SYLLABUS

SESSION: 2023-2024

PROGRAMME: B. Sc. (Honors) Chemistry I

PROGRAMME CODE: BSHCHE

FACULTY OF SCIENCES

P. G. DEPARTMENT OF CHEMISTRY

MATA GUJRI COLLEGE

Fatehgarh Sahib

(AN AUTONOMOUS COLLEGE)
Affiliated to Punjabi University, Patiala

Prof. (Dr.) Baljit Singh
Prof. (Dr.) Sonal Singhal
Mr. Ravinderjeet Singh
Ms. Rachna Bhardwaj
Dr. Poonam Patyar
Mr. Puneet Bhardwaj
Mrs. Priya Sharma
Dr. Kamalpreet Kaur
Mrs. Simrat Kaur
Dr. Kiran
Dr. Kuldeep Kaur
Mrs. Seema Maheshwari
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Program Name: Bachelor of Honours Chemistry

Program Code: BSHCHEM

Program Educational Objectives (PEO)

The Program aims at

PEO 1: To provide the foundation in the fundamentals and applications of various spheres of Chemical sciences such as Inorganic, Organic, Analytical and Physical Chemistry.

PEO 2: To equip student with the advanced tools, techniques and instruments used in Analytical domain.

PEO 3: To familiarize students with the emerging areas of Chemistry such as Green Chemistry, Novel Inorganic Solids, Polymer Chemistry, Fuel Chemistry, Inorganic Materials of Industrial Importance, Pesticide Chemistry.

PEO 4: To develop the skills of students in the proper handling of apparatus and chemicals through practical courses.

PEO 5: To make the students explore new areas of research in chemistry and allied fields of science and technology.

PEO 6: To make the students explain why Chemistry is an integral course for addressing social, economic, and environmental problems.

Program Outcomes (PO) for Under Graduate Program

After completing the Program, student will be able to:

PO 1: Demonstrate, solve and an understanding of major concepts in all disciplines of chemistry.

PO 2: Solve the problem and also think methodically, independently and draw a logical conclusion.

PO 3: Employ critical thinking and the scientific knowledge to design, carry out, record and analyze the results of chemical reactions.

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PO 4: Create an awareness of the impact of chemistry on the environment, society, and development outside the scientific community.

PO 5: To inculcate the scientific temperament in the students and outside the scientific community.

PO 6: To develop problem solving skills.

Program Specific Outcomes (PSO)

PSO 1: Gain the knowledge of Chemistry through theory and practical.

PSO 2: Understand good laboratory practices and safety.

PSO 3: Develop research-oriented skills and to make aware and handle the sophisticated instruments/equipments.

PSO 4: To develop skills in the proper handling of apparatus and chemicals. To be exposed to the different processes used in industries and their applications.

PSO 5: After being a graduate in Chemistry he/she can pursue the further education by joining M.Sc. (Hons.) and followed by research. He/she can lead career as a teacher. They can also join as a chemist in any research organization.

PSO 6: To understand basic facts and concepts in Chemistry while retaining the exciting aspects of Chemistry so as to develop interest in the study of chemistry as a discipline.

PSO 7: To be familiarized with the emerging areas of Chemistry and their applications in various spheres of Chemical sciences and to apprise the students of its relevance in future studies.

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Programme Structure

The Bachelors of Science in Chemistry course is a Three-Year Full-Time Course consisting of six semesters, to be known as Semester I, Semester II, Semester III, Semester IV, Semester V & Semester VI.

Part I	First Year	Semester I	Semester II
Part II	Second Year	Semester III	Semester IV
Part III	Third Year	Semester V	Semester VI

Course Structure

Semester	**Core courses (including ability enhancement courses)**			**Elective courses (including generic elective and Skill enhancement courses)**			**Discipline Specific Electives**			**Total Credits**
	No. of Theory + Practical Papers	Credits (L+P)	Total credits	No. of Theory + Practical Papers	Credits (L+P)	Total credits	No. of Theory + Practical Papers	Credits (L+P)	Total Credits	
I	4+2	14+4	18	1+1	4+2	6	0	0	0	24
II	4+2	12+4	16	1+1	4+2	6	0	0	0	22
III	3+3	12+6	18	1+2	4+4	8	0	0	0	26
IV	3+3	12+6	18	1+2	4+4	8	0	0	0	26
V	2+2	8+4	12	0	0	0	2+2	8+4	12	24
VI	2+2	8+4	12	0	0	0	2+2	8+4	12	24
Total Credits of the Programme= 146										

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ORDINANCES
Bachelor of Science Honours Chemistry

CHOICE BASED CREDIT SYSTEM (CBCS)

The CBCS provides an opportunity for the students to choose courses from the prescribed courses comprising core, elective/minor or skill-based courses. The courses can be evaluated following the grading system, which is considered to be better than the conventional marks system. Therefore, it is necessary to introduce uniform grading system in the entire higher education in India. This will benefit the students to move across institutions within India to begin with and across countries. The uniform grading system will also enable potential employers in assessing the performance of the candidates. In order to bring uniformity in evaluation system and computation of the Cumulative Grade Point Average (CGPA) based on student's performance in examinations, the UGC has formulated the guidelines to be followed. Outline of Choice Based Credit System:

1. **Core Course**: A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course.

2. **Elective Course**: Generally, a course which can be chosen from a pool of courses and which may be very specific or specialized or advanced or supportive to the discipline/ subject of study or which provides an extended scope or which enables an exposure to some other discipline/subject/domain or nurtures the candidate's proficiency/skill is called an Elective Course.

2.1 **Discipline Specific Elective (DSE) Course**: Elective courses may be offered by the main discipline/subject of study is referred to as Discipline Specific Elective. The College/Institute may also offer discipline related Elective courses of interdisciplinary nature (to be offered by main discipline/subject of study).

2.2 **Dissertation/Project**: An elective course designed to acquire special/advanced knowledge, such as supplement study/support study to a project work, and a candidate studies such a course on his own with an advisory support by a teacher/faculty member is called dissertation/project.

2.3 **Generic Elective (GE) Course**: An elective course chosen generally from an unrelated discipline/subject, with an intention to seek exposure is called a Generic Elective.

P.S.: A core course offered in a discipline/subject may be treated as an elective by other disciplines /subject and vice versa and such electives may also be referred to as Generic Elective.

3. **Ability Enhancement Courses (AEC)/Competency Improvement Courses/Skill Development Courses/Foundation Course**:

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The Ability Enhancement (AE) Courses may be of two kinds: AE Compulsory Course (AECC) and AE Elective Course (AEEC). "AECC" courses are the courses based on the content that leads to Knowledge enhancement. They ((i) Environmental Science, (ii) English/MIL Communication) are mandatory for all disciplines. AEEC courses are value-based and/or skill-based and are aimed at providing hands-on -training, competencies, skills, etc. 3.1 AE Compulsory Course (AECC): Environmental Science, English Communication /MIL Communication. 3.2 AE Elective Course (AEEC): These courses may be chosen from a pool of courses designed to provide value-based and/or skill-based instruction. Project work/Dissertation is considered as a special course involving application of knowledge in solving / analyzing /exploring a real-life situation / difficult problem.

Notwithstanding the integrated nature of a course spread over more than one academic year, the ordinances in force at the time a student joins a course shall hold good only for the examination held during or at the end of the academic year. Nothing in these Ordinances shall be deemed to debar the College from amending the ordinances subsequently and the amended ordinances, if any, shall apply to all the students whether old or new.

