY COURSE

INORGANIC CHEMISTRY

Elective Course-II (other than the field of Specialization)

Course Code:

Credit Hours: 3

Marks: 100

4th Year **Semester-VIII**

CHEMISTRY COURSE

INORGANIC CHEMISTRY
Course Title: Inorganic Chemistry
Special Practical/Research–II
Course Code: CHEM-679/689
Credit Hours: 2
Marks:

Title of Course: Special Practicals/Research Project/Position Paper (Literature Survey)

ORGANIC CHEMISTRY

BS 4th Year **Semester-VIII**

CHEMISTRY COURSE
ORGANIC CHEMISTRY
Course Title: Reaction mechanism determination, Bio Molecules and Synthetic Drugs
Course code: CHEM-681.6
Paper-IV
Credit Hours: 03
Marks: 100

Course Objectives
On completing this course the student should be able to:

1. Predict the mechanism of the sequence of reactions**.**
2. Determine the mechanism of the reaction using kinetic and thermodynamic techniques.
3. Have introductory knowledge of the chemistry and applications of lipids, proteins, carbohydrates and nucleic acids.
4. Have exposure to the chemistry and application of the classes of medicines under study.

Course Contents
Mechanisms and Methods of Determining These:
Review of kinds and mechanisms of organic reactions; thermodynamic and kinetic requirements for reactions: kinetic and thermodynamic control; The Hammond postulate; microscopic reversibility; methods of determining mechanisms; identification of products; determination for the presence of an intermediate; the study of catalysis; crossover experiments; isotopic labeling; stereochemical and kinetic studies; solvent effect.
Lipids, Proteins, Carbohydrates and Nucleic Acids:
Chemistry of lipids, proteins, carbohydrates, nucleic acids and their importance in living systems.
Drugs-Pharmaceutical Compounds:
Introduction; classification; chemistry of analgesics and antipyretics, sulpha drugs/sulphonamides, antimalarials and antibiotics.

Recommended Books
(Latest available editions of the following books)

1. Carroll, F. A., *Perspectives on Structure and Mechanism in Organic Chemistry*, Brooks/Cole Publishing Company, New York.
2. Jones, R. A. Y., *Physical and Mechanistic Organic Chemistry*, Cambridge University Press, Cambridge.
3. Carey, F. A.; Sundberg, R. J., *Advanced Organic Chemistry Part B: Reactions and Synthesis*, Plenum Press, New York.
4. March, J., *Advanced Organic Chemistry*, John Wiley & Sons, New York.
5. Clayden, J.; Greeves, N.; Warren, S.; Wothers, P., *Organic Chemistry*, Oxford University Press, New York.
6. Blei, I.; Odian, G., *General Organic and Biochemistry*, W.H. Freeman & Company, New York. .

7. Burger, A., *Medicinal Chemistry Part I & II*, John Wiley & Sons,New York.
8. Wolff, M. E., *Burger's Medicinal Chemistry Part II*, John Wiley & Sons, New York.
9. Williams, D. A.; Lemke, T. L., *Foye's Principles of Medicinal Chemistry*, Lippincott Williams & Wilkins, New York.
10. Isaacs, N. S., *Physical Organic Chemistry*, Longman, London.

Supplementary Reading Material

1. Atta-ur-Rehman., *Nuclear Magnetic Resonance Spectroscopy*, UGC, Islamabad.
2. Davis, R.; Freason, M., *Mass Spectrometry*, John Wiley & Sons, New York.
3. Loudon, G. M., *Organic Chemistry*, Oxford University Press, New York.
4. Lambert, J. B.; Shurvell, H. F.; Lightner, D. A.; Cooks, R. G., *Introduction to Organic Spectroscopy*, Macmillan Publishing Company, New York.
5. Anderson, R. J.; Bendell, D.; Groundwater, P., *Organic Spectroscopic Analysis*, The Royal Society of Chemistry, Cambridge.

BS 4th Year **Semester-VIII**

CHEMISTRY COURSE
ORGANIC CHEMISTRY
Course Title: Natural Products Chemistry
Course code: CHEM-682.6
(Paper-V)
Credit Hours: 3
Marks: 100

Course Objectives

1. Understand the field of natural products chemistry.
2. Identify natural products and their probable biosynthetic pathways.
3. Enhance their understanding of biological and biochemical sciences.
4. Natural products chemistry endeavors to examine the natural source, mechanisms whereby the source biosynthetically constructs the product, processes whereby the product can be isolated from the source and techniques used to identify the product/s.
5. Understand classical and modern synthetic routes to the natural products.
6. Learn process whereby the product can be isolated from the source and techniques used to identify it.

Course Contents

Alkaloids:

Introduction; classification; isolation; general methods for structure elucidation; discussion with particular reference to structure and synthesis of ephedrine, nicotine, atropine, quinine, papaverine and morphine.

Terpenoids

Introduction; classification; isolation; general methods for structure elucidation; discussion with particular reference to structure and synthesis of citral, α-terpineol, α-pinene, camphor and α cadinene.

Steroids

Introduction; nomenclature and stereochemistry of steroids; structure determination of cholesterol and bile acids; introduction to steroidal hormones with particular reference to adrenal cortical hormones.

Recommended Books

(Latest available editions of the following books)

1. Finar, I. L., *Organic Chemistry*, Vol. 2, Pearson Education Ltd., Delhi.
2. Shoppee, C. W., *Chemistry of the Steroids*, Butterworths, London.
3. Hesse, M., *Alkaloid Chemistry*, John Wiley & Sons, New York.
4. Fieser, L. F.; Fieser, M., *Steroids*, Asia Publishing House, London.

Supplementary Reading Material

5. Morrison, R. T.; Boyd, R. N., *Organic Chemistry*, Prentice-Hall of India, New Delhi.
6. Solomons, T. W. G.; Fryhle, C. B., *Organic Chemistry*, John Wiley & Sons, New York.

BS 4th Year **Semester-VIII**

CHEMISTRY COURSE
ORGANIC CHEMISTRY
Course Title: Synthesis and Mechanism-III
Course Code: CHEM-683.6
(Paper-VI)
Credit Hours: 3
Marks: 100

Course Objectives

Upon completion of this class, all students should be able to:

1. Generate a new carbon-carbon bond by the transition metal catalyzed cross coupling of aromatic and other substrates.
2. Prepare/characterize a coordination compound for use as a catalyst for the coupling reaction.
3. Determine the effect of ligand on the regiochemistry of the cross-coupling reaction.
4. Analyze products of catalytic reactions by gas chromatography.
5. Draw chemical structures of some representative polymers; define and understand basic polymer concepts; derive and apply the basic principles behind polymer molecular weights and molecular weight determination; and identify the different types of polymer isomerism and conformational changes and what effect these changes have on polymer properties.
6. Outline synthetic procedures and mechanisms for polymer formation, derive and manipulate chemical kinetic equations describing polymer formation in order to specify reaction conditions to achieve target molecular weights and polymer or copolymer architectures.
7. Describe different methods for the production of polymeric materials such as solution, bulk, suspension and emulsion polymerizations.

Course Contents

Transition Metal Catalyzed Coupling Reactions

Transition metals and their complexes; oxidation states; the d^n notations; electron counting: the 16- and 18- electron rules; fundamental reactions of transition metal complexes; the Heck reaction and other examples of transition metal catalyzed reactions.

Reterosynthesis

Introduction to reterosynthesis and disconnection approach; synthesis of aromatic compounds with 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.

Synthetic Polymers

Introduction to polymer chemistry; step growth polymerization; free radical polymerization; ionic polymerization; stereochemistry in polymers; polymerization using Ziegler-Natta catalyst; stereo-regulation and conformation polymers; molecular weight determination of polymers; structure-property relationship; reactions of synthetic polymers; degradation and stability with special emphasis on thermal and photo-degradation.

Recommended Books

(Latest available editions of the following books)

1. Bruckner, R., *Advanced Organic Chemistry Reaction Mechanisms*", Harcourt Science & Technology Company, New York.
2. Powell, P., *Principles of Organometallic Chemistry*, Chapman & Hall, New York.
3. Parkins, A. W.; Poller, R. C., *An Introduction to Organometallic Chemistry*, Macmillan, London.
4. Waren, S., *Organic Synthesis- The Disconnection Approach*, John Wiley & Sons, New York.
5. Waren, S., *Workbook for Organic Synthesis-The Disconnection Approach*, John Wiley & Sons, New York.
6. Smith, M. B., *Organic Synthesis*, McGraw-Hill, New York..
7. Parker, D. B. V., *Polymer Chemistry*, Applied Science Publishers, London.
8. Challa, G., *Polymer Chemistry an Introduction*, Ellis Horwood, New York.
9. Stevens, M. P., *Polymer Chemistry an Introduction*, Addision-Wesley Publishing Company, London.

Supplementary Reading Material

1. Clayden, J.; Greeves, N.; Warren, S.; Wothers, P., *Organic Chemistry*, Oxford University Press, New York
2. Wade Jr., L. J., *Organic Chemistry*, Pearson Education, Delhi.

