Study & Evaluation Scheme

of

Bachelor of Science (Hons.) (Chemistry)

[Applicable for Academic Session 2021-22]

[As per CBCS guidelines given by UGC]

TEERTHANKER MAHAVEER UNIVERSITY

N.H.-24, Delhi Road, Moradabad, Uttar Pradesh-244001

Website: www.tmu.ac.in

TEERTHANKER MAHAVEER UNIVERSITY
(Established under Govt. of U.P. Act No. 30, 2008)
Delhi Road, Bagarpur, Moradabad (U.P.)

Study & Evaluation Scheme	
SUMMARY	
Institute Name	*Faculty of Engineering*
Programme	*B.Sc.(H) Chemistry*
Duration	*Three Years full time (Six Semesters)*
Medium	*English*
Minimum Required Attendance	*75%*
Credits	
Maximum Credits	*144*
Minimum Credits Required for Degree	*140*

Assessment:

Evaluation			**Internal**	**External**	**Total**
Theory			40	60	100
Practical/ Dissertations/ Project Reports/ Viva-Voce			50	50	100
Class Test-1	**Class Test-2**	**Class Test-3**	**Assignment(s)**	**Attendance & Participation**	**Total**
Best two out of three					
10	10	10	10	10	40
Duration of Examination			**External**	**Internal**	
			3 Hours	1.5 Hours	

To qualify the course a student is required to secure a minimum of 45% marks in aggregate including the semester end examination and teachers continuous evaluation.(i.e. both internal and external). A candidate who secures less than 45% of marks in a course shall be deemed to have failed in that course. The student should have at least 45% marks in aggregate to clear the semester.

 # Provision for delivery of 25% content through online mode.

 # Policy regarding promoting the students from semester to semester & year to year. No specific condition to earn the credit for promoting the students from one semester to next semester.

 # Maximum no of years required to complete the program: N+2 (N=No of years for program)

Question Paper Structure	
1	*The question paper shall consist of six questions. Out of which first question shall be of short answer type (not exceeding 50 words) and will be compulsory. Question no. 2 to 6 (from Unit-I to V) shall have explanatory answers (approximately 350 to 400 words) along with having an internal choice within each unit.*
2	*Question No. 1 shall contain 8 parts from all units of the syllabus with at least one question from each unit and students shall have to answer any five, each part will carry 2 marks.*
3	*The remaining five questions shall have internal choice within each unit; each question will carry 10 marks.*
IMPORTANT NOTES:	
1	*The purpose of examination should be to assess the Course Outcomes (CO) that will ultimately lead to of attainment of Programme Specific Outcomes (PSOs). A question paper must assess the following aspects of learning: Remember, Understand, Apply, Analyze, Evaluate & Create (reference to Bloom's Taxonomy).*
2	*Case Study is essential in every question paper (wherever it is being taught as a part of pedagogy) for evaluating higher-order learning. Not all the courses might have case teaching method used as pedagogy.*
3	*There shall be continuous evaluation of the student and there will be a provision of fortnight progress report.*

Program Structure-B.Sc. (H) Chemistry

A. Introduction:

Chemistry is referred to as the science that systematically studies the composition, properties, and reactivity of matter at atomic and molecular level. The scope of chemistry is very broad. The key areas of study of chemistry comprise Organic chemistry, Inorganic Chemistry, Physical Chemistry and Analytical Chemistry. Organic chemistry deals with study of substances containing carbon mostly; inorganic chemistry deals with study of all other elements/compounds/substances and their chemical properties. Physical chemistry deals with applications of concepts, laws to chemical phenomena. Analytical chemistry, in general, deals with identification and quantification of materials. Development of new interdisciplinary subjects like nano-materials, biomaterials, etc. and their applications from chemistry point of view added new dimension to materials chemistry. Thus, the degree programme in chemistry also intended to cover overlapping areas of chemistry with physics, biology, environmental sciences. Further, a broad range of subjects such as materials chemistry, biomaterials, nanomaterials, environmental chemistry, etc., has also been introduced which can be helpful for students/faculty members to broaden the scope of their studies and hence applications from job prospective point of view. Therefore, as a part of efforts to enhance employability of graduates of chemistry, the curricula also include learning experience with industries and research laboratories as interns. In addition, industrial visits/industrial projects are encouraged and added to the curriculum in order to enhance better exposure to jobs/employment opportunities in industries, scientific projects and allied sectors. This modified syllabus has been drafted to enable the students to equip for national level competitive exams that they may attempt in future. To ensure implementation of a holistic pedagogical model, several allied disciplines are covered/introduced in this framework, including Physics, Mathematics, Biology and a number of generic, and ability enhancement electives. In addition, employability of B.Sc. Chemistry graduate is given due importance such that their core competency in the subject matter, both theoretical and practical, is ensured. To expand the employability of graduates, a number of skill development courses are also introduced in this framework.

The aim of bachelor's degree programme in chemistry is intended to provide: (i).Broad and balance knowledge in chemistry in addition to understanding of key chemical concepts, principles and theories. (ii). To develop students' ability and skill to acquire expertise over solving both theoretical and applied chemistry problems. (iii). To provide knowledge and skill to the students' thus enabling them to undertake further studies in chemistry in related areas or multidisciplinary areas that can be helpful for self-employment/entrepreneurship. (iv). To provide an environment that ensures cognitive development of students in a holistic manner. A complete dialogue about chemistry, chemical equations and its significance is fostered in this framework, rather than mere theoretical aspects. (v). To provide the latest subject matter, both theoretical as well as practical, such a way to foster their core competency and discovery learning. A chemistry graduate as envisioned in this framework would be sufficiently competent in the field to undertake further discipline-specific studies, as well as to begin domain-related employment. (vi). To mould a responsible citizen who is aware of most basic domain-independent knowledge, including critical thinking and communication. (vii).To enable the graduate prepare for national as well as international competitive examinations, especially UGC-CSIR NET and UPSC Civil Services Examination.

The programme structure and credits for B.Sc. (H) are finalized based on the stakeholders' requirements and general structure of the programme. Minimum number of classroom contact teaching credits for the B.Sc. (H) program will be 144 credits (one credit equals 1.0 hour. However, the minimum number of the credits for award of B.Sc. (H) degree will be 140 credits. Out of 144 credits of classroom contact teaching, 84 credits are to be allotted for core courses (CC), 06 credits are

allotted to Ability-Enhancement Compulsory Course (AECC), 01 credit is allotted to Skill enhancement course, 06 credits are allotted to Mandatory Courses (MC), 26 credits are allotted to Open/Generic Elective Course (OEC/GEC), 18 credits are allotted to Program/Discipline Specific Elective Course (DSEC), 03 credits are allotted to Project. Credits distribution is given below in tabular form:

B.Sc. (H) Chemistry: Three-Year (6-Semester) CBCS Programme			
Basic Structure: Distribution of Courses			
S. No.	**Type of Course**	**Credit Hours**	**Total Credits**
1	Core Course (CC)	14 Courses of 4 Credit each (Total Credit 14X4)	56
2	Laboratory Course (LC)	14 Courses of 2 Credit each (Total Credit 14X2)	28
3	Ability-Enhancement Compulsory Course (AECC)	2 Courses of 3 Credit each (Total Credit 4X3)	06
4	Skill Enhancement Course (SEC)	1 Courses of 1 Credit each (Total Credit 1X1)	01
5	Open/Generic Elective Course (OEC/GEC)	4 Courses of 4 Credit each (Total Credit 4X4) 2 Courses of 2 Credit each (Total Credit 2X2) 2 Courses of 3 Credit each (Total Credit 2X3)	26
6	Program/Discipline Specific Elective Course (DSEC)	3 Courses of 4 Credit each (Total Credit 3X4) 3 Courses of 2 Credit each (Total Credit 3X2)	18
7	MC-Mandatory Courses	2 Courses of 3 Credit each (Total Credit 2X3)	06
8	Project/Industrial Training	1 Courses of 3 Credit each (Total Credit 1X3)	03
9	Value Added Course (VAC)	4 Courses of 0 Credit each (Total Credit 6X0)	00
10	MOOC-Optional (credits will consider only in case a student fails to secure minimum required credits for the award of degree)	2 Courses of 0 Credit each (Total Credit 2X0)	00
Total Credits			**144**

Contact hours include work related to Lecture, Tutorial and Practical (LTP), where our institution will have flexibility to decide course wise requirements.

B. Choice Based Credit System (CBCS)

Choice Based Credit System (CBCS) is a versatile and flexible option for each student to achieve his target number of credits as specified by the UGC and adopted by our University.

The following is the course module designed for the B.Sc (H) program:

- ***Core competency:*** Students will acquire core competency in the subject Chemistry, and in allied subject areas. (i). Systematic and coherent understanding of the fundamental concepts in Physical chemistry, Organic Chemistry, Inorganic Chemistry, Analytical Chemistry and all other related allied chemistry

subjects. (ii).Students will be able to use the evidence based comparative chemistry approach to explain the chemical synthesis and analysis. (iii).The students will be able to understand the characterization of mater. (iv). Students will be able to understand the basic principle of equipments, instruments used in the chemistry laboratory. (v).Students will be able to demonstrate the experimental techniques and methods of their area of specialization in Chemistry.

- ***Program/Discipline Specific Elective Course (DSEC):*** A graduate student is expected to be capable of demonstrating comprehensive knowledge and understanding of both theoretical and experimental/applied chemistry knowledge in various fields of interest like Analytical Chemistry, Physical Chemistry, Inorganic Chemistry, Organic Chemistry, Material Chemistry, etc. Further, the student will be capable of using of advanced instruments and related soft-wares for in-depth characterization of materials/chemical analysis and separation technology.

- ***Skilled communicator:*** The course curriculum incorporates basics and advanced training in order to make a graduate student capable of expressing the subject through technical writing as well as through oral presentation.

- ***Critical thinker and problem solver:*** The course curriculum also includes components that can be helpful to graduate students to develop critical thinking ability by way of solving problems/numerical using basic & advance knowledge and concepts of Chemistry.

- ***Sense of inquiry:*** It is expected that the course curriculum will develop an inquisitive characteristics among the students through appropriate questions, planning and reporting experimental investigation.

- ***Skilled project manager:*** The course curriculum has been designed in such a manner as to enabling a graduate student to become a skilled project manager by acquiring knowledge about mathematical project management, writing, planning, study of ethical standards and rules and regulations pertaining to scientific project operation.

- ***Ethical awareness/reasoning:*** A graduate student requires understanding and developing ethical awareness/reasoning which the course curriculums adequately provide.

- ***Lifelong learner:*** The course curriculum is designed to inculcate a habit of learning continuously through use of advanced ICT technique and other available techniques/books/journals for personal academic growth as well as for increasing employability opportunity.

- ***Value Added Course (VAC):*** A value added audit course is a non-credit course which is basically meant to enhance general ability of students in areas like soft skills, quantitative aptitude and reasoning ability - required for the overall development of a student and at the same time crucial for industry/corporate demands and requirements. The student possessing these skills will definitely develop acumen to perform well during the recruitment process of any premier organization and will have the desired confidence to face the interview. Moreover, these skills are also essential in day-to-day life of the corporate world. The aim is to nurture every student for making effective communication, developing aptitude and a general reasoning ability for a better performance, as desired in corporate world. There shall be four courses of Aptitude in Semester I, II, III & IV semesters and two courses of Soft Skills in III & IV Semesters and will carry no credit, however, it will be compulsory for every student to pass these courses with minimum 45% marks to be eligible for the certificate. These marks will not be included in the calculation of CGPI. Students have to specifically be registered in the specific course of the respective semesters.

- ***Skill Enhancement Course:*** This course may be chosen from a pool of courses designed to provide value-based and/or skill-based knowledge.

- ***Generic/Open Elective Course (OEC):*** Open Elective is an interdisciplinary additional subject that is compulsory in a program. The score of Open Elective is counted in the overall aggregate marks under Choice Based Credit System (CBCS). Each Open Elective paper will be of 3 Credits in V semesters. Each student has to take Open/Generic Electives from department other than the parent department. Core / Discipline Specific Electives will not be offered as Open Electives.

- ***Mandatory Course (MC):*** This is a compulsory course that does not have any choice and will be of 3 credits. Each student of B.Sc (H). Program has to compulsorily pass the Environmental Studies and Human values & professional Ethics.

C. Programme Outcomes (POs)

The learning and abilities or skills that a student would have developed by the end of three-years B.Sc (H) Programs**:**

PO – 1	**Critical thinking** - This is based on the assumption, thinking and actions. These assumptions are tested for accuracy & validity taking into consideration the ideas and decisions. These ideas may be collected from intellectual organization or personal from different prospectus.
PO – 2	**Effective communication-** Effective communication an important tool to enhance the effectiveness of learning among the students. The speaking, reading & writing must be followed correctly.
PO – 3	**Social interaction –**Social interaction also play important role to reads the conclusion in group settings.
PO – 4	**Effective citizenship**- This contributes in the national development and promptness to achieve the goals. It develops awareness through volunteering.
PO – 5	**Ethics-** It has direct impact to recognize the different value systems. It gives proper understanding in different dimension for making decisions.
PO – 6	**Environment and sustainability**- Essential to understand the environmental issues & sustainable development.
PO – 7	**Self-directed & lifelong learning –** Acquire the ability to engage in independent and life- long learning in broad spectrum including socio technological changes.
PO- 8	**Problem analysis & Solving:** Identify, formulate, research literature, and analyze complex basic sciences problems reaching substantiated conclusions using first principles of mathematics, natural sciences.
PO- 9	**Entrepreneurship:** An Entrepreneurship cut across every sector of human life including the field of engineering, engineering entrepreneurship is the process of harnessing the business opportunities in engineering and turning it into profitable commercially viable innovation.
PO- 10	**Interpersonal skills:** Interpersonal skills involve the ability to communicate and build relationships with others. Effective interpersonal skills can help the students during the job interview process and can have a positive impact on your career advancement.
PO- 11	**Technology savvy/usage:** Being technology savvy is essentially one's skill to be smart with technology. This skill reaches far beyond 'understanding' the concepts of how technology works and encompasses the 'utilization' of such modern technology for the purpose of enhancing productivity and efficiency.

D. Programme Specific Outcomes (PSOs)

The learning and abilities or skills that a student would have developed by the end of three-years B.Sc (H) Chemistry**:**

PSO – 1	**Understanding** the basic information of chemistry including symbols, types of bonds, structure, definitions etc.
PSO – 2	**Remembering** basic concept of chemistry including classification & properties of elements, functional groups, formation of bonds and configuration of compounds.
PSO – 3	**Applying** chemical synthesis of compounds, various types of chemical reactions, physicochemical analysis and identification of compounds.
PSO – 4	**Executing** the known techniques to analysis of new compounds, elemental analysis for percentage determination and establishing the molecular formula and structure by modern techniques like IR, NMR, and Raman Spectroscopy etc.
PSO – 5	**Developing** new derivatives of the existing compounds and study their physical and chemical properties and comparative studies for various derivatives of existing compounds and can grow evaluating aptitude.
PSO – 6	**Facing** all types of competitions and challenges with confidence

E. Pedagogy & Unique practices adopted:

"Pedagogy is the method and practice of teaching, especially for teaching an academic subject or theoretical concept". In addition to conventional time-tested lecture method, the institute will **emphasize on experiential learning:**

- ***Role Play & Simulation:*** Role-play and simulation are forms of experiential learning. Learners take on different roles, assuming a profile of a character or personality, and interact and participate in diverse and complex learning settings. Role-play and simulation function as learning tools for teams and groups or individuals as they "play" online or face-to-face. They alter the power ratios in teaching and learning relationships between students and educators, as students learn through their explorations and the viewpoints of the character or personality they are articulating in the environment. This student-centered space can enable learner-oriented assessment, where the design of the task is created for active student learning. Therefore, role-play& simulation exercises such as virtual share trading, marketing simulation etc. are being promoted for the practical-based experiential learning of our students.

- ***Video Based Learning (VBL) & Learning through Movies (LTM):*** These days technology has taken a front seat and classrooms are well equipped with equipment and gadgets. Video-based learning has become an indispensable part of learning. Similarly, students can learn various concepts through movies. In fact, many teachers give examples from movies during their discourses. Making students learn few important theoretical concepts through VBL & LTM is a good idea and method. The learning becomes really interesting and easy as videos add life to concepts and make the learning engaging and effective. Therefore, our institute is promoting VBL & LTM, wherever possible.

- ***Field/Live Projects*:** The students, who take up experiential projects in companies, where senior executives with a stake in teaching guide them, drive the learning. All students are encouraged to do some live project other their regular classes.

- ***Industrial Visits:*** Industrial visit are essential to give students hand-on exposure and experience of how things and processes work in industries. Our institute organizes such visits to enhance students' exposure to practical learning and work out for a report of such a visit relating to their specific topic, course or even domain.

- ***MOOCs:*** Students may earn credits by passing MOOCs as decided by the college. Graduate level programs may award Honors degree provided students earn pre-requisite credits through MOOCs.
  University allows students to undertake additional subjects/course(s) (In-house offered by the university through collaborative efforts or courses in the open domain by various internationally recognized universities) and to earn additional credits on successful completion of the same. Each course will be approved in advance by the University following the standard procedure of approval and will be granted credits as per the approval.
  Keeping this in mind, University proposed and allowed a maximum of two credits to be allocated for each MOOC courses. In the pilot phase it is proposed that a student undertaking and successfully completing a MOOC course through only NPTEL could be given 2 credits for each MOOC course.
  For smooth functioning and monitoring of the scheme the following shall be the guidelines for MOOC courses, Add-on courses carried out by the College from time to time.

  a) It will necessary for every student to take at least one MOOC Course throughout the programme.
  b) There shall be a MOOC co-ordination committee in the College with a faculty at the level of Professor heading the committee and all Heads of the Department being members of the Committee.
  c) The Committee will list out courses to be offered during the semester, which could be requested by the department or the students and after deliberating on all courses finalize a list of courses to be offered with 2 credits defined for each course and the mode of credit consideration of the student. The complete process shall be obtained by the College before end of June and end of December for Odd and Even semester respectively of the year in which the course is being offered. In case of MOOC course, the approval will be valid only for the semester on offer.
  d) Students will register for the course and the details of the students enrolling under the course along with the approval of the Vice Chancellor will be forwarded to the Examination department within fifteen days of start of the semester by the Coordinator MOOC through the Principal of the College.
  e) After completion of MOOC course, Student will submit the photo copy of Completion certificate of MOOC Course to the Examination cell as proof.
  f) Marks will be considered which is mentioned on Completion certificate of MOOC Course.
  g) College will consider the credits only in case a student fails to secure minimum required credits then the additional subject(s) shall be counted for calculating the minimum credits required for the award of degree.

- ***Special Guest Lectures (SGL) &Extra Mural Lectures (EML):*** Some topics/concepts need extra attention and efforts as they either may be high in difficulty level or requires experts from

specific industry/domain to make things/concepts clear for a better understanding from the perspective of the industry. Hence, to cater to the present needs of industry we organize such lectures, as part of lecture-series and invite prominent personalities from academia and industry from time to time to deliver their vital inputs and insights.

- ***Student Development Programs (SDP):*** Harnessing and developing the right talent for the right industry an overall development of a student is required. Apart from the curriculum teaching various student development programs (training programs) relating to soft skills, interview skills, SAP, Advanced excel training etc. that may be required as per the need of the student and industry trends, are conducted across the whole program. Participation in such programs is solicited through volunteering and consensus.

- ***Industry Focused programes:*** Establishing collaborations with various industry partners to deliver the programme on sharing basis. The specific courses are to be delivered by industry experts to provide practice based insight to the students.

- ***Special assistance programe for slow learners & fast learners:*** write the note how would you identify slow learners, develop the mechanism to correcting knowledge gap. Terms of advance topics what learning challenging it will be provided to the fast learners.

- ***Induction program:*** Every year 3 weeks induction program is organized for 1st year students to make them familiarize with the entire academic environment of university including Curriculum, Classrooms, Labs, Faculty/ Staff members, Academic calendar and various activities.

- **Mentoring scheme:** There is Mentor-Mentee system. One mentor lecture is provided per week in a class. Students can discuss their problems with mentor who is necessarily a teaching faculty. In this way, student's problems or issues can be identified and resolved.

- **Competitive exam preparation:** Students are provided with one class in every week for GATE/ Competitive exams preparation.

- **Extra-curricular Activities:** organizing & participation in extracurricular activities will be mandatory to help students develop confidence & face audience boldly. It brings out their leadership qualities along with planning & organizing skills. Students undertake various cultural, sports and other competitive activities within and outside then campus. This helps them build their wholesome personality.

- **Career & Personal Counseling:** - Identifies the problem of student as early as possible and gives time to discuss their problems individually as well as with the parents. Counseling enables the students to focus on behavior and feelings with a goal to facilitate positive change.
  Its major role lies in giving: Advice, Help, Support, Tips, Assistance, and Guidance.
  Strategies: a) Once in a week the counselors meet the students in order to inquire about problems.
  b) Available 24x7 on SOS basis.

- **Participation in Workshops, Seminars & writing & Presenting Papers:** Departments plan to organize the workshops, Seminars & Guest lecturers time to time on their respective topics as per academic calendar. Students must have to attend these programs. These participation would be count in the marks of general Discipline & General Proficiency which is the part of course scheme as noncredit course.

- **Formation of Student Clubs, Membership & Organizing & Participating events:** Every department has the departmental clubs with the specific club name. The entire student's activity would be performed by the club. One faculty would be the coordinator of the student clubs & students would be the members with different responsibility.

