

**CURRICULUM
OF
CHEMISTRY
BS (4-YEAR)**

2008



**HIGHER EDUCATION COMMISSION
ISLAMABAD**

CURRICULUM DIVISION, HEC

Dr. Syed Sohail H. Naqvi	Executive Director
Prof. Dr. Riaz ul Haq Tariq	Member (Acad)
Miss. Ghayyur Fatima	Deputy Director (Curri)
Mr. M. Tahir Ali Shah	Assistant Director
Mr. Shafiullah Khan	Assistant Director

TABLE OF CONTENTS

1.	Introduction.....	7
2.	Objectives	17
3.	Frame Work/Template for BS (4-YEAR) in Chemistry	11
4.	Scheme of Studies for BS (4-YEAR) in Chemistry	12
5.	Details of Courses for BS (4-YEAR) in Chemistry	18
6.	Details of Compulsory subjects (Annexures A, B, C, D, E & F).....	91

PREFACE

Curriculum development is a highly organized and systematic process and involves a number of procedures. Many of these procedures include incorporating the results from international research studies and reforms made in other countries. These studies and reforms are then related to the particular subject and the position in Pakistan so that the proposed curriculum may have its roots in the socio-economics setup in which it is to be introduced. Hence, unlike a machine, it is not possible to accept any curriculum in its entirety. It has to be studied thoroughly and all aspects are to be critically examined before any component is recommended for adoption.

In exercise of the powers conferred by sub-section (1) of section 3 of the Federal Supervision of Curricula Textbooks and Maintenance of Standards of Education Act 1976, the Federal Government vide notification No. D773/76-JEA (cur.), dated December 4th 1976, appointed the University Grants Commission as the competent authority to look after the curriculum revision work beyond class XII at the bachelor level and onwards to all degrees, certificates and diplomas awarded by degree colleges, universities and other institutions of higher education.

In pursuance of the above decisions and directives, the Higher Education Commission (HEC) is continually performing curriculum revision in collaboration with universities. According to the decision of the special meeting of Vice-Chancellor's Committee, the curriculum of a subject must be reviewed after every 3 years.

A committee of experts comprising of conveners from the National Curriculum Revision of HEC in Basic, Applied Social Sciences and Engineering disciplines met in April 2007 and developed a unified template to standardize degree programs in the country to bring the national curriculum at par with international standards, and to fulfill the needs of the local industries. It also aimed to give a basic, broad based knowledge to the students to ensure the quality of education. The new BS degree shall be of 4 years duration, and will require the completion of 130-136 credit hours. For those social sciences and basic sciences degrees, 63.50% of the curriculum will consist of discipline specific courses, and 36.50% will consist of compulsory courses and general courses offered through other departments.

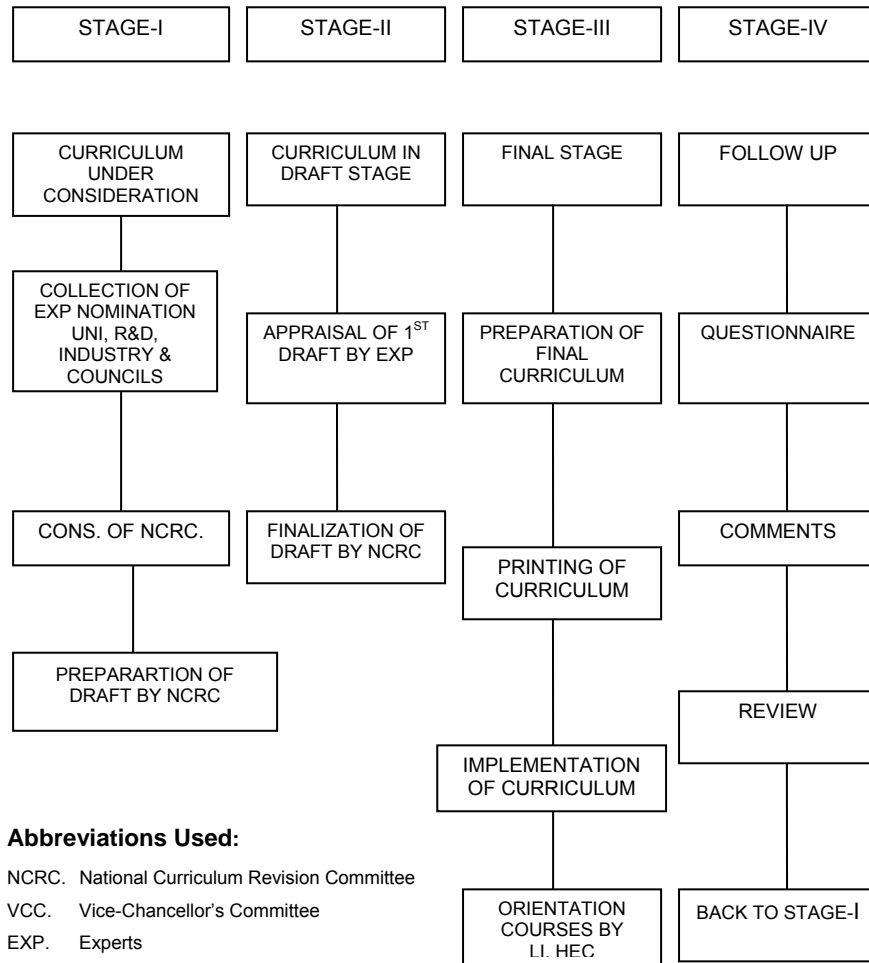
For the purpose of curriculum revision various committees are constituted at the national level, comprising of senior teachers nominated by universities, degree awarding institutions, R&D organizations and respective accreditation councils. The National Curriculum Revision

Committee for chemistry in a meeting held on March 10-11, 2008, at the HEC Regional Center, Lahore, in continuation of its earlier meeting held on October 30-31, 2007, at HEC Regional Center, Karachi, revised the curriculum in light of the unified template. The final draft prepared by the National Curriculum Revision Special Committee, duly approved by the competent authority, is being circulated for implementation in the concerned institutions.

DR. RIAZ-UL-HAQ TARIQ
Member Academics

June 2008

CURRICULUM DEVELOPMENT



Abbreviations Used:

- NCRC. National Curriculum Revision Committee
- VCC. Vice-Chancellor's Committee
- EXP. Experts
- COL. Colleges
- UNI. Universities
- PREP. Preparation
- REC. Recommendations
- LI Learning Innovation
- R&D Research & Development Organization
- HEC Higher Education Commission

INTRODUCTION

The Final meeting of National Curriculum Revision Committee (NCRC) in Chemistry was held at HEC Regional Centre Lahore on March 10-11, 2008. This Meeting was a follow up of the previous meeting held on October 30-31, 2007 at HEC Regional Centre, Karachi. The following attended the meetings.

- | | | |
|----|---|----------|
| 1. | Prof. Dr. Fahim Uddin
Adjunct Professor
Department of Chemistry
University of Karachi, Karachi | Convener |
| 2. | Prof. Dr. G. A. Miana
Rector / Director R & D
Riphah Institute of Pharmaceutical Sciences
7 th Avenue, G-7/4, Islamabad | Member |
| 3. | Prof. Dr. Muhammad Shahid Ansari
Department of Chemistry
Quaid-i-Azam University, Islamabad | Member |
| 4. | Prof. Dr. Sher Khan Sadozai
Chairman
Department of Chemistry
Gomal University, D.I.Khan | Member |
| 5. | Prof. Dr. Muhammad Kaleem Tahir
Chairman
Department of Chemistry
Allama Iqbal Open University, Islamabad | Member |
| 6. | Prof. Dr. Ubedullah M.Abbasi
Director
Dr.M.A.Kazi Institute of Chemistry
University of Sindh, Jamshoro | Member |
| 7. | Prof. Dr. Humayun Pervez
Professor / Chairman
Department of Chemistry
Bahauddin Zakariya University, Multan | Member |
| 8. | Prof. Dr. Muhammad Arfan
Institute of Chemical Sciences
University of Peshawar, Peshawar | Member |

- | | | |
|-----|---|----------------------|
| 9. | Prof. Dr. Abdullah Khan
Chairman
Department of Chemistry
University of Balochistan
Quetta | Member |
| 10. | Prof Dr. Ahmed Saeed
Department of Chemistry
Gomal University
D.I Khan | Member |
| 11. | Prof. Dr. Syed Ishrat Ali
Chairman
Department of Applied Chemistry
University of Karachi
Karachi | Member |
| 12. | Dr. Zafar Iqbal Zafar
Department of Chemistry
Bahauddin Zakariya University
Multan | Member |
| 13. | Prof. Dr. Jamil Anwar
Director
Institute of Chemistry
University of the Punjab, Lahore | Member |
| 14. | Prof. Dr. Muhammad Arif
Department of Chemistry
Bahauddin Zakariya University
Multan | Member |
| 15. | Prof. Dr. Muhammad Aslam Shad
Department of Chemistry
Bahauddin Zakariya University
Multan | Member |
| 16. | Prof. Dr. Abdul Shakoor Qureshi
Dr. M.A. Kazi
Institute of Chemistry
University of Sindh
Jamshoro | Member |
| 17. | Prof. Dr. Mohammad Saeed Iqbal
Chairman
Department of Chemistry
G.C. University
Lahore | Member/
Secretary |

The meeting on 30th October 2007, started with recitation of a few verses from the Holy Quran by Mr. Shafiullah Khan, Assistant Director (Curriculum), HEC, Islamabad . The meeting was chaired by Prof. Dr. Riaz-ul-Haq Tariq, Member (Academics), HEC, Islamabad. The Member briefed the participants about the overall structure of template / framework of four year Bachelor Degree Program being developed by the Conveners of National Curriculum Revision Committees in Basic, Social, Natural and Applied Sciences in their meeting held on April 30, 2007 at HEC Islamabad under the supervision of the Executive Director, HEC. He emphasized the participants to revise / finalize the curriculum for BS (4 year) program in Chemistry in the light of the approved template. He pointed out to agree to some broad guidelines so as to suit the needs of the students, faculty and industry, and also to include the elements of creativity, independent learning and problem solving approach.

Then, the Chairman asked to select new Convener and Secretary for the current and forthcoming meeting (s). The participants selected Dr. Fahim Uddin, Professor & Chairman, Department of Chemistry, University of Karachi, Karachi as Convener and Prof. Dr. Mohammad Saeed Iqbal, Chairman, Department of Chemistry, G.C. University, Lahore as Secretary. The forum was handed-over to the Convener who conducted the subsequent proceedings on 30-31 October 2007 and 10-11 March 2008

The Agenda Items were discussed as Follows:

1. Development of Scheme of Studies for BS (4 year) programme in Chemistry. After thorough discussion the Scheme of Studies was discussed at length.
2. Constitution of sub-committees to prepare course of lines of various specializations.
3. To finalize the course outlines prepared by sub-committees.

After thorough discussions the scheme of studies was discussed at length and approved as follows:

The revised B.S four years scheme in line with the general guide lines for the Generic unified frame work/ Templates for the programs was adjusted.

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
Institutional Option	8

- iv) The third digit may be used to indicate diversity within the specialty.
- v) Codes for the special courses in 7th and 8th semester may be assigned in accordance with the above guidelines.

The salient features of this scheme are:

- Introduction of required weightage of social sciences.
- Independent life-long learning.
- Development of creative thinking.

After exhaustive discussion, the following layout of courses was finalized and approved in the light of guidelines provided by the HEC:

Compulsory Requirements (The Student Has No Choice)		General Courses to Be Chosen from Other Dept.	
9 Courses		7- 8 Courses	
25 Credit hours		21- 24 Credit hours	
Subject	Cr. hr	Subject	Cr. hr
1. ENGLISH I	3	1. GEN-100	3
2. ENGLISH II	3	2. GEN-101	3
3. ENGLISH III	3	3. GEN-201	3
4. ENGLISH IV/ UNIVERSITY OPTIONAL *	3	4. GEN-301	3
5. PAKISTAN STUDIES	2	5. GEN-302	3
6. ISLAMIC STUDIES / ETHICS	2	6. GEN-400	3
7. MATHEMATICS-I	3	7. GEN-401	3
8. MATHEMATICS-II / UNIVERSITY OPTIONAL **	3		
9. INTRODUCTION TO COMPUTER			
Total	25		21

Discipline specific foundation courses		Major courses including research project/internship		Elective courses within the major	
9-10 Courses		11-13 Courses		4 Courses	
30-33 Credit hours		36 - 42 Credit hours		12 Credit hours	
Subject	Cr. hr	Subject	Cr. hr	Subject	Cr. hr
CHEM-151	3+1	CHEM-251	3+1	ELECTIVE	3
CHEM-161	3+1	CHEM-261	3+1	COURSE – I	
STAT-100	3	CHEM-271	3+1	ELECTIVE	3
CHEM-111	2	CHEM-211/231	3+1	COURSE – II	
CHEM-131	2	CHEM-351	3+1	RESEARCH	2
CHEM-121	2	CHEM-361	3+1	PROJECT /	
CHEM-171	3+1	CHEM-371	3+1	ADVANCED	
CHEM-141	2	CHEM-311/331	3+1	PRACTICAL – I	
		CHEM-PAPER-I	3	/ POSITION	
		CHEM- PAPER-II	3	PAPER	
		CHEM- PAPER-III	3	RESEARCH	2
		PRACTICAL.-I	1	PROJECT /	
		CHEM-PAPER-IV	3	ADVANCED	
		CHEM-PAPER-V	3	PRACTICAL – II	
		CHEM-PEPER-VI	3	/ POSITION	
		PRACTICAL-II	1	PAPER	
	23		52		10

**THE FOLLOWING SCHEME OF STUDIES
WAS APPROVED BY THE COMMITTEE**

**BS (4-YEAR) PROGRAM IN CHEMISTRY
SCHEME OF STUDIES**

Course Title	Credit hours	
	Theory	Practical
Semester - I		
ENG-100 English-I (Functional)	3	0
GEN-100 General-I	3	0
GEN-101 General-II	3	0
MATH-100 Mathematics-I Mathematics-I/Functional Biology	3	0
COMP-100 Computer and Its Applications in Chemistry	3	0
CHEM-151 Inorganic Chemistry	3	1
Total	18	1
Semester - II		
ENG-200 English-II (Functional)	3	0
GEN-200 Islamic Studies / Ethics	2	0
GEN-201 General-III	3	0
MATH-200 Mathematics-II/Functional Biology/University Optional	3	0
STAT-100 Statistics	3	0
CHEM-161 Organic Chemistry	3	1
Total	17	1
Semester - III		
ENG-300 English-III (Report Writing)	3	0
GEN-300 Pakistan Studies	2	0
GEN-301 General-IV	3	0
GEN-302 General-V	3	0
CHEM-141 Environmental Chemistry	2	0
CHEM-171 Physical Chemistry	3	1
Total	16	1
Semester - IV		
ENG-400 English-IV / University Optional	3	0
GEN-400 General-VI	3	0
GEN-401 General-VII	3	0
CHEM-111 Analytical Chemistry	2	0
CHEM-121 Industrial Chemistry	2	0
CHEM-131 Biochemistry	2	0
Total	15	0