BS 4th Year **Semester –VIII**

CHEMISTRY COURSE
ORGANIC CHEMISTRY
Course Title: Experiments based on theory topics covered in Paper IV, V, and VI.
Course Code: CHEM-684 (Practical-II)
Credit Hours: 1
Marks: 25

4th Year **Semester-VIII**

CHEMISTRY COURSE
ORGANIC CHEMISTRY
Elective Course-II (other than the field of Specialization)
Course Code:
Credit Hours: 3
Marks: 100

BS 4th Year **Semester-VIII**

CHEMISTRY COURSE
ORGANIC CHEMISTRY
Course Title: Special Practical/Research Project/Position Paper (Literature Survey)
Course code: 679/689 (Special Practical-II/Research–II)
Credit Hours: 2
Marks: 100

PHYSICAL CHEMISTRY

BS 4th Year **Semester-VIII**

CHEMISTRY COURSE
PHYSICAL CHEMISTRY
Course Title: Advanced Chemical Kinetics
Course code: CHEM-681.7
Paper-IV
Credit Hours: 03
Marks: 100

Course Objectives
To develop deep understanding of chemical kinetics.

Course Contents

Chemical Kinetics
Derivation of the rate equations. Theory of absolute reaction rate. Reversible reactions, parallel reactions and consecutive reactions. Correlation between physical properties and concentration. Comparison of collision and absolute reaction theories. Advanced theories of unimolecular reactions. 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 carrier with second order breaking. Experimental techniques for fast reactions.

Recommended Books

1. Albery J., Electrode Kinetics, Clarendon, Oxford (1975).
2. Espenson, J. H. Chemical Kinetics and Reaction Mechanism 2nd ed., McGraw Hill London (2002).
3. Espenson J.H. "Chemical Kinetics and Reaction Mechanisms" 2nd ed. McGraw Hill, New York (1995).
4. Frost A.A. and Pearson R.G. "Kinetic and Mechanism" 2nd ed. John Wiley and Sons Inc, New York (1961).
5. Laidler K.J. "Chemical Kinetics" 3rd ed. Pearson Education Company, New York (1987).
6. Laidler L.J. "Reaction Kinetic VII, II Reaction in Solution" Pergamon Press, New York (1963).

BS 4th Year **Semester-VIII**

CHEMISTRY COURSE
PHYSICAL CHEMISTRY
Course Title: Radiation and Photochemistry
Course code: CHEM-682.7
Paper-V
Credit Hours: 03
Marks: 100

Course Objectives
To acquire advanced knowledge about radiation chemistry and photochemistry.

Course Content

Radiation Chemistry
Development and advancement in radiation chemistry. Radiation dosimetry. Fricke dosimeter, dosimetry in pulse radiolysis. Energy states in radiation chemistry. Exited states, production formation through excited states. Fragmentation, predissociation, photochemical decay. Evidence for the existence of excited state and its types. Ions and electrons, radiolysis of gases. radiolysis of liquids, solids, and frozen liquids and gases, behavior of ions in radiation chemistry. General energy transfer. characteristic and applications of gas, liquid and solid phase radiolysis. Instrumentation, purity of chemicals and methods. Recent application of radiation chemistry.

Photochemistry
Scope of photochemistry. 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. Photochemical reaction in gas phase and in solutions. Flash photolysis. Advance approach to kinetics of photochemical reactions. Applied photochemistry. Atmospheric photochemistry. Photosynthesis, photochemistry of polymers, photomedicines. Techniques in photochemistry, introduction, light source. Incandescent filament lamps, discharge lamps, lasers, synchrotron reaction.

Recommended Books

1. Wayne and Richard P. “Photochemistry” Macmillan (1988).
2. Spinks J.W.T. and Woods R.J. “An introduction to Radiation Chemistry” Wiley Inter Sci. Pub, USA (1976).
3. Aziz F. and Rodgers M.A.J., “Radiation Chemistry Principles and Application” Ed., VCH Publishers, Inc. (1987)
4. Wayne R.P. “Principles and Application of Photochemistry”, Oxford University London (1988).

BS 4th Year **Semester-VIII**

CHEMISTRY COURSE
PHYSICAL CHEMISTRY
Course Title: Solid State Chemistry, Surface Chemistry and Catalysis
Course code: CHEM-683.7
Paper-VI
Credit Hours: 03
Marks: 100

Course Objectives
To acquire advanced knowledge about solid state chemistry, surface chemistry and catalysis.

Course Content

Solid State Chemistry
Intermolecular forces. Symmetry of condensed systems. Properties of solids (electrical, mechanical and optical). Lattice defects, doping for defects. Electron-gas model, heat capacity paradox, electrical conductivity. Band theory of metallic state. Conductors, semiconductors and insulators. Controlled valency and hopping phenomena, p & n-type conductivity, p, n-junctions. Solid-state reactions. Developments in superconductivity.

Surface Chemistry and Catalysis
Solid surfaces. Gas solid interface. Thermodynamics of adsorption. Heterogeneous catalysis. Kinetic and mechanisms of catalyzed reactions. Adsorption at liquid surfaces. Enzymatic catalysis. Organized molecular assemblies. Colloidal solutions. Catalyst preparation methods. Industrial catalysts.

Recommended Books

1. Segal H. "Enzyme Kinetics" John Wiley New York (1975).
2. Wetson R. and Schwavz H.A. "Chemical Kinetics" Prentice Hall Inc, New Jersey (1972).
3. West A.R. "Solid State Chemistry", J. Wiley, New York (1989).

BS 4th Year **Semester-VIII**

CHEMISTRY COURSE
PHYSICAL CHEMISTRY
Course Title: Practical-II
Course code: CHEM-684
Credit Hours: 1
Marks: 25

Experiments based on theory topics covered in Paper IV, V, and VI.

4th Year **Semester-VIII**

CHEMISTRY COURSE
PHYSICAL CHEMISTRY
Elective Course-II (other than the field of Specialization)
Course Code:
Credit Hours: 3
Marks: 100

4th Year **Semester-VIII**

CHEMISTRY COURSE
PHYSICAL CHEMISTRY
Course Title: Special Practical/Research-II
Course code: CHEM-679/689
Credit Hours: 2
Marks: 50

Title of Course: Special Practicals/Research Project/Position Paper (Literature Survey)

ANALYTICAL CHEMISTRY

4th Year **Semester-VIII**

CHEMISTRY COURSE
ANALYTICAL CHEMISTRY
Course Title: HYPHENATED TECHNIQUES
Paper: IV
Course Code : CHEM-681.1
Credit Hours: 3
Marks: 100

Course Objectives
By taking this course, students will learn how to increase the sensitivity and selectivity by interfacing different instruments.

Course Contents

Introduction to hyphenated techniques
Hyphenated techniques for complex organic mixtures and pharmaceutical analysis.
Gas Chromatography-Mass Spectroscopy (GC-MS), Gas Chromatography -Mass Spectroscopy-Mass Spectroscopy(GC-MS-MS), Liquid Chromatography-Mass Spectroscopy (LC-MS), Liquid Chromatography-Fourier Transform Infrared Spectroscopy(LC-MS),

Hyphenated techniques for elemental speciation studies.

ICP-MS, LC-ICP-MS, LC-AAS, LC-AFS, IC-ICP-MS,

Hyphenated techniques in Polymer Characterization.

TG-IR, TG-MS, DSC-FTIR,

Recommended Books

1. Christian, G. D., *Analytical Chemistry*, 6th ed., John Wiley and Sons, Inc NY, USA, 2004.
2. Christian, G. D., O.Reilly, J. E., *Instrumental Analysis*, Allyn and Bacon, 1986.
3. Ewing, G. W., *Instrumental Methods of Chemical Analysis*, 5th ed. McGraw-Hill International Editions 1985.
4. Willard, H.H.; Merit, D.L.; Dean, J.R.J.A.; Settle, F.A., *Instrumental Methods of Analysis*, 7th ed. Wadsworth Publishing Company, 1988.

Supplementary Reading Material

1. Braun, R. D., *Introduction to Instrumental Analysis*, McGraw-Hill Book Company, Singapore, 1987.
2. Skoog, D.A.; West, D.M., *Principles of Instrumental Analysis*, Holt, Rinehart and Winston Inc, 1971.

4th Year **Semester-VIII**

CHEMISTRY COURSE
ANALYTICAL CHEMISTRY
Title of Course: ADVANCED CHROMATOGRAPHY
Paper: V
Course Code: CHEM-682.1
Credit Hours: 3
Marks: 100

Course Objectives
By taking this course the student will gain knowledge about different instrumental separation techniques used for separation and determination of organic, inorganic and biochemical compounds in different types of samples.

Course Contents

General Description of Chromatography
Migration rate of solutes, Retention time, Column efficiency, Zone Shapes, effect of column variables on Zone broadening and column efficiency.