- **Capability Enhancement & Development Schemes:** The Institute has these schemes to enhance the capability and holistic development of the students. Following measures/ initiatives are taken up from time to time for the same: Career Counseling, Soft skill development, Remedial Coaching, Bridge Course, Language Lab, Yoga and Meditation, Personal Counseling

- **Library Visit & Utilization of E-Learning Resources:** Student can visit the library from morning 10 AM to evening 8 PM. Library created its resources Database and provided Online Public Access Catalogue (OPAC) through which users can be accessed from any of the computer connected in the LAN can know the status of the book. Now we are in process to move from OPAC to KOHA.
  - **a)** Institute Library & Information is subscribing online e-books and e-journals databases (DELNET and EBSCO host E-databases) as per the requirement of the institute and fulfilling AICTE norms. IP based access is given to all computers connected on campus LAN to access e-journals.
  - **b)** For the effective utilization of resources, Information Literacy training programs are conducted to the staff and students.
  - **c)** Wi-Fi enabled campus
  - **d)** Regular addition of latest books and journals
  - **e)** Well maintained e-library to access e-resources

Study & Evaluation Scheme

B.Sc. (H) (Chemistry)-Semester I

S. No	*Category*	*Course Code*	Course	*Periods*			*Credit*	*Evaluation Scheme*		
				L	*T*	*P*		*Internal*	*External*	*Total*
1	CC-1	BAS111	Inorganic Chemistry-I	4	-	-	4	40	60	100
2	CC-2	BAS112	Physical Chemistry-I	4	-	-	4	40	60	100
3	AECC-1	TMUGE101	English Communication-I	2	-	2	3	40	60	100
4	GEC-1		Generic Elective Course (Theory) Generic Elective-I	4	-	-	4	40	60	100
5	GEC-1		Generic Elective Course (Lab) Generic Elective-I	-	-	4	2	50	50	100
6	SEC-1	BAS167	Computer Skills for Chemist (Lab)	-	-	2	1	50	50	100
7	LC-1	BAS164	Inorganic Chemistry-I (Lab)	-	-	4	2	50	50	100
8	LC-2	BAS165	Physical Chemistry-I (Lab)	-	-	4	2	50	50	100
9	DGP-1	BGP111	Discipline & General Proficiency	**-**	**-**	**-**	**-**	100	-	100
			Total	**14**	**-**	**16**	**22**	**460**	**440**	**900**

Value Added Course (Optional): It is an audit course. The performance of the student in this course will not be counted in the overall result.

1	VAAC-1	TMUGA-101	Foundation in Quantitative Aptitude	2	1	-	-	40	60	100

Bridge Course:

1		BAS113	Elementary Mathematics	3	-	-	-	-	-	100

B.Sc. (H) (Chemistry)-Semester II

S. No	Category	Course Code	Course	Periods			Credit	Evaluation Scheme		
				L	T	P		Internal	External	Total
1	CC-3	BAS211	Organic Chemistry-I	4	-	-	4	40	60	100
2	CC-4	BAS212	Physical Chemistry-II	4	-	-	4	40	60	100
3	AECC-2	TMUGE201	English Communication-II	2	-	2	3	40	60	100
4	GEC-2		Generic Elective Course (Theory) / Generic Elective-II	4	-	-	4	40	60	100
5	GEC-2		Generic Elective Course (Lab) / Generic Elective-II	-	-	4	2	50	50	100
6	MC-1	TMU201	Environmental Studies	2	1	-	3	40	60	100
7	LC-3	BAS264	Organic Chemistry-I (Lab)	-	-	4	2	50	50	100
8	LC-4	BAS265	Physical Chemistry-II (Lab)	-	-	4	2	50	50	100
9	DGP-2	BGP211	Discipline & General Proficiency	-	-	-	-	100	-	100
			Total	**16**	**1**	**14**	**24**	**450**	**450**	**900**

Value Added Course (Optional):

1	VAAC-2	TMUGA-201	Analytical Reasoning	2	1	-	-	40	60	100

B.Sc. (H) (Chemistry)-Semester III

S. No	Category	Course Code	Course	Periods			Credit	Evaluation Scheme		
				L	T	P		Internal	External	Total
1	CC-5	BAS311	Inorganic Chemistry-II	4	-	-	4	40	60	100
2	CC-6	BAS312	Organic Chemistry-II	4	-	-	4	40	60	100
3	CC-7	BAS313	Physical Chemistry-III	4	-	-	4	40	60	100
4	GEC-3		Generic Elective Course (Theory) Generic Elective-III	4	-	-	4	40	60	100
5	LC-5	BAS361	Inorganic Chemistry-II (Lab)	-	-	4	2	50	50	100
6	LC-6	BAS362	Organic Chemistry-II (Lab)	-	-	4	2	50	50	100
7	LC-7	BAS363	Physical Chemistry-III (Lab)	-	-	4	2	50	50	100
8	DGP-3	BGP311	Discipline & General Proficiency	**-**	**-**	**-**	**-**	100	-	100
			Total	**16**	**-**	**12**	**22**	**410**	**390**	**800**

Value Added Course (Optional):

1	VAAC-3	TMUGE301	English Communication-III	2	-	2	-	40	60	100
2	VAAC-4	TMUGS-301	Managing Self	2	1	-	-	50	50	100

B.Sc. (H) (Chemistry)-Semester IV

S. No	*Category*	*Course Code*	Course	*Periods*			*Credit*	*Evaluation Scheme*		
				L	*T*	*P*		*Internal*	*External*	*Total*
1	CC-8	BAS419	Inorganic Chemistry-III	4	-	-	4	40	60	100
2	CC-9	BAS412	Organic Chemistry-III	4	-	-	4	40	60	100
3	CC-10	BAS413	Physical Chemistry-IV	4	-	-	4	40	60	100
4	GEC-4		Generic Elective Course: Generic Elective-IV	4	-	-	4	40	60	100
5	LC-8	BAS461	Inorganic Chemistry-III (Lab)	-	-	4	2	50	50	100
6	LC-9	BAS462	Organic Chemistry-III (Lab)	-	-	4	2	50	50	100
7	LC-10	BAS465	Physical Chemistry-IV (Lab)	-	-	4	2	50	50	100
8	DGP-4	BGP411	Discipline & General Proficiency	**-**	**-**	**-**	**-**	100	-	100
			Total	**16**	**-**	**12**	**22**	**410**	**390**	**800**

Value Added Course (Optional):

1	VAAC-5	TMUGE401	English Communication-IV	2	-	2	-	40	60	100
2	VAAC-6	TMUGS-401	Managing Work and Others	2	1	-	-	50	50	100

MOOC Course:

1	MOOC-1	MOOC12	MOOC Program –I (Optional)	-	-	-	2	-	100	100

B.Sc. (H) (Chemistry)-Semester V

S. No	Category	Course Code	Course		Periods			Credit	Evaluation Scheme		
					L	T	P		Internal	External	Total
1	CC-11	BAS525	Organic Chemistry-IV		4	-	-	4	40	60	100
2	CC-12	BAS526	Physical Chemistry-V		4	-	-	4	40	60	100
3	MC-2	BHM515	Human Values & Professional Ethics		3	-	-	3	40	60	100
DSE-I											
4	DSE-1		Discipline Specific Elective Courses	Discipline Specific Elective Course-I	4	-	-	4	40	60	100
5	DSE-1			Discipline Specific Elective Course-I(Lab)	-	-	4	2	50	50	100
6	OEC-1		Open Elective Course	Open Elective-I	3	-	-	3	40	60	100
7	LC-11	BAS561	Organic Chemistry-IV (Lab)		-	-	4	2	50	50	100
8	LC-12	BAS562	Physical Chemistry-V (Lab)		-	-	4	2	50	50	100
9	PROJ-1	BAS598	Industrial Training & Presentation		-	-	6	3	50	50	100
10	DGP-5	BGP511	Discipline & General Proficiency		-	-	-	-	100	-	100
			Total		**18**	**-**	**18**	**27**	**500**	**500**	**1000**

MOOC Course:

1	MOOC-2	MOOC13	MOOC Program –II (Optional)	-	-	-	2	-	100	100

B.Sc. (H) (Chemistry)-Semester VI

S. No	Category	Course Code	Course		Periods			Credit	Evaluation Scheme		
					L	T	P		Internal	External	Total
1	CC-13	BAS624	Inorganic Chemistry-IV		4	-	-	4	40	60	100
2	CC-14	BAS625	Organic Chemistry-V		4	-	-	4	40	60	100
DSE- II											
3	DSE-3		Discipline Specific Elective Courses	Discipline Specific Elective Course-II	4	-	-	4	40	60	100
4	DSE-4			Discipline Specific Elective Course-II (Lab)	-	-	4	2	50	50	100
DSE-III											
5	DSE-5		Discipline Specific Elective Courses	Discipline Specific Elective Course-III	4	-	-	4	40	60	100
6	DSE-6			Discipline Specific Elective Course-III (Lab)	-	-	4	2	50	50	100
7	OEC-2		Open Elective Course	Open Elective-II	3	-	-	3	40	60	100
8	LC-13	BAS661	Inorganic Chemistry-IV (Lab)		-	-	4	2	50	50	100
9	LC-14	BAS662	Organic Chemistry-V (Lab)		-	-	4	2	50	50	100
10	DGP-6	BGP611	Discipline & General Proficiency		-	-	-	-	100	-	100
			Total		**19**	**-**	**16**	**27**	**500**	**500**	**1000**

ELECTIVE COURSES OFFERED

S. No	Code	Course	L	T	P	Credit
Semester I - Generic Elective I - (Any one)						
1	BAS114	Mechanics	4	-	-	4
	BAS166	Mechanics (Lab)	-	-	4	2
2	BAS117	Trigonometry & Differential Calculus	4	-	-	4
	BAS173	Calculus Lab (Lab)	-	-	4	2
Semester II- Generic Elective II -(Any one)						
3	BAS220	Waves & optics	4	-	-	4
	BAS266	Waves & Optics (Lab)	-	-	4	2
4	BAS231	Discrete Mathematics	4	-	-	4
	BAS271	Introduction to MATLAB	-	-	4	2
Semester III- Generic Elective III -(Any one)						
5	BAS314	Elements of Modern Physics	4	-	-	4
6	BAS331	Numerical Analysis	4	-	-	4
Semester IV- Generic Elective IV -(Any one)						
7	BAS435	Thermal Physics	4	-	-	4
8	BAS418	Introduction to Probability	4	-	-	4
Semester V						
Discipline Specific Elective Course-I (Any one)						
9	BAS527	Analytical Chemistry	4	-	-	4
	BAS563	Analytical Chemistry (Lab)	-	-	4	2
10	BAS529	Molecular modeling & Drug Design	4	-	-	4
	BAS565	Molecular modeling & Drug Design (Lab)	-	-	4	2
Semester VI						
Discipline Specific Elective Course-II (Any One)						
12	BAS637	Polymer Chemistry	4	-	-	4
	BAS671	Polymer Chemistry (Lab)	-	-	4	2
13	BAS638	Novel Inorganic Solids	4	-	-	4
	BAS672	Novel Inorganic Solids (Lab)	-	-	4	2
Semester VI						
Discipline Specific Elective Course-III (Any One)						
14	BAS626	Green Chemistry	4	-	-	4
	BAS663	Green Chemistry (Lab)	-	-	4	2
15	BAS627	Chemistry of Drugs, Cosmetics & Perfumes	4	-	-	4
	BAS664	Chemistry of Drug Cosmetics & Perfumes (Lab)	-	-	4	2

Course Code: BAS113	**B.Sc (H) Chemistry (Bridge Course)** **Elementary Mathematics**	**L-3 T-0 P-0 C-0**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Understanding the concepts of Limit, Continuity and Differentiability of functions.	
CO2.	Understanding the concepts of differential equation in one- & two-dimensions heat transformation equations	
CO3.	Understanding the concepts of eigenvalue & eigen vectors of matrices.	
CO4.	Understanding concepts of curvilinear systems and application of vector Integration in finding Area, Volume & Moment of Inertia	
Course Content:		
Unit-1:	**Statistics:** Meaning of statistics, uses & applications of statistics, classification of data: primary & secondary data, Measures of central tendency: Mean, Median, Mode. Measures of variation-Range, Inter Quartile range, quartile deviations, Mean deviation & standard deviation.	**8 Hours**
Unit-2:	**Probability:** Introduction of Probability, Types of probability, dependent & independent events, Addition law of probability & multiplication law of probability.	**8 Hours**
Unit-3:	**Differential and Integral Calculus:** Introduction of differentiation, Product rules, Differentiation by first principal, Integration by substitution, Integration of Algebraic, trigonometric, logarithmic, exponential function, Integration by partial fraction. Limit & Continuity.	**8 Hours**
Unit-4:	**Matrix:** Definition of matrix, type of matrix, addition &subtraction, Multiplication, inverse of matrix. Solution of system of algebraic equation, Crammer's rule.	**8 Hours**
Unit-5:	**Vector Calculus:** Representation of vectors, Vector addition, multiplication & properties, Triple vector products.	**8 Hours**
Text Books:	• Mathematics for Physical Chemistry DONALD A. MCQUARRIE, University Science Books. • https://study.com/academy/lesson/application-of-statistics-in-daily-life.html	
Reference Books:	*** Latest editions of all the suggested books are recommended.**	

Course Code: BAS111	B.Sc (H) Chemistry (Semester-I) Inorganic Chemistry-I	L-4 T-0 P-0 C-4
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Understanding the concept of modern atomic structure, Periodicity of elements and Chemical reactions	
CO2.	Understanding the Schrodinger's wave equation to explain the origin of quantum numbers & standard electrode potential.	
CO3.	Understanding the theories of chemical bonding & Born Haber's cycle.	
CO4.	Applying theories of chemical bonding to know the characteristics of molecules.	
CO5.	Analyzing the relationship between Ionization potential , reactivity of metals , electron gain enthalpy & reactivity of non-metals.	
Course Content:		
Unit-1:	**Atomic Structure:** Schrödinger's wave equation, significance of ψ and ψ^2. Quantum numbers and their significance. Normalized and orthogonal wave functions. Sign of wave functions. Radial and angular wave functions for hydrogen atom. Radial and angular distribution curves. Shapes of s, p, d and f orbitals. Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, Aufbau's principle and its limitations.	**8 Hours**
Unit-2:	**Periodicity of Elements:** Effective nuclear charge, shielding or screening effect, Atomic& ionic radii, Ionization enthalpy, Successive ionization enthalpies and factors affecting ionization energy. Applications of ionization enthalpy, Electron gain enthalpy, Electronegativity, trends in periodic table and applications in predicting and explaining the chemical behavior.	**8 Hours**
Unit-3:	**Chemical Bonding - I:** Covalent bond: Valence Bond theory& its limitations. Hybridization& shapes of simple inorganic molecules & ions, Valence shell electron pair repulsion theory (VSEPR), shapes of simple molecules and ions containing lone pairs and bond pairs of electrons, Resonance and resonance energy, Molecular orbital theory & MO diagrams of Homo & heteronuclear (CO, NO) diatomic molecules.	**8 Hours**
Unit-4:	**Chemical Bonding - II:** Ionic Solids: 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 Ionic structures, radius ratio effect and coordination number, limitation of radius ratio rule, lattice energy and Born-Haber cycle, salvation energy and solubility of ionic solid. .	**8 Hours**

Unit-5:	Metallic bond-free electron, Semiconductors & insulators, valence bond and band theories Weak Chemical Forces: van der Waals forces, ion-dipole forces, dipole-dipole inter actions, induced dipole interactions, Instantaneous dipole-induced dipole interactions. Repulsive forces, Hydrogen bonding, Effects of chemical force, melting and boiling points, solubility & energetics of dissolution process. **Oxidation-Reduction:** Redox equations, Standard Electrode Potential and its application to inorganic reactions.	**8 Hours**
Text Books:	1. Lee, J.D. Concise Inorganic Chemistry ELBS.	
Reference Books:	**1.** Atkins, P.W. & Paula, J. Physical Chemistry, Oxford University Press. **2.** Rodger, G.E. Inorganic and Solid-State Chemistry, Cengage Learning India Edition. **3.** https://socratic.org/questions/what-are-the-four-quantum-numbers-in-chemistry **4.** https://www.electrical4u.com/schrodinger-wave-equation/ *** Latest editions of all the suggested books are recommended.**	

Course Code: BAS112	B.Sc (H) Chemistry (Semester-I) Physical Chemistry-I	L-4 T-0 P-0 C-4
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Understanding the concept of kinetic theory of gases and behavior of real gases.	
CO2.	Understanding the effect of solute and temperature on the physical properties of liquids.	
CO3.	Understanding the elements of symmetry, crystal structure of ionic compounds.	
CO4.	Analyzing the Ionization of electrolytes, acid- base indicators, salt hydrolysis and buffer action.	
CO5.	Applying the concepts of Ionic Equilibria to determine the degree of ionization Ionization constant	
Course Content:		
Unit-1:	**Gaseous stat**e: Postulates and derivation of the kinetic gas equation; collision frequency; collision diameter; mean free path, including their temperature and pressure dependence. Behavior of real gases: Deviations from ideal gas behavior, compressibility factor, Z, Causes of deviation from ideal behavior. Vander Waals equation of state, its derivation and application in explaining real gas behavior, virial equation of state; van der Waals equation expressed in virial form and calculation of Boyle temperature.	**8 Hours**
Unit-2:	**Liquid state:** Qualitative treatment of the structure of the liquid state; Radial distribution function; physical properties of liquids; vapor 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.	**8 Hours**
Unit-3:	**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; Bragg's law, Analysis of powder diffraction patterns of NaCl, CsCl and KCl. Defects in crystals.	**8 Hours**
Unit-4:	**Ionic equilibria I:** 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)..	**8 Hours**

Unit-5:	**Ionic equilibria II:** 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. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle Theory of acid–base indicators; selection of indicators and their limitations.	**8 Hours**
Text Books:	1. Atkins, P. W. & Paula, J. de Atkin's Physical Chemistry, Oxford university Press.	
Reference Books:	2. Castellan, G. W. Physical Chemistry, Narosa. 3. Mortimer, R. G. Physical Chemistry, Elsevier: 4. Engel, T. & Reid, P. Physical Chemistry, Pearson. 5. https://www.youtube.com/watch?v=w70iLR6lheo *** Latest editions of all the suggested books are recommended.**	

Course Code: TMUGE101	**B.Sc. (H) Chemistry- Semester-I** **English Communication – I**	**L-2 T-0 P-2 C-3**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	**Remembering and understanding** of the basic of English grammar and vocabulary.	
CO2.	**Understanding** of the basic Communication process.	
CO3.	**Applying** correct vocabulary and tenses in sentences construction.	
CO4.	**Analyzing** communication needs and developing communication strategies using both verbal & non-verbal method.	
CO5.	**Drafting** applications in correct format for common issues.	
CO6.	**Developing** self-confidence.	
Course Content:		
Unit-1:	**Introductory Sessions** • Self-Introduction • Building Self Confidence: Identifying strengths and weakness, reasons Failure, strategies to overcome Fear of Failure • Importance of English Language in present scenario (Practice: Self-introduction session)	**6 Hours**
Unit-2:	**Basics of Grammar** • Parts of Speech • Tense • Subject and Predicate • Vocabulary: Synonym and Antonym (Practice: Conversation Practice)	**12 Hours**
Unit-3:	**Basics of Communication** • Communication: Process, Types, 7Cs of Communication, Importance & Barrier • Language as a tool of communication • Non-verbal communication: Body Language • Etiquette & Manners • Basic Problem Sounds (Practice: Pronunciation drill and building positive body language)	**10 Hours**
Unit-4:	**Application writing** • Format & Style of Application Writing • Practice of Application writing on common issues.	**8 Hours**
Unit-5:	**Value based text reading:** Short Story (Non- detailed study) • Gift of Magi - O. Henry	**4 Hours**
Text Books:	**1**. Singh R.P., An Anthology of Short stories, O.U.P. New Delhi.	
Reference Books:	**1.** Kumar, Sanjay. & Pushp Lata. "Communication Skills" New Delhi: Oxford University Press.	

	2. Carnegie Dale. "How to win Friends and Influence People" New York: Simon & Schuster. **3.** Goleman, Daniel. "Emotional Intelligence' Bantam Book. ***Latest editions of all the suggested books are recommended.**	
Additional electronics reference material:	**1.** https://www.youtube.com/watch?v=4XEa-8HD3lE **2.** https://www.youtube.com/watch?v=sb6ZZ2p3hEM&feature=youtu.be **3.** https://www.youtube.com/watch?v=Df3ysUkdB38 **4.** https://www.youtube.com/watch?v=0LdYaj3jcws **5.** https://www.youtube.com/watch?v=64XIkMqPm_8 **6.** https://www.youtube.com/watch?v=_vS6O8YlMq0	
Methodology:	**1.** Language Lab software. **2.** The content will be conveyed through Real life situations, Pair Conversation, Group Talk and Class Discussion. **3.** Conversational Practice will be effectively carried out by Face to Face & Via Media (Telephone, Audio-Video Clips) **4.** Modern Teaching tools (PPT Presentation, Tongue-Twisters & Motivational videos with sub-titles) will be utilized	

Evaluation Scheme

Internal Evaluation			**External Evaluation**		**Total Marks**
40 Marks			**60 Marks**		**100**
20 Marks (Best 2 out of Three CTs) ***(From Unit- II, IV & V)***	10 Marks (Oral Assignments) ***(From Unit I & III)***	10 Marks (Attendance)	40 Marks (External Written Examination) ***(From Unit II, IV & V)***	20 Marks (External Viva)* ***(From Unit -1 & III)***	

*Parameters of External Viva

Content	**Body Language**	**Confidence**	**Question Responsiveness**	**TOTAL**
05 Marks	05 Marks	05 Marks	05 Marks	20 Marks

Note: External Viva will be conducted by 2-member committee comprising

a) One Faculty teaching the class

b) One examiner nominated by University Examination cell.