Course Title	Credit hours	
	Theory	Practical
Semester - V		
CHEM-251 Inorganic Chemistry	3	1
CHEM-261 Organic Chemistry	3	1
CHEM-271 Physical Chemistry	3	1
CHEM-211 Analytical-/ CHEM-231 Bio-Chemistry	3	1
Total	12	4
Semester - VI		
CHEM-351 Inorganic Chemistry	3	1
CHEM-361 Organic Chemistry	3	1
CHEM-371 Physical Chemistry	3	1
CHEM-311 Analytical-/ CHEM-331 Bio- Chemistry	3	1
Total	12	4
Semester - VII: Specialization (Inorganic/ Organic/Physical/Applied/ Analytical/Bio Chemistry)	Theory	Practical
Paper-I	3	0
Paper-II	3	0
Paper-III	3	0
Practical-I	0	1
Elective Course-I (other than the field of specialization)	3	0
Research Project / Advanced Practical / Position Paper (literature survey)	0	2
Total	12	3
Semester - VIII : Specialization (Inorganic/ Organic/Physical/ Applied/ Analytical-/Bio-Chemistry)	Theory	Practical
Paper - IV	3	0
Paper - V	3	0
Paper - VI	3	0
Practical - II	0	1
Elective Course - II (other than the field of specialization)	3	0
Research Project / Advanced Practical / Position Paper (write-up)	0	2
Total	12	3

Total Credit Hours: 131

The list of general courses was also reviewed and approved as follows:

List of General Courses:

(Proposed in NCRC special meeting in Chemistry)

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

OR

Any other, including supportive science courses other than chemistry, depending upon the expertise available

2. Constitution of Sub-Committees to Prepare Course Outlines of Various Specializations:

Various sub-committees were constituted to prepare course outlines of various specializations. The sub-committees constituted are as under:

- | Inorganic Chemistry | | Physical Chemistry | |
|----------------------------|--|---------------------------|--|
| 1. | Prof. Dr. M Arif
Chairman
Department of Chemistry
Bahauddin Zakaria
University, Multan | 1. | Prof. Dr. Fahim Uddin
Chairman
Department of Chemistry
University of Karachi
Karachi |
| 2. | Prof. Dr. Sher Khan Sadozai
Chairman
Department of Chemistry
Gomal University
D. I. Khan | 2. | Prof. Dr. M. Shahid Ansari
Department of Chemistry
Quaid-i-Azam University
Islamabad |

- | | | | |
|----|---|----|---|
| 3. | Prof. Dr. Muhammad Mazhar
Chairman
Department of Chemistry
Quaid-i-Azam University
Islamabad | 3. | Prof. Dr. Ghulam Hussain
Dean
Faculty of Sciences &
Tech., University of
Sargodha, Sargodha |
| 4 | Prof. Dr. Abdullah Khan
Department of Chemistry
University of Balochistan
Quetta. | 4. | Prof. Dr. Sher Akbar
Department of Chemistry
University of Balochistan
Quetta |
| 5. | Prof. Dr. Saeed-ur-Rehman
Department of Chemistry
University of Peshawar,
Peshawar | 5. | Prof. Dr. Shafique A. Arain
Department of Chemistry
Shah Abdul Latif Univ.
Khairpur |
| | | 6. | Dr. Habib-ur-Rehman
Institute of Chemical
Sciences
University of Peshawar
Peshawar |
| | Organic Chemistry | | Biochemistry |
| 1. | Prof. Dr. Humayun Pervez
Chairman
Department of Chemistry
Bahauddin Zakariya
University, Multan | 1. | Prof. Dr. M. Kalim Tahir
Chairman
Department of Chemistry
Allama Iqbal Open
University, Islamabad |
| 2. | Prof. Dr. Muhammad Arfan
Institute of Chemical Sciences
University of Peshawar
Peshawar, Peshawar | 2. | Prof. Dr. Ahmed Saeed
Department of Chemistry
Gomal University
D.I. Khan |
| 3. | Prof. Dr. G. A. Miana
Director
Ripha Institute of
Pharmaceutical Sciences
Islamabad | 3. | Prof. Dr. Munir Ahmed Sheikh
Department of Chemistry
University of Agriculture
Faisalabad |
| 4. | Prof. Dr. Habib-ur-Rehman
Department of Chemistry
AJK University, Muzaffarabad | 4. | Prof. Dr. Saeed Ahmed Nagra
Dept. of Chemistry
University of the Punjab
Lahore |
| 5. | Prof. Dr. Rehana Ifzal
Department of Chemistry
University of Karachi
Karachi | 5. | Prof. Dr. M. M. Yasinzai
Director
Institute of Biochemistry
Univ. of Balochistan
Quetta |

6.	Prof. Dr. Rehana Rashid Department of Chemistry University of Balochistan Quetta	6.	Prof. Dr. M. Aslam Shad Dept. of Chemistry Bahauddin Zakariya University, Multan
	Analytical/Environmental Chemistry		Applied Chemistry
1	Prof. Dr. M. Saeed Iqbal Chairman Department of Chemistry GC University Lahore	1.	Prof. Dr. Syed Ishrat Ali Deptt. of Applied Chem. University of Karachi Karachi.
2.	Prof. Dr. Ubedullah M. Abbasi Director Dr. M. A. Kazi Institute of Chemistry University of Sindh, Jamshoro	2.	Prof. Dr. Fazeelat Tahira Chairperson Deptt. of Chemistry Univ. of Engg. & Technology, Lahore
3.	Prof. Dr. Jamil Anwar Director, Institute of Chemistry University of the Punjab Lahore	3.	Prof. Dr. Bakhtiar Muhammad Chairman Deptt. of Chemistry Hazara University Mansehra
4.	Prof. Dr. Rasul Jan Director, Institute of Chemical Sciences, University of Pshawar, Peshawar	4.	Dr. Zafar Iqbal Zafar Deptt. of Chemistry Bahauddin Zakariya University, Multan
5.	Dr. Ikhtiar Khan Institute of Chemical Sciences University of Peshawar Peshawar	5.	Dr. Yousuf Iqbal Institute of Chemical Science University of Peshawar Peshawar
6.	Dr. Aziz Ahmed Chaudhry Department of Chemistry AJK University Muzaffarabad		

It was decided that the Convener will coordinate with the sub-committees with the help of HEC to prepare the course outlines which will be presented to the NCRC meetings to be held at an appropriate time and date in Islamabad for approval of these courses. It was further decided that the course outlines of the following subjects will be prepared by

holding separate meetings of the sub-committees constituted for that purpose. However, the following members will coordinate with these committees to assist in preparation of these courses.

Mathematics:	Prof. Dr. Fahim Uddin
Biology:	Prof. Dr. M. Kalim Tahir
Statistics:	Prof. Dr. M. Saeed Iqbal
English:	Prof. Dr. Humayun Pervez

The course outlines of the general subjects will be got prepared and provided by the relevant committees under the directions of HEC.

3. Before the Start of the formal Proceedings on 10-11 March 2008, Fateha was offered for the Departed Soul of Prof. Dr. Rashid Iqbal, former Chairman, Department of Chemistry, Quaid-e-Azam University, Islamabad

The course outlines prepared by the sub-committees were reviewed, finalized and approved by the NCR Special Committee. The Heads of the sub-committees were advised to send the course contents to the respective members and to incorporate the minor changes as proposed by the members. Each Heads of subcommittee shall submit the final modules of the course contents to the Convener NCRC latest by March 30, 2008 for onward transmission to the HEC.

Final Version is detailed below:

MISSION STATEMENT

1. The common purpose is to achieve the highest possible standards of scholarship, teaching and research in chemistry and allied subjects.
2. 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.

DETAILS OF COURSE
BS 1st Year
Semester-I

Title of the Course:	Inorganic Chemistry	Code: CHEM-151
Credit Hours:	03	Marks: 100

The program is aimed that the student should learn:

1. The Development of periodic law and properties of elements in a systematic way.
 2. The principal of chemical bonding
 3. Chemistry of acid and bases
 4. Chemistry of p-block Elements
1. **The Periodic Law and Periodicity**
 Development of Periodic Table; Classification of elements based on *s*, *p*, *d* and *f* orbitals, group trends and periodic properties in *s*, *p*, *d* and *f* block elements, i.e., atomic radii, ionic radii, ionization potential, electron affinities, electronegativities and redox potential.
 2. **Principles of Chemical Bonding**
 Types of chemical bonding; ionic bonding; the localized bond approach: VB theory, hybridization and resonance; the

delocalized approach to bonding: molecular orbital theory as applied to diatomic and polyatomic molecules, three center bonds, bonding theory of metals and intermetallic compounds; conductors, insulators and semiconductors; bonding in electron deficient compounds; hydrogen bonding.

3. 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.

4. 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 (CHEM-151) (1-Cr. Hr.)

1. Laboratory Ethics and safety measures

Awareness about the toxic nature of chemicals and their handling, cleaning of glassware, safe laboratory operations

2. Qualitative analysis

Analysis of four ions (two anions and two cations) from mixture of salts

3. Quantitative analysis

Laboratory work illustrating topics covered in the lecture of **CHEM-151**

Recommended Books

1. Huheey, J. E., Keiter, E. A. and Keiter, R. L., "Inorganic Chemistry: Principles of Structure and Reactivity", 4th Ed., Harper and Row, New York, 2001
2. Cotton, F. A., Wilkinson, G. and Gaus, P. L., "Basic Inorganic Chemistry", 3rd Ed., Wiley, New York, 1995.
3. Clyde Day, M. & Selbin, J., "Theoretical Inorganic Chemistry", 2nd Ed., Van Nustrand Reinhold, 1969.
4. Lee, J.D., "Concise Inorganic Chemistry", Chapman and Hall, 5th Edition, 1996.
5. Shriver, D. F., Atkins, P. W. and Langford, C. H., "Inorganic Chemistry", Oxford University Press, 2nd Edition, 1994.

6. Bassette, J., Denney, G. H. and Mendham, J., "Vogel's Textbook of Quantitative Inorganic Analysis Including Elementary Instrumental Analysis" English Language Book Society, 4th Edition, 1981.
7. Vogel, A. I., "A Textbook of Micro and Semi-micro Qualitative Inorganic Analysis" Longman Green & Co. 1995.

BS 1st Year Semester-II

Title of the Course: Organic Chemistry Code: CHEM-161
Credit Hours: 03 Marks: 100

Introduction to Organic Chemistry

Organic chemistry-the chemistry of carbon compounds; the nature of organic chemistry-a historical perspective.

Chemical Bonding and Properties of Organic Molecules

Localized and delocalized chemical bonding; concept of hybridization leading to bond angles, bond lengths, bond energies and shape 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.

Classes and 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, and carboxylic acids and their derivatives.

Recommended Literature

(Latest available editions of the following books)

1. Clayden, J., Greeves, N., Warren, S. and Wothers, P., "Organic Chemistry", Oxford University Press, New York.

2. Loudon, G. M., "Organic Chemistry", Oxford University Press, New York
3. Sorrell, T. N., "Organic Chemistry", Viva Books Private Ltd., New Delhi.
4. Finar, I. L., "Organic Chemistry", Vol. 1, Pearson Education, Delhi.
5. Carey, F. A., "Organic Chemistry", McGraw-Hill, New York.
6. Ahluwalia, V. K. and Goyal, M., "A Text Book of Organic Chemistry", Narosa Publishing House, New Delhi
7. March, J., "Advanced Organic Chemistry", John Wiley & Sons, New York.
8. Bansal, R. K., "Organic Reaction Mechanisms", Tata McGraw-Hill Publishing Company Ltd., New Delhi.
9. Pine, S. H., "Organic Chemistry", National Book Foundation, Islamabad.
10. Bailey Jr., P. S. and Bailey, C. A., "Organic Chemistry-A Brief Survey of Concepts and Applications", Prentice-Hall, New Jersey.

Supplementary Literature

(Latest available editions of the following books)

1. Morrison, R. T. and Boyd, R. N., "Organic Chemistry", Prentice-Hall of India, New Delhi.
2. Carey, F. A. and 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. Hand, C. W. and Blewitt, H. L., "Acid-Base Chemistry", Macmillan Publishing Company, New York.
5. McMurry, J., "Organic Chemistry", Brooks/Cole Publishing Company, California.
6. Solomons, T. W. G. and Fryhle, C. B., "Organic Chemistry", John Wiley & Sons, New York.
7. Panico, R., Powell, W. H. and Richer, J. C., "A Guide to IUPAC Nomenclature of Organic Compounds", Jain-Interscience Press, Delhi.
8. Streitwieser Jr., A. and Heathcock, C.H., "Introduction to Organic Chemistry", Macmillan Publishing Company, New York.
9. Fox, M. A. and Whitesell, J. K., "Organic Chemistry", Jones and Bartlett Publishers, London.

PRACTICAL (CHEM-161) (1-Cr. Hr.)

*Laboratory work illustrating topics covered in
the lecture of Chem-161*

BS 2nd Year Semester-III

Title of the Course: Environmental Chemistry Code: CHEM-141
Credit Hours: 02 Marks: 100

Objectives of the Course:

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 Outlines:

Atmospheric Chemiser

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 and 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 Text 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. Brimblecombe, D. L. Dent and P. S. Liss, Edward Arnold Ltd., London, 1980.
5. Staneley E. Manahan, Environmental Chemistry, Brooks, California.

Recommended Reference Books

Latest editions of the following books:

1. Peter O. Neill, Environmental Chemistry, Chapman and Hall, London, 1993.
2. Derek M. Elsom, Atmospheric Pollution, Blackwell Publishers, Oxford, 1992.
3. Geoffrey Lean and Don Hinrichsen, Atlas of the Environment, Helicon Publishing Ltd., Oxford, 1992.

Recommended Journals/Periodicals Journals

Related to:

1. Atmospheric Chemistry.
2. Air Pollution.
3. Water Pollution.
4. Soil Pollution/Soil sciences.
5. Environmental Technology.

Recommended World Web:

Web Sites related to:

1. Global Warming/Green House Effect.
2. Ozone depletion.
3. Acid Rain

4. Environmental Pollution
5. Energy Conservation

BS 2nd Year Semester-III

Title of the Course: Physical Chemistry Code: CHEM-171
Credit Hours: 03 Marks: 100

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. 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 its applications. Elementary concepts underlying complex and fast reactions.

Solution Chemistry

Ideal and non-ideal solutions. Raoult's and Henry'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.

Electrochemistry

Basic concepts of electrochemistry. Ions in solution. Measurement of conductance and Kohlrausch's law. Debye-Hueckel theory and activity coefficient. Application of conductance measurement. Electrode potential. Electrochemical cell. Application of electrode potential

Practicals (Chem-171) (1-Cr. Hr.)