Gas Chromatography
Basic principle and Instrumentation: Carrier Gas, Injection system: Value method, head-space method, injection through septum. Columns: Packed columns, open tubular columns, support-coated open tubular, wall-coated open tubular columns and porous-layer Column preparation, Detectors: Electron Capture detector, Thermal Conductivity detector, Flame Ionization detector, Flame photometer as a detector, Nitrogen-phosphorus detector, Mass spectrometer as a detector. Capillary gas chromatography. Types of chromatogram. Qualitative and Quantitative Analysis in GC.

High Pressure Liquid Chromatography
Principle, Choice of Column material for HPLC, Preparation of Column, Selection of the Support, selection of the mobile phase. Instrumentation of HPLC, Pumps, Columns, Injection Systems, detectors (U.V., Refractive Index, Fluorimetric and Electrochemical detectors). Normal and Reverse phase chromatography. Isocratic and Gradient elution chromatography. Applications of HPLC. High Pressure Thin Layer Chromatography.

Ion Chromatography
Ion-Exchange resins, applications of Ion-Exchange resins to Chromatography, Ion Chromatography based on suppressors, single-column Ion Chromatography, detector in Ion Chromatography, selection of mobile phase. Applications of Ion Chromatography. Comparison of HPLC with GLC.

Recommended Books

1. Braun, R. D., *Introduction to Instrumental Analysis*, McGraw-Hill Book Company, Singapore, 1987.
2. Christian, G. D.; O.Reilly, J. E., *Instrumental Analysis*, Allyn and Bacon, 1986.

3. Miller, J. M., *Chromatography Concepts and Contrasts*, John Wiley and Sons, NY, USA, 1988.

4. Braithwaite, A.; Smith, F.J., *Chromatographic Methods*, Chapman and Hall, 1985.

5. Ahuja, S., Editor "Chromatography and Separation Chemistry", Advances and Developments, ACS, Washington, DC 1986.

Supplementary Reading Material

1. Christian, G. D., *Analytical Chemistry*, 5th ed. John Wiley and Sons, NY, USA, 1994.

2. Ewing, G. W., *Instrumental Methods of Chemical Analysis*, 5th Edition, McGraw-Hill International Editions 1985.

3. Skoog, D.A.; West, D.M., *Principles of Instrumental Analysis*, Holt, Rinehart and Winston Inc, 1971.

4. Grab, R.L., *Modern Practice of Gas Chromatography*, John Wiley and Sons, NY, USA, 1985.

5. Poole, C.F.; Schuette, S.A., *Contemporary Practice of Chromatography*, 2nd ed. Elsevier Scientific Publishing Company, NY, USA, 1985.

6. Sewell, P.A.; Clarke, B., Chromatographic Separations, Editor: Kealey, D., Analytical Chemistry by Open Book Learning, John Wiley and Sons, Chichester, 1991.

4th Year **Semester –VIII**

CHEMISTRY COURSE
ANALYTICAL CHEMISTRY
Title of Course: SPECIAL TOPICS
PAPER: VI
Course Code: CHEM-683.1
Credit Hours: 3
Marks: 100

Course Objectives
By taking this course, students will learn about the recent development in the area of electrochemical sensors, mass spectrometry and automation in the process and chemical analysis.
Course Contents

Electrochemical Sensors

Biosensors, enzyme-based electrode, Affinity biosensors, Gas sensors, Solid state devices, Sensor Arrays, New materials for sensors.
Mass Spectrometry:

Basic principle, instrumentation, various sources of ionization, analyzers and detectors. Types of Mass Spectrometry. Applications to biological and environmental chemistry.
Process Instrument and Automation in chemical Analysis:

Principles of automations, automated instruments in process control, automatic instruments, flow injection analyzers, microprocessor controlled instruments.

Recommended Books

1. Braun, R. D., *Introduction to Instrumental Analysis*, McGraw-Hill Book Company, Singapore, 1987.
2. Christian, G. D.; O.Reilly, J. E., *Instrumental Analysis*, Allyn and Bacon, 1986.
3. Skoog, D.A.; West, D.M., *Principles of Instrumental Analysis*, Holt, Rinehart and Winston Inc, 1971.
4. Willard, H.H.; Merit, D.L.; Dean, J.R.J.A.; Settle, F.A., *Instrumental Methods of Analysis*, 7th ed. Wadsworth Publishing Company, 1988.

Supplementary Reading Material

1. Christian, G. D., *Analytical Chemistry*, 6th ed. John Wiley and Sons, NY, USA, 2004.
2. Ewing, G. W., *Instrumental Methods of Chemical Analysis*, 5th ed., McGraw-Hill International Editions 1985.
3. Davis, R.; Frearson, M., *Mass Spectrometry*, Editor: Richard, F.E., Analytical Chemistry by Open Book Learning, John Wiley and Sons, Chichester, 1987.

4th Year **Semester –VIII**

CHEMISTRY COURSE
ANALYTICAL CHEMISTRY
Practical-II
Course Code: CHEM-684
Credit Hours: 1
Mark: 25
Experiments based on theory topics covered in Paper IV, V, and VI.

4th Year **Semester-VIII**

CHEMISTRY COURSE
ANALYTICAL CHEMISTRY
Elective Course-II (other than the field of Specialization)
Course Code:
Credit Hours: 3
Marks: 100

4th Year **Semester-VIII**

CHEMISTRY COURSE
ANALYTICAL CHEMISTRY
Special Practical/Research–II
Course Code: CHEM-679/689
Credit Hours: 2
Marks: 50
Title of Course: Special Practical/Research Project/Position Paper (Literature Survey)

APPLIED CHEMISTRY

BS 4th Year **Semester-VIII**

CHEMISTRY COURSE
APPLIED CHEMISTRY
PAPER: IV
Course Code: CHEM-681.2
Credit Hours: 3
Marks: 100
Title of the Course: Organic Based Industries

Course Objectives
To understand the structure, mechanism , properties and fabrication of various polymers.The course will also provide the knoeledge about perfumes and cosmetics industries. production of explosives propellants and its applications will be discussed in the course.

Course Contents
Industrial Polymerization and 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; Production of drug delievery 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.

Production of Explosives, Propellants and their Applications
Raw materials; Manufacture of industrial explosives and propellants; Types of explosives and their safety measures; Chemistry involved in production of military explosives.

Recommended Books
Terold M. Schultz, Polymer Materials Science, (1974).
Beat Meyer, Urea Formaldehyde Resins, (1979).
Paul J. Flory, Principles of Polymer Chemistry, (1975).
George Ordian, Principles of Polymerization, Villey Inferences,Printed and published by Replika Press PVT Ltd. India, (2004).
Cowie J. M.G., Polymers Chemistry and Physics of Modern Material, 1st Ed. Intertext Book New York, (1973).
Urbanski T., Chemistry and Technology of Explosives Vol-II,Authorised Translation by. Ornaf, W and S. London, 2nd Ed.,Pergamon Press London, (1983).
Urbanski, T., Chemistry and Technology of Explosives Vol-1,Authorised Translation by I. Jeczalikowa ad S. Laverton, 2nd Ed., Pergamon Press London, (1983).

George T. Auston., Shreve's Chemical Process Industries, 5th Edition., McGraw Hill Book Company Inc. New York, (1984).
Riegel, E. R., Industrial Chemistry, 5th Ed., Reinhold Publishing Corporation NewYork, (1997).
Howard L.White, Introduction to Industrial Chemistry, (1986).

Supplementary Reading Materials

Google/topic/book/publication /search.
http://en.wikipedia.org.
http://www.sciencedirect.com.

BS 4th Year **Semester-VIII**

CHEMISTRY COURSE
APPLIED CHEMISTRY
PAPER: V
Course Code: CHEM-682.2
Credit Hours: 3
Marks: 100
Title of the Course: Industrial Products

Course Objectives
To provide the knowledge about different pharmaceutical industries, nuclear industry and its peaceful applications, crude petroleum production and refining and production of various petrochemicals.

Course Contents
Pharmaceutical Industry
Classification of pharmaceutical products and pharmaceutical processing; Manufacture of paracetamol/disprol and aspirin; Chemistry involved in the production and manufacture of various antibiotics such as streptomycin, erythromycin, penicillin etc.

Nuclear Industry and Peaceful Applications
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.

Petroleum Refinery 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
Nelson, W. L., Petroleum Refinery Engineering, 4th Ed., (1985).
George T. Auston., Shreve's Chemical Process Industries, 5th Edition, McGraw Hill Book Company Inc. New York, (1984).
Riegel, E. R., Industrial Chemistry, 5th Ed., Reinhold Publishing Corporation New York, (1997).
Jain, P. C., A Textbook of Applied Chemistry, (1993).

Supplementary Reading Materials

Google/topic/book/publication /search.
http://en.wikipedia.org.
http://www.sciencedirect.com.

BS 4th Year **Semester-VIII**

CHEMISTRY COURSE
APPLIED CHEMISTRY
PAPER: VI
Course Code: CHEM-683.2
Credit Hours: 3
Marks: 100
Title of the Course: Metallurgy

Course Objectives
The course is designed to give sufficient knowledge about iron, steel and its alloys. the course also provide 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 Industries
Iron ores, constituents and their classification; Manufacture of iron and steel; Types of iron and steel; Metal Extractions and production of Alloys.