1. B.Sc. Hons. (Chemistry) is an integrated course comprising three parts spread over three years. Each part will consist of two semesters. The course of study of B.Sc. shall be divided in six semesters and College examination will be held at the end of every semester in the months of November/December (for semester I, III & V) and May/June (for semester II, IV & VI) or as fixed by the Academic Council /CBCS given in point 1 above.
2. A candidate must complete and pass the whole course of three years within a maximum of six years from the date of admission in B.Sc. first semester.
3. The outlines of tests and syllabi shall be such as prescribed by the Academic Council from time to time.
4. A candidate will be eligible to join 1st semester of B.Sc. course, only if he/she has passed +2 examination (medical/Non-medical, without reappear) of CBSE, Punjab School Education Board, or any other examination recognised as equivalent thereto.
5. Semester examination will be open to regular candidates who have been on the rolls of the college and meet the attendance and other requirements as prescribed in the Ordinances No.7
6. Subject to fulfilment of requirement of House examinations, the attendance requirements and these ordinances there will be no condition of passing papers for promotion from odd semester to even semester in an Academic Session. (a) To qualify for admission to 2nd year of the Course, the candidate must have passed 50% of total papers of the two semesters of the 1st year. Similarly, to qualify for admission to 3rd year of the course, the candidate should have

passed 50% of total papers of four semesters of the earlier two years. (b) A candidate placed under reappear in any paper, will be allowed two chances to clear the reappear, which should be availed within consecutive two years/chances i.e., to pass in a paper the candidate will have a total of three chances, one as regular student and two as reappear candidate. The examination of reappear papers of odd semester will be held with regular examination of the odd semester and reappear examination of the even semester will be held with regular examination of even semester. But if a candidate is placed under reappear in the last semester of the course, he/she will be provided chance to pass the reappear with the examination of the next semester, provided his reappear of lower semester does not go beyond next semester.

7. **Attendance Requirements**: A candidate will be required to attend a minimum of 75% lectures delivered to that class in each paper as well as 75% of the laboratory work, seminars etc. separately. Provided that a deficiency in attendances may be condoned for special reasons, as per the relevant ordinances on the subject.
8. **Late College Students:** A candidate, who has completed the prescribed course of instructions for a semester but has not appeared in the examination or having appeared, has failed in the examination, may appear as a late college student within the prescribed period.
9. The pass and reappear students of B.Sc. Part-I and II from Panjab University, Guru Nanak Dev University and Punjab Technical University shall be treated at par with the corresponding students of this College. But in case such a student is admitted in B.Sc. semester III in this College, he/she will be required to clear deficient papers, if any.
10. Amount of examination fee to be paid by a candidate for each semester shall be as fixed by the College from time to time.
11. **Applications for admission to the examination shall be made on the prescribed form attested by the competent authority as per College rules. The last date by which admission forms and fees must reach the Registrar shall be as follows: Semester**
12. College medal will be awarded to a candidate who has secured first position in the College on the basis of the marks of all the six semesters taken together. The general rules and conditions of the College for the award of medal/prizes etc. will be applicable in the award of College medal to the topper of this examination.
13. The medium of instructions and examination will be English except for the non English subjects.
14. Subject to the restrictions contained in the Ordinances, a candidate for B.Sc.+3 Scheme shall be required to take up the following subjects as given in attached syllabus according to choice based credit system.

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15. Punjab History and Culture in the lieu of Punjabi shall be allowed to the following categories of candidates:
    i) Candidates who have passed their Matriculation examination from a School located outside the State of Punjab.
    ii) Candidates who have passed their Matriculation examination from a School located in the State of Punjab will not be allowed to take up the subject of Punjab History & Culture in lieu of Punjabi Compulsory at the graduate level. This clause will not apply to students covered by clause No. 3 given below.
    iii) Children of Defence personnel/Para military personnel (serving as well as retired) will be allowed to take up the subject of Punjab History & Culture, provided the father or the mother/guardian (in case father is deceased) of the candidate gives an affidavit that the candidate has not studied Punjabi at the School level.
16. The Candidate shall also be entitled to grace marks as admissible under the ordinances, relating to the 'Grace Marks.'
17. The minimum number of marks required to pass the examination in each Part shall be 40% in each subject, provided that in subject with practical the percentage shall be required separately in written and practical/map work.
18. A Candidate shall be allowed to join:
    i) First Semester: Provided that he/she has passed at least, one academic year previously, the +2 examination of Punjab School Education Board, or any other examination recognised as equivalent thereto.
    ii) Second Semester: Provided that he/she has undergone a regular course of studies of first semester as provided under the regulations and fulfils the conditions as laid in ordinance 6(a).
    iii) Third Semester: Provided that he/she has undergone a regular course of studies of First and Second semesters as provided under the regulations in sequential order and fulfils the conditions as laid in ordinance 6(a).
    iv) Fourth Semester: Provided that he/she has undergone a regular course of studies of First, Second and Third semesters as provided under the regulations in sequential order and has passed the First Semester Examination as a whole, and fulfils the conditions as laid in ordinance 6(a).
    v) Fifth Semester: Provided that he/she has undergone a regular course of studies of First, Second, Third and Fourth semesters as provided under the regulations in

sequential order and has passed the First and Second Semester examinations as a whole, respectively; and fulfils the conditions as laid in ordinance 6(a).

vi) Sixth Semester: Provided that he/she has undergone a regular course of studies of First, Second, Third, Fourth and Fifth semesters as provided under the regulations in sequential order and has passed First, Second and Third Semester examinations as a whole, respectively and fulfils the conditions as laid in ordinance 6(a).

19. Three weeks after the termination of examination or as soon thereafter as possible, the Registrar shall publish the result of the candidates. Each candidate shall receive a certificate indicating details of marks obtained in each examination. Successful candidates at the end of Semester-VI examination shall receive a degree stating the division according to ordinance 20.

20. The successful candidates shall be classified on the basis of aggregate marks secured in all the six semesters of B.Sc. taken together as under: (a) 75% or more with Distinction. (b) 60% or more in the First division. (c) 50% or more but less than 60% in the Second division. (d) below 50% in the Third division.

21. A candidate who has passed B.Sc. Hons. Chemistry in +3 examination scheme from this College shall have two chances within a period of two years after passing the examination to improve division 55% marks. Improvement shall be allowed in not more than 50% of total theory papers offered in Part-I, II and III examination. However, previous marks of Practical/Project will be carried forward in the paper(s) in which he/she appears for improvement.