Each member will evaluate on a scale of 20 marks and the average of two would be the 20 marks obtained by the students.

Course Code: BAS114	**Generic Elective Course-- I** **B.Sc. (H) Chemistry- Semester-I** **Mechanics**	**L-4 T-0 P-0 C-4**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	**Remembering** the concepts of Newtonian Mechanics of general bodies.	
CO2.	**Understanding** the concepts of rotational dynamics of bodies, gravitation, central forces, Oscillatory motion, Elasticity and fluid motions.	
CO3.	**Understanding** the frames of references and fundamentals of Special Theory of Relativity.	
CO4.	**Applying** the concepts of gravitation for understanding the motion of Satellites and planets.	
CO5.	**Applying** the concept of relativity in understanding the phenomena of time dilation, mass energy equivalence, twin paradox and relativistic addition of velocities.	
Course Content:		
Unit-1:	**Rotational Dynamics**: Centre of Mass and Laboratory frames. Angular momentum of a particle and system of particles, Torque, Principle of conservation of angular momentum, Rotation about a fixed axis, Moment of Inertia, Calculation of moment of inertia for rectangular, cylindrical and spherical bodies, Kinetic energy of rotation, Motion involving both translation and rotation.	**8 Hours**
Unit-2:	**Fluid Motion:** Kinematics of Moving Fluids: Poiseuille's Equation for Flow of a Liquid through a Capillary Tube. **Gravitation and Central Force Motion:** Law of gravitation. Gravitational potential energy, Inertial and gravitational mass, Potential and field due to spherical shell and solid sphere, **Non-Inertial Systems:** Non-inertial frames and fictitious forces. Uniformly rotating frame, Centrifugal force, Coriolis force.	**8 Hours**
Unit-3:	**Elasticity:** Relation between Elastic constants, Twisting torque on a Cylinder or Wire. **Central Forces:** Motion of a particle under a central force field. Two-body problem and its reduction to one-body problem and its solution, Kepler's Laws, Satellite in circular orbit and applications. Geosynchronous orbits. Weightlessness, Basic idea of global positioning system (GPS).	**8 Hours**
Unit-4:	**Oscillations:** SHM: Simple Harmonic Oscillations. Differential equation of SHM and its solution, Kinetic energy, potential energy, total energy and their time-average values, Damped oscillation. Forced oscillations: Transient and steady states; Resonance, sharpness of resonance; power dissipation and Quality Factor.	**8 Hours**
Unit-5:	**Special Theory of Relativity:** Michelson-Morley Experiment and its outcome. Postulates of Special Theory of Relativity, Massless Particles. Lorentz Transformations: Simultaneity, Length contraction, Time dilation, Twin Paradox, Relativistic addition of velocities, Variation of mass with velocity. Mass energy Equivalence.	**8 Hours**
Text Books:	**1.** An introduction to mechanics, D. Kleppner, R.J. Kolenkow, McGraw-Hill. **2.** Mechanics, Berkeley Physics, vol.1, C. Kittel, W. Knight, et.al. Tata McGraw-Hill. Physics, Resnick, Halliday and Walker, Wiley.	
Reference Books:	**1.** Analytical Mechanics, G.R. Fowles and G.L. Cassiday. Cengage Learning. **2.** Feynman Lectures, R. P. Feynman, R. B. Leighton, M. Sands, Pearson Education Introduction to Special Relativity, R. Resnick, John Wiley and Sons. University Physics, Ronald Lane Reese, Thomson Brooks/Cole. **3.** Mechanics, D.S. Mathur, S. Chand and Company Limited, University Physics.	

	4. J.W. Jewett, R.A. Serway, Cengage Learning Theoretical Mechanics, M.R. Spiegel, Tata McGraw Hill. **5.** http://www.physics.hmc.edu/~saeta/courses/p111/uploads/Y2013/chap07.pdf *** Latest editions of all the suggested books are recommended.**	

Course Code: **BAS117**	**Generic Elective Course-- I** **B.Sc. (H) Chemistry- Semester-I** **Trigonometry & Differential Calculus**	**L-4** **T-0** **P-0** **C-4**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	**Understanding** the concepts of trigonometric functions, hyperbolic functions, inverse circular and inverse hyperbolic functions of complex quantities.	
CO2.	**Understanding** the concept of Successive differentiation and partial differentiation.	
CO3.	**Understanding** the concepts of envelopes, evolutes, curvature and asymptotes of curves in Cartesian and polar coordinates.	
CO4.	**Applying** the concept of Leibnitz's theorem for successive derivatives.	
CO5.	**Applying** the concept of tangent, normal and asymptotes to tracing of curves in Cartesian, parametric and polar coordinates.	
Course Content:		
Unit-1:	Circular and Hyperbolic functions of Complex quantities, Separation of real and imaginary parts of Trigonometric, Logarithmic, and Exponential functions.	**8 Hours**
Unit-2:	Gregory's series, Summation of series, Expansion of functions (Maclaurin's and Taylor's expansion of functions).	**8 Hours**
Unit-3:	Successive differentiation, Leibnitz theorem (without proof), Partial differentiation, Euler's theorem, Jacobians, Maxima and Minima	**8 Hours**
Unit-4:	Tangents and Normals, Envelopes and Evolutes, Curvature and Asymptotes of curves in Cartesian and Polar coordinates.	**8 Hours**
Unit-5:	Tracing of curves in Cartesian, Parametric and Polar coordinates (Conics, Asteroid, Hypocycloid, Folium of Descartes, Cycloid, Circle, Cardioids, Lemniscates, Equiangular spiral), Limit and its properties, Indeterminate forms.	**8 Hours**
Text Books:	1. "Differential Calculas" by Gorakh Prasad, Pothishala Pvt Ltd.. 2. "Trigonometry" by A. K. Saxena, Aeykay Prakashan, Bareilly.	
Reference Books:	1. "Trigonometry" by A.R. Vashistha and R. K. Gupta, Krishna Prakashan Mandir. 2. "Differential Calculus" by N. Pishkunor, Peace Publishers Moscow. 3. "Differential Calculus" by Khalil Ahmed, Anamya Publication, New Delhi. 4. https://mathworld.wolfram.com/GregorySeries.html ***Latest editions of all the suggested books are recommended.**	

Course Code: BAS166	Generic Elective Course-- I B.Sc.(H) Chemistry- Semester-I **Mechanics (Lab)**	L-0 T-0 P-4 C-2
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	**Remembering** of basic concepts of pendulums like Bar & Kater's pendulums and measuring the value of g.	
CO2.	**Understanding** of Kinematics of oscillating and bending bodies	
CO3.	**Understanding** and measuring the random errors in experiments.	
CO4.	**Applying** time period concepts to determine the acceleration due to gravity, moment of inertia & young modulus using bar, kater's pendulum, mass spring system, fly wheel & cantilever.	
CO5.	**Applying** Poiseuille's equation to determine coefficient of viscosity & sextant to determine the height of building.	
CO6.	**Analyzing** the mechanical processes in performing the experiments.	
Experiments:	**Note: Minimum 10 experiments should be performed:**	
Experiment-1:	Measurements of length (or diameter) using vernier caliper, screw gauge and travelling microscope.	
Experiment-2:	To study the random error in observations.	
Experiment-3:	To determine the height of a building using a Sextant.	
Experiment-4:	To study the Motion of Spring and calculate (a) Spring constant, (b) **g** and (c) Modulus of rigidity.	
Experiment-5:	To determine the Moment of Inertia of a Flywheel.	
Experiment-6:	To determine **g** and velocity for a freely falling body using Digital Timing Technique	
Experiment-7:	To determine Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method).	
Experiment-8:	To determine the Young's Modulus of a Wire by Optical Lever Method.	
Experiment-9:	To determine the Modulus of Rigidity of a Wire by Maxwell's needle.	
Experiment-10:	To determine the elastic Constants of a wire by Searle's method.	
Experiment-11:	To determine the value of g using Bar Pendulum.	
Experiment-12:	To determine the value of g using Kater's Pendulum.	
Experiment-13:	To determine Modulus of Rigidity by using Torsion pendulum.	
Experiment-14:	To determine Young's Modulus in case of Cantilever using Pin and Microscope.	
Experiment-15:	To determine the frequency of A.C. mains by means of a sonometer.	

Evaluation Scheme of Practical Examination:

Internal Evaluation (50 marks)

Each experiment would be evaluated by the faculty concerned on the date of the experiment on a 4-point scale which would include the practical conducted by the students and a Viva taken by the faculty concerned. The marks shall be entered on the index sheet of the practical file.

Evaluation scheme:

PRACTICAL PERFORMANCE & VIVA DURING THE SEMESTER (35 MARKS)				ON THE DAY OF EXAM (15 MARKS)		TOTAL INTERNAL (50 MARKS)
EXPERIMENT (5 MARKS)	FILE WORK (10 MARKS)	VIVA (10 MARKS)	ATTENDANCE (10 MARKS)	EXPERIMENT (5 MARKS)	VIVA (10 MARKS)	

External Evaluation (50 marks)

The external evaluation would also be done by the external Examiner based on the experiment conducted during the examination.

EXPERIMENT (20 MARKS)	FILE WORK (10 MARKS)	VIVA (20 MARKS)	TOTAL EXTERNAL (50 MARKS)

Course Code: BAS173	**Generic Elective Course- I (Lab)** **B.Sc. (H) Chemistry- Semester-I** **Calculus (LAB)**	**L-0** **T-0** **P-4** **C-2**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	**Understanding** the different coordinate systems of reference by plotting curves in a plane using its mathematical properties.	
CO2.	**Understanding** the graphs of polynomial in Physical Sciences.	
CO3.	**Understanding** the Matrix operations for quantum applications.	
CO4.	**Analyzing** complex numbers and their representations.	
CO5.	**Analyzing** the area of surfaces of revolution and the volume of solids by integrating over cross-sectional areas.	
Experiments:	**Note: All experiments should be performed:**	
Experiment-1:	Plotting the graphs of the following functions: ax, $[x]$ (greatest integer function), $\sqrt{ax+b}$, $\lvert ax+b\rvert$, $c \pm \lvert ax+b\rvert$, $x^{\pm n}$, $x^{1/n}$ $(n \in \mathbb{Z})$, $\lvert x\rvert/x$, $\sin(1/x)$, $x\sin(1/x)$, and , $e^{\pm 1/x}$, for $x \neq 0$. e^{ax+b}, $\log(ax+b)$, $1/(ax+b)$, $\sin(ax+b)$, $\cos(ax+b)$, $\lvert\sin(ax+b)\rvert$, $\lvert\cos(ax+b)\rvert$. Observe and discuss the effect of changes in the real constants a, b and c on the graphs.	
Experiment-2:	Plotting the graphs of polynomial of degree 4 and 5, the derivative graph, the second derivative graph and comparing them.	
Experiment-3:	Sketching parametric curves.	
Experiment-4:	Tracing of conics in Cartesian coordinates.	
Experiment-5:	Obtaining surface of revolution of curves.	
Experiment-6:	Sketching ellipsoid, hyperboloid of one and two sheets, elliptic cone, elliptic paraboloid, hyperbolic paraboloid using Cartesian co-ordinates.	
Experiment-7:	To find numbers between two real numbers and plotting of finite and infinite subset of R.	
Experiment-8:	Matrix operations (addition, multiplication, inverse, transpose, determinant, rank, eigenvectors, eigenvalues, Characteristic equation and verification of Cayley Hamilton equation, system of linear equations	
Experiment-9:	Graph of Hyperbolic functions.	
Experiment-10:	Computation of limit, differentiation and integration of vector functions.	
Experiment-11:	Complex numbers and their representations, operations like addition, multiplication, division, modulus. Graphical representation of polar form.	
Text Books:	M. J. Strauss, G. L. Bradley and K. J. Smith, Calculus (3rd Edition), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi, 2007	
Reference Books:	2. H. Anton, I. Bivens and S. Davis, Calculus (7th Edition), John Wiley and sons (Asia), Pt Ltd., Singapore, 2002. 3. http://www.math.utah.edu/online/1220/notes/ch11.pdf *** Latest editions of all the suggested books are recommended**	

Evaluation Scheme of Practical Examination:

Internal Evaluation (50 marks)

Each experiment would be evaluated by the faculty concerned on the date of the experiment on a 4-point scale which would include the practical conducted by the students and a Viva taken by the faculty concerned. The marks shall be entered on the index sheet of the practical file.

Evaluation scheme:

PRACTICAL PERFORMANCE & VIVA DURING THE SEMESTER (35 MARKS)				ON THE DAY OF EXAM (15 MARKS)		TOTAL INTERNAL (50 MARKS)
EXPERIMENT (5 MARKS)	FILE WORK (10 MARKS)	VIVA (10 MARKS)	ATTENDANCE (10 MARKS)	EXPERIMENT (5 MARKS)	VIVA (10 MARKS)	

External Evaluation (50 marks)

The external evaluation would also be done by the external Examiner based on the experiment conducted during the examination.

EXPERIMENT (20 MARKS)	FILE WORK (10 MARKS)	VIVA (20 MARKS)	TOTAL EXTERNAL (50 MARKS)

Course Code: BAS167	B.Sc (H) Chemistry (Semester-I) Computer Skills for Chemist (Lab)	L-0 T-0 P-2 C-1
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Describe the usage of computers and why computers are essential components in business and society.	
CO2.	Utilize the Internet Web resources and evaluate on-line e-business system	
CO3.	Solve common business problems using appropriate Information Technology applications and systems.	
CO4.	Identify categories of programs, system software and applications. Organize and work with files and folders.	
CO5.	Describe various types of networks network standards and communication software.	
Course Content:		

Module 1:

Introduction to computers hardware and software components; Operating System; Usage of Internet and Intranet; protocols and their importance; networking; Internet Browsing: Net Surfing, Search Engine, Email.

Module 2:

Introduction to MS office: Word, Power point, Excel, Short cut Keys, Mail Merge, Watermarking, Animation in presentation.

Module 1 & 2 are prerequisite for experiment hence needs to be explained before commencement of experiments.

LIST OF EXPERIMENTS:

1. Fundamentals of computer system, with its functional components.
2. Create a formatted WORD document.
3. Create a WORD document using different fonts.
4. Create a table & perform operations in it.
5. Create a WORD document, using the functions page set up, & page preview, and then print that document.
6. Implement Mail Merge.
7. Collect the information of any company & perform the below operation in it:

(a) Insert the data into Row/Column of Excel, worksheet

(b) Create a worksheet in Excel, perform alignment, text wrapping & sort the data.

8. Collect the information of any company & perform the below operation in it:

(a) Generate the graph in Excel.

(b) Create a Hyperlink to a word document.

(c) Create a worksheet using the functions- page set up, print preview & then print the worksheet.

9. Create, save & print the power point presentation

10. Create a power point presentation using clipart, Word art gallery & then add transition & Animation effects.

Evaluation Scheme of Practical Examination:

Internal Evaluation (50 marks)
Each experiment would be evaluated by the faculty concerned on the date of the experiment on a 4-point scale which would include the practical conducted by the students and a Viva taken by the faculty concerned. The marks shall be entered on the index sheet of the practical file.

Evaluation scheme:

PRACTICAL PERFORMANCE & VIVA DURING THE SEMESTER (35 MARKS)				ON THE DAY OF EXAM (15 MARKS)		TOTAL INTERNAL (50 MARKS)
EXPERIMENT (5 MARKS)	FILE WORK (10 MARKS)	VIVA (10 MARKS)	ATTENDANCE (10 MARKS)	EXPERIMENT (5 MARKS)	VIVA (10 MARKS)	

External Evaluation (50 marks)
The external evaluation would also be done by the external Examiner based on the experiment conducted during the examination.

EXPERIMENT (20 MARKS)	FILE WORK (10 MARKS)	VIVA (20 MARKS)	TOTAL EXTERNAL (50 MARKS)

Course Code: BAS164	B.Sc (H) Chemistry (Semester-I) Inorganic Chemistry-I (Lab)	L-0 T-0 P-4 C-2
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Remembering & understanding the concept of Normality & Molarity.	
CO2.	Estimation of carbonates, bicarbonates & hydroxides by acids base titrations.	
CO3.	Estimation of free alkalies presents in soaps & detergent by acids base titrations.	
CO4.	Estimation of strength of Fe(II) in the given sample by by Oxidation-Reduction Titrimetric.	
CO5.	Estimation of oxalic acid and sodium oxalate in given mixture by Oxidation-Reduction Titrimetric.	
Course Content:		

(A) Titrimetric Analysis

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

(B) Acid-Base Titrations

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

(c) Oxidation-Reduction Titrimetry

6. Estimation of Fe(II) and oxalic acid using standardized KMnO4 solution.
7. Estimation of oxalic acid and sodium oxalate in a given mixture.
8. Estimation of Fe(II) with $K_2Cr_2O_7$ using internal (diphenylamine, anthranilic acid) and external indicator.

Evaluation Scheme of Practical Examination:
Internal Evaluation (50 marks)
Each experiment would be evaluated by the faculty concerned on the date of the experiment on a 4-point scale which would include the practical conducted by the students and a Viva taken by the faculty concerned. The marks shall be entered on the index sheet of the practical file.

Evaluation scheme:

PRACTICAL PERFORMANCE & VIVA DURING THE SEMESTER (35 MARKS)				ON THE DAY OF EXAM (15 MARKS)		TOTAL INTERNAL (50 MARKS)
EXPERIMENT (5 MARKS)	FILE WORK (10 MARKS)	VIVA (10 MARKS)	ATTENDANCE (10 MARKS)	EXPERIMENT (5 MARKS)	VIVA (10 MARKS)	

External Evaluation (50 marks)

EXPERIMENT (20 MARKS)	FILE WORK (10 MARKS)	VIVA (20 MARKS)	TOTAL EXTERNAL (50 MARKS)

The external evaluation would also be done by the external Examiner based on the experiment conducted during the examination.

Course Code: BAS165	B.Sc (H) Chemistry (Semester-I) Physical Chemistry-I (Lab)	L-0 T-0 P-4 C-2
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Determining the surface tension of aqueous solution by using stalagmometer.	
CO2.	Determining the surface tension of aqueous solution by using Ostwald's viscometer.	
CO3.	Analyzing the effect on change in pH by addition of acid/ base.	
CO4.	Preparing the buffer solution of different pH range.	
CO5.	Determining the strength of an acid using pH meter.	
Course Content:		

(A) Surface tension measurements.

1. Determine the surface tension by (i) drop number (ii) drop weight method.

(B) Viscosity measurement using Ostwald's viscometer.

2. Determination of viscosity of aqueous solutions of (i) ethanol and (ii) sugar at room temperature.

3. Study the variation of viscosity of sucrose solution with the concentration of solute.

(C) pH metry

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

5. Preparation of buffer solutions of different pH
- Sodium acetate-acetic acid
- Ammonium chloride-ammonium hydroxide

6. pH metric titration of
- strong acid vs. strong base,
- weak acid vs. strong base.

Text &Reference Books:

1. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi.

2. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. Experiments in Physical Chemistry; McGraw-Hill: New York.

3. Halpern, A. M. & McBane, G. C. Experimental Physical Chemistry; W.H. Freeman & Co.: New York.

*** Latest editions of all the suggested books are recommended**

Evaluation Scheme of Practical Examination:

Internal Evaluation (50 marks)

Each experiment would be evaluated by the faculty concerned on the date of the experiment on a 4-point scale which would include the practical conducted by the students and a Viva taken by the faculty concerned. The marks shall be entered on the index sheet of the practical file.

Evaluation scheme:

PRACTICAL PERFORMANCE & VIVA DURING THE SEMESTER (35 MARKS)				ON THE DAY OF EXAM (15 MARKS)		TOTAL INTERNAL (50 MARKS)
EXPERIMENT (5 MARKS)	FILE WORK (10 MARKS)	VIVA (10 MARKS)	ATTENDANCE (10 MARKS)	EXPERIMENT (5 MARKS)	VIVA (10 MARKS)	

External Evaluation (50 marks)

EXPERIMENT (20 MARKS)	FILE WORK (10 MARKS)	VIVA (20 MARKS)	TOTAL EXTERNAL (50 MARKS)

The external evaluation would also be done by the external Examiner based on the experiment conducted during the examination.

Course Code: BGP111	B.Sc.(H) Chemistry- Semester-I **Discipline & General Proficiency**	L-0 T-0 P-0 C-0

There shall be continuous evaluation of the student on the following broad parameters:

1. Observance of dress code.

2. Participation in Conferences /Workshops / Seminars.

3. Attendance in guest lectures, invited talks and special technical sessions organized from time to time.

4. Participation in community projects including NSS.

5. Exhibiting team spirit in different Culture & extra curriculum activities, Department Club activities of the University and College organized from time to time.

6. Observance of rule & regulations in the College/University, Behavior in Campus Premises, Bus, hostel mess and hostel.

7. Performance and awards received in different events (sports/ co-curricular activities) organized at College / University and other level.

8. General behavior

9. Any extraordinary achievement.

The above is an indicative list of parameters on which the students shall be continuously evaluated. The college may evaluate the student on the specific parameters by informing them through a notice displayed on the notice board before evaluation. There shall be no external examination for this course; however, the marks shall be included for calculation of cumulative Performance Index (CPI).