Corrosion and its Prevention
Chemistry and causes of corrosion phenomena; Types and theories of corrosion; Corrosion prevention and inhibitors; Surfaces coating and Electroplating.

Color Chemistry
Organic dyes, sources and classification of dyes; Chemistry and production of various organic dyes, Methods of dyeing, Finishing and dyeing of textiles.

Lubrication
Lubrication Phenomena, fluid lubrication, boundary lubrication, extreme pressure lubrication. Manufacture of lubricants by solvent extraction methods and properties

Absorption of Gases
Gas liquid equilibrium, Mechanism of absorption, Diffusion Theory, Absorption equipment and Gas cleaning equipments.

Recommended Books
Christie, R. M., Colour Chemistry, The Royal Society of Chemistry, (2001).
Gyngell, E. S., Applied Chemistry for Engineers, 3rd Ed. Edward Arnold, Ltd London, (1972) Reprinted (1989).
Kuriacose J. C.; J. Rajaran., Chemistry in Engineering and Technology, Vol. II (1988).
Evans, U. R., An Introduction to Metallic Corrosion, 3rd Ed., Edward Arnold (1981).

Supplementary Reading Materials

1. Google/topic/book/publication /search.
http://en.wikipedia.org.
http://www.sciencedirect.com.

BS 4th Year **Semester-VIII**

CHEMISTRY COURSE
APPLIED CHEMISTRY
Title of Course: Special Practical/Research Project/Review Paper (Literature Survey)
Special Practical–II
Course code: CHEM-679/689
Credit Hours: 1
Marks: 25

Experiments based on theory topics covered in Paper IV, V, and VI.

4th Year **Semester-VIII**

CHEMISTRY COURSE
APPLIED CHEMISTRY
Elective Course-II (other than the field of Specialization)
Course Code:
Credit Hours: 3
Marks: 100

BS 4th Year **Semester-VIII**

CHEMISTRY COURSE
APPLIED CHEMISTRY
Title of Course: Special Practical/Research Project/Review Paper (Literature Survey)
Special Practical/Research –II
Course code: CHEM-679/689
Credit Hours: 2
Marks: 100

BIOCHEMISTRY

4th Year **Semester-VII**

CHEMISTRY COURSE

BIOCHEMISTRY
Course Title: Biochemistry
Paper-IV
Course Code: CHEM-681.3
Credit Hours: 3
Marks: 100
Title of the Course: Physiological Chemistry and Chemotherapy

Course Objectives
The course presents a comprehensive account of the principles of physiological chemistry and the structure and applications of some important drugs and antibiotics.

Course Contents

Physiological Chemistry
Respiration: Structure and function of lungs. Physical exchange of gases, Transport of oxygen by blood, Transport of CO2 in blood. Buffer system of the blood. Acid-Base balance.
Kidney: Structure and function of nephrons. Formation of urine, Filtration, Glomerular filtration rate. Action of the tubule, Reabsorption of Na, Cl and water. Loop of Henle.
Structure and function of muscle tissues, Nerve tissues and Connective tissues. Nerve conduction and sensory system.
Chemotherapy
Structure and mode of action of antipyretics, analgesic, antimalarials, supha-drugs, antibiotics with special reference to penicillin, sulphanilamides. Mechanism of drugs action and resistance.

Recommended Books

1. Guyton, A.C.; and Hall, J. E., *Text Book of Medical Physiology*, 9th ed. W. B. Saunders Company, Tokyo, 1996.
2. Wilson,C.O.; Gisvold, O.; Deorge, R. F., Text Book of Organic Medicinal & Pharmaceutical Chemistry, 7th ed. J.B. Lippincott Company, Philadelphia, Toronto, 1977.
3. Gilman, A. G.; Goodman, L. S.; Rail, T. W.; Murad, F., *The Pharmacological basis of Therapeutics*, Macmillan, 7th ed. New York, 1985.

Supplementary Reading Material

1. Smith, E.L.; Hill, R.L.; Lehman, I.R.; Lefkowitz, R.J.; Handler, P.; White, A., *Principles of Biochemistry (Mammalian Biochemistry)*, 7th ed. McGraw-Hill Companies Inc., New York, 1984.
2. West, W. R.; Todd, H. S., *Text Book of Biochemistry*, 4th ed. Macmillan, London, 1968.
3. Jacob, L. S., *Pharmacology*, 3rd ed. Harwal publishing Company, Malvern, Pennsylvania, 1992.

4th Year **Semester-VII**

CHEMISTRY COURSE

BIOCHEMISTRY
Course Title: Biochemistry
Paper-V
Course Code: CHEM-682.3
Credit Hours: 3
Marks: 100
Title of the Course: Microbiology and Immunology

Course objectives
The course aims at giving introduction to full range of microbial life, beneficial and adverse interations between microbes and humans and an overview of environmental, industrial and food microbiology. The course will also provide basic knowledge of chemical, cellular and molecular immunology required to understand basic concepts of immune responses.

Course Contents

Fundamentals of Microbiology: Prokaryotic cell structure and function, Prokaryotic growth and nutrition. Prokaryotic genetics.

Introduction to virus (bacteriophage): fungi, bacteria and common parasites.

Bacterial Diseases: Airborne, Food borne and waterborne bacterial diseases.

Industrial Microbiology and Biotechnology: Microorganisms in industry. Alcoholic beverages. Other important microbial products

Immunology:
Chemistry of immunoglobulins, antigens. Characteristics of antigens and antibody reactions. myeloma and hybridoma immunoglobulins. Immune system and its abnormalities. Allergy and inflammation. Complement system, peripheral leucocytes and macrophages.

Immune Disorders

Type I IgE-Mediated Hypersensitivity, other types of hypersensitivity. Autoimmune disorders. Immunodeficiency disorders.

Recommended Books

1. Prescott, L.M.; Harley, J.P.; Klein, D.A., *Microbiology*, 6th ed. McGraw Hill Companies Inc. New York, 2005.
2. Kuby. J., *Immunology*, 2nd ed. W. H. Freeman & Company, New York, 1994.
3. Nester, E.W.; Anderson, D.G.; Roberts, C.E.; Pearsall, N.N.; and Nester, M.T., *Microbiology*, 4th ed. McGraw Hill Companies Inc, New York, 2004.

Supplementary Reading Material

1. Stanier, R. Y.; Ingraham, J.L.; Wheelis, M. L.; Painter, P. R., *The Microbial World*, 5th ed. Prentice- Hall, New Jersey, 1986.
2. Doan, T.; Melvold, R.; Viselli, S.; and Waltenbaugh, C., *Immunology: Lippincott Illustrated Reviews*, Lippincott Williams& Wilkins, Philadelphia, 2008.
3. Stroll, W.A.; Rouse, H.; Champe, P.C.; Harvey. R.A., *Microbiology Lippincott Illustrated Reviews*, Lippincott Williams& Wilkins.

4th Year **Semester-VII**

CHEMISTRY COURSE

BIOCHEMISTRY
Title of the Course: Nutrition
Paper-VI
Course Code: CHEM-683.3
Credit Hours: 3
Marks: 100

Course Objectives
The course is designed to assist the students to acquire knowledge of biochemical composition of different foods, energy needs and nutritional requirements of different age groups. The course will also cover a comprehensive account on minerals and vitamins as essential components of nutrition.

Course Contents
Major Dietary Constituents. Principles of nutrition. Nutritional importance of Carbohydrates, Proteins, Amino Acids, Lipids, and Dietary fiber. Energy Needs. Assessment and requirement of energy in different age groups. Calorimetry, RQ and BMR. Nutrition in Growth and Aging (Nutritional requirement during infancy, childhood, adolescence and elderly).

Minerals.
Biochemical role of Calcium, Chromium, Copper, Iron, Iodine, Magnesium, phosphorous, Selenium, and Zinc. Their dietary sources, 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, Biotin and Ascorbic acid.

Recommended Books

1. Thorpe, W. V.; Bray, H. G.; James, S., *Biochemistry for Medical students*, 8th ed. J. & A. Churchill Ltd., London, 1996.
2. Shils, M.E.; Olson, J.A.; Shike, M., *Modern Nutrition in Health and Disease*, 8th ed. Lea & Febiger, Philadelphia, 1994.
3. Brody, t., *Nutritional Biochemistry*, 2nd ed. Academic Press, San Diego, CA, 1999.

Supplementary Reading Material

1. Wardlaw, G. M.; Lusel,P. M.; Seyler, M. F.,*Contemporary Nutrition issues & insights*, Mosly Year Book,Inc. USA, 1992.
2. Passmore, R.; Eastwood, M.A., *Human Nutrition and Dietetics*, 8th ed. Churchill Livingstone, London, 1986.
3. www.foodsci.ucdavis.edu/fst/courses/fstexpcourse.html
4. www.tanf.co.uk/journals
5. Belitz, H.; Schieberle. P.; Grosch, W., *Food Chemistry*, 3rd ed. Springer-Verlag, 2004.

4th Year **Semester-VII**

CHEMISTRY COURSE

BIOCHEMISTRY
Practical-II
Course Code: CHEM-684
Credit Hours: 1
Marks: 25

Experiments based on theory topics covered in Paper IV, V, and VI.