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

Books Recommended (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. Laidler K.J. "The World of Physical Chemistry" 1st ed., Oxford University Press (1993).
4. Laidler K.J., John H.M. and Bryan C.S. "Physical Chemistry" 4th ed., Houghton Mifflin Publishing Company Inc.(2003).
5. Peter P.A. "Chemical Thermodynamics" Oxford University Press (1983).
6. Brain S.E. "Basic Chemical Thermodynamics" 4th ed., E.L.B.S. Publishers (1990).
7. Barrow G.M. "Physical Chemistry" 5th ed., McGraw Hill (1992).

Books Recommended (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).

BS 2nd Year Semester-IV

Title of the Course: Analytical Chemistry Code: CHEM-111
Credit Hours: 02 Marks: 100

Course Goals

- This course will introduce you to the vocabulary and concepts used in basic Analytical Chemistry.
- You will learn the details of steps involved in the preparation and analysis of a sample, the chemical basis and various techniques of analysis.
- You will also learn and use statistical methods to determine the precision and accuracy of experimental results.
- Graded assignments, quizzes, class tests and a *final exam* will test your understanding of the material dealing with these goals.
- To develop skills needed to solve analytical problems in a quantitative manner, particularly with the aid of the spreadsheet tools.
- Teaching laboratory skills that will give students confidence in their ability to obtain high-quality analytical data.

Course Description

- Introduction to Analytical Chemistry
- Measuring Apparatus
- Expression of Quantities and Concentrations
- Basic Approach to Equilibrium
- Errors in Chemical Analyses and Quality of Results
- Chemicals and reagents
- Use and handling of standards
- Sampling
- Errors
- Precision, Accuracy, Signal-to-noise ratio, Limits of detection and

- Statistical Evaluation of Data
- Quality Control and Quality Assurance

BS 2nd Year Semester-IV

Title of the Course: Industrial Chemistry Code: CHEM-121
Credit Hours: 02 Marks: 100

Fundamentals of Chemical Industry

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, sulfitation, 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; Photochromic 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.

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 of 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.

BS 2nd Year Semester-IV

Title of the Course: Bio-chemistry Code: CHEM-131
Credit Hours: 02 Marks: 100

Title of the Course: **Basic Chemistry and Functions of Biomolecules**

Prerequisites: Basic courses of Organic Chemistry and Biology

Objective of the Course: 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 Outline:

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

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, peptides. Proteins; their classification, properties and biological significance, Primary, secondary tertiary and *quaternary* structure of proteins. Denaturation of proteins.

Nucleic Acids

Chemical composition of nucleic acids. Structure and biological significance of nucleic acids. Chemical synthesis of oligonucleotides. Nucleic acids hydrolysis. Isolation and separation of Nucleic acids. Introduction to recombinant DNA technology.

Recommended Text Books

1. Lehninger, A. L, " Principles of Biochemistry", Worth Publisher, New York, (2001).
2. Voet, D. and Voigt J. G., "Biochemistry", John Wiley & Sons, New York, (2000).
3. Murray, R. K., Mayes P. A., Granner, D. K. and Rodwell, V. W., Harper's Biochemistry", Appleton & Lange (2000).
4. Robert, Harper's Biochemistry", 25th Ed, (2000).
5. West, Text Book of Biochemistry", 4th Ed., (2000) .
6. Zubay, G., Biochemistry, 4th Ed., Macmillan Publishing Co. (1999).
7. Bhagavan. N. V., Biochemistry, 2nd Ed., J.B. Lippincott Company (1978)

BS 3rd Year Semester-V

Title of the Course:	Inorganic Chemistry	Code:	CHEM-251
Credit Hours:	03	Marks:	100

Objective of the Program

After completing this program students will be able to learn the following:

1. The historical development of transition element chemistry
2. The importance and applications of the transition elements
3. To learn about coordination chemistry and various theories developed to explain the structure and properties of these complexes
4. Reactions in non aqueous solvents.

1. Coordination Compounds

Historical back ground of coordination compounds, geometry of complexes having coordination number 2 to 9, 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 complexes, applications of coordination compounds.

2. Non Aqueous Solvents

Classification of solvents, types of reactions in solvents, effect of physical and chemical properties of solvent, detailed study of liq. NH_3 , liq. H_2SO_4 , liq. HF , and liq. SO_2 , BrF_3 and reaction in molten salts system.

PRACTICAL (CHEM-251) (1-Cr. Hr.)

- Semi-micro analysis and Separation of anions in a mixture by paper chromatography
- Preparation of at least four coordination compounds in a pure state
- Complexometric titrations

Recommended Books

1. Huheey, J. E., Keiter, E. A. and Keiter, R. L., "Inorganic Chemistry: Principles of Structure and Reactivity", 4th Ed., Harper and Row, New York, 2001
2. Cotton, F. A., Wilkinson, G. and Gaus, P. L., "Basic Inorganic Chemistry", 3rd Ed., Wiley, New York, 1995.
3. Atkins, P. and Jones, L., "Chemicals Principles" Freeman & Company, 2002.
4. F. A. Cotton, G. Wilkinson, C. A. Murillo and M. Bochmann, "Advanced Inorganic Chemistry", 6th Ed., Wiley-Interscience, New York, 1999.
5. A. K. Holliday, and A. G. Massey, "Inorganic Chemistry in Non-Aqueous Solvents", Pergamon Press, New York, 1990.
6. Larsen, E. M., "Transition Elements", W. A. Benjamin Inc., 1995
7. Bassette, J., Denney, G. H. and Mendham, J., "Vogel's Textbook of Quantitative Inorganic Analysis Including Elementary Instrumental Analysis" English Language Book Society, 4th Edition, 1981.
8. Vogel, A. I., "A Textbook of Micro and Semi-micro Qualitative Inorganic Analysis" Longman Green & Co. 1995.

BS 3rd Year Semester-V

Title of the Course: Organic Chemistry Code: CHEM-261
Credit Hours: 03 Marks: 100

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, stereospecific and stereoselective 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, ¹H-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 SN₂, SN₁, S_Ni, SN₂', SN₁', S_Ni' 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 SE₁, SE₂ (front), SE₂ (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 E₁, E₁cB and E₂ 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 Proceeding by Non-polar Mechanisms: Pyrolytic eliminations—study of E_i and free-radical mechanisms; orientation in pyrolytic eliminations.

Recommended Literature

(Latest available editions of the following books)

1. Eliel, E. L., Wilen, S. H. and 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. and 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. and Kriz, G. S., "Introduction to Spectroscopy: A Guide for Students of Organic Chemistry", Saunders Golden Sunburst Series, London.
8. Morrison, R. T. and Boyd, R. N., "Organic Chemistry", Prentice-Hall of India, New Delhi.

Supplementary Literature

(Latest available editions of the following books)

1. McMurry, J., "Organic Chemistry", Brooks/Cole Publishing Company, California.
2. Carey, F. A., "Organic Chemistry", McGraw-Hill, New York.
3. Solomons, T. W. G. and Fryhle, C. B., "Organic Chemistry", John Wiley & Sons, New York.

PRACTICAL (CHEM-261) (1 Cr. Hr.)

Laboratory work illustrating topics covered in the lecture of Chem-261

BS 3rd Year Semester-V

Title of the Course:	Physical Chemistry	Code:	CHEM-271
Credit Hours:	03	Marks:	100

Kinetic Theory of Gases

Virtual 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 (N_A).

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. Schrodinger wave equation and its solution for particle in 1-dimensional and 3-dimensional boxes. Concept of quantization of energy, introduction to spectroscopy of molecules, spectra of hydrogen and hydrogen like atoms.

PRACTICALS (CHEM-271) (1Cr. Hr.)

- Equilibrium constant of the $KI + I_2 = KI_3$ reaction
- Kinetics of saponification of ethyl acetate
- Acid catalyzed hydrolysis of sucrose
- Study of the adsorption isotherms of acetic acid-charcoal system
- Study of the charge transfer complex formation between iodine and benzene
- Determination of activation energy for the acid catalyzed hydrolysis of ethyl acetate
- Determination of partial molar volumes
- Characterization of the given compound by UV-Vis spectroscopy

Books Recommended (Theory)

1. Alberty, R. A., Robert J.S. and Mounji G. B. " Physical Chemistry". 4th ed, John Wiley and Sons (2004).
2. Ball, D W., "Physical Chemistry" 1st ed., Brooks/Cole Co. Inc. (2003).
3. Engel, Thomas and Reid p., "Thermodynamics, Statistical Thermodynamics, and Kinetics" 1st ed., Benjamin Cummings (2006).
4. James K. and Wothers, P., "Why Chemical Reactions Happen". Oxford University Press (2003).
5. Smith, E. Brain, "Basic Chemical Thermodynamics" 5th ed., Imperial College Press (2004).
6. Stephen B. R., Rice S. A. and Roses J., "Physical Chemistry" 2nd ed., Oxford University Press (2000).
7. Jurg W., "Basic Chemical Thermodynamics" W. A. Benjamin (1969).
8. Chorkendorff, I. and Niemantsverdriet, J.W. "Concept of Modern Catalysis and Kinetics" 1st ed., John Wiley and Sons (2003).
9. Espenson, J. H. " Chemical Kinetics and Reaction Mechanism" 2nd ed., McGraw Hill (2002).
10. Berry R. S., Stuart A.R., and Roses J. " Physical and Chemical Kinetics" 2nd ed., Oxford University Press (2000).

Books Recommended (Practicals)

- Helpen Arthur M., "Experimental Physical Chemistry: A Laboratory Textbook" 2nd ed., Prentice Hall (1997).
- Bassette J., Denney C., Jeffery G. H. and Mendham J. "Vogel's Textbook of Quantitative Inorganic Analysis Including Elementary Instrumental Analysis" English Language Book Society. 4th ed. (1978).
- Daniel, F., "Experimental Physical Chemistry" McGraw Hill (1962).
- Shoemaker, D., "Experimental Physical Chemistry" McGraw Hill (1989)

BS 3rd Year Semester-V

Title of the Course:	Analytical Chemistry	Code:	CHEM-211
Credit Hours:	03	Marks:	100

Principles and Application of Chemical Equilibrium Systems in Quantitative Analysis

- Gravimetric Methods of Analysis
- Stoichiometric Reactions
- Acids, Bases and Buffers
- Acid-Base Titrations
- Complexometric Titrations
- Redox Titrations
- Non-aqueous Titrations
- Karl-Fischer Titrations

PRACTICAL (CHEM-211) (1-Cr. Hr.)

- Calibration of volume measuring glassware
- Calibration of electronic analytical balance
- Calibration of conductivity meter and potentiometer
- Two experiments demonstrating the use of gravimetry in quantitative analysis
- Two experiments based on acid-base titrations
- Two experiments based on complexometric titrations
- Two experiments based on redox titrations
- Two experiments based on non-aqueous titrations
- Two experiments based on Karl-Fischer titrations

BS 3rd Year Semester-V

Title of the Course: Bio-Chemistry Code: CHEM-231
Credit Hours: 03 Marks: 100

Title of the Course: Bioenergetics and Metabolism of Biomolecules

Objective of the Course:

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 Outline:

Intermediary Metabolism And Bioenergetics

Biological oxidation—Reduction including respiratory carriers. Cell bioenergetics. Oxidative Phosphorylation. Free energy change and redox System.

Metabolism of Carbohydrates

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

Metabolism of Lipids

Digestion of Lipids. Absorption and Transport of lipids and fatty Acids. Oxidation of saturated, Un saturated. 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 of Catabolism, of Nucleosides DNA Polymerases and other enzymes involved in metabolism.

Recommended Text Books

1. Lehninger, A. L., " Principles of Biochemistry", Worth Publisher, New York, (2001).
2. Voet, D. and Voet J. G., "Biochemistry", John Wiley & Sons, New York, (2000).
3. Murray, R. K., Mayes P. A., Granner, D. K. and Rodwell, V. W., Harper's Biochemistry", Appleton & Lange (2000).
4. Robert, Harper's Biochemistry", 25th Ed, (2000).
5. West, Text Book of Biochemistry", 4th Ed., (2000).
6. Zubay, G., Biochemistry, 4th Ed., Macmillan Publishing Co. (1999).

7. Bhagavan. N. V., Biochemistry, 2nd Ed., J.B. Lippincott Company (1978).

PRACTICALS **(CHEM-231) (1-Cr. Hr.)**

Prerequisite: Chem.: 131

Qualitative and Quantitative analysis of carbohydrates, lipids and proteins

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)

BS 3rd Year **Semester-VI**

Title of the Course:	Inorganic Chemistry	Code: CHEM-351
Credit Hours:	03	Marks: 100

Objective of the Program

After completing this program students will be able to learn the following:

1. Chemistry of Lanthanides, their purification and properties.
2. Chemistry of actinide and their characteristics.
3. Chemistry of metal carbonyls their synthesis structure and properties.

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.

Acceptor Complexes

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

PRACTICAL

(CHEM-351) (1 Cr. Hr.)

- Semi-micro analysis and Separation of cations in a mixture by paper chromatography
- Redox Titration
- Estimation of at least two halides by adsorption indicator
- Gravimetric estimation of Ba^{2+} and $\text{C}_2\text{O}_4^{2-}$ ions

Recommended Books

1. Huheey, J. E, Keiter, E. A. and Keiter, R. L., "Inorganic Chemistry: Principles of Structure and Reactivity", 4th Ed., Harper & Row, New York, 2001.
2. Cotton, F. A., Wilkinson, G., Murillo, C. A. and Bochmann. M., "Advanced Inorganic Chemistry", 6th Ed., Wiley-Interscience, New York, 1999.
3. Greenwood, N. N., and Earnshaw, A., "Chemistry of the Elements", 2nd Ed., Pergamon Press, New York, 1992.
4. William W. Porterfield. Inorganic chemistry, Unified approach, Elsevier company, Delhi, (2005)
5. Mackay, K. M., Mackay, R. A. and Henderson, W., "Introduction to Modern Inorganic Chemistry", 5th Edition, Stanley Thomas Publisher Ltd. 1996
6. Bassette, J., Denney, G. H. and Mendham, J., "Vogel's Textbook of Quantitative Inorganic Analysis Including Elementary Instrumental Analysis" English Language Book Society, 4th Edition, 1981.
7. Vogel, A. I., "A Textbook of Micro and Semi-micro Qualitative Inorganic Analysis" Longman Green & Co. 1995.

BS 3rd Year Semester-VI

Title of the Course:	Organic Chemistry Code:	CHEM-361
Credit Hours:	03	Marks: 100

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 derivatives of ammonia; stereoselectivity in carbonyl addition reactions.

Organometallic Compounds

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

Chemistry of Enolate Ions and Enols

Acidity of carbonyl compounds; enolization of carbonyl compounds; α -halogenation of carbonyl compounds; aldol-addition and aldol-condensation; condensation reactions involving ester enolate ions; alkylation of ester enolate ions.

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 S_NAr, S_N1 and benzyne mechanisms; structure and reactivity - the effects of substrate structure, leaving group and the attacking nucleophile on the rates of substitution reactions.

Recommended Literature

(Latest available editions of the following books)

1. Norman, R. O.C. and Coxon, J. M., "Principles of Organic Synthesis", Nelson Thornes, Cheltenham.
2. Clayden, J., Greeves, N., Warren, S. and Wothers, P., "Organic Chemistry", Oxford University Press, New York.
3. Sykes, P., "A Guide Book to Mechanism in Organic Chemistry", Longman, London.