Head of Department would be display GP marks on notice board in prescribed format after IInd & IIIrd CT in semester:

S No		Enroll No.	Student Name	Dress code	Participation in Conferences /Workshops / Seminars	Participation in guest lectures, invited talks and special technical sessions	Participation in community Services	Participation in Culture & extra curriculum activities, Department Club Activities	Participation in sports/ co-curricular activities	General Behavior	Any Extra Achievement
				(5)	**(15)**	**(20)**	**(10)**	**(20)**	**(20)**	**(5)**	**(5)**
	Responsible for marks			Mentor	Head	Head	Mentor	Cultural Events Coordinator & Department Club Coordinator	Sports Coordinator	Mentor	Director or Principal

Course Code: TMUGA-101	Value Added Course B.Sc (H) Chemistry- Semester-I **Foundation in Quantitative Aptitude**	L-2 T-1 P-0 C-0
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Solving complex problems using Criss cross method, base method and square techniques.	
CO2.	Applying the arithmetical concepts of Average, Mixture and Allegation.	
CO3.	Evaluating the different possibilities of various reasoning based problems in series, Blood relation and Direction.	
CO4.	Operationalizing the inter-related concept of Percentage in Profit Loss and Discount, Si/CI and Mixture/Allegation.	
Course Content:		
Unit-1:	**Speed calculations** Squares till 1000,square root, multiplications: base 100, 200 300 etc., 11-19, crisscross method for 2X2, 3X3, 4X4, 2X3, 2X4 etc., cubes, cube root	**3 Hours**
Unit-2:	**Percentages** Basic calculation, ratio equivalent, base, change of base, multiplying factor, percentage change, increment, decrement, successive percentages, word problems	**5 Hours**
Unit-3:	**Profit Loss Discount** Basic definition, formula, concept of mark up, discount, relation with successive change, faulty weights	**5 Hours**
Unit-4:	**SI and CI** Simple Interest, finding time and rate, Compound Interest, difference between SI and CI, Installments	**4 Hours**
Unit-5:	**Averages** Basic Averages, Concept of Distribution, Weighted Average, equations	**3 Hours**
Unit-6:	**Mixtures and allegations** Mixtures of 2 components, mixtures of 3 components, Replacements	**5 Hours**
Unit-7:	**Blood relations** Indicating type, operator type, family tree type	**3 Hours**
Unit-8:	**Direction sense** Simple statements, shadow type	**2 Hours**
Reference Books:	• R1:-Arun Shrama:- How to Prepare for Quantitative Aptitude • R2:-Quantitative Aptitude by R.S. Agrawal • R3:-M Tyra: Quicker Maths • R4:-Nishith K Sinha:- Quantitative Aptitude for CAT • R5:-Reference website:- Lofoya.com, gmatclub.com, cracku.in, handakafunda.com, tathagat.mba, Indiabix.com • R6:-Logical Reasoning by Nishith K Sinha • R7:-Verbal and Non Verbal Reasoning by R.S. Agrawal *** Latest editions of all the suggested books are recommended.**	

Course	B.Sc (H) Chemistry (Semester-II)	L-4

Code: BAS 211	Organic Chemistry-I	T-0 P-0 C-4
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Understanding basic concepts of organic Chemistry regarding nomenclature hybridization electronic displacements, electrophilic and Nucleophilic reagents & type of organic reactions.	
CO2.	Understanding & remembering the chemistry of alkanes, alkenes, alkynes, aromatic electrophilic substitution along with directive influence of groups.	
CO3.	Understanding the electronic displacement concept, relative strength of acid and base relative stability, elimination v/s substitution known mechanism of various organic reactions.	
CO4.	Analyzing the concept of stereochemistry, relative and absolute control of organic molecules can be known.	
CO5.	Applying the concept of stereochemistry in relative and absolute control of organic molecules can be known.	
Course Content:		
Unit-1:	**Basics of Organic Chemistry I:** Organic Compounds: Classification, and Nomenclature, Hybridization, Shapes of molecules, Influence of hybridization on bond properties. Electronic Displacements: Inductive, electrometric, resonance and mesmeric effects, hyperconjugation and their applications; Dipole moment; Organic acids and bases; their relative strength.	**8 Hours**
Unit-2:	**Basics of Organic Chemistry II:** Hemolytic and Heterolytic fission. Curly arrow rules, formal charges; Electrophiles and Nucleophiles; Nucleophilicity and basicity; Types, shape and their relative stability of Carbocations, Carbanions, Free radicals and Carbenes. Introduction to types of organic reactions and their mechanism: Addition, Elimination and Substitution reactions. Chemistry of alkanes: Formation of alkanes, Wurtz Reaction, Wurtz-Fittig Reactions, Free radical substitutions: Halogenation -relative reactivity and selectivity.	**8 Hours**
Unit-3:	**Chemistry of Carbon-Carbon pi bonds:** Formation of alkenes and alkynes by elimination reactions, Mechanism of E1, E2, E1cb reactions. Saytzeff and Hofmann eliminations. Reactions of alkenes: Electrophilic additions their mechanisms (Markownikoff/ Anti-Markownikoff addition), hydroboration-oxidation, ozonolysis, reduction (catalytic and chemical). 1,2-and 1,4-addition	**8 Hours**

	reactions in conjugated dienes and, Diels-Alder reaction; Allylic brominating and mechanism, e.g. propene, 1-butene. Reactions of alkynes: Acidity, Electrophilic and Nucleophilic additions. Hydration to form carbonyl compounds, Alkylation of terminal alkynes.	
Unit-4:	**Stereochemistry:** Fischer Projection, Newman and Sawhorse Projection formulae and their interconversions; Geometrical isomerism: cis–trans and, syn-anti isomerism E/Z notations with C.I.P rules. Optical Isomerism: Optical Activity, Specific Rotation, Chirality/Asymmetry, Enantiomers, Molecules with two or more chiral-centers, Di-stereoisomers, meso structures, Racemic mixture and resolution. Relative and absolute configuration: D/L and R/S designations.	**8 Hours**
Unit-5:	**Aromaticity:** Hückel'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.	**8 Hours**
Text Book:	**1.** Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).	
Reference Books:	**1.** Finar, I. L. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education). **2.** Finar, I. L. Organic Chemistry (Stereochemistry and the Chemistry of Natural Products), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education). **3.** Kalsi, P. S. Stereochemistry Conformation and Mechanism, New Age International. **4.** McMurry, J.E. Fundamentals of Organic Chemistry, Cengage Learning India Edition. **5.** https://www.masterorganicchemistry.com/2020/02/11/e1cb-elimination-unimolecular-conjugate-base/ *** Latest editions of all the suggested books are recommended.**	

Course Code: BAS212	**B.Sc (H) Chemistry (Semester-II)**	**L-4 T-0 P-0**

	Physical Chemistry-II	C-4
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Understanding the concept of heat, work, internal energy.	
CO2.	Understanding the entropic changes for reversible & irreversible process.	
CO3.	To understand & apply Gibb's & Helmholtz equations & its impact on temperature, volume & pressure.	
CO4.	Understanding the physical & chemical equilibria & application of Le Chatelier principles.	
CO5.	Determining the molecular masses of ionic & organic compounds by using colligative properties.	
Course Content:		
Unit-1:	**Chemical Thermodynamics-I:** 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.	**8 Hours**
Unit-2:	**Chemical Thermodynamics-II:** Second Law: Concept of entropy; thermodynamic scale of temperature, statement of the second law of thermodynamics; Calculation of entropy change for reversible and irreversible processes. 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. Third Law: Statement of third law, concept of residual entropy, calculation of absolute entropy of molecules	**8 Hours**
Unit-3:	**Thermochemistry and Systems of Variable Composition:** 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, effect of temperature (Kirchhoff's equations) and pressure on enthalpy of reactions. Partial molar quantities, Gibbs-Duhem equation, chemical potential of ideal mixtures, change in thermodynamic functions in mixing of ideal gases.	**8 Hours**
Unit-4:	**Chemical Equilibrium:** Criteria of thermodynamic equilibrium, chemical equilibria in ideal gases. Thermodynamic derivation of relation between Gibbs free energy of reaction and reaction quotient. Equilibrium constants and their quantitative dependence on temperature, pressure and concentration.	**8 Hours**

	Free energy of mixing and spontaneity; thermodynamic derivation of relations between the various equilibrium constants Kp, Kc and Kx. Le Chatelier principle	
Unit-5:	**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].	**8 Hours**
Text Books:	1. Atkins, P. W. & Paula, J. de Atkin's Physical Chemistry, Oxford university Press.	
Reference Books:	**1.** Castellan, G. W. Physical Chemistry, Narosa. **2.** McQuarrie, D. A. & Simon, J. D. Molecular Thermodynamics Viva Books Pvt. Ltd.: New Delhi. **3.** Levine, I.N. Physical Chemistry 6th Ed., Tata Mc Graw Hill. **4.** Metz, C.R. 2000 solved problems in chemistry, Schaum Series **5.** https://www.grc.nasa.gov/www/k-12/airplane/thermo2.html *** Latest editions of all the suggested books are recommended.**	

Course Code: TMUGE201	**B.Sc.(H) Chemistry- Semester-II** **English Communication – II**	**L-2** **T-0** **P-2** **C-3**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	**Remembering & understanding** the basics of English Grammar and Vocabulary.	
CO2.	**Understanding** the basics of Listening, Speaking & Writing Skills.	
CO3.	**Understanding** principles of letter drafting and various types of formats.	
CO4.	**Applying** correct vocabulary and grammar in sentence construction while writing and delivering presentations.	
CO5.	**Analyzing** different types of listening, role of Audience & Locale in presentation.	
CO6.	**Drafting** Official Letters, E-Mail & Paragraphs in correct format.	
Course Content:		
Unit-1:	**Functional Grammar** • Prefix, suffix and One words substitution • Modals • Concord	**10 Hours**
Unit-2:	**Listening Skills** • Difference between listening & hearing, Process and Types of Listening • Importance and Barriers to listening	**04Hours**
Unit-3:	**Writing Skills** • Official letter and email writing • Essentials of a paragraph, • Developing a paragraph: Structure and methods Paragraph writing (100-120 words)	**12 Hours**
Unit-4:	**Strategies & Structure of Oral Presentation** • Purpose, Organizing content, Audience & Locale, Audio-visual aids, Body language. • Voice dynamics: Five P's - Pace, Power, Pronunciation, Pause, and Pitch. • Modes of speech delivery and 5 W's of presentation	**8 Hours**
Unit-5:	**Value based text reading:** Short Essay (Non- detailed study) How should one Read a book? - Virginia Woolf	**6 Hours**
Text Books:	**1.** Singh R.P., An Anthology of English Essay, O.U.P. New Delhi	
Reference Books:	**1.** Nesfield J.C. "*English Grammar Composition & Usage*" Macmillan Publishers **2.** Sood Madan "*The Business letters"* Goodwill Publishing House, New Delhi **3.** Kumar Sanjay & Pushplata "*Communication Skills*" Oxford University Press, New Delhi. ***Latest editions of all the suggested books are recommended.**	

Additional Electronics Reference Material	**1.** https://www.youtube.com/watch?v=A0uekze2GOU **2.** https://www.youtube.com/watch?v=JIKU_WT0Bls **3.** https://www.youtube.com/watch?v=3Tu1jN65slw **4.** https://youtu.be/sb6ZZ2p3hEM **5.** https://youtu.be/yY6-cgShhac **6.** https://youtu.be/cc4yXwOQsBk **7.** https://youtu.be/yY6-cgShhac **8.** https://youtu.be/84qoeCofXXQ **9.** https://www.youtube.com/watch?v=-9MXmxLisI8&t=28s	
Methodologies:	**1.** Words and exercises, usage in sentences. **2.** Language Lab software. **3.** Sentence construction on daily activities and conversations. **4.** Format and layout to be taught with the help of samples and preparing letters on different subjects. **5.** JAM sessions and Picture presentation. **6.** Tongue twisters, Newspaper reading and short movies. **7.** Modern Teaching tools (PPT Presentation, Tongue-Twisters & Motivational videos with sub-titles) will be utilized. **8.** Text reading: discussion in detail, critical appreciation by reading the text to develop students' reading habits with voice modulation.	

Evaluation Scheme

<table>
<tr><th colspan="3">Internal Evaluation</th><th colspan="2">External Evaluation</th><th>Total Marks</th></tr>
<tr><td colspan="3">40 Marks</td><td colspan="2">60 Marks</td><td rowspan="4">100</td></tr>
<tr><td>20 Marks (Best 2 out of Three</td><td>10 Marks (Oral</td><td rowspan="3">10 Marks (Attendance)</td><td>40 Marks (External Written</td><td>20 Marks</td></tr>
<tr><td>CTs)</td><td>Assignments)</td><td>Examination)</td><td>(External Viva)*</td></tr>
<tr><td>(From Unit-I, III & V)</td><td>(From Unit-II &IV)</td><td>(From Unit-1, III & V)</td><td>(From Unit- II & IV)</td></tr>
</table>

*Parameters of External Viva

Content	Body Language	Communication skills	Confidence	TOTAL
05 Marks	05 Marks	05 Marks	05 Marks	20 Marks

***Note**: External Viva will be conducted by 2-member committee comprising*

***a)** One Faculty teaching the class*

***b)** One examiner nominated by University Examination cell.*

Each member will evaluate on a scale of 20 marks and the average of two would be the 20 marks obtained by the students.

Course Code: BAS220	**Generic Elective Course-II** **B.Sc. (H) Chemistry- Semester-II** **Waves & optics**	**L-4** **T-0** **P-0** **C-4**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	**Remembering t**he concepts of optical phenomena like reflection, refraction, interference, diffraction & waves.	
CO2.	**Understanding** the principles of divisions of waves.	
CO3.	**Applying** the Fermat's principle to understand the optical phenomena.	
CO4.	**Applying** the concept of superposition of waves to draw the Lissajous Figures.	
CO5.	**Applying** the concept of diffraction phenomenon or using to single and multi-slit to find out the dispersive and resolving power of different optical devices like telescope, microscope and gratings.	
CO6.	**Applying** the concept of interference and diffraction phenomenon to Construct and reconstruct the holograms using two plane waves as well as zone plates.	
Course Content:		
Unit-1:	**Geometrical optics:** Fermat's principle, reflection and refraction at plane interface, Application to thick lenses, Ramsden and Huygens eyepiece. **Wave Motion:** Plane and Spherical Waves. Longitudinal and Transverse Waves, Plane Progressive (Travelling) Waves. Wave Equation. Particle and Wave Velocities, Differential Equation, Pressure of a Longitudinal Wave, Energy Transport, Intensity of Wave.	**8 Hours**
Unit-2:	**Superposition of two perpendicular Harmonic Oscillations**: Graphical and Analytical methods, Lissajous Figures (1:1 and 1:2) and their uses, Superposition of N harmonic waves, **Interference:** Division of amplitude and wave front, Young's double slit experiment, Fresnel's Biprism, Interference in Thin Films: parallel and wedge-shaped films. Newton's Rings: Measurement of wavelength and refractive index.	**8 Hours**
Unit-3:	**Wave Optics:** Electromagnetic nature of light, Definition and properties of wave front, Huygens's Principle, Temporal and Spatial Coherence. **Interferometer**: Michelson Interferometer-(1) Idea of form of fringes (No theory required), (2) Determination of Wavelength, (3) Wavelength Difference, (4) Refractive Index, and (5) Visibility of Fringes. Fabry-Perot interferometer.	**8Hours**
Unit-4:	**Fraunhofer diffraction**: Single slit, double slit & nth slits, Diffraction grating. Resolving Power of a telescope Resolving power of grating. **Holography**: Principle of Holography. Recording and Reconstruction Method, Theory of Holography as Interference between two Plane Waves.	**8 Hours**

Unit-5:	**Fresnel Diffraction**: Fresnel's Assumptions. Fresnel's Half-Period Zones for Plane Wave, Explanation of Rectilinear Propagation of Light. Theory of a Zone Plate: Multiple Foci of a Zone Plate. Fresnel's Integral, Fresnel diffraction pattern of a straight edge.	**8 Hours**
Text Books:	1. Waves: Berkeley Physics Course, Francis Crawford, Tata McGraw-Hill. 2. Fundamentals of Optics, F.A. Jenkins and H.E. White, McGraw-Hill.	
Reference Books:	1. Principles of Optics, Max Born and Emil Wolf, Pergamon Press. Optics, Ajoy Ghatak, Tata McGraw Hill. 2. Fundamental of Optics, A. Kumar, H.R. Gulati and D.R. Khanna, 2011, R. Chand Publications. https://www.renishaw.com/en/interferometry-explained--7854 *** Latest editions of all the suggested books are recommended.**	

Course Code: **BAS231**	**Generic Elective Course-II** **B.Sc.(H) Chemistry- Semester-II** **Discrete Mathematics**	**L-4** **T-0** **P-0** **C-4**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	**Understanding** basic concept of sets, relation, algebraic structure, Logic gates like countable set, equivalence relation, group, k-maps.	
CO2.	**Understanding** the basic concept of truth table, recurrence relation like tautology contradiction.	
CO3.	**Applying** the concept of relation to find out the equivalence relation, one-one, onto & into.	
CO4.	**Applying** the concept of relation to find out the equivalence relation, one-one, onto & into.	
CO5.	**Applying** the concept of truth table to find out the tautology, contradiction & contingency.	
Course Content:		
Unit-1:	Definition of set, countable and uncountable sets, Venn diagrams, proof of some general identity of sets, relation, types of relation, composition of relation, pictorial representation of relation, equivalence relation, function, types of function, one to one, into and onto function, inverse function, composition of function, mathematical induction (simple and strong).	**8 Hours**
Unit-2:	Introduction to algebraic structure, properties, semi-grouped, monoid, groups, abelian groups, properties of groups, subgroups, cyclic groups.	**8 Hours**
Unit-3:	Posets, hass diagram of posets, isomorphism of ordered sets, well ordered sets, Boolean algebra, SOP and POS form, logic gates, K-maps.	**8 Hours**
Unit-4:	Propositional logic, basic logic operator, truth tables, tautology, contradiction, algebra of proposition, logical implications, logical equivalence, predicates.	**8 Hours**
Unit-5:	Recurrence relations, generating function, graph definition, types of graphs, representation of graphs, isomorphism and homomorphism of graphs.	**8 Hours**
Text Books:	**1.** Discrete mathematics by Vinaya Rawol and bhakti Raul, Techmax publications. **2.** Discrete mathematics and its applications by Kenneth H Rosen.	
Reference Books:	**1.** Piskunov N, Differential & Integral Calculus, Moscow Peace Publishers. https://www.geeksforgeeks.org/proposition-logic/ ***Latest editions of all the suggested books are recommended.**	

Course Code: BAS266	**Generic Elective Course-II (Lab)** **B.Sc. (H) Chemistry- Semester-II** **Waves & Optics (Lab)**	**L-0** **T-0** **P-4** **C-2**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	**Remembering t**he concepts of optical properties and character of lights.	
CO2.	**Understanding** the concepts to measure the focal lengths of concave, convex lenses and mirrors.	
CO3.	**Applying** the concepts of Schuster's method for optical adjustment of spectrometer.	
CO4.	**Analyzing** the diffraction and interference patterns obtained from different optical instruments.	
CO5.	**Analyzing** the dispersive power to verify the prism materials.	
Experiments:	**Note: Minimum ten experiments should be performed:**	
Experiment-1:	To determine the frequency of an electric tuning fork by Melde's experiment and verify λ^2 –T law.	
Experiment-2:	To investigate the motion of coupled oscillators.	
Experiment-3:	To study Lissajous Figures.	
Experiment-4:	Familiarization with: Schuster`s focusing; determination of angle of prism.	
Experiment-5:	To determine refractive index of the Material of a prism using sodium source.	
Experiment-6:	To determine the dispersive power and Cauchy constants of the material of a prism using mercury source.	
Experiment-7:	To determine the wavelength of sodium source using Michelson's interferometer.	
Experiment-8:	To determine wavelength of sodium light using Fresnel Bi-prism.	
Experiment-9:	To determine wavelength of sodium light using Newton's Rings	
Experiment-10:	To determine the thickness of a thin paper by measuring the width of the interference fringes produced by a wedge-shaped Film.	
Experiment-11:	To determine wavelength of (1) Na source or (2) spectral lines of Hg source using plane diffraction grating	
Experiment-12:	To determine dispersive power and resolving power of a plane diffraction grating.	
Experiment-13:	To find the equivalent focal length of a lens system by nodal slide assembly.	
Experiment-14:	To determine ordinary and extra ordinary refractive indices for calcite or quartz crystal.	
Experiment-15:	To determine Resolving power of a telescope.	

Experiment-16:	To determine the focal length of a convex and concave lens.	
Experiment-17:	To determine the focal length of a convex and concave mirror.	
Reference Books	**1.** Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, Asia Publishing House. **2.** B.Sc. Practical Physics, H. Singh & P.S. Hemne, S. Chand Publishing. **3.** B.Sc. Practical Physics, C. L. Arora, S. Chand Publishing. **4.** A Laboratory Manual of Physics for undergraduate classes, D.P. Khandelwal, Vani Pub. **5.** https://www.physics.brocku.ca/Courses/2P20/lab-manual/CoupledOscillators/CoupledOscillators.pdf ***Latest editions of all the suggested books are recommended.**	

Evaluation Scheme of Practical Examination:

Internal Evaluation (50 marks)

Each experiment would be evaluated by the faculty concerned on the date of the experiment on a 4-point scale which would include the practical conducted by the students and a Viva taken by the faculty concerned. The marks shall be entered on the index sheet of the practical file.