4th Year **Semester-VIII**

CHEMISTRY COURSE
BIOCHEMISTRY
Elective Course-II (other than the field of Specialization)
Course Code:
Credit Hours: 3
Marks: 100

4th Year **Semester-VII**

CHEMISTRY COURSE

BIOCHEMISTRY

Title of Course: Special Practicals/Research Project/Position Paper (Literature Survey) Special Practical/Research –II

Course Code: CHEM-679/689

Credit Hours: 02

Marks: 100

FUEL CHEMISTRY

4th Year **Semester-VII**

CHEMISTRY COURSE

FUEL CHEMISTRY
Course Title: Chemistry of Coal Conversion Processes-II
Paper-IV
Course Code: CHEM-681.8
Credit Hours: 3
Marks: 100

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 behaviour 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).

Supplementary Reading Materials:

1. Francis, W. “Fuels and Fuel Technology” Pergamon Press, London. (1980).
2. Merick, D. “Coal Combustion and Conversion Technology” McMillan Ltd., London (1984).
3. Berkowitz, N. “The chemistry of Coal” Elsevier Amsterdam. (1985).

4th Year **Semester-VII**

CHEMISTRY COURSE

FUEL CHEMISTRY

Course Title: Petroleum and Petrochemicals-II
Paper-V
Course Code: CHEM-682.8
Credit Hours: 3
Marks: 100

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).

Supplementary Reading Materials:

1. List, H.L. "Petrochemical Technology" Printice-Hall Englewood Cliffs, New Jersey. (1986).
2. Smith, M.L, Stinson, K.W. "Fuels and Combustion" McGraw Hill Book Company. Reprint by National Book Foundation in (1972).
3. Goodger, E.M. "Hydrocarbon Fuels" Union Brothers Ltd, London. (1975).
4. Maleev, V.L. "Internal Combustion Engines" McGraw Hill Book Company London, (1985).
5. Hughes, J.R., and Swindells, N.S. "Storage and Handling of Petroleum Liquids" Charless Griffin and Company Ltd, London. (1987).

4th Year **Semester-VII**

CHEMISTRY COURSE

FUEL CHEMISTRY

Course Title: Characterization of Fossil Fuels by Advanced Instrumental Techniques -II
Paper-VI
Course Code: CHEM-683.8
Credit Hours: 3
Marks: 100

Course objectives

The students will acquire knowledge of the state of the arts spectroscopic techniques currently used in modern refineries and research organizations for characterization, structure elucidation and identification of various soiled, liquid and gaseous fuels.

Course Contents

Mass Spectrometry: Basic principles, Inlet systems, Ionization sources, Mass analyzers, Single and double focusing mass spectrometers, Interpretation of a mass spectrum and fragmentation processes, Application of mass spectrometry in characterization of fossil fuels.

Chromatography: Introduction to chromatography, Classification of chromatographic separations, Elution chromatography, Theory of elution chromatography, Gas chromatograph, Types of liquid chromatography, HPLC, Chromatographic columns, Chromatographic detectors, Application of chromatography in characterization of fossil fuels.

X-ray Fluorescence spectrometry: General theory, X-ray tube and radioactive sources, Wave length-dispersive and energy dispersive, X-ray fluorescence spectrometers, Quantitative X-ray fluorescence analysis, Application of X-ray fluorescence.

Nuclear Magnetic Resonance Spectroscopy: General theory and principles, Spinning nuclei, Larmor frequency and equation, The Boltzman distribution and nuclear relaxation processes, The chemical shift, Shielding and deshielding of the protons, Spin-spin coupling, The N.M.R. spectrometer, Theory of electron spin resonance spectroscopy, Hyperfine splitting in E.S.R. Application of N.M.R.

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)

Supplementary Reading Materials:

1. Karr, C. "Analytical Methods for Coal and Coal Products" Academic Press, New York. (1978)
2. Kemp, W. "Organic Spectroscopy" The MancMillan Press Ltd London (1994).
3. Skooge, D.A."Instrumental Analysis". Sanat Printer, Indian Edition,2009.

4th Year **Semester-VII**

CHEMISTRY COURSE

FUEL CHEMISTRY
Practical-II
Course Code: CHEM-684
Credit Hours: 1
Marks: 25

Experiments based on theory topics covered in Paper IV, V, and VI.

4th Year **Semester-VIII**

CHEMISTRY COURSE
FUEL CHEMISTRY
Elective Course-II (other than the field of Specialization)
Course Code:
Credit Hours: 3
Marks: 100

4th Year **Semester-VII**

CHEMISTRY COURSE

FUEL CHEMISTRY

Title of Course: Special Practicals/Research Project/Position Paper (Literature Survey) Special Practical/Research –II

Course Code: CHEM-679/689

Credit Hours: 02

Marks: 100

GENERAL COURSES

Annexure "A"

THE HEC recommended List of General Courses:
(Proposed in NCRC special meeting in Chemistry)

Semester-I
General-I
Course Title: Logic & Critical Thinking
Course Code: GEN-311 (GEN-I)
Teacher: Dr. Shuja Ahmad
Credit Hours: 3
Marks: 100

Semester-I
General -II
Course Title: History of Human Civilization
Course Code: GEN-312 (Gen-II)
Teacher: Dr. Mukhtar Ali Durrani
Credit Hours: 3
Marks: 100

Semester-II

General-III

Course Title: Social Psychology
Course Code: GEN- 322 (GEN-III)
Teacher: Ms. Ruqea Gul
Credit Hours: 3
Marks: 100

Semester-III
General =IV

Course Title: **Philosophy of Science**
Course Code: GEN-431 (Gen-IV)
Teacher: Mian Sohail
Credit Hours: 3
Marks: 100

Semester-III
GEN-V

Course Title: **Principles of Management**

Course Code:GEN-432 (Gen-V)
Teacher: Dr. Sajjad
Credit Hours: 3
Marks: 100

1. Community Development
2. Environmental Sciences
3. Principles of Management
4. Logic and Reasoning
5. Teaching and Learning
6. Social Issues of Pakistan
7. Entrepreneurship
8. Human Resource Management
9. Basic Financial Management
10. History of Human Civilization
11. History of Science

GENERAL COURSE

Course Title: Education Psychology
Course Code: GEN-441
Credit Hours: 3
Marks: 100

Course Objective

To familiarize students with concept of educational psychology, personality development, effective learning & teaching, role of research, current issues/problems of education, etc.

Course Contents

1. Aims of Education
   - Meaning and types of Education
   - General aims of education
   - Aims of education in Pakistan
   - Philosophical, sociological and psychological foundations of education

2. The Nature of Learning
   - Theories of learning (behavior and cognitive)
   - Factors affecting leaning

3. Individual Differences
   - The nature nurture debate
   - Models of intelligence
   - Measuring intelligence
   - Emotional intelligence (EQ)
   - Learners with exceptional abilities

4. Personality Development
   - Theories of personality
   - Assessment of personality
   - Personality and achievement

5. Role of Teachers in the Process of Education
   - Qualities of a good teacher
   - Educational technology
   - Teaching strategies

6. Assessment
   - Assessment, measurement, evaluation and testing
   - Types of assessment

7. Research Paradigms
   - Qualitative Research Method

Quantitative research Method
Mixed Research (or mixed method research)
Ethics in research

8. Education in Pakistan
   System of Education in Pakistan
   Literacy rate
   Education policies
   System of examination in
   Pakistan (strengths and limitation)
   How to improve system of education in Pakistan?

Recommended Books

Krause,K.L., Duchesne,S.,&Sandra(2003). Psychology of teaching and learning. Nilson Australia: Pvt Limited.
Jonsons,B., & Christensen,L.(2008). Educational Research(3rd ed).London:Sage Pvt.
Mangal,S.K.(2003)Advanced Educational Psychology, New Delhi:…
Child,D.(1993).Psychology and teacher,Leeds: UK.
Lindzey,H.(1957).Theories of personality, New York
Hilgard.R,(1975). Thoeries of learning.USA: Printice Hall.
Robert,T.(1955). Measurement &Evaluation in Psyshology and Education Hohn Wiley.
Aggarawal,J.C.(1994).Essentials of Educational psychology.New Delhi: Vikas Pumlishing HouseTVT LTD.
Misra, B.(2008). Current issues in modern education ,New Delhi:Mohit Publications.
Stephen D.Brookfield(1990).The skillful teacher Sanfrancisco:John Wiley&Sons,Inc.
Guy R.Lefrancois(2000). Thories of human learning (4th ed) USA:Wadsworth.
Bhatia,K.K.(2004).Psychological foundations of Education.New Delhi:Ajit Printers.
UNESCO report on Education 2008
Educational policies, commissions, Reports(1947 through 2010)

GENERAL COURSE
Course Title: LOGIC & CRITICAL THINKING
Course Code: GEN-100
Credit Hours: 3
Marks: 100

Course Objectives:
To familiarize students with basic concepts of logic

Contents

Introduction: What is logic ?, Argument, Premises and Conclusions, Deduction and Induction, Truth and Validity.