4. March, J., "Advanced Organic Chemistry", John Wiley & Sons, New York.
5. Loudon, G. M., "Organic Chemistry", Oxford University Press, New York.
6. Carey, F. A., "Organic Chemistry", McGraw-Hill, New York.
7. Morrison, R. T. and Boyd, R. N., "Organic Chemistry", Prentice-Hall of India, New Delhi.

Supplementary Literature

(Latest available editions of the following books)

1. Solomons, T. W. G. and Fryhle, C. B., "Organic Chemistry", John Wiley & Sons, New York.
2. Pine, S. H., "Organic Chemistry", National Book Foundation, Islamabad.
3. Bruckner, R., "Advanced Organic Chemistry-Reaction Mechanisms", Harcourt Science & Technology Company, New York.
4. Carroll, F. A., "Perspectives on Structure and Mechanism in Organic Chemistry", Brooks/Cole Publishing Company, New York.
5. Ege, S., "Organic Chemistry", A.I.T.B.S. Publishers & Distributors, Delhi.
6. Parkins, A. W. and Poller, R. C., "An Introduction to Organometallic Chemistry", Macmillan, London.

PRACTICAL(CHEM-361) (1 Cr. Hr.)

Laboratory work illustrating topics covered in the lecture of Chem-361

BS 3rd Year Semester-VI

Title of the Course:	Physical Chemistry	Code: CHEM-371
Credit Hours:	03	Marks: 100

Electrochemistry

An introduction to electrochemistry, chemical reactions and redox potentials, electrochemical cells and types of electrodes. Nernst's equation and its application. Predicting reactions, stability of oxidation states, cell potential and thermodynamics. Theory of metallic conduction. Electrode potential, liquid junction potential, transference number. Ions in aqueous solution. Ionic activity and Debye Hückel theory.

Nuclear Chemistry

Atomic nucleus, nuclides, nuclear stability, modes of decay, nuclear energetics, 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-371) (1 CR. HR.)

- Spectroscopic determination of Cu % in the given sample.
- Conductometric determination of Cu (II)- EDTA mole ratio in the complex.
- To determine the effectiveness of an extraction of I₂ solution by using Solvent Extraction method.
- Determination of molecular weight of a polymer by viscosity method.
- Determination of percentage composition of KMnO₄/ K₂Cr₂O₇ in a given solution by spectrophotometry.
- Evaluation of pK_a value of an indicator by spectrometric method.
- Conductometric determination of hydrolysis constant (K_n) of conjugate base of a weak acid.

Recommended Books (Theory)

1. Cotton F.A. "Chemical Applications of Groups Theory" Interscience 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 Mounji 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).
6. Suppan P. "Principles of Photochemistry", The Chemical Soc., UK (1973).
7. Vertes A. "Basics of Nuclear Science" Kluwer Academic Publisher London (2003).
8. Friedlander G. and Kennedy J.W. "Nuclear and Radiochemistry" 3rd ed., Wiley, New York (1981).

Recommended Books (Practical)

1. Bassetts J., Denney C., Jeffery G.H. and Mendham J. "Vogel's Textbook of Quantitative Inorganic Analysis Including Elementary Instrumental Analysis" English Language Book Society. 4th ed. (1978).
2. Hatch R.C. "Experimental Chemistry" van Nostrand Reinhold Company (1972).
3. Halpern, Arthur M. "Experimental Physical Chemistry: A Laboratory Textbook" 2nd ed., Prentice Hall (1962).
4. Shoemaker D. "Experimental Physical Chemistry" McGraw Hill (1989).

BS 3rd Year Semester-VI

Title of the Course:	Analytical Chemistry	Code: CHEM-311
Credit Hours:	03	Marks: 100

Separation Techniques

- Introduction to Analytical Separations: Masking, Precipitation and Filtration,
- Solvent Extraction
- Chromatography
- Electrophoresis

Thermal Analysis

- Thermogravimetry
- Differential Thermal Analysis
- Differential Scanning Calorimetry
- Thermo-Mechanical Analysis

PRACTICAL
(CHEM-311) (1-Cr. Hr.)

Ten experiments based on theory topics as per facilities available

BS 3rd Year
Semester-VI

Title of the Course:	Bio-Chemistry	Code:	CHEM-331
Credit Hours:	03	Marks:	100

Title of the Course: **Biocatalysts and Acid-Base Regulation**

Objective of the Course:

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

Course Outline:

Enzymes

Chemical nature, nomenclature and classification of enzymes, 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 factor on enzyme activity, Bisubstrate reactions, Quantative assays of enzyme activity, Enzyme Inhibition, Regulatory enzymes; Allostric 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 Text Books

1. Lehninger, A. L, "Principles of Biochemistry", Worth Publisher, New York, (2001).
2. Voet, D. and Voet J. G., "Biochemistry", John Wiley & Sons, New York, (2000).
3. West, Text Book of Biochemistry", 4th Ed., (2000) .
4. Zubay, G., Biochemistry, 4th Ed., Macmillan Publishing Co. (1999).
5. Wilhelm R. Frisell, "Human Biochemistry", Macmillan Publishing Co., Inc. New York (1982)
6. Guyton AC and Hall JE, "Text Book of Medical Physiology", 9thEd, W. B. Saunders Company, Tokyo, (1996).

PRACTICALS

(CHEM-331) (1-Cr. Hr.)

Laboratory work illustrating topics covered in the lecture of Chem. 331.
Determination of pH, Preparation of buffers,
Enzyme catalysis, Progress curve for enzyme catalyzed reactions,
Determination of K_m values, To study the effect of different factors on the rate of enzyme catalyzed reactions.

Recommended Books

1. Plummer, D.T., An introduction to practical biochemistry, TATA McGraw-Hill Publishing Company LTD. Sawhney, S. K. and R. Sing (Editors), Introductory Practical Biochemistry, Narosa Publishing House, New Delhi, (2005)

BS 4th Year Semester-VII

Title of the Course: Inorganic Chemistry

Paper: I

Credit Hours: 03

Marks: 100

Objective of the Program

After completing this program students will be able to learn the following:

1. Periodic Anomalies and Bonding in Electron deficient Compounds
2. Kinetics and Reaction Mechanism of Inorganic Reactions
3. Electron Transfer Reaction

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; $p\pi$ - $d\pi$ bonds; the use of *p*- orbitals in π - bonding; periodic anomalies of non-metals and post-transition metals. Multicenter bonding in electron deficient molecules, three centre two electron bond (3c-2e) and three-center, four-electron (3c-4e) bond model.

Kinetics and Reaction Mechanism of Inorganic Reactions

Classification of reaction mechanisms; rate laws; steady state approximation; inert and labile complexes; substitution reactions; 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, effect of leaving group, mechanism of substitution, 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., and Pearson, R. G., "Mechanism of Inorganic Reactions", Wiley, New York, 1982.
2. Huheey, J. E, Keiter, E. A. and 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. and Kotz, J.C., "Inorganic Chemistry" W.B. Saunders Company Holt-Saunders Internal editions 1977.

5. Shirve D.F. Atkins P.W. and 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 inorganic chemistry second edition McGraw Hill Company 1991.
8. Porter Field. W.W., Inorganic Chemistry a Unified Approach 2nd ed. Elsevier Publishers, 2005 Douglas, McDaniel & John Alexander. "Concepts and Models of Inorganic Chemistry" by John Willey and Sons, 1994.
9. R.B. Jordan, Reaction Mechanisms of Inorganic and Organometallics Systems. Oxford University Press, New York, 1991. An excellent introduction.
10. R.G. Wilkins, The study of kinetics and Mechanisms of Reactions of transition metal complexes 2nd ed., VCH Publishers, New York, 1991. Excellent discussions of rate laws, their interpretation and experimental establishment.

BS 4th Year Semester-VII

Title of the Course:	Inorganic Chemistry	PAPER: II
Credit Hours:	03	Marks: 100

Objective of the Program

After completing this program students will be able to learn and had a sound knowledge of the following:

1. Organic Reagents used in Inorganic Analysis, their selectivity, specificity etc.
2. Polymer Chemistry

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 "An Introduction to Macromolecules" 2nd Springer 1983
3. Ravue, "Principles of Polymer Chemistry" 2nd edition Plenum Publishers 2000.
4. Emeleus and Sharpe., "Modern Aspects of Inorganic Chemistry".
5. Huheey, J. E, Keiter, E. A. and Keiter, R. L., "Inorganic Chemistry: Principles of Structure and Reactivity", 4th Ed., Harper & Row, New York, 2001.
6. F. W. Billmeyer. "A Text book of Polymer Science" John Willey & Sons, New Delhi, 20002.
7. P.Powell. "Non Metal Chemistry", Chopman & Hall., 1974
8. Miessler G.L. and Tar Donald, A. "Inorganic Chemistry" Prentice Hall Int. edition, 1991.
9. Douglas, McDaniel & John Alexander. "Concepts and Models of Inorganic Chemistry" by John Willey and Sons, 1994.

BS 4th Year Semester-VII

Title of the Course	: Inorganic Chemistry	PAPER: III
Credit Hours	: 03	Marks: 100

Objective of the Program

After completing this program students will be able to learn and able to interpret simple spectra.

1. Nuclear Magnetic Resonance Spectroscopy.
2. Ultra violet spectroscopy
3. Infrared spectroscopy
4. Mass Spectrometry
5. Thermal Analysis

Instrumental Methods of Analysis

Physical methods in Inorganic Chemistry, TGA & DTA, NMR, IR, UV Spectroscopy, Mass Spectroscopy; Basic principles, Instrumentation and Applications

Recommended Books

1. Vogel, A. I., "A Text book of Quantitative Inorganic Analysis", English language Book Society 4th edition, 1978.
2. Daniels, T., "Thermal Analysis" 1998.
3. Pavia, D. L., Lampman, G. M. and Kriz, G.S., "Introduction to Spectroscopy", Saunders College Publishing, 1980
4. Silverstein, R. M., Barler, C. G. and Mogrill, T. C., "Spectrometric Identification of Organic Compounds",
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. and Mendham, J., "Vogel's Textbook of Quantitative Inorganic Analysis including Elementary Instrumental Analysis", English language book society 4th edition, 1978.
8. Douglas, A. Skoog, F. James Holler, Trmothy, A., "Principles of Instrumental Analysis", 5th edition, Saunders College Publishing, New York, 1997.
9. Ewing, G.W., "Instrumental Methods of Chemical Analysis", 5th edition, McGraw Hill, New York, 1985.

BS 4th Year Semester-VII

Title of the Course: Inorganic Chemistry PAPER: I (PRACTICAL)
Credit Hours: 01 Marks: 100

- Use of some organic reagents for the estimation of various elements
- Preparation of at least six compounds/organometallic compounds in a pure state and determination of their state of purity
- The experiments may be set making use of conductivity meter and potentiometer depending upon the availability.

Recommended Books

1. Bassette, J., Denney, G. H. and Mendham, J., "Vogel's Textbook of Quantitative Inorganic Analysis Including Elementary Instrumental Analysis" English Language Book Society, 4th Edition, 1981.
2. Fritz, J. S. and Schenk, G. H., "Quantitative Analytical Chemistry", Allyn and Bacon Inc., 4th Edition, 1979
Pass, G and Sutcliffe, H., "Practical Inorganic Chemistry", Van Nostrand Reinhold Company, 1972

BS 4th Year Semester-VII

Title of the Course:	Chemistry	PAPER: I
Credit Hours:	03	Marks: 100

Oxidation and Reduction

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; cheletropic reactions; sigmatropic rearrangements; the ene-reaction and related reactions.

Recommended Literature

(Latest available editions of the following books)

1. Norman, R. O.C. and 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. Loudon, G. M., "Organic Chemistry", Oxford University Press, New York.

4. Smith, M. B., "Organic Synthesis", McGraw-Hill, New York.
5. March, J., "Advanced Organic Chemistry", John Wiley & Sons, New York.
6. Sykes, P., "A Guide Book to Mechanism in Organic Chemistry", Longman, London.
7. Clayden, J., Greeves, N., Warren, S. and Wothers, P., "Organic Chemistry", Oxford University Press, New York.
8. Carey, F. A. and Sundberg, R. J. "Advanced Organic Chemistry Part B: Reactions and Synthesis", Plenum Press, New York.
9. Morrison, R. T. and Boyd, R. N., "Organic Chemistry", Prentice-Hall of India, New Delhi.

Supplementary Literature

(Latest available editions of the following books)

1. Bruckner, R., "Advanced Organic Chemistry-Reaction Mechanisms", Harcourt Science & Technology Company, New York.
2. March, J., "Advanced Organic Chemistry", John Wiley & Sons, New York.
3. House, H. O., "Modern Synthetic Reactions", The Benjamin/Cummings Publishing Company, California.
4. Finar, I. L., "Organic Chemistry", Vol. 1, Pearson Education, Delhi.
5. Greene, T. W., "Protective Groups in Organic Synthesis", John Wiley & Sons, New York.

BS 4th Year Semester-VII

Title of the Course:	Organic Chemistry	PAPER: I
Credit Hours:	03	Marks: 100

Molecular Rearrangements

Types of rearrangements; general mechanisms of nucleophilic, free radical and electrophilic rearrangements; 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-halogenation, oxidation and substitution involving aryl radicals.

Reactive Intermediates

Carbenes, nitrenes, and arynes: Their generation, stability, reactions and synthetic applications.

Recommended Literature

(Latest available editions of the following books)

1. March, J., "Advanced Organic Chemistry", John Wiley & Sons, New York
2. Norman, R. O.C. and 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. Morrison, R. T. and Boyd, R. N., "Organic Chemistry", Prentice-Hall of India, New Delhi.
5. Carey, F. A. and Sundberg, R. J., "Advanced Organic Chemistry Part A: Structure and Mechanisms", Kluwer Academic /Plenum Publishers, New York.
6. Sykes, P., "A Guide Book to Mechanism in Organic Chemistry", Longman, London.
7. Clayden, J., Greeves, N., Warren, S. and Wothers, P., "Organic Chemistry", Oxford University Press, New York.
8. Gilchrist, T. L. and Rees, C. W., "Carbenes, Nitrenes and Arynes", Nelson, London.

Supplementary Literature

(Latest available editions of the following books)

1. Pine, S. H., "Organic Chemistry", National Book Foundation, Islamabad.
2. Loudon, G. M., "Organic Chemistry", Oxford University Press, New York.
3. McMurry, J., "Organic Chemistry", Brooks/Cole Publishing Company, California.
4. Finar, I. L., "Organic Chemistry", Vol. 1, Pearson Education, Delhi.
5. Smith, M. B., "Organic Synthesis", McGraw-Hill, New York.
6. Lwowski, W., "Nitrenes", Interscience Publishers, New York.

BS 4th Year Semester-VII

Title of the Course: Organic Chemistry PAPER: III
Credit Hours: 03 Marks:100

Organic Spectroscopy

A brief review of introductory organic spectroscopy.