Evaluation scheme:

PRACTICAL PERFORMANCE & VIVA DURING THE SEMESTER (35 MARKS)				ON THE DAY OF EXAM (15 MARKS)		TOTAL INTERNAL (50 MARKS)
EXPERIMENT (5 MARKS)	FILE WORK (10 MARKS)	VIVA (10 MARKS)	ATTENDANCE (10 MARKS)	EXPERIMENT (5 MARKS)	VIVA (10 MARKS)	

External Evaluation (50 marks)

The external evaluation would also be done by the external Examiner based on the experiment conducted during the examination.

EXPERIMENT (20 MARKS)	FILE WORK (10 MARKS)	VIVA (20 MARKS)	TOTAL EXTERNAL (50 MARKS)

Course Code: BAS271	Generic Elective Course-II (Lab) B.Sc.(H) Chemistry- Semester-II **Introduction to MATLAB**	L-0 T-0 P-4 C-2
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	**Understanding** simple program modules to implement single numerical methods and algorithms.	
CO2.	**Applying** to use basic flow controls (if-else, for, while).	
CO3.	**Applying** Test program output for accuracy using hand calculations and debugging techniques	
CO4.	**Applying** multiple program modules into larger program packages	
CO5.	**Analyzing** the generate plots and export this for use in reports and presentations.	
Course Content:		
Unit-1:	MATLAB Software Working Environment: MATLAB Initializing & Ending, Quick Access Tool Bar, Command Window, Command History, Workspace Browser, Current folder window, Editor Window, Help Browser, Figure Window, Simulink Window, Creating Command Shortcuts, MATLAB Path Options MATLAB Programming, Debugging MATLAB codes.	**8 Hours**
Unit-2:	MATLAB Input Entry & Executing Commands & Methods: Input and Output, Symbolic Mathematics, Arithmetic, Algebra, Symbolic Expressions, Variable Precision and Exact Arithmetic, Errors in Input, Variables and Assignments, Predefined Variables, Operators & Special Characters, Control Structures, Input & Output Commands. Matrices: Arrays, Matrix representation, Matrix & Inverse of Matrix, Entry Retrieving, Matrix Division, Eigen values and vectors, Special matrices.	**8 Hours**
Unit-3:	Polynomials: Polynomial Overview, Representing Polynomials, Arithmetic operations on polynomials, Polynomial Roots, Polynomial coefficients, Polynomial Evaluation, Convolution and De-convolution. Solving Equations: Solution to first order differential Equations, Solving Second Order Differential Equations, Partial Fraction Expansion.	**8 Hours**
Unit-4:	MATLAB Graphics: 2-D Plot, Plotting Process, Creating a Graph, Exploring Data, Editing the Graph Components, Annotating Graphs, Printing and Exporting Graphs, Accessing Properties with the Property Inspector, Plotting Two Variables with Plotting Tools, Changing the Appearance of Lines and Markers, Placing Markers at Every Tenth Data Point, Adding More Data to the Graph, To add data using the Plot Browser, Changing the Type of Graph, Modifying the Graph Data Source, Providing New Values for the Data Source, Figure Windows, Clearing the Figure for a New Plot, Controlling the Axes, Setting Axis Limits, Setting the Axis Aspect Ratio - Setting Axis Visibility, Setting Grid Lines.	**8 Hours**
Unit-5:	Application Tools: Partial Differential Equation (PDE), Curve fitting	**8 Hours**

Text Books:	**1.** Amos Gilat, "MATLAB: An Introduction with Applications", Wilay Publication	
Reference Books:	**1.** J. Chakrabarty "Introduction to Matlab" Universities Press. **2.** R. Pratap, "Getting Started with MATLAB A Quick Introduction for Scientists and Engineers" Oxford University Press **3.** https://www.youtube.com/watch?v=9-cfacG8J3Y ***Latest editions of all the suggested books are recommended.**	

Experiments:

Experiments:	**Note: Minimum 15 experiments should be performed:**	
Experiment-1:	To find the Local Environment for MATLAB programming.	
Experiment-2:	Enter the m*n order matrix.	
Experiment-3:	Find the matrix transpose.	
Experiment-4:	Find the inverse of matrix.	
Experiment-5:	Find the addition, subtraction & multiplication of matrix.	
Experiment-6:	If V_1 = 5v, V_2 = 6v, Z_{11}=2, Z_{12}=1, Z_{21}=3 Z_{22}=4, get the value of I_1 and I_2?	
Experiment-7:	If A1 = [2 7 6 8 9 10] and B1 = [6 4 3 2 3 4], Find a) C1 = A1.*B1 b) D1 = A1./B1	
Experiment-8:	If r1 = [7 3 5] and s1 = [2 4 3], get a) q1 = r1.^s1 b) q2 = r1.^2	
Experiment-9:	State if the following statements are true or false, a) If a MATLAB statement ends with a semicolon (;) MATLAB evaluates the statement but suppresses the display of the results. b) The end of each row in entering a matrix, is indicated by a semicolon (;) c) MATLAB is case sensitive in naming variables only.	
Experiment-10:	Enter the following matrix, **A = 1 3 4 2** **2 0 1 6** **4 1 2 7** **0 3 6 4** a. Get the diagonal of the matrix A b. Get the sum of each column in the matrix A c. Get the sum of each row in the matrix A d. Get the sum of all elements in the matrix A e. Add 2 to the element in the 2nd row and 3rd column	
Experiment-11:	Enter the following complex number, z = 2-j3 then a. Get the real and the imaginary parts of z	

	b. Get the magnitude and the phase angle of z c. If y = 3+j5, calculate the following: y+z, y-z, y×z	
Experiment-12:	If w = [1+j 5-2*j; 3+2*j 4+3*j] a. Get the conjugate transpose b. Get the point transpose c. Type the elements of 2nd row only	
Experiment-13:	Reshape matrix.	
Experiment-14:	Eliminate Rows of matrix.	
Experiment-15:	Sorting a matrix	
Experiment-16:	Plot, xlabel, ylabel, title, and axis commands;	
Experiment-17:	Find difference between plot, semilogy, semilogx, logog commands	
Experiment-18:	Bar plot, Pie chart, 3D plots command	
Experiment-19:	Creating and performing symbolic computations.	

Evaluation Scheme of Practical Examination:

Internal Evaluation (50 marks)
Each experiment would be evaluated by the faculty concerned on the date of the experiment on a 4-point scale which would include the practical conducted by the students and a Viva taken by the faculty concerned. The marks shall be entered on the index sheet of the practical file.

Evaluation scheme:

PRACTICAL PERFORMANCE & VIVA DURING THE SEMESTER (35 MARKS)				ON THE DAY OF EXAM (15 MARKS)		TOTAL INTERNAL (50 MARKS)
EXPERIMENT (5 MARKS)	FILE WORK (10 MARKS)	VIVA (10 MARKS)	ATTENDANCE (10 MARKS)	EXPERIMENT (5 MARKS)	VIVA (10 MARKS)	

External Evaluation (50 marks)

The external evaluation would also be done by the external Examiner based on the experiment conducted during the examination.

EXPERIMENT (20 MARKS)	FILE WORK (10 MARKS)	VIVA (20 MARKS)	TOTAL EXTERNAL (50 MARKS)

Course Code: TMU201	B.Sc.(H) Chemistry- Semester-II **Environmental Studies**	L-2 T-1 P-0 C-3
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	**Understanding** environmental problems arising due to constructional and developmental activities.	
CO2.	**Understanding** the natural resources and suitable methods for conservation of resources for sustainable development.	
CO3.	**Understanding** the importance of ecosystem and biodiversity and its conservation for maintaining ecological balance.	
CO4.	**Understanding** the types and adverse effects of various environmental pollutants and their abatement devices.	
CO5.	**Understanding** Greenhouse effect, various Environmental laws, impact of human population explosion, environment protection movements, different disasters and their management.	
Course Content:		
Unit-1:	Definition and Scope of environmental studies, multidisciplinary nature of environmental studies, Concept of sustainability & sustainable development. **Ecology and Environment**: Concept of an Ecosystem-its structure and functions, Energy Flow in an Ecosystem, Food Chain, Food Web, Ecological Pyramid& Ecological succession, Study of following ecosystems: Forest Ecosystem, Grass land Ecosystem & Aquatic Ecosystem & Desert Ecosystem.	**8 Hours**
Unit-2:	**Natural Resources:** Renewable & Non-Renewable resources; Landre sources and landuse change; Land degradation, Soil erosion & desertification. **Deforestation**: Causes & impacts due to mining, Dam building on forest biodiversity & tribal population. **Energy Resources**: Renewable & Non-Renewable resources, Energy scenario & use of alternate energy sources, Case studies. **Biodiversity:** Hot SpotsofBiodiversityinIndiaandWorld,Conservation,ImportanceandFactorsResponsibleforLossofBiodiversity,BiogeographicalClassification of India	**8 Hours**
Unit-3:	**Environmental Pollutions:** Types, Causes, Effects & control; Air, Water, soil & noise pollution, Nuclear hazards & human health risks, Solid waste Management; Control measures of urban & industrial wastes, pollution case studies	**8 Hours**
Unit-4:	**Environmental policies & practices: Climate change & Global** Warming (Greenhouse Effect),Ozone Layer -Its Depletion and Control Measures, Photo chemical Smog, Acid Rain Environmental laws: Environment protection Act; air prevention & control of pollution act, Water Prevention & Control of Pollution Act, Wild Life Protection Act, Forest Conservation Acts, International Acts; Montreal & Kyoto Protocols & Convention on biological diversity, Nature reserves, tribal population & Rights & human wild life conflicts in Indian context	**8 Hours**

Unit-5:	Human population growth; impacts on environment, human health & welfare, Resettlement & rehabilitation of projects affected person: A case study, Disaster Management; Earthquake, Floods & Droughts, Cyclones & Landslides, Environmental Movements; Chipko, Silent Valley, Vishnoi's of Rajasthan, Environmental Ethics; Role of Indian & other regions & culture in environmental conservation, Environmental communication & public awareness; Case study	**8 Hours**
Field Work:	**1.** Visit to an area to document environmental assets; river/forest/flora-fauna etc. **2.** Visit to a local polluted site: urban/rural/industrial/agricultural. **3.** Study of common plants, insects, birds & basic principles of identification. **4.** Study of simple ecosystem; pond, river etc.	
Text Books:	**1.** "Environmental Chemistry", De, A. K., New Age Publishers Pvt. Ltd. **2.** "Introduction to Environmental Engineering and Science", Masters, G. M., Prentice Hall India Pvt. Ltd. **3.** "Fundamentals of Ecology", Odem, E. P., W. B. Sannders Co.	
Reference Books:	**1.** "Biodiversity and Conservation", Bryant, P. J., Hypertext Book **2.** "Textbook of Environment Studies", Tewari, Khulbe & Tewa I.K. Publication **3.** https://www.nationalgeographic.org/encyclopedia/biodiversit ***Latest editions of all the suggested books are recommended.**	

Course Code: BAS264	B.Sc (H) Chemistry (Semester-II) Organic Chemistry-I (Lab)	L-0 T-0 P-4 C-2
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Purification of organic compounds by crystallization.	
CO2.	Determination of the melting points of above compounds and unknown organic compounds	
CO3.	Understanding the effect of impurities on the melting point of organic compounds.	
CO4.	Separation of mixture of organic compounds by Thin Layer Chromatography (TLC).	
CO5.	Determination of purity of the organic compounds by mixed melting point & TLC.	
Course Content:		

List of Experiments:

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 (Electrically heated melting point apparatus)
4. Effect of impurities on the melting point – mixed melting point of two unknown organic compounds
5. Determination of Extra elements in the given organic compounds.
6. Chromatography
   a. Separation of a mixture of two ink mixture by paper chromatography
   b. Separation of a mixture of o-and p-nitrophenol or o-and p-aminophenol by thin layer chromatography (TLC)

Text & Reference Books:

1. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education.
2. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry, Pearson.

*** Latest editions of all the suggested books are recommended**

Evaluation Scheme of Practical Examination:
Internal Evaluation (50 marks)
Each experiment would be evaluated by the faculty concerned on the date of the experiment on a 4-point scale which would include the practical conducted by the students and a Viva taken by the faculty concerned. The marks shall be entered on the index sheet of the practical file.

Evaluation scheme:

PRACTICAL PERFORMANCE & VIVA DURING THE SEMESTER (35 MARKS)				ON THE DAY OF EXAM (15 MARKS)		TOTAL INTERNAL (50 MARKS)
EXPERIMENT (5 MARKS)	FILE WORK (10 MARKS)	VIVA (10 MARKS)	ATTENDANCE (10 MARKS)	EXPERIMENT (5 MARKS)	VIVA (10 MARKS)	

External Evaluation (50 marks)

The external evaluation would also be done by the external Examiner based on the experiment conducted during the examination.

EXPERIMENT (20 MARKS)	FILE WORK (10 MARKS)	VIVA (20 MARKS)	TOTAL EXTERNAL (50 MARKS)

Course Code: BAS265	B.Sc (H) Chemistry (Semester-II) Physical Chemistry-II (Lab)	L-0 T-0 P-4 C-2
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Determination of heat capacity of calorimeter, enthalpy of ionization and neutralization of acids.	
CO2.	To study the calculation of the enthalpy of ionization of ethanoic acid.	
CO3.	To determine Surface tension and Viscosity of aqueous solutions.	
CO4.	Determination of enthalpy of hydration of copper sulphate.	
CO5.	Determination of solubility of benzoic acid in water.	
Course Content:		

List of Experiments:

Thermochemistry

1. Determination of heat capacity of the calorimeter and enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
2. Calculation of the enthalpy of ionization of ethanoic acid.
3. Determination of heat capacity of the calorimeter and integral enthalpy (endothermic and exothermic) solution of salts.
4. Determination of enthalpy of hydration of copper sulphate.
5. Study of the solubility of benzoic acid in water and determination of ΔH.

Text & Reference Books:

1. Khosla, B. D.; Garg, V. C. & Gulati, A., Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi.
2. Athawale, V. D. & Mathur, P. Experimental Physical Chemistry New Age International: New Delhi.

*** Latest editions of all the suggested books are recommended**

Evaluation Scheme of Practical Examination:

Internal Evaluation (50 marks)

Each experiment would be evaluated by the faculty concerned on the date of the experiment on a 4-point scale which would include the practical conducted by the students and a Viva taken by the faculty concerned. The marks shall be entered on the index sheet of the practical file.

Evaluation scheme:

PRACTICAL PERFORMANCE & VIVA DURING THE SEMESTER (35 MARKS)				ON THE DAY OF EXAM (15 MARKS)		TOTAL INTERNAL (50 MARKS)
EXPERIMENT (5 MARKS)	FILE WORK (10 MARKS)	VIVA (10 MARKS)	ATTENDANCE (10 MARKS)	EXPERIMENT (5 MARKS)	VIVA (10 MARKS)	

External Evaluation (50 marks)

The external evaluation would also be done by the external Examiner based on the experiment conducted during the examination.

EXPERIMENT (20 MARKS)	FILE WORK (10 MARKS)	VIVA (20 MARKS)	TOTAL EXTERNAL (50 MARKS)

Course Code: BGP211	B.Sc. (H) Chemistry- Semester-II **Discipline & General Proficiency**	L-0 T-0 P-0 C-0

There shall be continuous evaluation of the student on the following broad parameters:

1. Observance of dress code.

2. Participation in Conferences /Workshops / Seminars.

3. Attendance in guest lectures, invited talks and special technical sessions organized from time to time.

4. Participation in community projects including NSS.

5. Exhibiting team spirit in different Culture & extra curriculum activities, Department Club activities of the University and College organized from time to time.

6. Observance of rule & regulations in the College/University, Behavior in Campus Premises, Bus, hostel mess and hostel.

7. Performance and awards received in different events (sports/ co-curricular activities) organized at College / University and other level.

8. General behavior

9. Any extraordinary achievement.

The above is an indicative list of parameters on which the students shall be continuously evaluated. The college may evaluate the student on the specific parameters by informing them through a notice displayed on the notice board before evaluation. There shall be no external examination for this course; however, the marks shall be included for calculation of cumulative Performance Index (CPI).

Head of Department would be display GP marks on notice board in prescribed format after IInd & IIIrd CT in semester:

S No		Enroll No.	Student Name	Dress code	Participation in Conferences /Workshops / Seminars	Participation in guest lectures, invited talks and special technical sessions	Participation in community Services	Participation in Culture & extra curriculum activities, Department Club Activities	Participation in sports/ co-curricular activities	General Behavior	Any Extra Achievement
				(5)	**(15)**	**(20)**	**(10)**	**(20)**	**(20)**	**(5)**	**(5)**
	Responsible for marks			Mentor	Head	Head	Mentor	Cultural Events Coordinator & Department Club Coordinator	Sports Coordinator	Mentor	Director or Principal

Course Code: TMUGA-201	Value Added Course B.Sc. (H) Chemistry- Semester-II **Analytical Reasoning**	L-2 T-1 P-0 C-0
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Applying the arithmetical concepts in Ratio Proportion Variation.	
CO2.	Employing the techniques of Percentage; Ratios and Average in inter related concepts of Time and Work, Time Speed and Distance.	
CO3.	Identifying different possibilities of reasoning based problems of Syllogisms and Venn diagram.	
CO4.	Examining the optimized approach to solve logs and Surds.	
Course Content:		
Unit-1:	**Ratio, proportions and variations** Concept of ratios, proportions, variations, properties and their applications	**5 Hours**
Unit-2:	**Time and Work** Same efficiency, different efficiency, alternate work, application in Pipes and Cisterns	**6 Hours**
Unit-3:	**Time Speed Distance** Average speed, proportionalities in Time, Distance, trains, boats, races, circular tracks	**6 Hours**
Unit-4:	**Logs and Surds** Concept and properties of logs, surds and indices	**4 Hours**
Unit-5:	**Coding and decoding** Sequential coding, reverse coding, abstract coding	**3 Hours**
Unit-6:	**Syllogisms** Two statements, three statements	**4 Hours**
Unit-7:	**Venn diagram** Basic concept and applications	**2 Hours**
Reference Books:	• R1:-Arun Shrama:- How to Prepare for Quantitative Aptitude • R2:-Quantitative Aptitude by R.S. Agrawal • R3:-M Tyra: Quicker Maths • R4:-Nishith K Sinha:- Quantitative Aptitude for CAT • R5:-Reference website:- Lofoya.com, gmatclub.com, cracku.in, handakafunda.com, tathagat.mba, Indiabix.com • R6:-Logical Reasoning by Nishith K Sinha • R7:-Verbal and Non Verbal Reasoning by R.S. Agrawal *** Latest editions of all the suggested books are recommended.**	

Course Code: BAS311	B.Sc (H) Chemistry (Semester-III) Inorganic Chemistry-II	L-4 T-0 P-0 C-4
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Understanding the concept of Acid & Bases and its application.	
CO2.	Understanding the Chemistry of main group elements i.e s & p block elements.	
CO3.	Understanding the Chemistry of Inorganic polymers & its industrial application.	
CO4.	Applying theories of chemical bonding to know the characteristics of molecules.	
CO5.	Identifying the relationship between various physical & chemical properties of main group elements.	
Course Content:		
Unit-1:	**Acids and Bases:** Brönsted-Lowry concept of acid-base reactions, solvat proton, relative strength of acids, types of acid-base reactions, levelli solvents, Lewis acid-base concept, Classification of Lewis acids, Hard a Soft Acids and Bases (HSAB) Application of HSAB principle.	**8 Hours**
Unit-2:	**Chemistry of s and p Block Elements I :** Inert pair effect, Relative stability of different oxidation states, diagonal relationship and anomalous behavior of first member of each group. Allotropy and catenation. Complex formation tendency of s and p block elements. Hydrides and their classification ionic, covalent and interstitial.	**8 Hours**
Unit-3:	**Chemistry of s and p Block Elements II:** Structure, bonding, preparation, properties and uses of Boric acid and borates, boron nitrides, borohydrides (diborane) carboranes and graphitic compounds, silanes, Oxides and oxoacids of nitrogen, Phosphorus and chlorine. Peroxo acids of sulphur, interhalogen compounds, polyhalide ions, pseudohalogens and basic properties of halogens.	**8 Hours**
Unit-4:	**Noble Gases:** Occurrence and uses, rationalization of inertness of noble gases, Clathrates; preparation and properties of XeF2, XeF4 and XeF6; Nature of bonding in noble gas compounds (Valence bond treatment and MO treatment for XeF2). Molecular shapes of noble gas compounds (VSEPR theory).	**8 Hours**
Unit-5:	**Inorganic Polymers:** Types of inorganic polymers, comparison with organic polymers, synthesis, structural aspects and applications of silicones and siloxanes. Borazines, silicates and phosphazenes, and polysulphates.	**8 Hours**

Text Books:	**1.** Lee, J.D. Concise Inorganic Chemistry, ELBS.	
Reference Books:	**1.** Douglas, B.E; Mc Daniel, D.H. & Alexander, J.J. Concepts & Models of Inorganic Chemistry, John Wiley Sons, N.Y. **2.** Greenwood, N.N. & Earnshaw. Chemistry of the Elements, Butterworth-Heinemann. **3.** Cotton, F.A. & Wilkinson, G. Advanced Inorganic Chemistry, Wiley, VCH. **4.** https://byjus.com/chemistry/acids-and-bases/ *** Latest editions of all the suggested books are recommended.**	