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Semester-wise Course Details

SEMESTER I				
Number of core courses and ability enhancement courses	Six (4 Theory + 2 Practical)			
	Credits in each course			
	Theory	Practical	Tutorial	Total
Core Course I	4	2	0	6
Core Course II	4	2	0	6
Ability enhancement compulsory Course I	4	0	0	4
Ability enhancement compulsory Course II	2	0	0	2
Total credits in core courses and AECC	**18**			
Number of Elective courses	Two (1 Theory + 1 Practical)			
	Credits in each course			
	Theory	Practical	Tutorial	Total
Generic Elective Course I	4	2	0	6
Total credits in Elective courses	**6**			
Total credits in semester I	**24**			

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SEMESTER II				
Number of core courses and ability enhancement courses	Six (4 Theory + 2 Practical)			
	Credits in each course			
	Theory	Practical	Tutorial	Total
Core Course III	4	2	0	6
Core Course IV	4	2	0	6
Ability enhancement compulsory Course III	4	0	0	4
Ability enhancement compulsory Course IV	0	0	0	0 (Qualifying Paper)
Total credits in core courses and AECC	**16**			
Number of Elective courses	Two (1 Theory + 1 Practical)			
	Credits in each course			
	Theory	Practical	Tutorial	Total
Generic Elective Course II	4	2	0	6
Total credits in Elective courses	**6**			
Total credits in semester II	**22**			
SEMESTER III				
Number of core courses	Six (3 Theory + 3 Practical)			
	Credits in each course			
	Theory	Practical	Tutorial	Total
Core Course V	4	2	0	6
Core Course VI	4	2	0	6
Core Course VII	4	2	0	6
Total credits in core courses.	**18**			

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Number of Elective courses	Two (1 Theory + 2 Practical)			
	Credits in each course			
	Theory	Practical	Tutorial	Total
Generic Elective Course III	4	2	0	6
Skill Enhancement Course-I	0	2	0	2
Total credits in Elective courses	**8**			
Total credits in semester II	**26**			

SEMESTER IV				
Number of core courses	Six (3 Theory + 3 Practical)			
	Credits in each course			
	Theory	Practical	Tutorial	Total
Core Course VIII	**4**	2	**0**	6
Core Course IX	4	**2**	**0**	6
Core Course X	4	**2**	**0**	6
Total credits in core courses.	**18**			
Number of Elective courses	Two (1 Theory + 2 Practical)			
	Credits in each course			
	Theory	Practical	Tutorial	Total
Generic Elective Course IV	4	2	0	6
Skill Enhancement Course-II	0	2	0	2
Total credits in Elective courses	**8**			
Total credits in semester II	**26**			

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SEMESTER V				
Number of core courses	Two (2 Theory + 2 Practical)			
	Credits in each course			
	Theory	Practical	Tutorial	Total
Core Course XI	4	2	0	6
Core Course XII	4	2	0	6
Total Credits in core course	**12**			
Number of elective courses	Two (2 Theory + 2 Practical)			
Discipline Specific Elective-I	4	2	0	6
Discipline Specific Elective-II	4	2	0	6
Total credits in elective courses	**12**			
Total Credits in Semester V	**24**			

SEMESTER VI				
Number of core courses	Two (2 Theory + 2 Practical)			
	Credits in each course			
	Theory	Practical	Tutorial	Total
Core Course XIII	4	2	0	6
Core Course XIV	4	2	0	6
Total Credits in core course	**12**			
Number of elective courses	Two (2 Theory + 2 Practical)			
Discipline Specific Elective-III	4	2	0	6
Discipline Specific Elective-IV	4	2	0	6

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Total credits in elective courses	**12**
Total Credits in Semester VI	**24**

Total credits of the course = 24+ 22+ 26+ 26+ 24+ 24= 146

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SCHEME OF COURSE
B.Sc. HONOURS CHEMISTRY

NOTE: In the first semester one subject of Generic Elective has to be taken out of 4 options, which they will continue to study for the first four semesters. The option they opted in first semester will not change in the coming semesters.

In the third and fourth semester one paper of Skill enhancement course has to be opted.

In the third year Discipline specific electives (DSE) are introduced. A student has to choose two D.S.E papers in third and fourth semester. Pass Percentage is 40% and these are to be obtained in external examination and internal assessment individually. There is no internal assessment in the lab paper.

SEMESTER	PAPER CODE	COURSE TYPE	COURSE NAME	CREDITS	Max. Marks (External+Internal)
I	BSHCHE101	Core Course-I	Inorganic Chemistry-I	4	100 (75+25)
	BSHCHE101(P)	Core Course-I Practical	Inorganic Chemistry-I Lab	2	50
	BSHCHE102	Core Course-II	Physical Chemistry-I	4	100 (75+25)
	BSHCHE102(P)	Core Course-II Practical	Physical Chemistry-I Lab	2	50
	BPHGE1/ UGCS1901/ BSHMATGE-101/ BSHZ(G) 01	Generic Elective-I	Wave and Optics / Computer Fundamental/ Algebra & Trignometry/ Animal Diversity	4	100 (75+25)
	BPHGE1 (P)/ UGCS1901Lab/ BSHZ(G) 01-Lab	Generic Elective-I Practical	Wave and Optics Lab/ Software lab based on office automation tools/ Animal Diversity	2	50
	PBI 2001/PBI 2001A	Ability Enhancement Compulsory Course	Punjabi/Basic Punjabi	4	100 (75+25)
	EVS3001	Ability Enhancement Compulsory Course	Environmental and Road Safety Awareness	2	50 (35+15)

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SEMESTER	PAPER CODE	COURSE TYPE	COURSE NAME	CREDITS	Max. Marks (External+ Internal)
II	BSHCHE201	Core Course-III	Organic Chemistry-I	4	100 (75+25)
	BSHCHE201(P)	Core Course-III Practical	Organic Chemistry-I Lab	2	50
	BSHCHE202	Core Course-IV	Physical Chemistry-II	4	100 (75+25)
	BSHCHE202(P)	Core Course-IV Practical	Physical Chemistry-II Lab	2	50
	BPHGE2/ UGCS1902/ BSHMATGE-201/ BSHZ(G) 02	Generic Elective-II	Solid State and Modern Physics/ Computer Programming/ Calculus/ Biology of Non-Insect Pests and their management	4 6 For Maths	100 (75+25)
	BPHGE2 (P)/ UGCS1902-Lab/ BSHZ(G) 02-Lab	Generic Elective-II Practical	Solid State and Modern Physics Lab/Software lab based on computer programming/ Biology of Non-Insect Pests and their management	2	50
	ENG1002	Ability Enhancement Compulsory Course-III	English communication skills	4	50 (35+15)
	DA4001	Ability Enhancement Compulsory Course-IV	Drug Abuse	Qualifying paper	50 (35+15)
III	BSHCHE301	Core Course-V	Inorganic Chemistry-II	4	100 (75+25)
	BSHCHE301(P)	Core Course-V Practical	Inorganic Chemistry-II Lab	2	50
	BSHCHE302	Core Course-VI	Organic Chemistry-II	4	100 (75+25)
	BSHCHE302(P)	Core Course-VI Practical	Organic Chemistry-II Lab	2	50

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	BSHCHE303	Core Course-VII	Physical Chemistry-III	4	100 (75+25)
	BSHCHE303(P)	Core Course-VII Practical	Physical Chemistry-III Lab	2	50
	BPHGE3/ UGCS1903/ BSHMATGE-301/BSHZ(G) 03	Generic Elective-III	Thermodynamics and Laser Physics/Data structure/ Partial Differential equation & Laplace Transform/ Human Physiology	4 6 For Maths	100 (75+25)
	BPHGE3 (P)/ UGCS1903-Lab / BSHZ(G) 03-Lab	Generic Elective-III Practical	Thermodynamics and Laser Physics Lab/Software lab based on data structure/ Human Physiology	2	50
	BSHCHE305 A/B (P)	Skill Enhancement Course -I	Green Chemistry OR Pesticide Chemistry	2	50