¹H-NMR and ¹³C-NMR

Chemical shift; factors affecting chemical shift; spin relaxation; spin-spin coupling; coupling constants; factors affecting coupling constants; 2-D NMR.

Mass Spectrometry

Introduction; mass spectrometers; ionization and ion sources: electron impact and chemical ionization; field ionization; field desorption; fast atom bombardment; plasma desorption, thermospray and electrospray mass spectra; fragmentation pattern of common functional groups. Combined usage of IR, UV, NMR and Mass spectrometric methods for structure elucidation of organic compounds having medium complexity.

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 Literature

(Latest available editions of the following books)

1. Kemp, W., "Organic Spectroscopy", Palgrave, New York.
2. Silverstein, R. N., Barrler, G. C. and Morrill, T. C., "Spectrometric Identification of Organic Compounds", John Wiley & Sons, New York.
3. Williams D. H. and Fleming, I., "Spectroscopic Methods in Organic Chemistry", Athlone Press, London.
4. Atta-ur-Rehman, "Nuclear Magnetic Resonance Spectroscopy", UGC, Islamabad.
5. Davis, R. and Freason, M., "Mass Spectrometry", John Wiley & Sons, New York.

6. Bansal, R. K., "Heterocyclic Chemistry", Wiley Eastern Ltd., New Delhi.
7. Loudon, G. M., "Organic Chemistry", Oxford University Press, New York.

Supplementary Literature

(Latest available editions of the following books)

1. Lambert, J. B, Shurvell, H. F., Lightner, D. A. and Cooks, R. G., "Introduction to Organic Spectroscopy", Macmillan Publishing Company, New York.
2. Anderson, R. J., Bendell, D. and Groundwater, P., "Organic Spectroscopic Analysis", The Royal Society of Chemistry, Cambridge.
3. Gilchrist, T. L., "Heterocyclic Chemistry", Longman, Singapore.
4. Joule, J. A. and Mills, K., "Heterocyclic Chemistry", Blackwell Science, Tokyo.

BS 4th Year Semester-VII

Title of the Course:	Organic Chemistry	PAPER: I (PRACTICAL)
Credit Hours:	01	Marks: 100

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

(ADVANCED PRACTICAL-I IN LIEU OF RESEARCH PROJECT AND POSITION PAPER) (2 CR., LABORATORY)

BS 4th Year Semester-VII

Title of the Course:	Physical Chemistry	PAPER: I
Credit Hours:	03	Marks: 100

Statistical Thermodynamics

Description of various systems. Concepts of states, accessible states and distribution. Probability concepts. Maxwell - Boltzmann's statistics for the systems of independent particles. Partition functions. The relationship of partition function to the various thermodynamic functions. Transitional, vibrational and rotational partition 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.

Books Recommended

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. Smith E.B. "Basic Chemical Thermodynamics" 4th ed. Oxford University Press (1990).
4. Bockris J.O.M. and Reddy A.K.N. "Modern Electrochemistry" Vol-I and II, 4th ed. Plenum Press, London (2003).
5. Muhammad M. and Amjad M. "Principles of Electrode Kinetics" Rooha Printers, Lahore (2001).
6. Seddon J.M. and Gale J.D. "Thermodynamics and Statistical Mechanics" Royal Soc Chem, UK (2002).
7. Aston J.G. and Fritz J.J. "Thermodynamics and Statistical Thermodynamics" John-Wiley, New York (1987).
8. Albery J., Electrode Kinetics, Clarendon, Oxford (1975).
9. Engel, Thomas and Philip Reid, "Thermodynamics, Statistical Thermodynamics", and Kinetics 1st ed., Benjamin Cummings (2006).
10. Bard A.J. and Faulkner L.R. "Electrochemical Methods" John Wiley & Sons (2001).

BS 4th Year Semester-VII

Title of the Course:	Physical Chemistry	PAPER:	II
Credit Hours:	03	Marks:	100

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. Allcock H.R. and Lampe F.W. "Contemporary Polymer Chemistry" Prentice-Hall (1990).
4. Rudin "The Element of Polymer Science and Engineering" Academic Press (1990).
5. Sperling L.H. "Introduction to Physical Polymer Science" Wiley Interscience (1992).
6. Boyd R.H. and Phillips P.J. "The Science of Polymer Molecules" Cambridge (1993).
7. Malcolm P.S. "Polymer Chemistry" Oxford University Press (2005).
8. Ravue, "Principles of Polymer Chemistry" 2nd ed. Plenum Publishers (2000).

BS 4th Year Semester-VII

Title of the Course:	Physical Chemistry	PAPER : III
Credit Hours:	03	Marks: 100

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. Whiffen D. H. "Spectroscopy" Longmans Green and Co.: London, (1966).
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).
7. Hayward, David O., "Quantum Mechanics for Chemists" 1st ed., John Wiley (2003).
8. House, James E., "Fundamentals of Quantum Mechanics" 2nd ed., Elsevier-Academic Press (2003)

BS 4th Year Semester-VII

Title of the Course:	Physical Chemistry	PAPER:I (PRACTICAL)
Credit Hours:	01	Marks: 100

Specific experiments may be set making use of the following instruments depending upon their availability. Special experiments may also be designed for which a specimen list of instruments is given below. For the innovative designing of experiments the Journal of Chemical Education may be consulted.

Instruments:

PH-meter
Conductivity meter
Dipole meters
Electrogravimetric apparatus
UV/Visible spectrometer
Infrared spectrophotometer
Atomic absorption spectrophotometer
Stopped flow spectrometers
Gas Chromatography
HPLC
Light Scattering Instruments

Practical – I

- Determination of partial molar quantities.
- Determination of free energy changes, standard free energies.
- Verification of Kohlrausch law.
- Study of temperature dependence of electrode potentials.
- Determination of heat of solution, ionic reactions and other experiments from thermochemistry.
- Determination of molecular weight of a polymer by viscosity method.
- Precipitation value of electrolytes.
- Measurement of IR spectra of simple compound and their interpretation.
- Measurement of cyclic voltammogram of an organic compound and its interpretation.
- Determination of dipole moment of an organic liquid.
- Determination of percentage composition of KMnO_4 - $\text{K}_2\text{Cr}_2\text{O}_7$ in given solution by spectrometry.
- Evaluation of pKa value an indicator by spectrometric method.
- Synthesis of metal oxide nanoparticles and their characterization using IR and XRD techniques.

Recommended Books

1. Braun R.D. and Walters F. "Application of Chemical Analysis" (1982).

2. David P. "Experiments in Physical Chemistry" 5th ed. (1989).
3. Shoemaker C.W., Nibler G.J.W. and Christian G.D. "Analytical Chemistry" 6th ed. (2004).
4. James A.M. and Prichard F.E. "Practical Physical Chemistry" 3rd ed. Longman (1974).
5. Mowry S. and Ogren P.J., J. Chemical Education, 76(7) (1999).
6. Shoemaker D.P., Garland C.W. and Nibler J.W. "Experiments in Physical Chemistry" McGraw Hills, New York (1989).

BS 4th Year Semester-VII

Title of the Course:	Applied Chemistry	PAPER: I
Credit Hours:	03	Marks: 100

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.

BS 4th Year Semester-VII

Title of the Course:	Applied Chemistry	PAPER: II
Credit Hours:	03	Marks: 100

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 super phosphate (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.

BS 4th Year Semester-VII

Title of the Course:	Applied Chemistry	PAPER: III
Credit Hours:	03	Marks: 100

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 phenomena of paints; Drying oils for paint and classification of drying oils.

BS 4th Year Semester-VII

Title of the Course: Applied Chemistry PAPER: I (PRACTICAL)
Credit Hours: 01 Marks: 100

Water analysis; Analysis of oil and fats; Testing and analysis of vegetable ghee; Synthesis of soap and its analysis; Analysis of bleaching powder; Fertilizer analysis and testing of raw materials such as phosphate rock and ores; Various other practicals may be added in accordance with the available facilities.

BS 4th Year Semester-VII

Title of the Course: Analytical Chemistry PAPER: I
Credit Hours: 03 Marks: 100

Spectroscopic Methods of Analysis

- Making Measurements with Light
- Instruments for Measuring Absorption
- Calculations Involving Absorption
- Atomic Spectroscopy

BS 4th Year Semester-VII

Title of the Course: Analytical Chemistry PAPER: II
Credit Hours: 03 Marks: 100

Electrochemical Methods

- Oxidation-Reduction Reactions, Electrochemical Cells, Electrode Potentials
- Calculating Potentials of Electrochemical Cells and Applications
- Ion-selective Electrodes
- Polarography
- Voltametry

BS 4th Year Semester-VII

Title of the Course:	Analytical Chemistry	PAPER: III
Credit Hours:	03	Marks: 100

Nuclear Techniques

- Radioactivity
- Neutron Activation Analysis
- Nuclear Quadrupole Resonance
- Isotope Dilution Method
- Isotope Ratio Mass Spectrometry
- Mössbauer Spectroscopy
- Radio-Immuno Assay
- X-Ray Technique

BS 4th Year Semester-VII

Title of the Course:	Analytical Chemistry	PAPER: (PRACTICAL)
Credit Hours:	01	Marks: 100

- Calibration of a uv-visible spectrophotometer as per requirements of British Pharmacopoeia
- Experimental determination of limits of detection and quantitation by use of spectrophotometry
- Experimental determination of precision, accuracy and specificity
- Two experiments for quantitative determination of analytes of interest by spectrophotometry
- Two experiments for quantitative determination of analytes of interest by atomic spectrometry
- Three experiments based on electrochemical techniques

Books Recommended (Theory)

1. Analytical Chemistry by Gary D. Christian; 6th ed. 2004; John Wiley & Sons, Inc.

2. Fundamentals of Analytical Chemistry by Douglas A. Skoog, Donald M. West, F. James Holler, Stanley R. Crouch; 8th ed. 2003; Saunders College Publishing, Philadelphia.
3. Instrumental Methods of Analysis by Hobert H. Willard D.L. Merrit & J.R.J.A. Dean, Frank A. Settle; 7th Sub edition 1988; Wadsworth Publishing Company.

Books Recommended (Practicals)

1. British Pharmacopoeia
2. United States Pharmacopoeia
3. Laboratory Manual of Analytical Chemistry by C. Reilly; Allyn and Bacon, London
4. Quantitative Analysis by W. J. Blaedal and V. W. Medloche; Harper & Row, N. Y.
5. Most of the experiments prescribed can be found on various websites.

BS 4th Year Semester-VII

Title of the Course: Bio-Chemistry	PAPER: I
Credit Hours: 03	Marks: 100

Title of the Course: **General Biochemistry Related to Biomedical Sciences**

Prerequisites: Course I and concept of basic human physiology

Objective of the Course: This course provides fundamental concepts biochemical and molecular aspects of endocrinology and chemistry of blood and other extracellular fluids. Emphasis is on relation of the above topics to medicine.

Course Outline:

Endocrinology

General Introduction, Chemical Nature of Hormones, Common Characteristics. Mode of action of hormones, Hormones receptors. Chemistry. Biosynthesis, Metabolism and biological functions of pituitary, Adrenal, Thyroid, parathyroid, pancreatic and gonadal hormones. Hormones of GIT, Renal and Pienal glands.

Blood and Other Body Fluids.

General composition of blood. Function 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, respiration and gas transport. Blood Coagulation and clotting of blood. Blood pressure. Blood groups
Composition of Urine, Extracellular Fluids Like: cerebrospinal fluid, lymph, Sweat, Tears, Synovial and interstitial fluid.

Recommended Text Books:

1. Lehninger, A. L., " Principles of Biochemistry", Worth Publisher, New York, (2001).
2. Voet, D. and Voigt J. G., "Biochemistry", John Wiley & Sons, New York, (2000).
3. Murray, R. K., Mayes P. A., Granner, D. K. and Rodwell, V. W., Harper's Biochemistry", Appleton & Lange (2000).
4. Guyton, C and Hall J. C., Text Book of Medical Physiology, 9th., W. B. Saunders Company, (1996)
5. Orten, J. M. & Neuhasus, O. W., Human Biochemistry, 9th Ed., The C. V. Mosby Company, Saint Louis (1975).
6. Devlin, T. M. (Editor), The Text Book of Biochemistry with Clinical Correlation, Wiley- Liss, New York (1997).
7. Wilhelm R. Frisell, "Human Biochemistry", Macmillan Publishing Co., Inc. New York (1982).

BS 4th Year Semester-VII

Title of the Course:	Bio-Chemistry	PAPER: II
Credit Hours:	03	Marks: 100

Title of the Course: **Physical Techniques in Biochemistry**

Course Outlines

Extraction, Fractionation and Purification of macromolecules

Homogenization, Solubilization and Concentration including ultrasonication, lyphilization and ultradecantation, Purification based on

differential solubility techniques, Ion-Exchange chromatography, Gel chromatography, Affinity chromatography, Paper & Thin layer chromatography and HPLC.

Electrophoresis

Paper and Gel electrophoresis. Two-dimensional electrophoresis. Capillary electrophoresis.

Electrofocusing

Preparative and Analytical electrofocusing.

Centrifugation

Principle. Preparative centrifugation. Application of density gradient and differential centrifugation. Ultracentrifugation. Sedimentation equilibrium and sedimentation velocity methods. Application of analytical centrifugation.

Tracer techniques

Detection and measurement of radioactivity. Application of radioisotopes in biological system.

U.V. and Visible Spectroscopy

Basic principles. Instrumentation and applications.

ELISA Techniques

Books Recommended

1. The tools of Biochemistry by Cooper
2. Principles and techniques of practical Biochemistry by William Edward and Arnold
3. Qualitative problems in Biochemistry by Dawas
4. A biologist's Physical chemistry by J.Gareth Morris
5. Protein purification, principle and practice by Robert.K.Scope.

BS 4th Year Semester-VII

Title of the Course:	Bio-Chemistry	PAPER: III
Credit Hours:	03	Marks: 100

Title of the Course: **Molecular Biology**

Course Outline:

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. Watson, J.D., Baker, T.A., Bell, S.P., Gann, **Molecular Biology of the Gene 2004**, Pearson Education, Inc.
2. Watson, J.D. Tooze, J and Kurtz, D.T. **Recombinant DNA** Scientific American Books. Freeman
3. Lewin B. **Gene VII**. Oxford University Press
4. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter **Molecular Biology of the Cell 5th** Edition Taylor &Francis
5. T. A. Brown. **Genomes 3rd** Edition Taylor &Francis

BS 4th Year Semester-VII

Title of the Course:	Bio-Chemistry	PAPER:I (PRACTICAL)
Credit Hours:	01	Marks: 100

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

Advanced Practical-I in lieu of Research Project and Position Paper. (2 Cr. Hr.)