Course Code: BAS312	B.Sc (H) Chemistry (Semester-III) Organic Chemistry-II	L-4 T-0 P-0 C-4
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Remembering the basic concept and methods of preparation of Halogenated Hydrocarbons Alcohols, Phenols, Ethers and Epoxides.	
CO2.	Remembering the basic concept and methods of preparation of Carbonyl Compounds and Carboxylic Acids and their Derivatives.	
CO3.	Understanding the structure and reaction mechanisms of Halogenated Hydrocarbons, Alcohols & Phenols.	
CO4.	Understanding the structure and reaction mechanisms of Ethers and Epoxides & Sulphur containing compounds.	
CO5	Understanding the structure and reaction mechanisms of Carbonyl Compounds, Carboxylic Acids and their Derivatives.	
Course Content:		
Unit-1:	**Chemistry of Halogenated Hydrocarbons:** Alkyl halides: Methods of preparation, nucleophilic substitution reactions – SN1, SN2 and SNi mechanisms with stereochemical aspects and effect of solvent etc.; nucleophilic substitution vs. elimination. Aryl halides: Preparation, including preparation from diazonium salts. nucleophilic aromatic substitution; SNAr, Benzyne mechanism. Relative reactivity of alkyl, allyl/benzyl, vinyl and aryl halides towards nucleophilic substitution reactions.	**8 Hours**
Unit-2:	**Alcohols, Phenols, Ethers and Epoxides:** Alcohols: preparation, properties and relative reactivity of 1°, 2°, 3° alcohols, Preparation and properties of glycols: Oxidation by periodic acid and lead tetraacetate, Pinacol-Pinacolone rearrangement; Phenols: Preparation and properties; Acidity and factors effecting it, Ring substitution reactions, Reimer–Tiemann and Kolbe's–Schmidt Reactions, Fries and Claisen rearrangements with mechanism;	**8 Hours**
Unit-3:	**Ethers and Epoxides& Sulphur containing compounds:** **Ethers and Epoxides**: Preparation and reactions with acids. Reactions of epoxides with alcohols, ammonia derivatives and LiAlH4 **Sulphur containing compounds**: Preparation and reactions of thiols, thioethers and sulphonic acids.	**8 Hours**
Unit-4:	**Carbonyl Compounds:** Structure, reactivity and preparation; Nucleophilic additions, Nucleophilic addition-elimination reactions with ammonia derivatives with mechanism; Mechanisms of Aldol and Benzoin condensation, Knoevenagel condensation, Claisen-Schmidt, Perkin, Cannizzaro and Wittig reaction, Beckmann and Benzil-Benzilic acid rearrangements, haloform reaction and	**8 Hours**

	Baeyer Villiger oxidation, oxidations and reductions (Clemmensen, Wolff-Kishner, LiAlH4, NaBH4,)	
Unit-5:	**Carboxylic Acids and their Derivatives:** Preparation, physical properties and reactions of monocarboxylic acids: Typical reactions of dicarboxylic acids, hydroxy acids and unsaturated acids: succinic/phthalic, lactic, malic, tartaric, citric, maleic and fumaric acids; Preparation and reactions of acid chlorides, anhydrides, esters and amides; Comparative study of nucleophilic substitution at acyl group -Mechanism of acidic and alkaline hydrolysis of esters.	**8 Hours**
Text Book:	**1.** Morrison, R. T. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).	
Reference Books:	**1.** Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education). **2.** Graham Solomons, T.W. Organic Chemistry, John Wiley & Sons, Inc. **3.** McMurry, J.E. Fundamentals of Organic Chemistry, Cengage Learning India Edition. **4.** https://www.toppr.com/guides/chemistry/alcohols-phenols-and-ethers/introduction-and-classification-of-alcohols-phenols-and-ethers/ *** Latest editions of all the suggested books are recommended.**	

Course Code: BAS313	B.Sc (H) Chemistry (Semester-III) Physical Chemistry-III	L-4 T-0 P-0 C-4
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Understanding the concept of phases, component and degree of freedom and its applications to various phase diagrams.	
CO2.	Understanding of phase equilibria in detail. Application of Nernst distribution law.	
CO3.	Applying Chemical kinetics to various reactions.	
CO4.	Understanding Arrhenius theory and other theories of reaction rates.	
CO5.	Remembering catalysis and surface chemistry.	
Course Content:		
Unit-1:	**Phase EquilibriaI:** Concept of phases, components and degrees of freedom, Clausius-Clapeyron equation and its applications to solid-liquid, liquid-vapour and solid-vapour equilibria, phase diagram for one component systems, with applications. Three component systems, water-chloroform-acetic acid system, triangular plots.	**8 Hours**
Unit-2:	**Phase Equilibria II:** Binary solutions: Gibbs-Duhem-Margules equation, its derivation and applications to fractional distillation of binary miscible liquids (ideal and nonideal), azeotropes, lever rule, partial miscibility of liquids, CST, miscible pairs, steam distillation. Nernst distribution law: its derivation and applications.	**8 Hours**
Unit-3:	**Chemical Kinetics I:** Order and molecularity of a reaction, rate laws in terms of the advancement of a reaction, differential and integrated form of rate expressions up to second order reactions, experimental methods of the determination of rate laws, kinetics of complex reactions (integrated rate expressions up to first order only): (i) Opposing reactions (ii) parallel reactions and (iii) consecutive reactions and their differential rate equations (steady-state approximation in reaction mechanisms) (iv) chain reactions.	**8 Hours**
Unit-4:	**Chemical Kinetics II:** Temperature dependence of reaction rates; Arrhenius equation; activation energy. Collision theory of reaction rates, Lindemann mechanism, qualitative treatment of the theory of absolute reaction rates.	**8 Hours**

Unit-5:	**Catalysis and Surface chemistry:** Types of catalyst, specificity and selectivity, mechanisms of catalyzed reactions at solid surfaces; Enzyme catalysis, Michaelis-Menten mechanism, acid-base catalysis. Physical adsorption, chemisorption, adsorption isotherms. nature of adsorbed state.	**8 Hours**
Text Books:	**1.** Peter Atkins & Julio De Paula, Physical Chemistry, Oxford University Press.	
Reference Books:	**1.** Castellan, G. W. Physical Chemistry, Narosa. **2.** McQuarrie, D. A. & Simon, J. D., Molecular Thermodynamics, Viva Books Pvt. Ltd.: New Delhi. **3.** Engel, T.& Reid, P. Physical Chemistry, Prentice-Hall. **4.** Ball, D. W. Physical Chemistry Cengage India.. **5.** https://www.toppr.com/content/concept/order-and-molecularity-of-a-reaction-203347/ *** Latest editions of all the suggested books are recommended.**	

Course Code: BAS314	Generic Elective Course-III B.Sc.(H) Chemistry- Semester-III **Elements of Modern Physics**	L-4 T--0 P-0 C-4
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	**Remembering** concepts of Black body radiation, Photoelectric effect and Compton scattering to learn the beginning of quantum mechanics.	
CO2.	**Understanding** Young's two slit interference of light into the two slit interference of particles (e.g. photon, electron, atom etc.)	
CO3.	**Understanding** the matter wave and deducing the Schrodinger wave equation.	
CO4.	**Understanding** the laws of radioactive decay including alpha-, beta- and gamma decay, fission and fusion nuclear process.	
CO5.	**Applying** the Heisenberg's uncertainty principle to deduce the Size and structure of atomic nucleus and its relation with atomic weigh.	
CO6.	**Applying** the Heisenberg's uncertainty principle to prove the impossibility of an electron being in the nucleus.	
Course Content:		
Unit-1:	**Planck's quantum-I:** Planck's constant and light as a collection of photons; Blackbody Radiation: Quantum theory of Light; Photo-electric effect and Compton scattering. De Broglie wavelength and matter waves. Two-Slit experiment with electrons	**8 Hours**
Unit-2:	**Planck's quantum-II:** Two slit interference experiment with photons, atoms and particles; linear superposition principle as a consequence; Matter waves and wave amplitude; Schrodinger equation for non-relativistic particles	**8 Hours**
Unit-3:	**Schrodinger Equations:** Schrodinger equations, Size and structure of atomic nucleus and its relation with atomic weight; Impossibility of an electron being in the nucleus as a consequence of the uncertainty principle. Nature of nuclear force	**8 Hours**
Unit-4:	**Fission and fusion:** Mass deficit, relativity and generation of energy; Fission - nature of fragments and emission of neutrons. Fusion and thermonuclear reactions driving stellar energy.	**8 Hours**
Unit-5:	**Radioactivity:** stability of the nucleus; Law of radioactive decay; Mean life and half-life; Alpha decay; Beta decay- energy released, spectrum and Pauli's prediction of neutrino; Gamma ray emission, energy-momentum conservation: electron-positron pair creation by gamma photons in the vicinity of a nucleus.	**8 Hours**
Text Books:	**1.** Concepts of Modern Physics, Arthur Beiser, McGraw-Hill.	
Reference Books:	**1.** Introduction to Quantum Mechanics, David J. Griffith, Pearson Education. **2.** Physics for scientists and Engineers with Modern Physics, Jewett and Serway, Cengage Learning. **3.** Modern Physics, G. Kaur and G. R. Pickrell, McGraw Hill. **4.** Quantum Mechanics: Theory & Applications, A. K. Ghatak & S. Lokanathan, Macmillan. **5.** http://galileo.phys.virginia.edu/classes/252/black_body_radiation.html ***Latest editions of all the suggested books are recommended**	

Course Code: BAS331	Generic Elective Course-III B.Sc.(H) Chemistry- Semester-III **Numerical Analysis**	L-4 T-0 P-0 C-4
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	**Understanding** finite differences and interpolation with equal intervals and Unequal Intervals.	
CO2.	**Understanding** introduction of operators and its properties.	
CO3.	**Applying** numerical solution of first order differential equation using Eulers, Picards and Runge Kutta methods and derivative using forward and backward difference interpolation.	
CO4.	**Analyzing** Lagrange's interpolation formula for unequal intervals.	
CO5.	**Evaluating** Numerical differentiation and Integration, Trapezoidal Formulae, Simpson's Rule, Weddle rule and Cote's formula.	
Course Content:		
Unit-1:	Introduction of finite differences; Forward and backward differences, Forward and backward differences table, Missing term problems, General Introduction of operators and its properties.	**8 Hours**
Unit-2:	Interpolation with equal intervals and Unequal Intervals; Newton Gregory Forward and Backward Formula, Divided difference table, Newton's divide difference Formula, Lagrange's Interpolation Formula, Hermit Interpolation formulas using differences.	**8 Hours**
Unit-3:	Central difference formulae, Bessel's and Strling formula, Gauss Forward and Backward, Evertt formula.	**8 Hours**
Unit-4:	Numerical differentiation and Integration, Derivative using forward and backward difference interpolation formula, Trapezoidal Rule, Simposon's one-third and three-eight rules, Weddle rule and Cotes formula.	**8 Hours**
Unit-5:	Numerical solution of first order differential equation using Eulers, Picards and Runge Kutta methods.	**8 Hours**
Text Books:	**1**. Numerical analysis", by Burden, Cengage Learning. **2.** "Numerical Analysis" by B. S. Grewal, Khanna Publishing. **3.** "Numerical Analysis" by Pradeep Niyosi, Tata Mcgraw Hell.	
Reference Books:	**1.** "Numerical Analysis" by P.P. Gupta and Sanjay Gupta, Krishana Prakashan Mandir. **2.** "Numerical Analysis" by S.S. Sastry, Prentice Hall of India. **3.** "Introduction to Numerical Analysis" by C. E. Froberg, Addition Welly Publishing Co. https://www.youtube.com/watch?v=awhBIJoemZU ***Latest editions of all the suggested books are recommended.**	

Course Code: BAS361	B.Sc (H) Chemistry (Semester-III) Inorganic Chemistry-II (Lab)	L-0 T-0 P-4 C-2
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Volumetric estimation of copper & Chromium from given salt solution.	
CO2.	Estimation of arsenite in tartar-emetic iodimetrically.	
CO3.	Estimation of antimony in tartar-emetic iodimetrically.	
CO4.	Estimation of available chlorine in the given solution of Bleaching powder.	
CO5.	Synthesizing some transition metal complexes.	
Course Content:		

List of Experiments:

1. Estimation of Cu(II) and K2Cr2O7 using sodium thiosulphate solution (Iodimetrically).
2. Estimation of (i) arsenite and (ii) antimony in tartar-emetic iodimetrically.
3. Estimation of available chlorine in bleaching powder iodometrically.
4. Preparation of Manganese (III) phosphate, MnPO4.H2O
5. Preparation of Aluminum potassium sulphate KAl(SO4)2.12H2O (Potash alum) or Chrome alum.
6. Determination of Total Hardness of the given water sample.
7. Determination of Calcium & Magnesium Hardness of the given water sample.

Text &Reference Books:

1.Mendham, J., A. I. Vogel's Quantitative Chemical Analysis, Pearson.

*** Latest editions of all the suggested books are recommended**

Evaluation Scheme of Practical Examination:
Internal Evaluation (50 marks)
Each experiment would be evaluated by the faculty concerned on the date of the experiment on a 4-point scale which would include the practical conducted by the students and a Viva taken by the faculty concerned. The marks shall be entered on the index sheet of the practical file.

Evaluation scheme:

PRACTICAL PERFORMANCE & VIVA DURING THE SEMESTER (35 MARKS)				ON THE DAY OF EXAM (15 MARKS)		TOTAL INTERNAL (50 MARKS)
EXPERIMENT (5 MARKS)	FILE WORK (10 MARKS)	VIVA (10 MARKS)	ATTENDANCE (10 MARKS)	EXPERIMENT (5 MARKS)	VIVA (10 MARKS)	

External Evaluation (50 marks)
The external evaluation would also be done by the external Examiner based on the experiment conducted during the examination.

EXPERIMENT (20 MARKS)	FILE WORK (10 MARKS)	VIVA (20 MARKS)	TOTAL EXTERNAL (50 MARKS)

Course Code: BAS 362	B.Sc (H) Chemistry (Semester-III) Organic Chemistry-II (Lab)	L-0 T-0 P-4 C-2
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Understanding qualitative analysis of organic compounds to detect the different functional groups present on it.	
CO2.	Understanding the mechanism of Acetylation and applying it in preparing few organic compounds.	
CO3.	Understanding the mechanism of Benzoylation and applying it in preparing few organic compounds.	
CO4.	Understanding the mechanism of Nitration and applying it in preparing few organic compounds.	
CO5.	Understanding the mechanism of reduction & applying it for preparing few organic compounds.	
Course Content:		

List of Experiments:

1. Functional group tests for alcohols, phenols, carbonyl and carboxylic acid group.
2. Organic preparations:
   - **i.** Acetylation of one of the following compounds: amines (aniline, o-, m-, p-toluidines and o-, m-, p-anisidine) and phenols (β-naphthol, salicylic acid) by any one method:
     - **a.** Using conventional method.
     - **b.** Using green approach
   - **ii.** Benzolyation of one of the following amines (aniline, o-, m-, p- toluidines and o-, m, p-anisidine) and one of the following phenols (β-naphthol, resorcinol, p-cresol) by Schotten-Baumann reaction.
   - **iii.** Nitration of any one of the following:
     - **a.** Acetanilide/nitrobenzene by conventional method
     - **b.** Salicylic acid by green approach (using ceric ammonium nitrate).
   - **iv.** Selective reduction of meta dinitrobenzene to m-nitroaniline.
   - **v.** Reduction of p-nitrobenzaldehyde by sodium borohydride.
   - **vi.** Hydrolysis of amides and esters.
   - **vii.** Semicarbazone of any one of the following compounds: acetone, ethyl methyl ketone, cyclohexanone, benzaldehyde.
   - **viii.** Benzil-Benzilic acid rearrangement.

The above derivatives should be prepared using 0.5-1g of the organic compound. The solid samples

must be collected and may be used for recrystallization, melting point and TLC.

Text &Reference Books:

1. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education.
2. Furniss, B.S., Hannaford, A.J., Smith, P.W.G. & Tatchell, A.R. Practical Organic Chemistry, Pearson.
3. Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, University Press.
4. Ahluwalia, V.K. & Dhingra, S. Comprehensive Practical Organic Chemistry: Qualitative Analysis, University Press.

*** Latest editions of all the suggested books are recommended**

Evaluation Scheme of Practical Examination:

Internal Evaluation (50 marks)

Each experiment would be evaluated by the faculty concerned on the date of the experiment on a 4-point scale which would include the practical conducted by the students and a Viva taken by the faculty concerned. The marks shall be entered on the index sheet of the practical file.

Evaluation scheme:

PRACTICAL PERFORMANCE & VIVA DURING THE SEMESTER (35 MARKS)				ON THE DAY OF EXAM (15 MARKS)		TOTAL INTERNAL (50 MARKS)
EXPERIMENT (5 MARKS)	FILE WORK (10 MARKS)	VIVA (10 MARKS)	ATTENDANCE (10 MARKS)	EXPERIMENT (5 MARKS)	VIVA (10 MARKS)	

External Evaluation (50 marks)

The external evaluation would also be done by the external Examiner based on the experiment conducted during the examination.

EXPERIMENT (20 MARKS)	FILE WORK (10 MARKS)	VIVA (20 MARKS)	TOTAL EXTERNAL (50 MARKS)

Course Code: BAS363	B.Sc (H) Chemistry (Semester-II) Physical Chemistry-III (Lab)	L-0 T-0 P-4 C-2
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Determining the critical solution temperature of the phenol-water system.	
CO2.	Analyzing the phase diagram using cooling curves	
CO3.	To study distribution of acetic/ benzoic acid between water and cyclohexane.	
CO4.	Analyzing the kinetics of Iodide-persulphate reaction and acid hydrolysis of methyl acetate with hydrochloric acid.	
CO5.	Understanding the validity of the Freundlich and Langmuir isotherms for adsorption of acetic acid on charcoal.	
Course Content:		

List of Experiments:

1. Determination of critical solution temperature and composition of the phenol-water system and to study the effect of impurities on it.
2. Phase equilibria: Construction of the phase diagram using cooling curves or ignition tube method:
   a) simple eutectic and
   b) congruently melting systems.
3. Distribution of acetic/ benzoic acid between water and cyclohexane.
4. Study the equilibrium of at least one of the following reactions by the distribution method:

   i. $I_2(aq) + I^- \rightarrow I_3^-(aq)^{2+}$

   ii. $Cu^{2+}(aq) + nNH_3 \rightarrow Cu(NH_3)_n$
5. Study the kinetics of the following reactions.
6. Initial rate method: Iodide-persulphate reaction
7. Integrated rate method:
   i. Acid hydrolysis of methyl acetate with hydrochloric acid.
   ii. Saponification of ethyl acetate.
8. Compare the strengths of HCl and H2SO4 by studying kinetics of hydrolysis of methyl acetate.
9. Verify the Freundlich and Langmuir isotherms for adsorption of acetic acid on activated charcoal.

Text & Reference Books:

1. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi.
2. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. Experiments in Physical Chemistry; McGraw-Hill: New York.
3. Halpern, A. M. &McBane, G. C. Experimental Physical Chemistry; W.H. Freeman & Co.: New York.

*** Latest editions of all the suggested books are recommended**

Evaluation Scheme of Practical Examination:

Internal Evaluation (50 marks)
Each experiment would be evaluated by the faculty concerned on the date of the experiment on a 4-point scale which would include the practical conducted by the students and a Viva taken by the faculty concerned. The marks shall be entered on the index sheet of the practical file.

Evaluation scheme:

PRACTICAL PERFORMANCE & VIVA DURING THE SEMESTER (35 MARKS)				ON THE DAY OF EXAM (15 MARKS)		TOTAL INTERNAL (50 MARKS)
EXPERIMENT (5 MARKS)	FILE WORK (10 MARKS)	VIVA (10 MARKS)	ATTENDANCE (10 MARKS)	EXPERIMENT (5 MARKS)	VIVA (10 MARKS)	

External Evaluation (50 marks)

The external evaluation would also be done by the external Examiner based on the experiment conducted during the examination.

EXPERIMENT (20 MARKS)	FILE WORK (10 MARKS)	VIVA (20 MARKS)	TOTAL EXTERNAL (50 MARKS)

Course Code: BGP311	B.Sc.(H) Chemistry- Semester-III **Discipline & General Proficiency**	L-0 T-0 P-0 C-0

There shall be continuous evaluation of the student on the following broad parameters:

1. Observance of dress code.

2. Participation in Conferences /Workshops / Seminars.

3. Attendance in guest lectures, invited talks and special technical sessions organized from time to time.

4. Participation in community projects including NSS.

5. Exhibiting team spirit in different Culture & extra curriculum activities, Department Club activities of the University and College organized from time to time.

6. Observance of rule & regulations in the College/University, Behavior in Campus Premises, Bus, hostel mess and hostel.

7. Performance and awards received in different events (sports/ co-curricular activities) organized at College / University and other level.

8. General behavior

9. Any extraordinary achievement.

The above is an indicative list of parameters on which the students shall be continuously evaluated. The college may evaluate the student on the specific parameters by informing them through a notice displayed on the notice board before evaluation. There shall be no external examination for this course; however, the marks shall be included for calculation of cumulative Performance Index (CPI).