SEMESTER	PAPER CODE	COURSE TYPE	COURSE NAME	CREDITS	Max. Marks (External+Internal)
IV	BSHCHE401	Core Course-VIII	Inorganic Chemistry-III	4	100 (75+25)
	BSHCHE401(P)	Course-VIII Practical	Inorganic Chemistry-III Lab	2	50
	BSHCHE402	Core Course-IX	Organic Chemistry-III	4	100 (75+25)
	BSHCHE402(P)	Course-IX Practical	Organic Chemistry-III Lab	2	50
	BSHCHE403	Core Course-X	Physical Chemistry-IV	4	100 (75+25)
	BSHCHE403(P)	Course-X Practical	Physical Chemistry-IV Lab	2	50
	BPHGE4/ UGCS1904/ BSHMATGE-401/BSHZ(G) 04	Generic Elective-IV	Mechanics and Electricity/ Database management systems/ Applied Statistics/ Food Nutrition and Health	4	100 (75+25)
	BPHGE4 (P)/ UGCS1904-Lab/ BSHMATGE-401 Lab/BSHZ(G) 04-Lab	Generic Elective-IV Practical	Mechanics and Electricity Lab/Software lab on Database management systems/ Applied Statistics/ Food Nutrition and Health	2	50

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	BSHCHE404 A/B (P)	Skill Enhancement Course -II	Basic Analytical Chemistry OR Minor Project in Chemistry	2	50
V	BSHCHE501	Core Course-XI	Organic Chemistry-IV	4	100 (75+25)
	BSHCHE501(P)	Core Course-XI Practical	Organic Chemistry-IV Lab	2	50
	BSHCHE502	Core Course-XII	Physical Chemistry-V	4	100 (75+25)
	BSHCHE502(P)	Core Course-XII Practical	Physical Chemistry-V Lab	2	50
	BSHCHE503(A)	Discipline Specific Elective-I	Inorganic Materials of Industrial Importance	4	100 (75+25)
	BSHCHE503(A)(P)	Discipline Specific Elective-I Practical	Inorganic Materials of Industrial Importance Lab	2	50
	OR				
	BSHCHE503(B)	Discipline Specific Elective-I	Novel Inorganic Solids	4	100 (75+25)
	BSHCHE503(B)(P)	Discipline Specific Elective-I Practical	Novel Inorganic Solids Lab	2	50
	BSHCHE504(A)	Discipline Specific Elective-II	Statistical Thermodynamics	4	100 (75+25)
	BSHCHE504(A)(P)	Discipline Specific Elective-II Practical	Physical Chemistry Lab	2	50
	OR				
	BSHCHE504(B)	Discipline Specific Elective- 2	Dissertation	6	150

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SEMESTER	PAPER CODE	COURSE TYPE	COURSE NAME	CREDITS	Max. Marks (External+Internal) Pass Percentage 40%
VI	BSHCHE601	Core Course-XIII	Inorganic Chemistry- IV	4	100 (75+25)
	BSHCHE601(P)	Core Course-XIII Practical	Inorganic Chemistry IV Lab	2	50
	BSHCHE602	Core Course-XIV	Organic Chemistry-V	4	100 (75+25)
	BSHCHE602(P)	Core Course-XIV Practical	Organic Chemistry-V Lab	2	50
	BSHCHE603(A)	Discipline Specific Elective-III	Polymer Chemistry	4	100 (75+25)
	BSHCHE603(A)(P)	Discipline Specific Elective-III Practical	Polymer Chemistry Lab	2	50
	OR				
	BSHCHE603(B)	Discipline Specific Elective-III	Advanced Inorganic Chemistry	4	100 (75+25)
	BSHCHE603(B)(P)	Discipline Specific Elective-III Practical	Advanced Inorganic Chemistry Lab	2	50
	BSHCHE604(A)	Discipline Specific Elective-IV	Analytical Methods in Chemistry	4	100 (75+25)
	BSHCHE604(A)(P)	Discipline Specific Elective-IV Practical	Analytical Methods in Chemistry Lab	2	50
	OR				
	BSHCHE604(B)	Discipline Specific Elective-IV	Solid State and Radiation Chemistry	4	100 (75+25)
	BSHCHE604(B)(P)	Discipline Specific Elective-IV Practical	Physical Chemistry Lab	2	50

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SYLLABUS
B.Sc.-I (Hons.) Chemistry
SEMESTER-I

Paper Code	Title of Paper	No. of Lectures	L T P (Credits)	Max. Marks (External+Internal)
BSHCHE101	Inorganic Chemistry-I	60	4 0 0 (4)	100 (75+25)
BSHCHE101(P)	Inorganic Chemistry-I Lab	60	2 0 0 (2)	50
BSHCHE102	Physical Chemistry-I	60	4 0 0 (4)	100 (75+25)
BSHCHE102(P)	Physical Chemistry-I Lab	60	2 0 0 (2)	50
BPHGE1/ UGCS1901/ BSHMATGE-101/ BSHZ(G) 01	Wave and Optics / Computer Fundamental/ Algebra & Trignometry/ Animal Diversity	60	4 0 0 (4) 5 1 0 (6) (For Maths)	100 (75+25)
BPHGE1(P)/ UGCS1901Lab/ BSHZ(G) 01-Lab	Wave and Optics Lab/ Software lab based on office automation tools/ Animal Diversity	60	0 0 2 (2)	50
PBI 2001/PBI 2001A	Punjabi/Basic Punjabi	60	4 0 0 (4)	100 (75+25)
EVS3001	Environmental and Road Safety Awareness	30	2 0 0 (2)	50 (35+15)

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SEMESTER-I

Core Course-I

BSHCHE101: INORGANIC CHEMISTRY-I

Maximum Marks: 100 Time: 3 Hrs.
External Examination: 75 Pass marks: 40%
Internal Assessment: 25
Theory: 60Hrs.
(Credits: 04)

COURSE OBJECTIVE

- This course is intended to learn the basic concepts of Inorganic Chemistry.
- To emphasize on Atomic structure, bonding and periodicity of elements.
- To understand the general concept of oxidation-reduction reaction.

COURSE OUTCOMES

On completion of this Course the student should be able to:

CO1: Explain the atomic theory and its evolution.

CO2: Interpret the physical and chemical characteristics of elements in various groups and periods according to ionic size, charge, etc. and show the position of elements in periodic table according to their properties.

CO3: Predict the Atomic structure, chemical bonding, and molecular geometry based on accepted models.

CO4: Identify an oxidation-reduction reaction based on changes in oxidation number across the chemical change and also explain the feasibility of reactions.

INSTRUCTIONS FOR THE PAPER SETTER

The question paper will consist of three units: Unit I, II and III. Unit I and II will have four questions each from the respective units of the syllabus and will carry12 marks each. Unit III will consist of 9 questions from the whole syllabus and will carry 3 marks each.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt two questions each from Unit I and Unit II. Unit III is compulsory.

NOTE: Internal assessment will be given on the basis of mid semester tests (12.5), attendance (5), general conduct (2.5), assignment/quiz/seminar (5).

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UNIT-I

Atomic Structure: Bohr's theory, its limitations and atomic spectrum of hydrogen atom, Wave mechanics: de Broglie equation, Heisenberg's Uncertainty Principle and its significance, Schrödinger's wave equation, significance of ψ and ψ^2, Quantum numbers and their significance, Normalized and orthogonal wave functions, Signs of wave functions for s, p, d orbitals, Radial and angular wave functions for hydrogen atom, Radial and angular distribution curves. Shapes of s, p, d and f orbitals, Contour boundary and probability diagrams, Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, Aufbau's principle and its limitations, Variation of orbital energy with atomic number**.**

(14 Hrs.)