The Uses of Language:

Three basic functions of language.
Discourse serving Multiple Functions.
Kinds of Agreement and Disagreement.
Emotively Neutral Language.

Fallacies

Fallacies of Relevance.
Fallacies of Ambiguity.
Avoiding Fallacies **.**

Deduction

Disputes, Verbal disputes and Definitions.
Kinds of definitions and Revolution of disputes.

Categorical Syllogism:

Categorical Propositions and classes.
Quality, Quantity and Distribution.
Symbolism and Diagram for Categorical Syllogism.
Standard-Form Categorical Syllogism.
Venn-Diagram technique for Testing Syllogism.
Rules and Fallacies.

Symbolic Logic:

The values of Special symbols.
The symbols for Conjunction, Disjunction and Negation.
Conditional Statements and material implication.
Truth tables
Statement form Material Equivalence, and Logical Equivalence
The Three " Laws of Thought". (Method of deduction).
Rules of inference.
Rules of replacement.
Formal proof of validity.

Induction:

Analogy and Probable Inference:

Argument by Analogy.
Appraising Analogical Argument.

Casual Connections:

The meaning of "Cause".
Mill!s Methods of Experimental Inquiry

A Brief Introduction of Science and Hypothesis:

The values of science.
Explanations: Scientific and Unscientific.
Evaluating Scientific Explanation.

Required Reading:

1. Copi, Irving M., *Introduction to Logic***,** New Yark Macmillan
2. Hurley, P.G., *Introduction to Logic***,** California, Worth Publishing Co.
3. Lemmon, E.J., *Beginning Logic***,** India – Polis Hachett Publishing Co.
4. Kearns, John T., *The Principles Of Deductive Logic*, *Albary* State University of New York Press
5. Jeffery, Riched, *Formal Logic: Its Scope And Limits,N*.Y. McGraw Hills.

GENERAL COURSE

Course Title: **Philosophy of Science**
Course Code: GEN-431
Credit Hours: 3
Marks: 100

Course Objectives:

Course Contents:

Greek Period; Physics, Astronomy, Maths and Biological ideas of the lonians, Pythagorians and Athenians Scientists/Philosophers are dealt with. Middle ages/Islamic periods; The Astronomy and Physics of the Alexandrians and ideas of Muslim scientists in various fields. Renaissance; Copernican revolution and other Ideas and developments up to 17 th century. Scientific revolution of 17 th , 18 th, 19 th, century and Newtonian and Industrial revolutions. Some significant Developments in 20 th century. Introductory concepts of logics, social /Historical; Logic argument, validity. Truth, table method for proving validity. Logical positivism; background of logical positivism, intuitism, principals of verification and scientific proposition; critical evaluation. Proper falscicationism, background, hypothetico-deductive method, falsification as criterion of being scientific, nature of science. Quine,s Holism; Duhem- Quine Thesis or Holism, thesis of under determination, critical evaluation. Khuns,s Paragigms or Holism; the nature of scientific paradigm, paradigm shift or scientific revolution, revolutionary science versus ordinary science.

Recommended Books:

1. Irving M, Copi M (1984) 7 th edition, " Introduction of Logic" W>H Freeman and Company.
2. Peter G (2003) ist edition, "An Introduction to the Philosophy of Science" Chicago Press University.
3. Martin C, Cover J (1999) 1st edition, " Philosophy of Science" W.W. Norton Company Inc.

GENERAL COURSE

GEN-II
(code from other institution: none)
Course Title: History of Human Civilization
Course Code:GEN-101
Credit Hours: 3
Marks: 100

Course Objectives
After completing this course, students will know about the importance of selected famous civilizations of the world. They will know about their culture, economy, trade, & commerce, living habits, food , festivals, etc. with a deep understanding of the community living in the past and their impact on present.

Course Contents
Concept of Civilisation: Concept of culture and civilisation, elements of civilisation, basic conditions of civilisation

Mesopotamian Civilisation: Environmental background, chronology (3500–600 BC), socio-political set-up of the Sumerians, Akkadians, Babylonians, Assyrians and Chaldeans, Various aspects of civilisation: art, architecture, writing, seals, religion and economy

Egyptian Civilisation: Egypt geophysical history and its impact on local cultures, art and architecture, religion, writing system, contribution in literature, science, philosophy, medicine

Chinese Civilisation: Shang Dynasty, Chou Dynasty, Chen Dynasty, Han Dynasty, art and architecture, contributions in philosophy

Iranian Civilizationn : Origin of Iranian Civilization, Achaemenians: history and formation of their empire, Provincial administration system, Zoroastrian Religion, Art and architecture, Cyrus, Darius I and Darius II and Sasanians

Greek Civilisation: Origin and development of the Greek Civilisation, Origin of city states, Hellenic and Hellenistic phases, Art and architecture, Literature, Philosophy and Science

Roman Civilisation: Origin and development of Roman Empire, General characteristics of Roman Culture, Art and architecture, Philosophy and science and Roman Law

Recommended Books

Roaf, M. *Cultural Atlas of Mesopotamia and the Ancient Near East*

Durant, W. *Our Oriental Heritage,* New York, 1954

Ralph and Burns, *World Civilization,* New York, 1974

GENERAL COURSE

(code from other institution: Course BES-115)

Course Title: INTRODUCTION TO ENVIRONMENTAL SCIENCES
Course Code:
Credit Hours: 3
Marks: 100

Course Objectives
After completing this course students will be know about the basic concepts related to environmental sciences including components of environment, pollution, social issues, etc.

Course Contents

Definitions, history, movements, and Environmental systems: atmosphere, lithosphere, hydrosphere and biosphere, origin and inter-relationship. Environmental factors; chemical, physical and biological. Environmental pollution, types, sources, causes, effects. Environmental dilemmas; deforestation, water logging, salinity, drought and desertification. Issues of environment and sustainable development. Issues of the social environment; population growth, urbanization, migration and poverty Environment and lifestyle.

Recommended books

1. Botkin, D. & Keller, E. Environmental Sciences; Earth as a Living Planet. 8th ed. John Wiley and Sons, Inc. (2000).
2. Cunningham, W.P, & Saigo, B.W. Environmental Sciences 6th ed. McGraw-Hill (2001).
3. Enger, E.D. & Smith, B.F. Environmental Science: A study of Interrelationship. McGraw-Hill, (1997).
4. Kupchella, C.E. & Hyland. M.C. Environmental Science; Living within the System of Nature. Prentice Hall, (1986).
5. Nebel, B.J. & Wright, R.T. Environmental Sciences, 6th ed. Prentice Hall. New Jersey, (1999).

GENERAL COURSE

(Code from other institution: Course BES-115)

Course Title: SOCIAL PSYCHOLOGY
Course Code:
Credit Hours: 3
Marks: 100

Course Objectives:
Course Contents

i) Nature and Scope of Social Psychology
ii) Historical Perspectives
iii) Research Methods in Social Psychology
vi) Socialization
vii) Human Motivation and Social Perception
viii) Liking and Interpersonal attraction
ix) Altruism: Helping others
x) Conformity and compliance
xi) Attitude and attitude change; Measurement
xii) Group dynamics
xiii) Leadership: Theories of leadership and leadership training
xiii) Mass Media and Communication
xiv) Social Psychology and its applications.
xv) Prejudice and reducing prejudice
xvi) International images and improving international relations
xvi) Social Psychological problems in Pakistan (Ethnicity Violence etc)
NOTE: Theory and research findings must be included pertaining to each area.

BOOKS RECOMMENDED

1. Allport, G.W,(1958). *The Nature of Prejudice*, Addison Westly.
2. Berkowitz, L.S (1986). *Survey of Social Psychology*. (3rd edition). N.Y. CB-s Publishing.
3. Edgly A. & Chaiker, S (1989). *The Psychology of Attitudes.* N.Y: Hartcourt Brace.
4. Fisher, R. J (1982). *Social Psychology*: *An Applied Approach.* New York: St Martin Press.
5. Freedman, J.L. Sears D.O. & Carlsmith, J.M. (1981). *Social Psychology. (* 4th ed.). New York: Prentice Hall.
6. Goldstein J.K,(1986). *Aggression & Crimes of Violence*, Oxford University Press.
7. Myrers, G. (1982). *Social Psychology*. (International Student ed.) NY: McGraw Hill.
8. Myers, D.G.(1994). *Exploring Social Psychology*. NY: McGraw Hill.
9. Lindzey, G., & Aronson, E. (Eds.). *The Hand Book of Social Psychology*. Vol. I-V. London: Addison-Wesley.
10.. Pandey J. (Ed)(1981). *Perspectives on Experimental Social Psychology in India* New, Delhi; Concept Publishing Co.
11. Wayant, J.M (1986). *Applied Social Psychology.* Oxford University Press.