Head of Department would be display GP marks on notice board in prescribed format after IInd & IIIrd CT in semester:

S No		Enroll No.	Student Name	Dress code	Participation in Conferences /Workshops / Seminars	Participation in guest lectures, invited talks and special technical sessions	Participation in community Services	Participation in Culture & extra curriculum activities, Department Club Activities	Participation in sports/ co-curricular activities	General Behavior	Any Extra Achievement
				(5)	**(15)**	**(20)**	**(10)**	**(20)**	**(20)**	**(5)**	**(5)**
	Responsible for marks			Mentor	Head	Head	Mentor	Cultural Events Coordinator & Department Club Coordinator	Sports Coordinator	Mentor	Director or Principal

Course Code: TMUGE301	Value Added Course B.Sc.(H) Chemistry- Semester-III **English Communication- III**	L-2 T-0 P-2 C-0
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	**Understanding** knowledge of grammar to face competitive exams.	
CO2.	**Understanding** advance English language by using variety of words i.e. idioms and phrase in variety of sentences in functional context.	
CO3.	**Understanding** listening for effective communication.	
CO4.	**Applying** their English grammar knowledge in day to day context.	
CO5.	**Applying** writing and comprehensive skills in English.	
CO6.	**Analyzing** Comprehending & enriching their vocabulary through prescribed text.	
Course Content:		
Unit-1:	English Grammar & Vocabulary **(d)** Correction of Common Errors (with recap of English Grammar with its usage in practical context.) **(e)** Synthesis: Simple, complex and compound sentence **(f)** Commonly used Idioms & phrases (Progressive learning whole semester)	**14 Hours**
Unit-2:	Speaking Skills **(a)** Art of public speaking **(b)** Common conversation **(c)** Extempore **(d)** Power Point Presentation (PPt) Skills: Nuances of presenting PPTs	**10 Hours**
Unit-3:	Comprehension Skills **(a)** Strategies of Reading comprehension: Four S's **(b)** How to solve a Comprehension (Short unseen passage: 150-200 words)	**6 Hours**
Unit-4:	Professional Writing **(a)** Preparing Notice, Agenda & Minutes of the Meeting	**7 Hours**
Unit-5:	Value based text reading: Short story **(a)** The Barber's Trade Union - Mulk Raj Anand	**3 Hours**
Text Books:	**(g)** Singh R.P., An Anthology of English Essay, O.U.P. New Delhi	
Reference Books:	**1.** Wren & Martin *"High School English Grammar and Composition"* S. Chand & Co. Ltd., New Delhi. **2.** Kumar Sanjay & Pushplata *"Communication Skills"* Oxford University Press, New Delhi. **3.** Agrawal, Malti *"Professional Communication"* Krishana Prakashan Media (P) Ltd. Meerut. ***Latest editions of all the suggested books are recommended.**	

Additional Electronics Reference Material	1- https://www.youtube.com/watch?v=dpYltVtsS_Q 2- https://www.youtube.com/watch?v=Z8HttKW8jVE 3- https://www.youtube.com/watch?v=srn5jgr9TZo 4- https://www.youtube.com/watch?v=En9-8xWYWqk 5- https://www.youtube.com/watch?v=aUEpmAo0OvM	
Methodology:	**1.** Idiom & Phrases and exercises, usage in sentences. **2.** Language Lab software. **3.** Power Point presentation. **4.** Newspaper reading, short articles from newspaper to comprehend and short movies. **5.** Modern Teaching tools (PPT Presentation & Motivational videos with sub-titles) will be utilized. **6.** Text reading: discussion in detail, Critical appreciation by reading the text to develop students' reading habits with voice modulation.	

Evaluation Scheme

Internal Evaluation			External Evaluation		Total Marks
40 Marks			60 Marks		
20 Marks (Best 2 out of Three CTs) (From Unit-I, III, IV & V)	10 Marks (Oral Assignments) (Unit -II)	10 Marks (Attendance)	40 Marks (External Written Examination) (From Unit-1, III, IV & V)	20 Marks (External Viva)* (Unit -II)	100

*Parameters of External Viva

Content	Body Language	Communication skills	Confidence	TOTAL
05 Marks	05 Marks	05 Marks	05 Marks	20 Marks

Note: External Viva will be conducted by 2-member committee comprising

a) One Faculty teaching the class

b) One examiner nominated by University Examination cell.

Each member will evaluate on a scale of 20 marks and the average of two would be the 20 marks obtained by the students.

Course Code: TMUGS-301	Value Added Course B.Sc.(H) Chemistry- Semester-III Managing Self	L-2 T-1 P-0 C-0
Course Outcomes:	**On completion of the course, the students will be:**	
CO1.	Utilizing effective verbal and non-verbal communication techniques in formal and informal settings	
CO2.	Understanding and analyzing self and devising a strategy for self-growth and development.	
CO3.	Adapting a positive mindset conducive for growth through optimism and constructive thinking.	
CO4.	Utilizing time in the most effective manner and avoiding procrastination.	
CO5.	Making appropriate and responsible decisions through various techniques like SWOT, Simulation and Decision Tree.	
CO6.	Formulating strategies of avoiding time wasters and preparing to-do list to manage priorities and achieve SMART goals.	
Course Content:		
Unit-1:	**Personal Development:** Personal growth and improvement in personality Perception Positive attitude Values and Morals High self motivation and confidence Grooming	**10 Hours**
Unit-2:	**Professional Development:** Goal setting and action planning Effective and assertive communication Decision making Time management Presentation Skills Happiness, risk taking and facing unknown	**8 Hours**
Unit-3:	**Career Development:** Resume Building Occupational Research Group discussion (GD) and Personal Interviews	**12 Hours**
Reference Books:	**1.** Robbins, Stephen P., Judge, Timothy A., Vohra, Neharika, Organizational Behaviour (2018), 18th ed., Pearson Education **2.** Tracy, Brian, Time Management (2018), Manjul Publishing House **3.** Hill, Napolean, Think and grow rich (2014), Amazing Reads **4.** Scott, S.J., SMART goals made simple (2014), Createspace Independent Pub **5.** https://www.hloom.com/resumes/creative-templates/ **6.** https://www.mbauniverse.com/group-discussion/topic.php **7.** Rathgeber, Holger, Kotter, John, Our Iceberg is melting (2017), Macmillan **8.** Burne, Eric, Games People Play (2010), Penguin UK **9.** https://www.indeed.com/career-advice/interviewing/job-interview-tips-how-to-make-a-great-impression *** Latest editions of all the suggested books are recommended.**	

Course Code: BAS419	B.Sc (H) Chemistry (Semester-IV) Inorganic Chemistry-III	L-4 T-0 P-0 C-4
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Understanding basic concepts of Crystal Field Theory (CFT) & Ligand Field Theory(LFT).	
CO2.	Remembering & understanding the Isomerism in Inorganic Complexes, Lability & inertness of transition metal complexes.	
CO3.	Applying CFT in determining CFSE value, color of complexes & magnetic moment of TM complexes.	
CO4.	Understanding the Physical & Chemical properties of d block elements.	
CO5.	Understanding the Physical & Chemical properties of Lanthanides & Actinides.	
Course Content:		
Unit-1:	**Coordination Chemistry I:** Werner's theory, valence bond theory (inner and outer orbital complexes), Crystal field theory, measurement of 10 Dq (o), CFSE in weak and strong fields, pairing energies, factors affecting the magnitude of 10 Dq (o, t). Octahedral vs. tetrahedral coordination, tetragonal distortions from octahedral geometry Jahn-Teller theorem, square planar geometry.	**8 Hours**
Unit-2:	**Coordination Chemistry II:** Qualitative aspect of Ligand field and MO Theory, IUPAC nomenclature of coordination compounds, isomerism in coordination compounds. Stereochemistry of complexes with 4 and 6 coordination numbers. Chelate effect, polynuclear complexes, Labile and inert complexes.	**8 Hours**
Unit-3:	**Transition Elements:** General group trends with special reference to electronic configuration, colour, variable valency, magnetic and catalytic properties, ability to form complexes. Stability of various oxidation states and e.m.f. (Latimer & Bsworth diagrams). Difference between the first, second and third transition series.	**8 Hours**
Unit-4:	**Lanthanoids and Actinoids:** **E**lectronic configuration, oxidation states, colour, spectral and magnetic properties, lanthanide contraction, separation of lanthanides (ion-exchange method only).	**8 Hours**
Unit-5:	**Bioinorganic Chemistry:** Metal ions present in biological systems, classification of elements according to their action in biological system. Geochemical effect on the distribution of metals. Sodium / K-pump, carbonic anhydrase and	**8 Hours**

	carboxypeptidase. Excess and deficiency of some trace metals. Toxicity of metal ions (Hg, Pb, Cd and As), reasons for toxicity, Use of chelating agents in medicine. Iron and its application in bio-systems, Hemoglobin; Storage and transfer of iron.	
Text Books:	1. Huheey, J.E., Inorganic Chemistry, Prentice Hall. 2. Greenwood, N.N. & Earnshaw A. Chemistry of the Elements, Butterworth-Heine	
Reference Books:	1. Purcell, K.F & Kotz, J.C. Inorganic Chemistry W.B. Saunders Co. 2. Lippard, S.J. & Berg, J.M. Principles of Bioinorganic Chemistry Panima Publishing Company. 3. Cotton, F.A. & Wilkinson, G, Advanced Inorganic Chemistry Wiley-VCH. 4. Basolo, F, and Pearson, R.C. Mechanisms of Inorganic Chemistry, John Wiley & Sons, NY 5. https://www.britannica.com/science/coordination-compound/Ligand-field-and-molecular-orbital-theories *** Latest editions of all the suggested books are recommended.**	

Course Code: BAS412	B.Sc (H) Chemistry (Semester-IV) Organic Chemistry-III	L-4 T-0 P-0 C-4
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Remembering the basic concept and methods of preparation of nitrogen containing compounds and their derivatives.	
CO2.	Remembering the introduction & classification of heterocyclic compounds.	
CO3.	Understanding the structure & synthesis of five & six membered rings containing one hetero atom heterocyclic compounds & their derivatives and poly-nuclear hydrocarbons.	
CO4.	Applying the mechanism of substitution reaction in preparing derivatives of heterocyclic compounds.	
CO5.	Understanding the isolation, structure & synthesis of alkaloids and terpenes.	
Course Content:		
Unit-1:	**Nitrogen Containing Functional Groups:** Preparation and important reactions of nitro compounds, nitriles and isonitriles Amines: Effect of substituent and solvent on basicity; Preparation and properties: Gabriel phthalimide synthesis, Carbylamine reaction, Mannich reaction, Hoffmann's exhaustive methylation, Hofmann-elimination reaction; Distinction between 1°, 2° and 3° amines with Hinsberg reagent and nitrous acid. Diazonium Salts: Preparation and their synthetic applications.	**8 Hours**
Unit-2:	**Polynuclear Hydrocarbons:** Reactions of naphthalene phenanthrene and anthracene Structure, Preparation and structure elucidation and important derivatives of naphthalene and anthracene; Polynuclear hydrocarbons.	**8 Hours**
Unit-3:	**Heterocyclic Compounds I:** Classification and nomenclature, Structure, aromaticity in 5-numbered and 6-membered rings containing one heteroatom; Synthesis, reactions and mechanism of substitution reactions of: Furan, Pyrrole (Paal-Knorr synthesis, Knorr pyrrole synthesis, Hantzsch synthesis), Thiophene	**8 Hours**
Unit-4:	**Heterocyclic Compounds II:** Pyridine (Hantzsch synthesis), Pyrimidine, Structure elucidation of indole, Fischer indole synthesis and Madelung synthesis), Structure elucidation of quinoline and isoquinoline, Skraup synthesis, Friedlander's synthesis, Knorr quinoline synthesis, Doebner-Miller synthesis, Bischler-Napieralski reaction, Pictet-Spengler reaction, Pomeranz-Fritsch reaction.	**8 Hours**

Unit-5:	**Alkaloids& Terpenes:** Natural occurrence, General structural features, Isolation and their physiological action Hoffmann's exhaustive methylation, Emde's modification, Structure elucidation and synthesis of Hygrine and Nicotine. Medicinal importance of Nicotine, Hygrine, Quinine, Cocaine, and Reserpine. Occurrence, classification, isoprene rule; Elucidation of structure and synthesis of Citral, Neral and α-terpineol.	**8 Hours**
Text Book:	**1.** Morrison, R. T. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).	
Text & Reference Books:	**1.** Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education). **2.** Graham Solomons, T.W. Organic Chemistry, John Wiley & Sons, Inc. **3.** McMurry, J.E. Fundamentals of Organic Chemistry, Cengage Learning India Edition. **4.** https://toxtown.nlm.nih.gov/chemicals-and-contaminants/polycyclic-aromatic-hydrocarbons-pahs *** Latest editions of all the suggested books are recommended.**	

Course Code: BAS413	B.Sc (H) Chemistry (Semester-IV) Physical Chemistry-IV	L-4 T-0 P-0 C-4
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Understanding the basic concept of conductance and electrochemistry.	
CO2.	Understanding the Faraday's Law of electrolysis and its applications.	
CO3.	Understanding the different types of electrochemical cells and determining the EMF of the cells.	
CO4.	*Understanding* the basic concept of electric and magnetic properties of molecules.	
CO5.	Appling the concept of conductance measurement in degree of dissociation, equilibrium constant and conductometric titrations.	
Course Content:		
Unit-1:	**Conductance I:** Arrhenius theory of electrolytic dissociation. Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. Molar conductivity at infinite dilution. Kohlrausch law of independent migration of ions. Debye-Hückel-Onsager equation, Walden's rules.	**8 Hours**
Unit-2:	**Conductance II:** Ionic velocities, mobilities and their determinations, transference numbers and their relation to ionic mobilities, determination of transference numbers using Hittorf and Moving Boundary methods. Applications of conductance measurement: (i) degree of dissociation of weak electrolytes, (ii) ionic product of water (iii) solubility and solubility product of sparingly soluble salts, (iv) conductometric titrations, and (v) hydrolysis constants of salts.	**8 Hours**
Unit-3:	**Electrochemistry I:** Chemical cells, reversible and irreversible cells with examples. Electromotive force of a cell and its measurement, Nernst equation; Standard electrode (reduction) potential and its application to different kinds of half-cells. Rules of oxidation/reduction of ions based on half-cell potentials Quantitative aspects of Faraday's laws of electrolysis, applications of electrolysis in metallurgy and industry.	**8 Hours**
Unit-4:	**Electrochemistry II:** Application of EMF measurements in determining free energy, enthalpy and entropy of a cell reaction, (ii) equilibrium constants, and (iii) pH values, using hydrogen, quinone-hydroquinone electrodes. Concentration cells with and without transference, liquid junction potential; determination of activity coefficients and transference numbers. Qualitative discussion of potentiometric titrations (acid-base, redox, precipitation).	**8 Hours**

Unit-5:	Basic ideas of electrostatics, Electrostatics of dielectric media, Clausius-Mosotti equation, Lorenz-Laurentz equation, Dipole moment and molecular polarizabilities and their measurements. Diamagnetism, Para magnetism, magnetic susceptibility and its measurement, molecular interpretation.	**8 Hours**
Text Books:	**1.** Atkins, P.W & Paula, J.D. Physical Chemistry, Oxford University Press.	
Reference Books:	**2.** Castellan, G. W. Physical Chemistry, Narosa. **3.** Barrow, G. M., Physical Chemistry, Tata McGraw Hill: New Delhi. **4.** https://byjus.com/chemistry/laws-of-electrolysis/ *** Latest editions of all the suggested books are recommended.**	

Course Code: BAS435	Generic Elective Course-IV B.Sc.(H) Chemistry- Semester-III **Thermal Physics**	L-4 T-0 P-0 C-4
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	**Remembering** and understanding the laws of thermodynamics, entropy, and Maxwell's thermodynamic relations.	
CO2.	**Understanding** the Kinetic theory of gases-distribution of velocities, and molecular collisions in Physics.	
CO3.	**Understanding** the basics of real gases.	
CO4.	**Applying** the T-S diagram to understand phase transition processes	
CO5.	**Applying** Maxwell's thermodynamic relations to understand ideal and Van der Waal Gases, Energy equations, Change of Temperature during Adiabatic Process	
Course Content:		
Unit-1:	**Introduction to Thermodynamics:** Zeroth, First & Second Law of Thermodynamics: Thermodynamic Variables & Equilibrium, Concept of Temperature, Work & Heat, Internal Energy, Applications of First Law: General Relation between C_P and C_V, Work Done during Isothermal and Adiabatic Processes, Compressibility and Expansion Co-efficient. Reversible and Irreversible process with examples, Conversion of Work into Heat and Heat into Work, Carnot's Cycle, Carnot engine & efficiency, Applications of Second Law of Thermodynamics.	**8 Hours**
Unit-2:	**Entropy & Thermodynamic Potentials:**Concept of Entropy, Clausius Theorem, Clausius Inequality, Second Law of Thermodynamics in terms of Entropy, Entropy of a perfect gas, Principle of Increase of Entropy. Entropy Changes in Reversible and Irreversible processes with examples. Entropy of the Universe, Principle of Increase of Entropy. Temperature–Entropy diagrams. Third Law of Thermodynamics. Thermodynamic Potentials, First and second order Phase Transitions with examples, Clausius Clapeyron Equation and Ehrenfest equations.	**8 Hours**
Unit-3:	**Maxwell's Thermodynamic Relations:** Derivations and applications of Maxwell's Relations, Maxwell's Relations:(1) Clausius Clapeyron equation, (2) Values of C_p-$C_{v,}$(3) TdS Equations, (4) Joule-Kelvin coefficient for Ideal and Van der Waal Gases, (5) Energy equations, (6) Change of Temperature during Adiabatic Process.	**8 Hours**
Unit-4:	**Kinetic Theory of Gases-Distribution of Velocities, Molecular Collisions:** Maxwell-Boltzmann Law of Distribution of Velocities in an Ideal Gas and its Experimental Verification, Degrees of Freedom. Law of equipartition of Energy (No proof required). Specific heats of Gases, Mean Free Path, Collision Probability, Estimates of Mean Free Path. Transport Phenomenon in Ideal Gases: (1) Viscosity, (2) Thermal Conductivity and (3) Diffusion. Brownian motion and its Significance.	**8 Hours**
Unit-5:	**Real Gases:** Behavior of Real Gases: Deviations from the Ideal Gas Equation. The	**8 Hours**

	Virial Equation, Critical Constants, Continuity of Liquid and Gaseous State. Vapour and Gas. Boyle Temperature. Van der Waal's Equation of State for Real Gases. P-V Diagrams, Joule's Experiment. Free Adiabatic Expansion of a Perfect Gas. Joule-Thomson Porous Plug Experiment. Joule-Thomson Effect for Real and Van der Waal Gases. Temperature of Inversion, Joule-Thomson Cooling.	
Text Books:	**1.** 1.Thermal Physics, S. Garg, R. Bansal and Ghosh, 2nd Edition, Tata McGraw-Hill Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, Springer	
Reference Books:	1. Heat and Thermodynamics, M.W. Zemansky, Richard Dittman, McGraw-Hill. A Treatise on Heat, Meghnad Saha, and B. N. Srivastava, Indian Press 2. Thermodynamics, Kinetic Theory & Statistical Thermodynamics, Sears & Salinger. Narosa. 3. Concepts in Thermal Physics, S.J. Blundell and K.M. Blundell, Oxford University Press 4. Thermal Physics, A. Kumar and S.P. Taneja, R. Chand Publications. 5. https://itp.uni-frankfurt.de/~gros/Vorlesungen/TD/5_Thermodynamic_potentials.pdf *** Latest editions of all the suggested books are recommended**	

Course Code: **BAS418**	**Generic Elective Course-IV** **B.Sc.(H) Chemistry- Semester-IV** **Introduction to Probability**	**L-4** **T-0** **P-0** **C-4**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	**Understanding** the concept of the probability, addition law of probability and multiplication law of probability with its applications.	
CO2.	**Applying** the concept of discrete and continuous random variable to calculate the moment and generating functions.	
CO3.	**Analyzing** the concept of mathematical expectation, addition and multiplication theorem of Expectation.	
CO4.	**Analyzing** the M.G.F, C.F and P.D.F of the discrete and continuous distributions.	
CO5.	**Evaluating** the concept of Probability distributions and its recurrence relation of the distribution.	
Course Content:		
Unit-1:	Probability: Introduction, sample space, events and algebra of events, Kinds of Probability: classical, statistical, and axiomatic. Conditional Probability, laws of addition and multiplication, independent events.	**8 Hours**
Unit-2:	Random Variables: Discrete and continuous random variables, p.m.f, p.d.f, c.d.f. Illustrations of random variables and its properties, variance, moments and moment generating function.	**8 Hours**
Unit-3:	Mathematical Expectation- Expectation of a Random Variable, Addition & Multiplication Theorem of Expectation, Moments-Moment Generating Function, Limitations of m.g.f, cumulants - additive property.	**8 Hours**
Unit-4:	Discrete probability distributions: Bernoulli distribution : M.G.F, C.F , mean and variance, Binomial distribution : M.G.F, C.F , P,D.F, mean and variance, Poisson distribution: M.G.F, C.F , P,D.F, mean and variance.	**8 Hours**
Unit-5:	Continuous Probability Distributions: Gamma Distribution : M.G.F, C.F , P,D.F, mean and variance, Beta distribution: M.G.F, C.F , P,D.F, mean and variance, and Uniform distribution: M.G.F, C.F , P,D.F, mean and variance,	**8 Hours**
Text Books:	**1.** Mathematical Statistics" by S.C. Gupta, S. Chand & co. **2.** Hogg, R.V., Tanis, E.A. and Rao J.M.: Probability. **3.** Statistical Inference, Pearson Education, New Delhi.	
Reference Books:	**1.** Miller, Irwin and Miller, Marylees : John E. Freund's Mathematical Statistics with Applications, Pearson Education, Asia. **2.** Myer, P.L.: Introductory Probability and Statistical Applications, Oxford & IBH Publishing, New Delhi. **3.** http://www.columbia.edu/~kr2248/4109/chapter4.pdf ***Latest editions of all the suggested books are recommended**	

Course Code: BAS461	B.Sc (H) Chemistry (Semester-IV) Inorganic Chemistry-III (Lab)	L-0 T-0 P-4 C-2
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Gravimetric Estimation of nickel (II) using Dimethylglyoxime (DMG).	
CO2.	Gravimetric **e**stimation of Copper as CUCNS.	
CO3.	Gravimetric **e**stimation of Iron as Fe_2O_3.	
CO4.	Separating mixture of inorganic compounds by Thin Layer Chromatography (TLC).	
CO5.	Preparing few metal complexes	
Course Content:		

List of Experiments:

Gravimetric Analysis:

1. Estimation of nickel (II) using Dimethylglyoxime (DMG).
2. Estimation of copper as CuSCN
3. Estimation of iron as Fe_2O_3 by precipitating iron as $Fe(OH)_3$.