Periodicity of Elements: s, p, d, and f block elements, the long form of periodic table, Detailed discussion of the following properties of the elements, with reference to s and p-block.

Effective nuclear charge, shielding or screening effect, Slater rules, variation of effective nuclear charge in periodic table.

Atomic radii (van der Waals), Ionic and crystal radii, covalent radii (octahedral and tetrahedral), Ionization enthalpy, Successive ionization enthalpies and factors affecting ionization energy, applications of ionization enthalpy, electron gain enthalpy, trends of electron gain enthalpy.

Electronegativity, Pauling's, Mulliken's, Allred Rachow's and Mulliken-Jaffe's electronegativity scales. Variation of electronegativity with bond order, partial charge, hybridization, group electronegativity, sanderson's electron density ratio.

(16 Hrs.)

UNIT-II

Chemical Bonding:

(i) Ionic bond: General characteristics, types of ions, size effects, radius ratio rule and its limitations. Packing of ions in crystals, Born-Lande equation with derivation, Madelung constant, Born-Haber cycle and its application, solvation energy.

(ii) Covalent bond: Lewis structure, Valence Bond theory (Heitler-London approach), energetics of hybridization, equivalent and non-equivalent hybrid orbitals, Bent's rule, Resonance and resonance energy, Molecular orbital theory, molecular orbital diagrams of diatomic and simple polyatomic molecules N_2, O_2, C_2, B_2, F_2, CO, NO, and their ions; HCl, BeF_2,

CO_2, (idea of s-p mixing and orbital interaction to be given), formal charge, Valence shell electron pair repulsion theory (VSEPR), shapes of simple molecules and ions containing lone pairs and bond pairs of electrons NH_3, H_2O, H_3O^+, SF_4, ClF_3, ICl_2^-, $SnCl_2$, XeF_4, IF_5, BF_4^-, $SnCl_6^{2-}$, multiple bonding (σ and π bond approach) and bond lengths, covalent character in ionic compounds, polarizing power and polarizability, Fajan's rules and consequences of polarization.

Ionic character in covalent compounds: Bond moment and dipole moment, percentage ionic character from dipole moment and Electronegativity difference.

(iii) Metallic Bond: Qualitative idea of valence bond and band theories, Semiconductor and insulators, defects in solids.

(iv) Weak Chemical Forces: Van der Waal's forces, ion-dipole forces, dipole-dipole interactions, induced dipole interactions, Instantaneous dipole-induced dipole interactions, Repulsive forces, Hydrogen bonding (theories of hydrogen bonding, valence bond treatment), Effects of chemical force on melting and boiling points, solubility, energetics of dissolution process. **(26Hrs.)**

Oxidation-Reduction: Standard redox potential with sign conventions, electrochemical series and its applications to explore the feasibility of reactions and equilibrium constant, Nernst equation; effect of pH, complexation & precipitation on redox potential, redox potential diagrams (Latimer, Frost & Pourbaix diagrams) of common elements and their applications.

(4Hrs.)

Reference Books:

1. Lee, J.D. Concise Inorganic Chemistry ELBS, 1991.
2. Douglas, B.E. and McDaniel, D.H. Concepts and Models of Inorganic Chemistry Oxford, 1970
3. Atkins, P.W. and Paula, J. Physical Chemistry, 10th Ed., Oxford University Press, 2014.
4. Day, M.C. and Selbin, J. Theoretical Inorganic Chemistry, ACS Publications, 1962.

Teaching-learning Activities

Assignments
Quizzes
Visual demonstration using online resources.

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BSHCHE101(P) INORGANIC CHEMISTRY-I LAB

Max. Marks: 50 No. of Lectures:60 Hrs.
Time Allowed: 3 hrs. Pass Marks: 40%
(Credits: 02)

COURSE OBJECTIVES

- To impart skill to students in the mode of quantitative chemical analysis that is used to determine the concentration of an identified analyte.
- Students will learn how to make solutions of different normality, molarity and calibration of apparatus.
- Student will learn the volumetric estimation using acid base and oxidation-reduction titration.

COURSE OUTCOMES

After completion of this course the students will able to:

CO1: Calibrate and handle the apparatus and prepare different concentration of solutions using normality and molarity equations.

CO2: Determine the concentration of an analyte of unknown concentration by making use of acid-base and oxidation-reduction titrations.

(A) Titrimetric Analysis

1. Calibration and use of apparatus.
2. Preparation of solutions of different Molarity/Normality of titrants.

(B) Acid-Base Titrations

1. Estimation of carbonate and hydroxide present together in mixture.
2. Estimation of carbonate and bicarbonate present together in a mixture.
3. Estimation of free alkali present in different soaps/detergents.

(C) Oxidation-Reduction Titrations

1. Estimation of Fe (II) and oxalic acid using standardized $KMnO_4$ solution.
2. Estimation of oxalic acid and sodium oxalate in a given mixture.
3. Estimation of Fe (II) with $K_2Cr_2O_7$ using internal (diphenylamine, anthranilic acid) and external indicators.

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Dr. Kuldeep Kaur
Mrs. Seema Maheshwari
Dr. Manpreet Kaur

Reference Books:

- Inorganic Quantitative analysis, Mendham, J. A. I. Vogel.
- Inorganic Quantitative Chemical Analysis 6th Ed., Pearson, 2009.

Teaching-learning Activities

Viva voce interviews.

Laboratory-based practical components and experiments.

Prof. (Dr.) Baljit Singh
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Core Course II
BSHCHE102 PHYSICAL CHEMISTRY- I

Maximum Marks:100 Time: 3 Hrs.
External Examination: 75 Pass marks: 40%
Internal Assessment: 25 Theory: 60 Hrs.
(Credits: 04)

Course Objectives

- Students will learn the basic theories of the electronic structure of materials.
- Students will learn how solid-state theory is applied to describe physical behaviour of solids and electronic devices.
- To understand the significance of the kinetic molecular theory of gases.

Course Outcomes

After the completion of this course students will be able to:

CO1: describe the properties of gases.

CO2: use kinetic-molecular theory to explain gas behaviours.

CO3: use the ideal gas equation to determine the density or molecular mass of a gas.

CO4: recognize why gases do not behave as ideal gases.

CO5: explain the influence of crystal binding energy on crystal structure and lattice vibration on thermal behaviour.

CO6: demonstrate an understanding of models to describe defects and diffusion.

CO7: apply the application of buffers in analytical chemistry and biochemical processes.

CO8: describe Le-Chatelier's principle.

Instructions for the Paper Setter

The question paper will consist of three units: Unit I, II and III. Unit I and II will have four questions each from the respective unit of the syllabus and will carry 12 marks each. Unit III will consist of 9 questions from the whole syllabus and will carry 3 marks each.

Instructions for the Candidates

Candidates are required to attempt two questions each from Unit I and Unit II. Unit III is compulsory.

NOTE: Internal assessment will be given on the basis of mid semester tests (12.5), attendance (5), general conduct (2.5), assignment/quiz/seminar (5).