BS 4th Year Semester-VIII

Title of the Course:	Inorganic Chemistry	PAPER: IV
Credit Hours:	03	Marks: 100

Objective of the Program

After completing this program students will be able to learn and have knowledge of the following:

1. Chemistry of Organometallics with especially with reference to their types and bonding.
2. Reactivity of Organometallic Compounds in Homogenous Catalytic

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- member 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 Organometallics Chemistry", 2nd edition London, 1995.
2. Akio Yamamoto "Organotransition Metal Chemistry", Prentice Hall, 1992.
3. F. A. Cotton, G. Wilkinson, C. A. Murillo and M. Bochmann, "Advanced Inorganic Chemistry", 6th Ed., Wiley-Interscience, New York, 1999.
4. Miessler G.L. and Tar Donald, A. "Inorganic Chemistry" Prentice Hall Int. edition, 1991.
5. Douglas, McDaniel & John Alexander. "Concepts and Models of Inorganic Chemistry" by John Willey and Sons, 1994.
6. Zuckerman, H., "Basic Organometallic Chemistry", 2nd Ed, 1985.
7. William. J., Modern inorganic chemistry second edition McGraw Hill Company, 1991.
8. Porter Field. W.W., Inorganic Chemistry a Unified Approach 2nd ed. Elsevier Publishers, 2005.

BS 4th Year Semester-VIII

Title of the Course: Inorganic Chemistry PAPER: V
Credit Hours: 03 Marks: 100

Objective of the Program

After completing this program students will be able to learn the following:

1. Magneto Chemistry
2. Oxidative Addition and Reductive Elimination

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 of for $p^1 - p^6$ and $d^1 - d^{10}$ systems, pigeon holes diagram, effect of temperature on magnetic properties of complexes. Magnetic moment of lengthanise.

Oxidative Addition and Reductive Elimination

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. and Alexander, J., "Concepts of Models of Inorganic Chemistry", John Wiley & Sons Inc., 3rd Edition, 1994
2. Huheey, J. E, Keiter, E. A. and Keiter, R. L., "Inorganic Chemistry: Principles of Structure and Reactivity", 4th Ed., Harper & Row, New York, 2001.
3. Mackay, K. M., Mackay, R. A. and Henderson, W., "Introduction to Modern Inorganic Chemistry", 5th Edition, Stanley Thomas Publisher Ltd. 1996
4. Miessler, G. L. and Tarr Donald, A., "Inorganic Chemistry", Prentice Hall International, 1991.
5. Purcell, K.F. and Kotz, J.C., "An Introduction to Inorganic Chemistry" W.B. Saunders Company Holt-Saunders Internal editions, 1980.
6. F. A. Cotton, G. Wilkinson, C. A. Murillo and M. Bochmann, "Advanced Inorganic Chemistry", 6th Ed., Wiley-Interscience, New York, 1999.

7. William. J., Modern inorganic chemistry second edition McGraw Hill Company 1991.

BS 4th Year Semester-VIII

Title of the Course: Inorganic Chemistry PAPER : VI
Credit Hours: 03 Marks: 100

Objective of the Program

After completing this program students will be able to learn the following:

1. The chemistry of radio isotopes, their reactions and applications.
2. Nuclear reactions

Nuclear Chemistry

Introduction, theory of disintegrations, 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 disintegration. Fission and Fusion reactions, Accelerators of charged particles, applications of Radio Isotopes

Recommended Books

1. Fried Landler, Kennedy and Miller, "Nuclear and Radiochemistry", John Willey and Sons, Inc. 2nd edition, 1964.
2. Choppin, G. R. and Rydber, J., "Theory and Applications", Pergamon 1980.
3. Arnikan, H. J., "Essentials of Nuclear Chemistry", 4th edition, 1990.
4. Harvey, B.G. "Nuclear Physics and Chemistry", Prentice-Hall Inc., 1990.
5. Naqvi, I. I., "Radiochemistry", University Grants Commission, 1990.

BS 4th Year Semester-VIII

Title of the Course: Inorganic Chemistry PAPER:II (PRACTICAL)
Credit Hours: 01 Marks: 100

- Spectroscopic determination of some metal ions.
- Recording and characterization of at least five organometallic compounds by IR and UV spectrophotometer to the subject of availability of facilities.
- Estimation of different metals in food, tap water and brass etc. by Atomic Absorption Spectrometer/ flame photometer / UV / Visible spectrophotometer, subject to the availability of facilities.

Recommended books

1. Bassette, J., Denney, G. H. and Mendham, J., "Vogel's Textbook of Quantitative Inorganic Analysis Including Elementary Instrumental Analysis" English Language Book Society, 4th Edition, 1981.
2. Vogel, A. I., "A Textbook of Micro and Semi-micro Qualitative Inorganic Analysis" Longman Green & Co. 1995.
3. Fritz, J. S. and Schenk, G. H., "Quantitative Analytical Chemistry", Allyn and Bacon Inc., 4th Edition, 1979.
4. Pass, G and Sutcliffe, H., "Practical Inorganic Chemistry", Van Nostrand Reinhold Company, 1972.

BS 4th Year Semester-VIII

Title of the Course:	Organic Chemistry	PAPER: IV
Credit Hours:	03	Marks: 100

Mechanisms and Methods of Determining Them

Review of kinds and mechanism 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 of 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 Literature

(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. and 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. Gould, E. S., "Mechanism and Structure in Organic Chemistry", Holt, Rinehart and Winston, New York.
6. Clayden, J., Greeves, N., Warren, S. and Wothers, P., "Organic Chemistry", Oxford University Press, New York.
7. Loudon, G. M., "Organic Chemistry", Oxford University Press, New York.
8. Brown, W. H., "Introduction to Organic Chemistry", Saunders College Publishing, Tokyo.
9. Ahluwalia, V. K. and Goyal, M., "A Text Book of Organic Chemistry", Narosa Publishing House, New Delhi.
10. Finar, I. L., "Organic Chemistry", Vol. 2, Pearson Education, Delhi.
11. Blei, I. and Odian, G., "General, Organic and Biochemistry", W. H. Freeman & Company, New York.
12. Solomons, T. W. G. and Fryhle, C. B., "Organic Chemistry", John Wiley & Sons, New York.
13. Burger, A., "Medicinal Chemistry Part I & II", John Wiley & Sons, New York.
14. Wolff, M. E., "Burger's Medicinal Chemistry Part II", John Wiley & Sons, New York.
15. Williams, D. A. and Lemke, T. L., "Foye's Principles of Medicinal Chemistry", Lippincott Williams & Wilkins, New York.

Supplementary Literature

(Latest available editions of the following books)

1. Sykes, P., "A Guide Book to Mechanism in Organic Chemistry", Longman, London.
2. Pine, S. H., "Organic Chemistry", National Book Foundation, Islamabad.
3. Norman, R. O. C. and Coxon, J. M., "Principles of Organic Synthesis", Nelson Thornes, Cheltenham.
4. Isaacs, N. S., "Physical Organic Chemistry", Longman, London.

BS 4th Year Semester-VIII

Title of the Course:	Organic Chemistry	PAPER: V
Credit Hours:	03	Marks: 100

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 Literature

(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. and Fieser, M., "Steroids", Asia Publishing House, London.

Supplementary Literature

(Latest available editions of the following books)

1. Morrison, R. T. and Boyd, R. N., "Organic Chemistry", Prentice-Hall of India, New Delhi.
2. Solomons, T. W. G. and Fryhle, C. B., "Organic Chemistry", John Wiley & Sons, New York.

BS 4th Year Semester-VIII

Title of the Course:	Organic Chemistry	PAPER: VI
Credit Hours:	03	Marks: 100

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 Literature

(Latest available editions of the following books)

1. Bruckner, R., "Advanced Organic Chemistry-Reaction Mechanisms", Harcourt Science & Technology Company, New York.
2. Loudon, G. M., "Organic Chemistry", Oxford University Press, New York.
3. Powell, P., "Principles of Organometallic Chemistry", Chapman & Hall, New York.
4. Parkins, A. W. and Poller, R. C., "An Introduction to Organometallic Chemistry", Macmillan, London.
5. Waren, S., "Organic Synthesis-The Disconnection Approach", John Wiley & Sons, New York.
6. Waren, S., "Workbook for Organic Synthesis-The Disconnection Approach", John Wiley & Sons, New York.

7. Smith, M. B., "Organic Synthesis", McGraw-Hill, New York.
8. Clayden, J., Greeves, N., Warren, S. and Wothers, P., "Organic Chemistry", Oxford University Press, New York.
9. Parker, D. B. V., "Polymer Chemistry", Applied Science Publishers, London.
10. Billmeyer Jr., F. W., "Textbook of Polymer Science", John Wiley & Sons, New York.

Supplementary Literature

(Latest available editions of the following books)

1. Challa, G., "Polymer Chemistry–An Introduction", Ellis Horwood, New York.
2. Stevens, M. P., "Polymer Chemistry–An Introduction", Addison-Wesley Publishing Company, London.
3. Wade Jr., L. J., "Organic Chemistry", Pearson Education, Delhi.
4. Morrison, R. T. and Boyd, R. N., "Organic Chemistry", Prentice-Hall of India, New Delhi.

BS 4th Year Semester-VIII

Title of the Course:	Organic Chemistry	PAPER:II (PRACTICAL)
Credit Hours:	01	Marks: 100

Laboratory work illustrating topics covered in the lecture of papers IV, V & VI.

(Advanced Practical-II in lieu of Research Project and Position Paper) (2 cr., laboratory)

Literature for Laboratory Work to be carried out during the Course of Studies

Recommended Literature

(Latest available editions of the following books)

1. Clarke, H. T., "A Handbook of Organic Analysis-Qualitative and Quantitative", CBS Publishers & Distributors, New Delhi.
2. Mann, F. G. and Saunders, B. C., "Practical Organic Chemistry", Longman, London.
3. Vogel, A. I., "Elementary Practical Organic Chemistry Part 3: Quantitative Organic Analysis", Longman, London.

4. Vishnoi, N. K., "Advanced Practical Organic Chemistry", Vikas Publishing House Pvt. Ltd., New Delhi.
5. Furniss, B. S., Hannaford, A. J., Smith, P. W. G. and Tatchell, A. R., "Vogel's Text Book of Practical Organic Chemistry", National Book Foundation, Islamabad.
6. Shriner, R. L., Hermann, C. K. F., Morrill, T. C., Curtin, D. Y. and Fuson, R. C., "The Systematic Identification of Organic Compounds", John Wiley & Sons, New York.
7. Mendham, J., Denney, R. C., Barnes, J. D. and Thomas, M. J. K., "Vogel's Text Book of Quantitative Chemical Analysis", Pearson Education, New Delhi.
8. Beckett, A. H. and Stenlake, J. B., "Practical Pharmaceutical Chemistry", Athlone Press, London.
9. Pavia, D. L., Lampman, G. M. and Kriz, G. S. "Introduction to Spectroscopy: A Guide for Students of Organic Chemistry", Saunders Golden Sunburst Series, London.
10. Silverstein, R. N., Barrler, G. C. and Morrill, T. C., "Spectrometric Identification of Organic Compounds", John Wiley & Sons, New York.
11. Kalsi, P.S. "Spectroscopy of Organic Compounds", Wiley Eastern Ltd., New Delhi.
12. Palleros, D. R., "Experimental Organic Chemistry", John Wiley & Sons, New York.

Supplementary Literature

(Latest available editions of the following books)

1. Keese, R, Muller, R. K. and Toube, T. P., "Fundamentals of Preparative Organic Chemistry", John Wiley & Sons, New York.
2. Gurtu, J. N. and Kapoor, R., "Advanced Experimental Chemistry", S. Chand & Company Ltd., New Delhi.
3. Newman, M. S., "An Advanced Organic Laboratory Course", Macmillan, New York.
4. Zubrick, J. W., "The Organic Chem Lab Survival Manual: A Student's Guide to Techniques", John Wiley & Sons, New York.
5. Kemp, W., "Organic Spectroscopy", Palgrave, New York.
6. Lambert, J. B, Shurvell, H. F., Lightner, D. A. and Cooks, R. G., "Introduction to Organic Spectroscopy", Macmillan Publishing Company, New York.
7. Williams D. H. and Fleming, I., "Spectroscopic Methods in Organic Chemistry", Athlone Press, London.
8. Atta-ur-Rehman, "Nuclear Magnetic Resonance Spectroscopy", UGC, Islamabad.
9. Davis, R. and Freason, M., "Mass Spectrometry", John Wiley & Sons, New York.

BS 4th Year Semester-VIII

Title of the Course:	Physical Chemistry	PAPER: IV
Credit Hours:	03	Marks: 100

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 pentoxide.

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

Title of the Course:	Physical Chemistry	PAPER: V
Credit Hours:	03	Marks: 100

Radiation Chemistry

Development and advancement in radiation chemistry. Radiation dosimetry. Fricke dosimeter, dosimetry in pulse radiolysis. Energy states in radiation chemistry. Excited 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 behaviour 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,

BS 4th Year Semester-VIII

Title of the Course:	Physical Chemistry	PAPER: VI
Credit Hours:	03	Marks: 100

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.

Books Recommended

1. Calvert J.G. and Pitts J.N. "Photochemistry" John Wiley, New York (1966).
2. Wayne and Richard P. "Photochemistry" Macmillan (1988).
3. Hughes G. "Radiation Chemistry" Oxford Series, UK (1973).
4. Spinks J.W.T. and Woods R.J. "An introduction to Radiation Chemistry" Wiley Inter Sci. Pub, USA (1976).
5. O'Donnell J.H. and Sangster D.F. "Principle of Radiation Chemistry" Edward Arnold Pub, UK (1970).
6. Baco Z.M. and Alexander P. "Fundamentals of Radiobiology" CLBS, UK (1972).
7. Suppan P. "Principle of Photochemistry" The Chemical Soc. UK (1973).
8. Aziz F. and Rodgers M.A.J., "Radiation Chemistry Principles and Application" Ed., VCH Publishers, Inc. (1987)
9. Wayne R.P. "Principles and Application of Photochemistry", University Press Oxford London (1988).
10. Segal H. "Enzyme Kinetics" John Wiley New York (1975).
11. Schlutz A.R. "Enzyme Kinetics" (1964) Cambridge University Press England.
12. Wetson R. and Schwavz H.A. "Chemical Kinetics" Prentice Hall Inc, New Jersey (1972).
13. West A.R. "Solid State Chemistry", J. Wiley, New York (1989).

BS 4th Year Semester-VIII

Title of the Course:	Physical Chemistry	PAPER:II (PRACTICAL)
Credit Hours:	03	Marks: 100

- Study of multistep reactions.
- Sugar analysis and inversion studies by polarimetry.
- Study of isotherms and experiments of surface chemistry.
- Kinetics of fading of phenolphthalein in alkaline solution.
- Study of the effect of pH on the rate constant of the reaction between iodide and persulphate ions.

- Study of the salt effect on the rate constant of the reaction between similar charges of ions.
- Kinetics of autocatalytic reaction between permanganate and oxalate ions.
- Determination of energy of activation of the reaction between similar charges of ions.
- Kinetics of the reaction between methylorange and peroxodisulphate ions in presence of bromide ions.
- Stoichiometry of a complex in solution by Job's method.