12. Tariq, P.(1983). *Socio-Psychological Aspects of Crime in Pakistan*, Islamabad: National Institute of Psychology.
13. Zaidi, S.M.H. (Ed.).(1975). *Frontiers of Psychological Research in Pakistan*. University of Karachi.
14 Saks, M.J and Krupat, E. (1988). *Social Psychology and its Applications* New York Harper & Row .
15. Secord, P.F. and Backman C.W. *Social Psychology*. London: McGraw Hill.
16. Krech, D., Crutchfield R.S & Ballachey, E.L (1992*). Individual in Society.* NY: McGraw Hill.
17. Schultz, D.P (1979).*Psychology in use: Introduction to Applied Psychology.* New York Macmillan Publishing Co.
18. Baron, R. A & Byrne, D.(1987). *Social Psychology*: *Understanding Human Interaction.* Boston: Allyn & Bacon,
19. Dodsteing, A.P, & Krasner, L.(1989). *Modern Applied Psychology.* New York: Pergamon Press.
20. Cartwright, D, & Zander, A. (1953). *Group Dynamics*. Evanston III: Row Peterson.
21 Wnightsman, L.S, & Deause, K *Social Psychology in the 80s.* (3rd ed.). Brooks/Cole Publishing Company
22. Krippendroff, K. (1990). *Content Analysis,* Sage Publications.

23. Journal of Personality & Social Psychology

24. Journal of Experimental Social Psychology

25. Journal of applied Social Psychology

26. Basic and Applied Social Psychology

27. Journal of Social Psychology

28. Sex Roles.

29. American Psychologist

30. British Journal of Social Psychology

GENERAL COURSE

Course Title: Fundamentals/ principles of Management
Course Code: GEN-432
Credit Hours: 3
Marks: 100

Course Objectives:

Students are expected to demonstrate a basic understanding in management and organizational behavior which includes the following topics:
• Management theories and practices in historical perspective
• Managerial roles and principles
• Cultures and their impact on organizations.
• Goal setting, planning, and fundamental strategic issues and motivation.
• Managerial decision making
• Organizational structure
• Control processes and performance standards
• Leadership

Course Contents

This course focuses on application. It is a broad overview of the field of management. It covers the functions of a manager, motivation, leadership and organization design. Students will complete a conflict profile designed to help them understand and improve their management and teamwork skills.

Texts:

Williams, Chuck. Management, 4th or 5th .ed. Thomson South-Western, Mason OH. ISBN:0324317158

GENERAL COURSE

Course Title: Community Development
Course Code:
Credit Hours: 3
Marks: 100

Course Objectives:

Course Contents:

I. INTRODUCTION TO COMMUNITY DEVELOPMENT
- 1.1 Meaning
- 1.2 Historical Development
- 1.3 Participatory Approaches and Methods
- 1.4 United Nations and Community Development Programme

II. HISTORY OF COMMUNITY DEVELOPMENT PROGRAMME IN PAKISTAN
- 2.1 Before Partition in the sub continent
- 2.2 After Partition-Specially V-AID Programme

III. COMMUNITY CONCEPTS AND DEFINITIONS
- 3.1 Nature of Community
- 3.2 Methodology and Organization of Community Development
- 3.3 Role of Social Welfare Councils in Community Development
- 3.4 Role of Motivation in Community Development
- 3.5 Social Organization and Social Organizer

IV. COMMUNITY ORGANIZATION AND RELATED SERVICES:
- a. Family and Child Welfare
- b. Cottage Industries, Income Generating Programmes, Protective Employment opportunities
- c. Adult Education, Skill Development
- d. Health and Housing, Sanitation Development in Rural/Urban Areas of Pakistan

V. CO-OPERATION AND COMMUNITY DEVELOPMENT
- 5.1 Principles and Methods of Co-operation
- 5.2 History of Co-operative Movement in Pakistan

COMMUNITY DEVELOPMENT

SUGGESTED READINGS

S.NO.	A U T H O R	T I T L E
1.	Hodgo Peter	Community Organization. London, Roultedge and Kagan Paul.
2.	MacMillan.	Community Organization. University of Chicago
3.	Pearaman, R. Etal.	Community Organization and Social Planning. New York, Harcourt, Brueo and Company
4.	Ross, Murry, G.,	Case Histories in Community Organization. New York, Harper Brother.
5.	Grosser, Charles, F.	New Direction in Community Organization. London, Pareger Publisher, 1973.
6.	Mozirow, Jack, D.	Dynamics of Community Development. New York, The Fleare Crow Press.
7.	United Nations	Popular Participation in Development Emerging Trends in Community Development. New York, UN. Publication Sale No.F/71, NO.6
8.	Leapiere, R.A.B.	Community Work. National Council of Social Services, 26 Bedford Square.
9.	King, Co.	Working with People in Community Action. New York, Association Press.
10.	Mrs. Sahib Zari Rafique	Techniques and Methods in Community Development. Department of Social Work, University of Peshawar, 1985.

GENERAL COURSE

Course Title: Entrepreneurship
Course Code:
Credit Hours: 3
Marks: 100

Course Objective

To familiarize students with concept entrepreneurship, entrepreneurial process, assess their competencies, exploring profitable business ventures, to experience real life market situation.

Course Contents

Entrepreneurial Process, Opportunity recognition, (search for higher ventures), entry strategies, Market opportunities and marketing, creating a successful business plan.

Recommended Books

- H.N Broom & J. G. Ccongenecker, Small Business Management, South Western Publishing Company.
- Dan Steinhoft, Small Business Management Fundamentals, N. Y., McGraw Hill.
- Herberk G. Hicks & C. RayGullet, Modern Business Management (A System & Environmental Approach, N. Y., McGraw Hill.

Reading List

1. Swenson, H. N and Woods, J. E., "Physical Science for Liberal Arts Students" New York: John Wiley & Sons.
2. Bhatti, I. A., "Everyday Science", Lahore: Bhatti Publishers.
3. Salom, A. "Science and Education in Pakistan", Italy: Pub. Third World Academy of Sciences.
4. Hiskis, A. L. and Hiskes, R.P., "Science, Technology and Policy Decisions", U.S: Westview Press.
5. Newspapers and Scientific Magazines.

GENERAL COURSE

Course Code

Title: Teaching and Learning
Course Code:
Credit Hours; 3
Marks: 100

COURSE OBJECTIVES
The following are the main objectives of the Course.

1. To understand the concept and meaning of education.
2. To enable students to understand skills of teaching.
3. To enable students to understand effective learning skills.
4. To keep the classroom environment conducive to learning.
5. To inculcate in the students the purpose of effective teaching and high professional standards.
6. To acquaint students with the problems and issues in education.

Unite No. 1.

i. Education, its aims and goals.
ii. Blooms Taxonomy of Educational objectives
iii. Philosophical, Sociological and Psychological foundations of Education.
iv. Technologies in Education.

Unite No.2.

i. Teaching Skills.
ii. Learning Skills.
iii. Process of Learning.
iv. Some theories of Learning.

Unite No.3

i. Lesson Planning.
ii. A.V Aids and its Importance.
iii. Mentoring.
iv. Components and concept of Intelligence.

Unite No. 4

i. Personality development.
ii. Leadership Concept.
iii. Motivation, Intrinsic & Extrinsic.
iv. Mental Health approach.

Unite No. 5

i. Measurement & Evaluation.
ii. Tests & kinds of tests.
iii. Planning, Control & Direction.

iv. Development Tasks.

Unite No. 6

i. Guidance & counseling.
ii. Functions & Philosophy of Guidance.
iii. Problems of Students & Teachers.
iv. Therapeutic approaches & need of Counselling etc.

Unite No. 7

i. System of Education in Pakistan.
ii. Education Polices.
iii. System of Examination in Pakistan.
iv. Status of Teachers in Pakistan.

Unite No. 8

i. Rewards & Punishment.
ii. Role of Teacher in the Education.
iii. Role of Parents & community.
iv. Literacy Rate, Population and Environment.

Unite No.9

i. Methods of Teaching Arts/ Sciences.
ii. English as Medium of Instruction.
iii. Four Elements of Language Teaching.
iv. Qualities of Good Teacher.

Unite No. 10

i. Research in Education.
ii. Kinds of Research / Repot Writing etc.
iii. Curriculum & Text Book Development.
iv. The use of Computer in Education.

REFERENCES:-

1. Denis Child 1993 Psychology and Teacher, Leeds U.K
2. Hall/ Lindzey 1957 Theories of Personality, New York
3. Hilgard. R, 1975 Theories of Learning, Prentice Hall U.S.A
4. Mc Daniel Henry. B 1956 Guidance in Modern Schools, New York
5. Sawery & Telford Advance Educational Psychology.
6. Thorndike, Robert. L 1955 Measurement & Evaluation in Psychology and Education, Hohn Wiley Sons Inc

Biotech-361	**(3+1 Credit Hours)**	**(100 marks)**

Course Assessment Method:
Assessment through external examiner (75% marks in theory + 25 marks in practical)

Course Prerequisites:
The students studying this course should have a sound knowledge of molecular biology and basics in computer offered in biotechnology.
Course of bioinformatics has the following objectives

a) To get an introductory knowledge about bioinformatics and its applications in various fields of life sciences.
b) To introduce the different databases of biomolecules e.g. protein date bank (PDB), gene banks etc
c) To learn the methods of retrieving the knowledge from these different databases,
d) To learn and practice the tools available for protein structure analysis.