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UNIT-I

GASEOUS STATE: Kinetic molecular model of a gas: postulates and derivation of the kinetic gas equation; collision frequency; collision diameter; mean free path and viscosity of gases, including their temperature and pressure dependence, relation between mean free path and coefficient of viscosity, calculation of σ from η; variation of viscosity with temperature and pressure, Maxwell distribution and its use in evaluating molecular velocities (average, root mean square and most probable) and average kinetic energy, law of equipartition of energy, degrees of freedom and molecular basis of heat capacities.

Behaviour of real gases: Deviations from ideal gas behaviour, compressibility factor, Z, and its variation with pressure for different gases. Causes of deviation from ideal behaviour, Van der Waals equation of state, it derivation and application in explaining real gas behaviour, mention of other equations of state (Berthelot, Dietrici); virial equation of state; van der Waals equation expressed in virial form and calculation of Boyle temperature, isotherms of real gases and their comparison with van der Waals isotherms, continuity of states, critical state, relation between critical constants and van der Waals constants, law of corresponding states. **(18 Hrs.)**

LIQUID STATE:

Qualitative treatment of the structure of the liquid state; Radial distribution function; physical properties of liquids; vapour pressure, surface tension and coefficient of viscosity, and their determination, effect of addition of various solutes on surface tension and viscosity, explanation of cleansing action of detergents, temperature variation of viscosity of liquids and comparison with that of gases, Qualitative discussion of structure of water.

(6 Hrs.)

UNIT-II

SOLID STATE:

Nature of the solid state, law of constancy of interfacial angles, law of rational indices, Miller indices, elementary ideas of symmetry, symmetry elements and symmetry operations, qualitative idea of point and space groups, seven crystal systems and fourteen Bravais lattices; X-ray diffraction, Bragg's law, rotating crystal method and powder pattern method, Structure of NaCl, CsCl and KCl, Defects in crystals Glasses and liquid crystal**.**

(16 Hrs.)

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Ionic equilibria: Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water, ionization of weak acids and bases, pH scale, common ion effect; dissociation constants of mono-, di- and triprotic acids (exact treatment), salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts, Buffer solutions; derivation of Henderson equation and its applications; buffer capacity, buffer range, buffer action and applications of buffers in analytical chemistry and biochemical processes in the human body.

Solubility and solubility product of sparingly soluble salts – applications of solubility product principle. Qualitative treatment of acid – base titration curves (calculation of pH at various stages), theory of acid–base indicators; selection of indicators and their limitations, multistage equilibria in polyelectrolyte systems; hydrolysis and hydrolysis constants**.**

(20 Hrs.)

Reference Books:

1. Atkins, P. W. and Paula, J. de Atkin's Physical Chemistry 10th Ed., Oxford University Press (2014).
2. Ball, D. W. Physical Chemistry Thomson Press, India (2007).
3. Castellan, G. W. Physical Chemistry 4th Ed. Narosa (2004).
4. Mortimer, R. G. Physical Chemistry 3rd Ed. Elsevier: NOIDA, UP (2009).
5. Engel, T. and Reid, P. Physical Chemistry 3rd Ed. Pearson (2013).

Teaching-learning Activities:

Assignments
Seminar presentation
Group tutorial work
Use of e-learning resources and self-study materials

Prof. (Dr.) Baljit Singh
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BSHCHE102(P) PHYSICAL CHEMISTRY-I LAB

Max. Marks: 50 No. of Lectures: 60 Hrs.
Time Allowed: 3 hrs. Pass Marks: 40%
(Credits: 02)

Course Objective

- To provide an insight into surface tension which is an important parameter in many industrial purposes.
- To measure the Viscosity which has precise importance in industry including biopharmaceutical and industrial industry.
- To determine the pH which is useful in chemical laboratory analyses.

Course Outcomes

Under the completion of the course, the students will be able to:

CO1: Measure the strength and equivalence point of different types of the electrolytes by the use of pH meter.

CO2: compare the surface tension of detergent with concentration.

CO3: measure the viscosity of different samples by using Ostwald's viscometer.

1. **Surface tension measurements:**

a) Determine the surface tension by
   I. Drop number method.
   II. Drop weight method.

b) Study the variation of surface tension of detergent solutions with concentration.

2. **Viscosity measurement using Ostwald's viscometer.**

a) Determination of viscosity of aqueous solutions of
   I. Polymer,
   II. Ethanol and
   III. Sugar at room temperature.

b) Study the variation of viscosity of sucrose solution with the concentration of solute.

c) To determine the viscosity and average molecular weight of a polymer.

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3. **pH meter**

a) Study the effect on pH of addition of HCl/NaOH to solutions of acetic acid, sodium acetate and their mixtures.

b) Preparation of buffer solutions of different pH

I. Sodium acetate-acetic acid

II. Ammonium chloride-ammonium hydroxide.

c) pH metric titration of (I) Strong Acid vs. Strong Base, (II) Weak Acid vs. Strong Base.

d) Determination of dissociation constant of a weak acid.

Reference Books:

1. Khosla, B. D.; Garg, V. C. and Gulati, A. Senior Practical Physical Chemistry, R. Chand and Co.: New Delhi (2011).
2. Garland, C. W.; Nibler, J. W. and Shoemaker, D. P. Experiments in Physical Chemistry 8th Ed.; McGraw-Hill: New York (2003).
3. Halpern, A. M. and McBane, G. C. Experimental Physical Chemistry 3rd Ed.; W.H. Freeman and Co.: New York (2013).

Teaching-learning Activities:

Viva-voce

Laboratory-based practical component and experiments

practicum and project-based learning

Prof. (Dr.) Baljit Singh
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SYLLABUS
B.Sc.-I (Hons.) Chemistry

SEMESTER-II				
Paper Code	**Title of Paper**	**No. of Lectures**	**L T P (Credits)**	**Max. Marks (External+Internal)**
BSHCHE201	Organic Chemistry-I	60	4 0 0 (4)	100 (75+25)
BSHCHE201(P)	Organic Chemistry-I Lab	60	0 0 2 (2)	50
BSHCHE202	Physical Chemistry-II	60	4 0 0 (4)	100 (75+25)
BSHCHE202(P)	Physical Chemistry-II Lab	60	0 0 2 (2)	50
BPHGE2/ UGCS1902/ BSHMATGE-201/ BSHZ(G) 02	Solid State and Modern Physics/ Computer Programming/ Calculus/ Biology of Non-Insect Pests and their management	60	4 0 0 (4) 5 1 0 (6) (For Maths)	100 (75+25)
BPHGE2 (P)/ UGCS1902-Lab BSHZ(G) 02-Lab	Solid State and Modern Physics Lab/Software lab based on computer programming/ Biology of Non-Insect Pests and their management	60	0 0 2 (2)	50
ENG1002	English communication skills	30	4 0 0 (4)	50 (35+15)
DA4001	Drug Abuse	60	Qualifying Paper	50 (35+15)

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SEMESTER-II
Core Course III
BSHCHE201 ORGANIC CHEMISTRY-I

Maximum Marks: 100 Time: 3 Hrs.
External Examination: 75 Pass marks: 40%
Internal Assessment: 25 Theory: 60Hrs.
(Credits: 04)

Course Objective

- To teach the fundamental concepts of chemistry and their applications.
- To provide students with fundamental understanding of stereochemical features of organic molecules.
- They will be able to understand various methods of preparation and properties of aliphatic and aromatic hydrocarbons like alkanes, alkenes, cycloalkanes and aromatic hydrocarbons.