Recommended Books

1. Braun R.D. and Walters F. "Application of Chemical Analysis" (1982).
2. David P. "Experiments in Physical Chemistry" 5th ed. (1989).
3. Shoemaker C.W., Nibler G.J.W. and Christian G.D. "Analytical Chemistry" 6th ed. (2004).
4. James A.M. and Prichard F.E. "Practical Physical Chemistry" 3rd ed. Longman (1974).
5. Mowry S. and Ogren P.J., J. Chemical Education, **76**(7) (1999).
6. Shoemaker D.P., Garland C.W. and Nibler J.W. "Experiments in Physical Chemistry" McGraw Hills, New York (1989).

BS 4th Year Semester-VIII

Title of the Course:	Applied Chemistry	PAPER: IV
Credit Hours:	03	Marks: 100

Paper and Pulp Technology

Raw materials for pulp and paper industries; Classification of paper products; Chemistry involved in the processing of kraft pulp, sulphite pulp and semi-chemical pulp; Manufacture of paper and regeneration of spent liquor.

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 delivery polymers.

Cosmetics and Perfumes

Chemistry and production of hair products and shampoos; Chemistry involved in hair curling and styling products; Hair tonics and depilatory products; Production of cold cream, vanishing cream, bleach cream and shaving creams; Tooth paste and face powders; Production of nail polish, lipsticks and mascaras.

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.

BS 4th Year Semester-VIII

Title of the Course:	Applied Chemistry	PAPER: V
Credit Hours:	03	Marks: 100

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.

Pharmaceutical Industry

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

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 modelling.

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.

BS 4th Year Semester-VIII

Title of the Course: Applied Chemistry PAPER: VI
Credit Hours: 03 Marks: 100

Iron, Steel and Alloyes Industries

Iron ores, constituents and their classification; Manufacture of iron and steel; Types of iron and steel; Metal Extractions and production of Alloyes.

Corrosion and its Prevention

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

Colour Chemistry

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

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.

BS 4th Year Semester-VIII

Title of the Course: Applied Chemistry PAPER: II (PRACTICAL)
Credit Hours: 01 Marks: 100

Analysis of coal and petroleum fuels; Cement analysis and testing of raw materials; Milk analysis; Analysis of lime stone; Preparations of various cosmetics such as cold cream, shaving cream, nail polish, shoe polish

etc. Various other of practicals may added in accordance with the available facilities.

Recommended Books

1. George T. Auston., 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 NewYork, (1997).
3. James, Handbook of Industrial Chemistry, (1974).
4. J. C Kuriacase & J Rajaran., Chemistry in Engineering and Technology, 2nd Ed., (1984).
5. Chuis A. Clauses III Guy Matison., Principles of Industrial Chemistry, (1978).
6. P. C. Jain., A Textbook of Applied Chemistry, (1993).
7. Shukla., A Textbook of Chemical Technology, (1977).
8. B. N. Chakrabarty, Industrial Chemistry, (1991).
9. Howard L.White, Introduction to Industrial Chemistry, (1986).
10. G. N. Pandey, A Text Book of Chemical Technology, 2nd Edition, Vikas Publishing house, (2000).
11. Haward L.White, Introduction to Industrial Chemistry, (1992).
12. Gyngell, E. S., Applied Chemistry for Engineers, 3rd Ed. Edward Arnold, Ltd London, (1972) Reprinted (1989).
13. P. C Jain., A Textbook of Applied Chemistry, (1993).
14. D. Sharp & T. F. West, The Chemical Industry, (1982).
15. J. C. Kuriacose J. Rajaran, Chemistry in Engineering and Technology, Vol. I (1988).
16. J. C. Kuriacose J. Rajaran, Chemistry in Engineering and Technology, Vol. II (1988).
17. Charles H. Fuchsman, PEAT Industrial Chemistry & Technology, (1980).
18. Richard M. Felder and Ronald W. Rousseau, Elementary Principles of Chemical Process, 3rd Edition, Replica Press PVT. Ltd India, (2005).
19. W. A. Poucher & G. M. Howard., Perfumes Cosmetics & Soaps, 1st Ed., (1974).
20. Marcel Billot F. V. Wells, Perfumery Technology, (1975).
21. G. H. Jenkins, Introduction to Cane Sugar Technology, (1965).
22. Chittararjan Kumar., Sugar Industry Management, (1994).
23. G. G. Birch & K. J. Parker., Sugar Science & Technology (1979).
24. Roy L. Whistler, James N. Bemiller Eugene F.Raschall, Starch Chemistry and Technology, (1984).
25. R. Lambourne., Paint & Surface Coatings Theory & Practice, (1987).

26. R. M. Christie, Colour Chemistry, The Royal Society of Chemistry, (2001).
27. P. C. Deb, Soaps and Detergents, 1st Edition, C. B. S. Publisher and distributes, (1996).
28. P. C. Deb., Modern Trends in Formulating Soaps and Detergents, (1996).
29. Samuel A. Matz., The Chemistry & Technology of Cereals as Food & Feed (1996).
30. G. C. Bye., Portland Cement, (1983).
31. We Worrall, Clays, (1968).
32. Academy of Science USSR, The Structure of glass, (1953).
33. G. O. Jones, Glass, 2nd Ed., (1971).
34. F. Moore Rheology of Ceramic Systems (1965).
35. W. F. Ford, The Effect of Heat on Ceramics, (1967).
36. Philip Rawson, Ceramics, (1971).
37. Wyatt, Metal Ceramics & Polymers, (1974).
38. F. K. Norton, Elements of Ceramics, 2nd Ed., (1974).
39. Irene Stitt, Ceramics last 100 years, (1974).
40. Kingery Bowen Uhlman, Introduction to Ceramics, 2nd Ed., (1976).
41. F. H. Norton, Refractories 4th Edition, McGraw-Hill Book Company, (1970).
42. James P. Casey, Pulp & Paper Chemistry and Chemical Technology, 3rd Ed., Vol.II, (1980).
43. W. L. Nelson., Petroleum Refinery Engineering, 4th Ed., (1985).
44. Theodore Dumas Walter Bulani, Oxidation of Petrochemicals Chemistry and Technology, (1974).
45. Urbanski, T., Chemistry and Technology of Explosives Vol-1, Authorised Translation by I. Jeczalikowa ad S. Laverton, 2nd Ed., Pergamon Press London, (1983).
46. Urbanski T., Chemistry and Technology of Explosives Vol-II, Authorised Translation by W. Ornaf and S. London, 2nd Ed., Pergamon Press London, (1983).
47. Urbanski, T., Chemistry and Technology of Explosives Vol-III, 1st Ed., Pergamon Press London (1984).
48. Urbanstri, T., Chemistry and Technology of Explosives, (1985).
49. Urnanski, T., Chemistry and Technology of Explosives Vol-IV, Authorised Translation by M.Jureki and Laverton, 3rd Ed., Pergamon press London (1988).
50. Billmeyer, F. W. Jr., Text Book of Polymer Science, 3rd Ed., John Wiley and Sons Inc. Singapore, (1994).
51. Nicholson, J. W., The Chemistry of Polymer, 2nd Ed., Published by Royal Society of Chemistry Cambridge (1997).

52. Terold M. Schultz, Polymer Materials Science, (1974).
53. Beat Meyer, Urea Formaldehyde Resins, (1979).
54. Paul J. Flory, Principles of Polymer Chemistry, (1975).
55. Gorge Ordian, Principles of Polymerisation, 3rd Edition, John Wiley Publishers (1991).
56. George Ordian, Principles of Polymerization, Wiley Inferences, Printed and published by Replika Press PVT Ltd. India, (2004).
57. Cowie J. M.G., Polymers Chemistry and Physics of Modern Material, 1st Ed. Intertext Book New York, (1973).
58. Evans, U. R., An Introduction to Metallic Corrosion, 3rd Ed., Edward Arnold (1981).
59. Mattsson, E. Basic Corrosion Technology for Scientists and Engineers, 1st Ed., Ellis Horwood, Ltd. UK (1989).
60. Ijaz Hussain Khan, Corrosion Technology, Vol. I (1989).
61. Leighou, R. B., Chemistry of Engineering Materials, Fourth Edition 1953, Mc Graw-Hill Book Company Inc. New York, (1953).
62. Henry C. Perkin, Air Pollution, (1974).
63. Glele Mamantov W. D. Shults, Determination of Air Quality, (1974).
64. K. Wark Cecil F. Warner, Air Pollution its origin & Control.(1976).
65. Nelson L. Nemerow, Industrial Water Pollution, (1978).
66. Colin Baird, Environmental Chemistry, (1995).
67. Warren L. McCabe Julian C. Smith Peter Harriott., Unit operations of Chemical Engineering, 4th Ed., (1985).
68. Coulson & Richardson., Chemical Engineering, 1st Ed., (1985).
69. Octave Levenspiel., Chemical Reaction Engineering, 2nd Ed., (1979).
70. Jugal Kishore Agrawal., Practicals in Engineering & Chemistry, (1987).
71. H. Scott Fogler, Elements of Chemical Reaction Engineering, 2nd Ed., (1992).
72. Walter. L. Badger & Julius T. Banchero, Introduction to Chemical Engineering, (1955).
73. Samuel Cate, Prescott Cecil Gordon Dunn Industrial Microbiology 3rd Ed., (1959).
74. Henry R. Bungay Georges Belfort., Advanced Biochemical Engineering, (1987).
75. P. F. Stanbury & A. Whitaker, Principles of fermentation Technology, (1987).
76. Prescott, Industrial Microbiology, (1959).
77. N. S. Subba Rao., C. Balagopalan S. V. Ramakrishna., New Trends in Biotechnology, 5th Ed., (1992).

78. Groggins, P.H., Unit Process in Organic Synthesis, 5th Ed, McGraw Hill Book Company Inc. York (1958).
79. Wiseman, P., Industrial Organic Chemistry, 2nd Ed., Applied Science Publisher Ltd., London, (1979).
80. Furnas, C. C., Industrial Chemistry, Vol-II 6th Ed., D. Van Nostrand Company, Inc. Princeton New Jersey, New York (1957).
81. Vogel, I. A., Text Book Quantitative Inorganic Analysis, 7rd Ed., Longman, Green and Co. Ltd. UK (1961) and (1978).
82. Jeffrey, G. H., J, Bassett, J. Mandham and R. C. Denney, Vogel's Textbook of Qualitative Chemical Analysis, 5th Ed., ELBS Longman Scientific and Technical Group, England (1989), Reprinted (1994).
83. Grant, Quantitative Analysis, 5th Ed., J and A Churchill Ltd., London, (1974).
84. Vogel, I. A., Text Book Quantitative Inorganic Analysis, 3rd Ed., Longman, Green and Co. Ltd. UK (1961) and (1978).
85. Ghoshad. A. K., Mahapatra. B. and Ghoshad. A., An Advanced Course in Practical Chemistry, (1997).
86. A. K. Spivas Tava, Chemical Analysis, 3rd Ed., (1997).
87. Brian S. Furniss Antony J. Hammaford, Textbook of Practical Organic Chemistry, (1989).

BS 4th Year Semester-VIII

Title of the Course:	Analytical Chemistry	PAPER: IV
Credit Hours:	03	Marks: 100

Hyphenated Techniques

- Gas Chromatography-Mass Spectrometry (GC-MS)
- Liquid Chromatography-Mass Spectrometry (LC-MS)
- MS-MS
- LC-FTIR
- Inductively Coupled Plasma-Mass Spectrometry

BS 4th Year Semester-VIII

Title of the Course:	Analytical Chemistry	PAPER: V
Credit Hours:	03	Marks: 100

Advanced Chromatography

- High Performance Liquid Chromatography
- Fast Protein Liquid Chromatography
- Thin Layer Chromatography
- Gel Permeation Chromatography
- Paper Chromatography

BS 4th Year Semester-VIII

Title of the Course: Analytical Chemistry PAPER : VI
Credit Hours: 03 Marks : 100

Special Topics

- Matrix-assisted Laser Desorption/Ionization-Time of Flight (MALDI-TOF) Mass Spectrometry
- Tandem Mass Spectrometry
- Ion Trap Mass Spectrometry
- Other topics of interest

BS 4th Year Semester-VIII

Title of the Course: Analytical Chemistry PAPER:II (PRACTICAL)
Credit Hours: 01 Marks: 100

- Calibration and validation of an HPLC system as per requirements of British Pharmacopoeia or United States Pharmacopoeia
- Experimental determination of limits of detection, quantitation, precision, accuracy and specificity, resolution, column efficiency etc by use of HPLC
- Determinations demonstrating the use of other chromatographic techniques

ADVANCED PRACTICALS (2 Cr. Hr.)

Suitable number of advanced practicals may be prescribed by the departments keeping in view the facilities and expertise available.

Books Recommended (Theory)

1. Analytical Chemistry by Gary D. Christian; 6th ed. 2004; John Wiley & Sons, Inc.
2. Fundamentals of Analytical Chemistry by Douglas A. Skoog, Donald M. West, F. James Holler, Stanley R. Crouch; 8th ed. 2003; Saunders College Publishing, Philadelphia.
3. Instrumental Methods of Analysis by Hobert H. Willard D.L. Merrit & J.R.J.A. Dean, Frank A. Settle; 7th Sub edition 1988; Wadsworth Publishing Company.

Practicals

4. British Pharmacopoeia
5. United States Pharmacopoeia
6. Laboratory Manual of Analytical Chemistry by C. Reilly; Allyn and Bacon, London
7. Quantitative Analysis by W. J. Blaedal and V. W. Medloche; Harper & Row, N. Y.
8. Most of the experiments prescribed can be found on various websites.

BS 4th Year Semester-VIII

Title of the Course:	Bio-Chemistry	PAPER: IV
Credit Hours:	03	Marks: 100

Title of the Course:	Physiological Chemotherapy	Chemistry	and
----------------------	---------------------------------------	------------------	------------

Course Outline

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.

Circulatory system.

Chemotherapy:

Structure and mode of action of antipyretics analgesic, antimalarial, supha-drugs, antibiotics with special reference to pencillin, sulphanilamides. Mechanism of drugs action and resistance.

Books Recommended

1. Principles of Biochemistry by White Hundler and Smith.
2. Biochemistry by Lehninger.
3. Review of Physiological Chemistry by H.A.Harper.
4. Text Book of Biochemistry by West Todd/Mason/Von Brugge.
5. Text Book of Biochemistry by Mazur/Harrow.
6. The Pharmacological basis of Therapeutics edited by L.S.Goodman and A.Gilman (Macmillan).

BS 4th Year Semester-VIII

Title of the Course:	Bio-Chemistry	PAPER: V
Credit Hours:	03	Marks: 100

Title of the Course: **Microbiology and Immunology**

Course Outline

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

Virus and Eukaryotic microorganisms: Virus. Bacteria, fungi and parasites

Bacterial Diseases: Airborne, Foodborne and waterborne bacterial diseases.

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

Immunology:

Chemistry of immunoglobulins, myeloma and hybridoma immunoglobulins. Immune system and its abnormalities. Allergy and inflammation. Complement system, peripheral leucocytes and macrophages.