Learning objectives:
After successful completion of this course

a) The students will be familiar with all biological databases
b) They will be able to search and get information from these databases
c) They will be able to submit their findings to these databases.
d) They be able to use different tools abd softwares available online for protein structure prediction and analysis.

Course Contents:

Molecular biology databases; DNA sequence databases (EMBL, GenBank, DDBJ). Protein sequence databases; (SWISS-PROT) PIR. Information retreval and database searching genomes, bacterial genome, protozoan genome, yeast genome invertabrate genomes, drosophila genome, mouse genome project, human genome project, plant genome project, plant genome project. Sequence Analyses; pair wise and multiple sequence alignment, pattern searches, profiles secondary structure prediction, phylogenetic analysis, WWW-based sequence analysis tools. Proteomics.

Recommended Books:

1. Claverie J, Cedric N (2003) “Bioinformatics-A Beginner’s Guide” Wiely publishing, lnc, USA.
2. Subramanian C (2001) 2nd edition, A Textbook of Bioinformatics” dominant publishers and Distributes New Delhi.
3. Gibas C, Jambeck P (2001) 1st edition, Developing Bioinformatics Computer Skills” O Relly & Associates, lnc. USA.
4. Stephen M, Setphen A (2000) 1st editions, “Bioinformatics” methods and protocols” Humana Press Totowa, New Jersey, USA.

5. Westhead D, Parish J Twyman R (2003) 2nd edition, “The Instant Noes series; Bioinformatics”, BIOS Scientific Limited, Oxford, UK.
6. Begeron B (2003) 1st edition “Bioinorganic Computing”, Prentice-Hall, lnc.
7. Higgins D, Taylor W (2005) 2nd edition “Bionorganic, sequence structure and detabank-A practical Approach” Oxford University Press.
8. Teresa k, David J, Smith P (2005) 2nd edition, “introduction to Bioinformatics” Pearson education Company.
9. Andreas d, Francis B (2000) 1st edition, “Bioinformatics-A practical Approach” John Wiley & Sons lnc.
10. Philip E, Healge W, Wiley L (2003) 1st edition, “Structural Bioinformatics” John Wiley & Sons lnc.

Biotech-122	**(3 Credit Hours)**	**(100 marks)**

Course Assessment Method:
Assessment through external examiner (100 marks)

Course Prerequisites:
The students studying this course should have a sound knowledge of F.Sc/A level biology and also principles of genetics offered in biotechnology.

Learning objectives:
Biotechnology has the direct influence on human life as it provides many benefits in fields such as, human health, drug industry, improved agriculture, food quality and improved yield in many fields. The basic knowledge has its objective as following;

a) Historical background of biotechnology.
b) The benefits of biotechnology in terms of health, agriculture and livestock.

Learning Outcomes:
This course includes the key areas of biotechnology and its role in shaping the worlds today. This has been structured for the students to understand theat how biotechnology would bring about a radical change in global economical and industrial context. Students will know about the basics of,

a) Tissue culture technique ,
b) Industrial importance of biotechnology,
c) Bioprocessing and genetic engineering and
d) Medical Biotechnilogy

Course Contents:
Historical background. Biotechnology– an interdisciplinary pursuit, scope and applicatin. Genetic engineering; history and application. Genenome, organization and basic tools of genetic engineering introduction to role of enzymes in industrial product synthesis. Tissue culture; importance, concept of totipotency, history of tissue culture. Details of culture techniques (explants, sterilization, growth, differentiation etc). Bioprocess and fermentation technology; introduction & principles of microbial growth. Important products formation. Bioreactor/ Fermenter technology (introduction & principle). Biotechnology & medicine: introduction pharmaceuticals and biopharmaceuticals, antibiotics, vaccines etc. introduction to gene therapy and AIDA. Biotechnology in agriculture & forestry; introduction, disease and resistant herbicide plants, micro propagation virus-free potatoes, herbicide resistant croops (Bt crops). Biotechnology for better animal production. Food and beverage technology: introduction, food & beverage fermentation, public acceptance & safety.

Recommended Books:
1. William j, Thieman J, Michael A (2003) 2nd edition, “introduction to Biotechnology” Mc Graw hill Book company, lnc.
2. Dubey R (2000) 1st edition “A text Book of Biotechnology” S Chand Publication
Subhan saib

PHARMACEUTICS-I (PHYSICAL PHARMACY) (WRITTEN)

Marks: 100

1. PHARMACY ORIENTATION:
   Introduction and orientation to the professional of Pharmacy I relation to Hospital Pharmacy, retail Pharmacy, Industrial pharmacy, industrial Pharmacy, Forensic Pharmacy, Pharmaceutical education and research etc.

2. HISTORY AND LITERATURE OF PHARMACY:
   a) A survey of the history of pharmacy through ancient, Greek and Arab periods with special reference to contribution of Muslim scientists to pharmacy and allied sciences.
   b) An introduction of various official books.

3. PHYSICO-CHEMICAL PRINCIPLES:
   a) solutions: Introduction, types, concentration expressions, ideal and real solution, colligative properties, their mathematical derivations and application in pharmacy, molecular weight determinations, distributions co-efficient and its applications in pharmacy
   b) solubilization: solubility factors affecting solubility, surfactants, their properties and types. Micellers, their formulation and types.
   c) Ionization, pH, pH indicators, pka, , buffer's equation, isotonic solution and their applications in pharmacy
   d) Hydrolysis, types and protection of drugs against hydrolysis,
   e) Micromeritics: Particle size and shapes, distribution of particles methods of determination of particle size and importance of particle size in Pharmacy.

4. DISPERSIONS:
   a) Colloids: Types, methodsof preparation, properties (optional, kinetic, electrical) Dialysis and artificial kidney, stability of colloids, protection and sensitization phenomenon and application of colloids in Pharmacy.
   b) Emulsions: Types, thories of emulsification, emulsifying agents their classification and stability of emulsion.
   c) Suspensions: Type Methods of Preparation, properties.suspending agents, their classification and stability.
   d) Adsorption: Techniques and process of adsorption in detail.

5. RHEOLOGY:
   a) Definition and Fundamental concept.
   b) Properties contributing to Rheological behaviour.
   c) Graphic presentation of Reheological data.

6. PHYSICOCHEMICAL PROCESSES:
   a) Precipitation: Process of precipitation and its applications in pharmacy.
   b) Crystallization: Types of crystals, Mechanism and methods of crystallization and its applications in pharmacy,

c) Distillation: Simple, fractionsl, steam distillation, vacuum distillation, destructive distillation and their applications in Pharmacy.
d) Miscellaneous Process: Efflorescence, deliquescence, lyophillization, elutrition, exiccation, ignition, sublimation, fusion, calcinations, adsorption decantation evaporation, vaporization, centrifugation, dessication, levigation and trituration.

7. RATE and ORDER OF REACTIONS.

8. Kinetic Principles and stability testing: theoretic considerations: Degradation:
a) Physical factors: influence of pH, temperature, ionic strength, acid-base catalysis, U.V. light.
b) Chemical Factors: Complex chemical reactions. Oxidation-reduction, hydrolysis.

PHARMACEUTICS-I (PHYSICAL PHARMACY) PRACTICAL

Paper 9 Marks: 100

Note: Practicals of the subject shall be designed from time to time on the basis of the above mentioned theoretical topics and availability of the facilities, e.g.

1. Experments to demonstrate some of physcio-chemical process like simple distillation, steam distillation, crystallization, Dialysis**.**

2. Determination of Emulsion system.

3. Determination of participle size.

4. Preparation of Buffer solutions and isotonic solution.

5. Determination of %age composition of solutions by specific gravity method.

6. Partition-coefficient, surface tension, viscosity.

Recommended Books

1. Martin, **Physical Pharmacy,** B I Waverly PVT, Delhi, 4th Ed., 1994.
2. Cooper and Gunms **Tutorial Pharmacy**, CBS Publishers & Distributors, New Delhi, 1986.
3. **Bentley's Pharmaceuties**, All India Treveler Book Seller, New Delhi, 1996.
4. Martin P, Bustamante P and Chun, **Physical & Chemical Principles of Pharmaceutical Sciences**. Academic Press, London, 1985.
5. Martin AMN, Banker G S and Chun AHC **Advances in Pharmaceutical Sciences**. Academic Press, London, 1985.
6. Mill C C Casson, N. **Rehology of disperses systems**. Pregamon Press, New York, 1975.
7. Rienger M and Scott-Blair. G,W **Rehology**. Academic press, London, 1990.
8. Barry B W **Advances in Pharmaceutical Sciences**, Academic Press, London 1990.
9. Sherman P **Emulsion Science**, Academic Press, London, 1972.
10. Martin A, Swarbrick J and Camatra A **Physical Pharmacy**, 3rd Ed., Lee & Febiger, Philadelphia. 1983.
11. Attwood d and Flocence A T **Surfactant Systems**. Champman and Hall Ltd, London, 1982.