COURSE OUTCOME

On successful completion of this course students will be able to:

CO1: Recall the fundamental principles of organic chemistry that include hybridization, electronic displacements and types of organic reactions.

CO2: Determine relative and absolute configurations of organic compounds.

CO3: do Interconversions of Newman projection, Sawhorse formulae, Fischer projection, flying wedge formulae.

CO4: predict the product and mechanisms of various reactions based on alkanes, alkenes and alkynes.

CO5: explain the relative stability of various conformations of cycloalkanes and aromaticity of organic compounds.

Instructions for the Paper Setter

The question paper will consist of 3 units: Unit I, II and III. Unit I and II will have four questions each from the respective unit of the syllabus and will carry 12 marks each. Unit III will consist of 9 questions from the whole syllabus and will carry 3 marks each**.**

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Instructions for the Candidates

Candidates are required to attempt two questions from Unit I and Unit II. Unit III is compulsory.

NOTE: Internal assessment will be given on basis of mid semester tests (12.5), attendance (5), general conduct (2.5), assignment/quiz/seminar (5).

UNIT-I

Basics of Organic Chemistry:

Structure and bonding: Classification, and Nomenclature, Hybridization, Shapes of molecules, Influence of hybridization on bond properties.

Electronic Displacements: Inductive, Electromeric, Resonance and Mesomeric effects, Hyperconjugation and their applications; Dipole moment; Organic acids and bases; their relative strength, Homolytic and Heterolytic Fission with suitable examples, Curly arrow rules, Formal charges; Electrophiles and Nucleophiles; Nucleophilicity and basicity; types, shape and relative stability of Carbocations, Carbanions, Free radicals and Carbenes, introduction to types of organic reactions and their mechanism: Addition, Elimination and Substitution reactions. **(12 Hrs.)**

Stereochemistry of Organic Compounds- Concept of isomerism. Types of isomerism.

Optical isomerism – Elements of symmetry, molecular chirality, enantiomers, stereogenic centre, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centres, diastereomers, threo and erythro diastereomers, meso compounds, resolution of enantiomers, inversion, retention and racemization. Relative and absolute configuration, sequence rules, D & L and R & S systems of nomenclature. Difference between configuration and conformation. Interconversions of Newman projection, Sawhorse formulae, Fischer projection, flying wedge formulae.

Geometric isomerism – Determination of configuration of geometric isomers. Cis-trans and syn-anti isomerism E/Z notations with C.I.P. rules.

(18 Hrs.)

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UNIT-II

Chemistry of Aliphatic Hydrocarbons

A. Carbon-Carbon sigma bonds

Chemistry of alkanes: Methods of preparation of alkanes, Physical properties, Reactions of alkanes: Halogenation its reactivity and selectivity, Nitration, Sulphonation, Oxidation.

B. Carbon-Carbon pi bonds:

Methods of Preparation of Alkenes: Elimination reactions (Types, stereochemistry, Factors influencing E_1 and E_2 reactions, Orientation: Saytzeff and Hofmann elimination), Thermal elimination reactions, Addition reactions, Wittig Reaction, Kolbe Hydrocarbon Synthesis. Physical Properties, Electrophilic Addition reactions,

Reactions of alkenes: Electrophilic additions their mechanisms (Markownikoff/ Anti Markownikoff addition), mechanism of Oxymercuration-Demercuration, Hydroboration-oxidation, Ozonolysis, Reduction (catalytic and chemical), syn and anti-hydroxylation (oxidation), Free radical addition, Nucleophilic Additions, Addition of Hydrogen, Oxidation of Alkenes, Addition of Ozone. 1,2 and 1,4-addition reactions in conjugated dienes and, Diels-Alder reaction; Allylic and Benzylic Bromination and mechanism, e.g., propene, 1-butene, toluene, ethyl benzene.

Reactions of alkynes: Methods of Preparation of Alkynes, Acidity of Alkynes, Chemical reactions: Reactions due to Acidic Hydrogen of Alkynes, Electrophilic additions (Addition of Halogens, Hydrogen Halide, water, HOX, Hydroboration, Addition of Carbene) and Nucleophilic additions, Oxidation of Alkynes, Addition of Ozone.

C. Cycloalkanes and Conformational Analysis

Types of cycloalkanes and their relative stability, Baeyer strain theory, Conformation analysis of alkanes: relative stability: energy diagrams of cyclohexane: Chair, Boat and Twist boat forms; relative stability with energy diagrams.

(20 Hrs.)

Aromatic Hydrocarbons

Aromaticity: Huckel's rule, aromatic character of arenes, cyclic carbocations/carbanions and heterocyclic compounds with suitable examples.

Electrophilic aromatic substitution: Halogenation, Nitration, Sulphonation and Friedel-Craft's Alkylation/Acylation with their mechanism, directing effects of the groups**.**

(10 Hrs.)

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Dr. Kuldeep Kaur
Mrs. Seema Maheshwari
Dr. Manpreet Kaur

Reference Books:

1. Morrison, R. N. and Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
3. Finar, I. L. Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
4. Eliel, E. L. and Wilen, S. H. Stereochemistry of Organic Compounds, Wiley: London, 1994.
5. McMurry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013.
6. Sykes, P. A Guidebook to Mechanism in Organic Chemistry, Orient Longman, New Delhi (1988)

Teaching - learning Activities:

Assignments
Seminar presentation
Group tutorial work
Use of e - learning resources and self-study materials

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BSHCHE201 (P) ORGANIC CHEMISTRY-I LAB

Max. Marks: 50 No. of Lectures: 60 Hrs.
Time Allowed: 3 hrs. Pass Marks: 40%
(Credits: 02)

Course Objective

- The objective of the course is to develop the skills in students regarding the techniques for purification of organic compound.
- To develop skills for determination of melting and boiling point by different methods & thin layer Chromatographic technique.

Course Outcome

CO1: Identify the organic compound by crystallization using solvents.
CO2: Develop skills regarding determination of melting points and boiling points used to characterize compounds and to ascertain their purity.
CO3: Experiment with chromatographic techniques like thin layer and paper chromatography used for separation and quality analyses.

1. Checking the calibration of the thermometer.
2. Purification of organic compounds by crystallization using the following solvents:

a) Water b) Alcohol c) Alcohol-Water.

3. Determination of the melting points of above compounds and unknown organic compounds (Kjeldahl method and electrically heated melting point apparatus).
4. Effect of impurities on the melting point – mixed melting point of two unknown organic compounds.
5. Determination of boiling point of liquid compounds. (boiling point lower than and more than 100 °C by distillation and capillary method).
6. Chromatography:
   a) Separation of a mixture of two amino acids by ascending and horizontal paper chromatography.
   b) Separation of a mixture of two sugars by ascending paper chromatography.
   c) Separation of a mixture of o-and p-Nitrophenol or o-and p-Aminophenol by Thin Layer Chromatography (TLC).

Reference Books:

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1. Mann, F.G. and Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009).
2. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry, 5th Ed., Pearson (2012).

Teaching - learning Activities:

Viva-voce

Laboratory-based practical components and experiments.

Workshop

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Core Course IV

BSHCHE202 PHYSICAL CHEMISTRY-II

Maximum Marks: 100 Time: 3 Hrs.
External Examination: 75 Pass marks: 40%
Internal Assessment: 25 Theory: 60 Hrs.
(Credits: 04)

Course Objectives

- This course in intended to explain the fundamental thermodynamic properties, interrelationship between thermodynamic cycles and laws of thermodynamics.
- To teach the students of a chemical reaction and its equilibrium constants.
- To provide knowledge of how the equilibrium quantities of reactant and product are shifted by change in temperature, pressure and concentration.