Immune Disorders

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

Recommended Books

1. Nester, E.W. D.G. Anderson, C.E. Roberts, N.N Pearsall and M.T. Nester. Microbiology 4th Ed. McGraw Hill Companies Inc.
2. Doan T., R.Melvold, S.Viselli and C. Waltenbaugh. Immunology: Lippincott Illustrated Reviews Lippincott Williams& Wilkins.
3. Stroll, W.A. H.Rouse, P.C. Champe, and R.A. Harvey. Microbiology Lippincott Illustrated Reviews Lippincott Williams& Wilkins.
4. Presscott, L.M. J.P. Harley and D.A.Klein Microbiology McGraw Hill Companies Inc.

BS 4th Year Semester-VIII

Title of the Course:	Bio-Chemistry	PAPER: VI
Credit Hours:	03	Marks:100

Title of the Course: **Nutrition**

Course Outline

Major Dietary Constituents

Nutritional importance of Carbohydrates, Proteins and Amino Acids, Lipids , and Dietary fiber

Energy Needs

Assessment and requirement of energy in different age groups.

Nutrition in Growth and Aging

Nutritional requirement during infancy and childhood. Diet, nutrition and adolescence. Nutrition in the Elderly.

Minerals

Biochemical role of Calcium, Chromium, Copper, Iron, Iodine, Magnesium, phosphorous, Selenium, and Zinc. Their dietary 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. Shils, M.E., J.A. Olson and M. Shike. Modern Nutrition in Health and Disease. Lea & Febiger USA
2. Passmore, R and M.A. Eastwood. Human Nutrition and Dietetics. Churchill Livingstone.
3. Murray, R.K., D.K. Grannar, P.A. Mayes and V.W. Rodwell. Harper's illustrated Biochemistry McGraw-Hill Companies Inc.
4. Smith, E.L., R.L. Hill, I.R. Lehman, R.J. Lefkowitz, P. Handler, and A. White. Principles of Biochemistry (Mammalian Biochemistry) McGraw-Hill Companies Inc.

BS 4th Year Semester-VIII

Title of the Course:	Bio-Chemistry	PAPER: II
Credit Hours:	01	Marks:100

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

Advanced Practical-II in lieu of Research Project and Position Paper. (2 Cr. Hr.)

Recommended Text Books:

1. Plummer, D.T., An introduction to practical biochemistry, TATA McGraw-Hill Publishing Company LTD.
2. Deyer, R. L. and G. F. Lata, Experimental Biochemistry, Oxford University Press.
3. Gowenlock, A. H., Varley's Practical Clinical Biochemistry, 6th Ed., Heinemann Professional Publishing, Oxford (1988).

4. Sawhney, S. K. and R. Sing (Editors), Introductory Practical Biochemistry, Narosa Publishing House, New Delhi, (2005)
5. Gosling, J. P., Immunoassay: Laboratory Analysis and Clinical application (1994)

**COMPULSORY COURSES IN ENGLISH FOR BS
(4 YEAR) IN BASIC & SOCIAL SCIENCES**

English I (Functional English)

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. Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 2. Third edition. Oxford University Press. 1997. ISBN 0194313506
- b) Writing
1. Writing. Intermediate by Marie-Christine Boutin, Suzanne Brinand and Françoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 0 19 435405 7 Pages 20-27 and 35-41.
- c) Reading/Comprehension
1. Reading. Upper Intermediate. Brian Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1992. ISBN 0 19 453402 2.
- d) Speaking

English II (Communication Skills)

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-Christine Boutin, Suzanne Brinand and Françoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 019 435405 7 Pages 45-53 (note taking).
 - 2. Writing. Upper-Intermediate by Rob Nolasco. Oxford Supplementary Skills. Fourth Impression 1992. ISBN 0 19 435406 5 (particularly good for writing memos, introduction to presentations, descriptive and argumentative writing).
- c) Reading
 - 1. Reading. Advanced. Brian Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1991. ISBN 0 19 453403 0.
 - 2. Reading and Study Skills by John Langan
 - 3. Study Skills by Richard Yorky.

English III (Technical Writing and Presentation Skills)

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 Editors: Janice Neulib; Kathleen Shine Cain; Stephen Ruffus and Maurice Scharon. (A reader which will give students exposure to the best of twentieth century literature, without taxing the taste of engineering students).

Pakistan Studies (Compulsory)

Introduction/Objectives

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

Course Outline

1. Historical Perspective

- a. Ideological rationale with special reference to Sir Syed Ahmed Khan, Allama Muhammad Iqbal and Quaid-i-Azam Muhammad Ali Jinnah.
- b. Factors leading to Muslim separatism
- c. People and Land
 - i. Indus Civilization
 - ii. Muslim advent
 - iii. Location and geo-physical features.

2. Government and Politics in Pakistan

Political and constitutional phases:

- a. 1947-58
- b. 1958-71
- c. 1971-77
- d. 1977-88
- e. 1988-99
- f. 1999 onward

3. Contemporary Pakistan

- a. Economic institutions and issues
- b. Society and social structure
- c. Ethnicity
- d. Foreign policy of Pakistan and challenges

e. Futuristic outlook of Pakistan

Books Recommended

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: National Commission on Historical and Cultural Research, 1993.

ISLAMIC STUDIES **(Compulsory)**

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.

Detail of Courses

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 (Verse No.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 Research Institute, 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)

Annexure “D”

Note: One course will be selected from the following six courses of Mathematics.

COMPULSORY MATHEMATICS COURSES FOR BS (4 YEAR)

(FOR STUDENTS NOT MAJORING IN MATHEMATICS)

1. MATHEMATICS I (ALGEBRA)

Prerequisite(s): Mathematics at secondary level

Credit Hours: 3 + 0

Specific Objectives of the Course: 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 Outline:

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* (6th edition), 1986, PWS-Kent Company, Boston

2. MATHEMATICS II (CALCULUS)

Prerequisite(s): Mathematics I (Algebra)

Credit Hours: 3 + 0

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

Course Outline:

Preliminaries: Real-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

3. MATHEMATICS III (GEOMETRY)

Prerequisite(s): Mathematics II (Calculus)

Credit Hours: 3 + 0

Specific Objectives of the Course: To prepare the students, not majoring in mathematics, with the essential tools of geometry to apply the concepts and the techniques in their respective disciplines.

Course Outline:

Geometry in Two Dimensions: Cartesian-coördinate mesh, slope of a line, equation of a line, parallel and perpendicular lines, various forms of

equation of a line, intersection of two lines, angle between two lines, distance between two points, distance between a point and a line.

Circle: Equation of a circle, circles determined by various conditions, intersection of lines and circles, locus of a point in various conditions.

Conic Sections: Parabola, ellipse, hyperbola, the general-second-degree equation

Recommended Books:

Abraham S, Analytic Geometry, Scott, Freshman and Company, 1969
 Kaufmann JE, College *Algebra and Trigonometry*, 1987, PWS-Kent Company, Boston

Swokowski EW, *Fundamentals of Algebra and Trigonometry* (6th edition), 1986, PWS-Kent Company, Boston

4. COURSE FOR NON-MATHEMATICS MAJORS IN SOCIAL SCIENCES

<i>Title of subject</i> :	MATHEMATICS
<i>Discipline</i> :	BS (Social Sciences).
<i>Pre-requisites</i> :	SSC (Metric) level Mathematics
<i>Credit Hours</i> :	03 + 00
<i>Minimum Contact Hours</i> :	40
<i>Assessment</i> :	written examination;
<i>Effective</i> :	2008 and onward

Aims : To give the basic knowledge of Mathematics and prepare the students not majoring in mathematics.

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

- Understand the use of the essential tools of basic mathematics;
- Apply the concepts and the techniques in their respective disciplines;
- Model the effects non-isothermal problems through different domains;

Contents :

1. *Algebra* : *Preliminaries*: Real and complex numbers, Introduction to sets, set operations, functions, types of functions. *Matrices*: Introduction to matrices, types of matrices, inverse of matrices, determinants,

system of linear equations, Cramer's rule. *Quadratic equations*: Solution of quadratic equations, nature of roots of quadratic equations, equations reducible to quadratic equations. *Sequence and Series*: Arithmetic, geometric and harmonic progressions. *Permutation and combinations*: Introduction to permutation and combinations, *Binomial Theorem*: Introduction to binomial theorem. *Trigonometry*: Fundamentals of trigonometry, trigonometric identities. *Graphs*: Graph of straight line, circle and trigonometric functions.

2. *Statistics* : *Introduction*: Meaning and definition of statistics, relationship of statistics with social science, characteristics of statistics, limitations of statistics and main division of statistics. *Frequency distribution*: Organisation of data, array, ungrouped and grouped data, types of frequency series, individual, discrete and continuous series, tally sheet method, graphic presentation of the frequency distribution, bar frequency diagram histogram, frequency polygon, cumulative frequency curve. *Measures of central tendency*: Mean median and modes, quartiles, deciles and percentiles. *Measures of dispersion*: Range, inter quartile deviation mean deviation, standard deviation, variance, moments, skewness and kurtosis.

Books Recommended:

1. Swokowski. E. W., '*Fundamentals of Algebra and Trigonometry*', Latest Edition.
2. Kaufmann. J. E., '*College Algebra and Trigonometry*', PWS-Kent Company, Boston, Latest Edition.
3. Walpole, R. E., '*Introduction of Statistics*', Prentice Hall, Latest Edition.
4. Wilcox, R. R., '*Statistics for The Social Sciences*',

5. MATHEMATICS FOR CHEMISTRY

Credit Hours: 3

Prerequisites: Mathematics at Secondary level

Specific Objectives of Course: To prepare the students not majoring in mathematics with the essential tools of Calculus to apply the concepts and the techniques in their respective disciplines.

Course Outline:

Preliminaries: Real Numbers and the Real Line, *Functions and their graphs:* Polynomial Functions, Rational Functions, Trigonometric Functions, and Transcendental Functions. Slope of a Line, Equation of a Line, 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 its Applications:* Differentiation of Polynomial, Rational and Transcendental Functions, Extreme Values of Functions. *Integration and Indefinite Integrals:* Integration by Substitution, Integration by Parts, Change of Variables in Indefinite Integrals. Least-Squares Line.

Recommended Books:

1. Thomas, Calculus, 11th Edition. Addison Wesley publishing company, 2005.
2. H. Anton, I. Bevens, S. Davis, Calculus, 8th edition, Jhon Willey & Sons, Inc. 2005.
3. Hughes-Hallett, Gleason, McCallum, et al, Calculus Single and Multivariable, 3rd Edition. John Wiley & Sons, Inc. 2002.
4. Frank A.Jr, Elliott Mendelson, Calculus, Schaum's Outline Series, 4th edition, 1999.
5. E. W. Swokowski, Calculus and Analytic Geometry PWS Publishers, Boston, 1983.
6. John H. Mathews, Numerical Methods for Mathematics Science and Engineering, Prentice-Hall, Second Edition 1992.

6. MATHEMATICS FOR PHYSICS

Contents

1. Preliminary calculus.
 - Differentiation
Differentiation from first principles; products; the chain rule; quotients; implicit differentiation; logarithmic differentiation; Leibnitz' theorem; special points of a function; theorems of differentiation.

- Integration
Integration from first principles; the inverse of differentiation; integration by inspection; sinusoidal function; logarithmic integration; integration using partial fractions; substitution method; integration by parts; reduction formulae; infinite and improper integrals; plane polar coordinates; integral inequalities; applications of integration.

2. **Complex numbers and hyperbolic functions**

- The need for complex numbers
- Manipulation of complex numbers
Additions and subtraction; modulus and argument; multiplication; complex conjugate; division
- Polar representation of complex numbers
Multiplication and division in polar form
- de Moivre's theorem
Trigonometrical identities; finding the n th roots of unity; solving polynomial equations
- Complex logarithms and complex powers
- Applications to differentiation and integration
- Hyperbolic functions
Definitions; hyperbolic-trigonometric analogies; identities of hyperbolic functions; solving hyperbolic equations; inverses of hyperbolic functions; calculus of hyperbolic functions.

3. **Series and limits**

- Series
- Summation of series
Arithmetic series; geometric series; arithmetico-geometric series; the difference method; series involving natural numbers; transformation of series
- Convergence of infinite series
Absolute and conditional convergence; convergence of a series containing only real positive terms; alternating series test
- Operations with series
- Power series
Convergence of power series; operations with power series
- Taylor series

- Taylor's theorem; approximation errors in Taylor series; standard Maclaurin series
- Evaluation of limits

4. Partial differentiation

- Definition of the partial derivative
- The total differential and total derivative
- Exact and inexact differentials
- Useful theorems of partial differentiation
- The chain rule
- Change of variables
- Taylor's theorem for many-variable functions
- Stationary values of many-variable functions
- Stationary values under constraints

5. Multiple integrals

- Double integrals
- Triple integrals
- Applications of multiple integrals
Areas and volumes; masses, centers of mass and centroids; Pappus' theorems; moments of inertia; mean values of functions
- Change of variables in multiple integrals
Change of variables in double integrals;

6. Vector algebra

- Scalars and vectors
- Addition and subtraction of vectors
- Multiplication by a scalar
- Basis vectors and components
- Magnitude of a vectors
- Multiplication of vectors
Scalar product; vector product; scalar triple product; vector triple product
- Equations of lines and planes
Equation of a line; equation of a plane
- Using vectors to find distances
Point to line; point to plane; line to line; line to plane
- Reciprocal vectors

7. Matrices and vector spaces

- Vectors spaces
Basic vectors; the inner product; some useful inequalities

- Matrices
- The complex and Hermitian conjugates of a matrix
- The determinant of a matrix
Properties of determinants
- The inverse of a matrix
- The rank of a matrix
- Simultaneous linear equations
N simultaneous linear equations in N unknowns
- Special square matrices
Diagonal; symmetric and antisymmetric; orthogonal;
Hermitian; unitary normal
- Eigen vectors and eigen values of a normal matrix; of
Hermitian and anti-Hermitian matrices; of a unitary matrix; of
a general square matrix
- Determination of eigen values and eigen vectors degenerate
eigen values

8. **Vector calculus**

- Differentiation of vectors
Composite vector expressions; differential of a vector
- Integration of vectors
- Space curves
- Vector functions of several arguments
- Surfaces
- Scalar and vector fields
- Vector operators
Gradient of a scalar field; divergence of a vector field; curl of
a vector field
- Vector operator formulae
Vector operators acting on sums and products; combinations
of grad, div and curl
- Cylindrical and spherical polar coordinates Cylindrical polar
coordinates; spherical polar coordinates

INTRODUCTION TO STATISTICS

Credit hrs: 3(3-0)

- 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, Histogram, 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-quartile 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.

Note: General Courses from other Departments

Details of courses may be developed by the concerned universities according to their Selection of Courses as recommended by their Board of Studies.

Annexure 'F'

BS 2nd Year (1st Semester) Functional Biology Credit Hours 3+0

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

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.

BS 2nd Year (2nd Semester) Functional Biology

Credit Hours 3+0

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.