Course Outcomes

On successful completion of this course students will be able to:

CO1: Apply the first and second laws of Thermodynamics to various gas processes and cycles.

CO2: Learn the complete knowledge of basic thermodynamic properties and units.

CO3: Develop and apply the continuity equation for open and closed systems.

CO4: apply thermochemical equations to relate the amount of heat energy transferred in reactions at constant pressure (ΔH) to the amount of substance involved in the reaction

CO5: explain the effects that temperature or the presence of a catalyst has on the position of a chemical equilibrium

CO6: determine the reversibility or irreversibility of a thermodynamic process.

CO7: Determine the concentration and molar mass of a non-volatile non electrolyte from its effect on the colligative properties of a solution

Instructions for the Paper Setter

The question paper will consist of 3 units: Unit I, II and III. Unit I and II will have four questions each from the respective unit of the syllabus and will carry12 marks each. Unit III will consist of 9 questions from the whole syllabus and will carry 3 marks each.

Instructions for the Candidates

Candidates are required to attempt two questions from unit I and unit II and unit III is compulsory.

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NOTE: Internal assessment will be given on basis of mid semester test (12), class performance (6), assignment/quiz/seminar (7)

UNIT-I

Chemical Thermodynamics: Intensive and extensive variables; state and path functions; isolated, closed and open systems; zeroth law of thermodynamics.

First law: Concept of heat, q, work, w, internal energy, U, and statement of first law; enthalpy, H, relation between heat capacities, calculations of q, w, U and H for reversible, irreversible and free expansion of gases (ideal and van der Waals) under isothermal and adiabatic conditions.

Thermochemistry: Heats of reactions: standard states; enthalpy of formation of molecules and ions and enthalpy of combustion and its applications; calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data, effect of temperature (Kirchhoff's equations) and pressure on enthalpy of reactions, adiabatic flame temperature, explosion temperature.

Second Law: Concept of entropy; thermodynamic scale of temperature, statement of the second law of thermodynamics; molecular and statistical interpretation of entropy, calculation of entropy changes for reversible and irreversible processes.

Third Law: Statement of third law, concept of residual entropy, calculation of absolute entropy of molecules, free energy functions: Gibbs and Helmholtz energy; variation of S, G, A with T, V, P, free energy change and spontaneity, relation between Joule-Thomson coefficient and other thermodynamic parameters; inversion temperature; Gibbs-Helmholtz equation; Maxwell relations; thermodynamic equation of state.

(36 Hrs.)

UNIT-II

Systems of Variable Composition:

Partial molar quantities, dependence of thermodynamic parameters on composition; Gibbs-Duhem equation, chemical potential of ideal mixtures, change in thermodynamic functions in mixing of ideal gases.

(8Hrs.)

Chemical Equilibrium: Criteria of thermodynamic equilibrium, degree of advancement of reaction, chemical equilibria in ideal gases, concept of fugacity, thermodynamic derivation of relation between Gibbs free energy of reaction and reaction quotient, coupling of exoergic

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and endoergic reactions, equilibrium constants and their quantitative dependence on temperature, pressure and concentration, free energy of mixing and spontaneity; thermodynamic derivation of relations between the various equilibrium constants K_p, K_c and K_x, Le-Chatelier's principle (quantitative treatment); equilibrium between ideal gases and a pure condensed phase**.** **(8 Hrs.)**

Solutions and Colligative Properties: Dilute solutions; lowering of vapour pressure, Raoult's and Henry's Laws and their applications, excess thermodynamic functions, thermodynamic derivation using chemical potential to derive relations between the four colligative properties [(i) relative lowering of vapour pressure, (ii) elevation of boiling point, (iii) Depression of freezing point, (iv) osmotic pressure] and amount of solute, Applications in calculating molar masses of normal, dissociated and associated solutes in solution.

(8 Hrs.)

Reference Books:

1. Peter, A. and Paula, J. de. Physical Chemistry 10th Ed., Oxford University Press (2014).
2. Castellan, G. W. Physical Chemistry 4th Ed., Narosa (2004).
3. Engel, T. and Reid, P. Physical Chemistry 3rd Ed., Prentice-Hall (2012).
4. McQuarrie, D. A. and Simon, J. D. Molecular Thermodynamics Viva Books Pvt. Ltd.: New Delhi (2004).
5. Assael, M. J.; Goodwin, A. R. H.; Stamatoudis, M.; Wakeham, W. A. and Will, S. Commonly Asked Questions in Thermodynamics. CRC Press: NY (2011).
6. Levine, I .N. Physical Chemistry 6th Ed., Tata Mc Graw Hill (2010).
7. Metz, C.R. 2000 Solved Problems in Chemistry, Schaum Series (2006).

Teaching-learning Activities

Peer teaching and learning
seminar presentation
group tutorial
Assignments

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BSHCHE202(P) PHYSICAL CHEMISTRY–II LAB

Max. Marks: 50 No. of Lectures: 60 Hrs.
Time Allowed: 3 hrs. Pass Marks: 40%
(Credits: 02)

Course Objective

- To provide an insight into thermochemistry including the determination of heat capacity, enthalpy of hydration, enthalpy of ionization, enthalpy of neutralization and basicity of polyprotic acids.

Course Outcomes

Under the completion of the course, the students will be able to:

CO1: calculate the change in enthalpy based on Hess's law and bond energy data.

CO2: Determine the basicity/proticity of a polyprotic acid by the thermochemical method.

CO3: determine the heat capacity of different electrolytes by using a calorimeter.

Thermochemistry:

1. Determination of heat capacity of a calorimeter for different volumes using change of enthalpy data of a known system (method of back calculation of heat capacity of calorimeter from known enthalpy of solution or enthalpy of neutralization).
2. Determination of heat capacity of the calorimeter and enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
3. Calculation of the enthalpy of ionization of ethanoic acid.
4. Determination of heat capacity of the calorimeter and integral enthalpy (endothermic and exothermic) solution of salts.
5. To determine the integral heat of dilution of sulphuric acid.
6. To determine heat of precipitation of barium sulphate.
7. To determine heat of transition of sodium sulphate.
8. To determine calorific value of solid and liquid samples.
9. Determination of basicity/proticity of a polyprotic acid by the thermochemical method in terms of the changes of temperatures observed in the graph of temperature versus time for different additions of a base. Also calculate the enthalpy of neutralization of the first step.
10. Determination of enthalpy of hydration of copper sulphate.
11. Study of the solubility of benzoic acid in water and determination of ΔH.

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Reference Books:

1. Khosla, B. D.; Garg, V. C. and Gulati, A., Senior Practical Physical Chemistry, R. Chand and Co.: New Delhi (2011).
2. Athawale, V. D. and Mathur, P. Experimental Physical Chemistry New Age International: New Delhi (2001).
3. Garland, C. W.; Nibler, J. W. and Shoemaker, D. P. Experiments in Physical Chemistry 8th Ed.; McGraw-Hill: New York (2003).
4. Halpern, A. M. and McBane, G. C. Experimental Physical Chemistry 3rd Ed.; W.H. Freeman and Co.: New York (2013).

Teaching-learning Activities:

Viva-Voce
Laboratory-based practical component and experiments
workshops

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