Inorganic Preparations:

4. Tetra ammine copper (II) sulphate, [Cu(NH3)4]SO4.H2O
5. Cis K[Cr(C2O4)2. (H2O)2] Potassium dioxalatodiaqua chromate (III)
6. Tetra ammine carbonatocobalt (III) ion
7. Potassium tris(oxalate)ferrate(III)

Chromatography of metal ions

8. Principle involved in chromatographic separations. Paper chromatographic separation of following metal ions:
   - **a)** Ni (II) and Co (II)
   - **b)** Fe (III) and Al (III)

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Text &Reference Book:

1. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis, Pearson.

*** Latest editions of all the suggested books are recommended**

Evaluation Scheme of Practical Examination:
Internal Evaluation (50 marks)

Each experiment would be evaluated by the faculty concerned on the date of the experiment on a 4-point scale which would include the practical conducted by the students and a Viva taken by the faculty concerned. The marks shall be entered on the index sheet of the practical file.

Evaluation scheme:

PRACTICAL PERFORMANCE & VIVA DURING THE SEMESTER (35 MARKS)				ON THE DAY OF EXAM (15 MARKS)		TOTAL INTERNAL (50 MARKS)
EXPERIMENT (5 MARKS)	FILE WORK (10 MARKS)	VIVA (10 MARKS)	ATTENDANCE (10 MARKS)	EXPERIMENT (5 MARKS)	VIVA (10 MARKS)	

External Evaluation (50 marks)

The external evaluation would also be done by the external Examiner based on the experiment conducted during the examination.

EXPERIMENT (20 MARKS)	FILE WORK (10 MARKS)	VIVA (20 MARKS)	TOTAL EXTERNAL (50 MARKS)

Course Code: BAS462	B.Sc (H) Chemistry (Semester-IV) Organic Chemistry-III (Lab)	L-0 T-0 P-4 C-2
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Finding extra elements in the organic compounds.	
CO2.	Qualitative analysis of organic compounds containing simple functional groups.	
Course Content:		

List of Experiments:

1. Detection of extra elements.
2. Functional group test for nitro, amine and amide groups.
3. Qualitative analysis of unknown organic compounds containing simple functional groups (alcohols, carboxylic acids, phenols and carbonyl compounds)

Text &Reference Books:

1. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education.
2. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry, Pearson.
3. Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, University Press.
4. Ahluwalia, V.K. & Dhingra, S. Comprehensive Practical Organic Chemistry: Qualitative Analysis, University Press.

*** Latest editions of all the suggested books are recommended**

Evaluation Scheme of Practical Examination:
Internal Evaluation (50 marks)
Each experiment would be evaluated by the faculty concerned on the date of the experiment on a 4-point scale which would include the practical conducted by the students and a Viva taken by the faculty concerned. The marks shall be entered on the index sheet of the practical file.
Evaluation scheme:

PRACTICAL PERFORMANCE & VIVA DURING THE SEMESTER (35 MARKS)				ON THE DAY OF EXAM (15 MARKS)		TOTAL INTERNAL (50 MARKS)
EXPERIMENT (5 MARKS)	FILE WORK (10 MARKS)	VIVA (10 MARKS)	ATTENDANCE (10 MARKS)	EXPERIMENT (5 MARKS)	VIVA (10 MARKS)	

External Evaluation (50 marks)
The external evaluation would also be done by the external Examiner based on the experiment conducted during the examination.

EXPERIMENT (20 MARKS)	FILE WORK (10 MARKS)	VIVA (20 MARKS)	TOTAL EXTERNAL (50 MARKS)

Course Code: BAS465	B.Sc (H) Chemistry (Semester-IV) Physical Chemistry-IV (Lab)	L-0 T-0 P-4 C-2
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Determination of cell constant.	
CO2.	Determining the equivalent conductance and dissociation constant of a weak acid by using conductivity meter.	
CO3.	Analyzing the acid- base conductometric titrations curve and determining the strength of an acid.	
CO4.	Estimating the strength of an acid through potentiometric titrations.	
Course Content:		

List of Experiments:

Conductometry:

1. Determination of cell constant
2. Determination of equivalent conductance, degree of dissociation and dissociation constant of a weak acid.
3. Perform the following conductometric titrations:
   - **a)** Strong acid vs. strong base
   - **b)** Weak acid vs. strong base
   - **c)** Mixture of strong acid and weak acid vs. strong base
   - **d)** Strong acid vs. weak base

Potentiometry:

1. Perform the following potentiometric titrations:
   - **a)** Strong acid vs. strong base
   - **b)** Weak acid vs. strong base
   - **c)** Dibasic acid vs. strong base
   - **d)** Potassium dichromate vs. Mohr's salt

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Text & Reference Books:

1. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi.
2. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. Experiments in Physical Chemistry; McGraw-Hill: New York.
3. Halpern, A. M. &McBane, G. C. Experimental Physical Chemistry; W.H. Freeman & Co.: New York.

*** Latest editions of all the suggested books are recommended**

Evaluation Scheme of Practical Examination:
Internal Evaluation (50 marks)
Each experiment would be evaluated by the faculty concerned on the date of the experiment on a 4-point scale which would include the practical conducted by the students and a Viva taken by the faculty concerned. The marks shall be entered on the index sheet of the practical file.

Evaluation scheme:

PRACTICAL PERFORMANCE & VIVA DURING THE SEMESTER (35 MARKS)				ON THE DAY OF EXAM (15 MARKS)		TOTAL INTERNAL (50 MARKS)
EXPERIMENT (5 MARKS)	FILE WORK (10 MARKS)	VIVA (10 MARKS)	ATTENDANCE (10 MARKS)	EXPERIMENT (5 MARKS)	VIVA (10 MARKS)	

External Evaluation (50 marks)

The external evaluation would also be done by the external Examiner based on the experiment conducted during the examination.

EXPERIMENT (20 MARKS)	FILE WORK (10 MARKS)	VIVA (20 MARKS)	TOTAL EXTERNAL (50 MARKS)

Course Code: BGP411	B.Sc.(H) Chemistry- Semester-IV **Discipline & General Proficiency**	L-0 T-0 P-0 C-0

There shall be continuous evaluation of the student on the following broad parameters:

1. Observance of dress code.

2. Participation in Conferences /Workshops / Seminars.

3. Attendance in guest lectures, invited talks and special technical sessions organized from time to time.

4. Participation in community projects including NSS.

5. Exhibiting team spirit in different Culture & extra curriculum activities, Department Club activities of the University and College organized from time to time.

6. Observance of rule & regulations in the College/University, Behavior in Campus Premises, Bus, hostel mess and hostel.

7. Performance and awards received in different events (sports/ co-curricular activities) organized at College / University and other level.

8. General behavior

9. Any extraordinary achievement.

The above is an indicative list of parameters on which the students shall be continuously evaluated. The college may evaluate the student on the specific parameters by informing them through a notice displayed on the notice board before evaluation. There shall be no external examination for this course; however, the marks shall be included for calculation of cumulative Performance Index (CPI).

Head of Department would be display GP marks on notice board in prescribed format after IInd & IIIrd CT in semester:

S No		Enroll No.	Student Name	Dress code	Participation in Conferences /Workshops / Seminars	Participation in guest lectures, invited talks and special technical sessions	Participation in community Services	Participation in Culture & extra curriculum activities, Department Club Activities	Participation in sports/ co-curricular activities	General Behavior	Any Extra Achievement
				(5)	**(15)**	**(20)**	**(10)**	**(20)**	**(20)**	**(5)**	**(5)**
	Responsible for marks			Mentor	Head	Head	Mentor	Cultural Events Coordinator & Department Club Coordinator	Sports Coordinator	Mentor	Director or Principal

Course Code TMUGE401	**Value Added Course** **B.Sc.(H) Chemistry- Semester-IV** **English Communication – IV**	**L-2 T-0 P-2 C-0**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	**Remembering** adequate knowledge of grammar and vocabulary through prescribed text to address competitive exams.	
CO2.	**Understanding** the value of listening to understand the basic content.	
CO3.	**Understanding** the usage of English grammar in day to day context.	
CO4.	**Understating** about the skills required in corporate world.	
CO5.	**Applying** writing and comprehensive skills in English.	
CO6.	**Creating** a simple proposal and report.	
Course Content:		
Unit-1:	**Vocabulary & Grammar** • Homophones and Homonyms • Correction of Common Errors (with recap of English Grammar with its usage in practical context.) • Transformation of sentences	**12 Hours**
Unit-2:	**Essence of Effective listening & speaking** • Listening short conversation/ recording (TED talks / Speeches by eminent personalities) *Critical Review of these abovementioned* • Impromptu	**5 Hours**
Unit-3:	**Professional Writing** • Proposal: Significance, Types, Structure & AIDA • Report Writing: Significance, Types, Structure& Steps towards Report writing	**8 Hours**
Unit-4:	**Job Oriented Skills** • Cover Letter • Preparing Resume and Curriculum-Vitae • Interview: Types of Interview, Tips for preparing for Interview and Mock Interview • Corporate Expectation & Professional ethics: Skills expected in corporate world.	**10 Hours**
Unit-5:	**Value based text reading:** Short story • A Bookish Topic - R.K. Narayan	**5 Hours**
Text Books:	**1.** Singh R.P., An Anthology of English Essay, O.U.P. New Delhi	
Reference Books:	**1.** Joseph, Dr C.J. & Myall E.G. "A *Comprehensive Grammar of Current English*" Inter University Press, Delhi **2.** Chaudhary Sarla "Basic Concept of Professional Communication" Dhanpat Rai Publication, New Delhi. **3.** Kumar Sanjay &Pushplata "Communication Skills" Oxford University Press, New Delhi. ***Latest editions of all the suggested books are recommended.**	

Additional Electronics Reference Material	1- https://www.youtube.com/watch?v=dpYltVtsS_Q 2 - https://www.youtube.com/watch?v=QthdqIB0WS8 3 - https://www.youtube.com/watch?v=MrgHfK8Pcfk 4 - https://www.youtube.com/watch?v=860LtRxP3rw 5 - https://www.youtube.com/watch?v=0nN7Q7DrI6Q	
Methodology:	**1.** The content will be conveyed through Real life situations, Pair Conversation, Group Talk and Class Discussion. **2.** Language Lab software. **3.** Sentence transformation on daily activities and conversations. **4.** Conversational Practice will be effectively carried out by Face to Face & Via Media (Audio-Video Clips) **5.** Modern Teaching tools (PPT Presentation & Motivational videos with sub-titles) will be utilized.	

Evaluation Scheme

Internal Evaluation			**External Evaluation**		**Total Marks**
40 Marks			**60 Marks**		**100**
20 Marks (Best 2 out of Three CTs) ***(From Unit - I, III, IV & V)***	10 Marks (Oral Assignments) ***(From Unit - II & IV)***	10 Marks (Attendance)	40 Marks (External Written Examination) ***(From Unit -I, III, IV & V)***	20 Marks (External Viva)* ***(From Unit -II & IV)***	

*Parameters of External Viva

Content	**Body Language**	**Communication skills**	**Confidence**	**TOTAL**
05 Marks	05 Marks	05 Marks	05 Marks	20 Marks

***Note**: External Viva will be conducted by 2-member committee comprising*

a) *One Faculty teaching the class*

b) *One examiner nominated by University Examination cell.*

Each member will evaluate on a scale of 20 marks and the average of two would be the 20 marks obtained by the students.

Course Code: TMUGS-401	Value Added Course B.Sc.(H) Chemistry- Semester-IV Managing Work and Others	L-2 T-1 P-0 C-0
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Communicating effectively in a variety of public and interpersonal settings.	
CO2.	Applying concepts of change management for growth and development by understanding inertia of change and mastering the Laws of Change.	
CO3.	Analyzing scenarios, synthesizing alternatives and thinking critically to negotiate, resolve conflicts and develop cordial interpersonal relationships.	
CO4.	Functioning in a team and enabling other people to act while encouraging growth and creating mutual respect and trust.	
CO5.	Handling difficult situations with grace, style, and professionalism.	
Course Content:		
Unit-1:	**Intrapersonal Skills:** Creativity and Innovation Understanding self and others (Johari window) Stress Management Managing Change for competitive success Handling feedback and criticism	**8 Hours**
Unit-2:	**Interpersonal Skills:** Conflict management Development of cordial interpersonal relations at all levels Negotiation Importance of working in teams in modern organisations Manners, etiquette and net etiquette	**12 Hours**
Unit-3:	**Interview Techniques:** Job Seeking Group discussion (GD) Personal Interview	**10 Hours**
Reference Books:	1. Robbins, Stephen P., Judge, Timothy A., Vohra, Neharika, Organizational Behaviour (2018), 18th ed., Pearson Education 2. Burne, Eric, Games People Play (2010), Penguin UK 3. Carnegie, Dale, How to win friends and influence people (2004), RHUK 4. Rathgeber, Holger, Kotter, John, Our Iceberg is melting (2017), Macmillan 5. Steinburg, Scott, Nettiquette Essentials (2013), Lulu.com	

	6. https://www.hloom.com/resumes/creative-templates/ 7. https://www.mbauniverse.com/group-discussion/topic.php 8. https://www.indeed.com/career-advice/interviewing/job-interview-tips-how-to-make-a-great-impression *** Latest editions of all the suggested books are recommended.**	

Course Code: BAS525	B.Sc (H) Chemistry (Semester-V) Organic Chemistry-IV	L-4 T-0 P-0 C-4
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Remembering & understanding mono, di & polysaccharides, amino acids, peptides, proteins, Nuclelic acid. Enzymes & Coenzymes & concept of energy in biosystem.	
CO2.	Remembering & understanding the role of Enzymes & Coenzymes in human body & concept of energy in biosystem.	
CO3.	Understanding the concept of reducing & non reducing sugars.	
CO4.	Understanding the concept of Zwitter ion, structure of peptides & nucleic acid, Characteristics of Enzyme & Coenzyme.	
CO5.	Applying knowledge in synthesis of sugar peptides, proteins, Nuclelic acid & role of enzyme can be assigned.	
Course Content:		
Unit-1:	**Carbohydrates:** Monosaccharides: Constitution and absolute configuration of glucose and fructose, epimers and anomers, mutarotation, determination of ring size of glucose and fructose, Haworth projections and conformational structures; Interconversions of aldoses and ketoses; Killiani-Fischer synthesis and Ruff degradation; Disaccharides – Structure elucidation of maltose, lactose and sucrose. Polysaccharides – Elementary treatment of starch, cellulose and glycogen.	**8 Hours**
Unit-2:	**Amino Acids, Peptides and Proteins:** Amino acids, Peptides and their classification. A-Amino Acids – Synthesis, ionic properties and reactions. Zwitterions, pKa values, isoelectric point and electrophoresis; Study of peptides: determination of their primary structures-end group analysis, methods of peptide synthesis. Synthesis of peptides using N-protecting, C-protecting and C-activating groups.	**8 Hours**
Unit-3:	**Nucleic Acids:** Components of nucleic acids, Nucleosides and nucleotides; Structure, synthesis and reactions of: Adenine, Guanine, Cytosine, Uracil and Thymine.	**8 Hours**
Unit-4:	**Enzymes:** Introduction, classification and characteristics of enzymes. Salient features of active site Tof enzymes. Mechanism of enzyme action, factors affecting	**8 Hours**

	enzyme action, coenzymes and cofactors and their role in biological reactions, specificity of enzyme action, enzyme inhibitors and their importance, phenomenon of inhibition.	
Unit-5:	**Concept of Energy in Biosystems:** Introduction to metabolism (catabolism, anabolism). ATP: The universal currency of cellular energy, ATP hydrolysis and free energy change. Agents for transfer of electrons in biological redox systems: NAD^+, FAD. Conversion of food to energy: Outline of catabolic pathways of carbohydrate- glycolysis, fermentation, Krebs cycle. Overview of catabolic pathways of fat and protein. Interrelation ship in the metabolic pathways of protein, fat and carbohydrate.	**8 Hours**
Text Book:	**1.** Murray, R.K., Granner, D.K., Mayes, P.A. & Rodwell, V.W., Harper's Illustrated Biochemistry, Lange Medical Books/ McGraw-Hill.	
Reference Books:	**2.** Berg, J.M., Tymoczko, J.L. & Stryer, L. Biochemistry, W.H. Freeman and Co. **3.** Nelson, D.L., Cox, M.M. & Lehninger, A.L., Principles of Biochemistry, W.H. Freeman and Co. **4.** https://www.medicalnewstoday.com/articles/161547#what-are-carbohydrates *** Latest editions of all the suggested books are recommended.**	

Course Code: BAS526	B.Sc (H) Chemistry (Semester-V) Physical Chemistry-V	L-4 T-0 P-0 C-4
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	***Understanding*** the interaction of electromagnetic radiation with molecules.	
CO2.	***Understanding*** the types of spectroscopy and their selection rules.	
CO3.	***Understanding*** the basic principle of rotational, vibrational, Raman, electronic, NMR, ESR spectroscopy.	
CO4.	***Understanding*** the laws of photochemistry and quantum yield.	
CO5.	***Analyzing*** the PMR spectra of simple organic molecule.	
Course Content:		
Unit-1:	**Rotational spectroscopy:** Interaction of electromagnetic radiation with molecules and various types of spectra; Born-Oppenheimer approximation. Rotation spectroscopy: Selection rules, intensities of spectral lines, determination of bond lengths of diatomic and linear triatomic molecules, isotopic substitution.	**8 Hours**
Unit-2:	**Vibrational Spectroscopy:** Vibrational spectroscopy: Classical equation of vibration, computation of force constant, amplitude of diatomic molecular vibrations, anharmonicity, Morse potential, dissociation energies, fundamental frequencies, overtones, hot bands, degrees of freedom for polyatomic molecules, modes of vibration, concept of group frequencies. Vibration-rotation spectroscopy: diatomic vibrating rotator, P, Q, R branches.	**8 Hours**
Unit-3:	**Raman and electronic spectroscopy:** Qualitative treatment of Rotational Raman effect; Effect of nuclear spin, Vibrational Raman spectra, Stokes and anti-Stokes lines; their intensity difference, rule of mutual exclusion. Application of IR and Raman spectroscopy. Franck-Condon principle, electronic transitions, singlet and triplet states, fluorescence and phosphorescence, dissociation and predissociation.	**8 Hours**
Unit-4:	**NMR and ESR Spectroscopy:** **Nuclear Magnetic Resonance (NMR) spectroscopy**: Principles of NMR spectroscopy, Larmor precession, chemical shift and low-resolution spectra, different scales, spin-spin coupling and high-resolution spectra, interpretation of PMR spectra of organic molecules. **Electron Spin Resonance (ESR) spectroscopy**: Its principle, hyperfine structure, ESR of simple radicals.	**8 Hours**

Unit-5:	**Photochemistry:** Characteristics of electromagnetic radiation, Lambert-Beer's law and its limitations, physical significance of absorption coefficients. Laws, of photochemistry, quantum yield, actinometry, examples of low and high quantum yields, photochemical equilibrium and the differential rate of photochemical reactions, photosensitized reactions, quenching. Role of photochemical reactions in biochemical processes (PHOTOSYNTHESIS), photo stationarystates, chemiluminescence.	**8 Hours**
Text Books:	**1.** Banwell, C. N. & Mc. Cash, E. M. Fundamentals of Molecular Spectroscopy, Tata McGraw-Hill: New Delhi.	
Reference Books	1 .Atkins, P.W & Paula, J.D. Physical Chemistry, Oxford University Press. **1.** Castellan, G. W. Physical Chemistry, Narosa. **2.** Barrow, G. M., Physical Chemistry, Tata McGraw Hill: New Delhi. **3.** https://www.youtube.com/watch?v=FWCN_ul5ygY *** Latest editions of all the suggested books are recommended.**	

Course Code: BHM515	B.Sc.(H) Chemistry- Semester-V **Human Values & Professional Ethics**	L-3 T-0 P-0 C-3
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	**Understanding** the importance of value education in life and method of self-exploration.	
CO2.	**Understanding** 'Natural Acceptance' and Experiential Validation- as the mechanism for self-exploration.	
CO3.	**Applying** right understanding about relationship and physical facilities.	
CO4.	**Analysing** harmony in myself, harmony in the family and society, harmony in the nature and existence.	
CO5.	**Evaluating** human conduct on ethical basis.	
Course Content:		
Unit-1:	Understanding of Morals, Values and Ethics; Introduction to Value Education- need for Value Education. Self- Exploration– content and process; 'Natural Acceptance' and Experiential Validation- as the mechanism for self-exploration. Continuous Happiness and Prosperity- basic Human Aspirations. Gender Issues: Gender Discrimination and Gender Bias (home & office), Gender issues in human values, morality and ethics.	**8 Hours**
Unit-2:	Conflicts of Interest: Conflicts between Business Demands and Professional Ethics. Social and Ethical Responsibilities of Technologists. Ethical Issues at Workplace: Discrimination, Cybercrime, Plagiarism, Sexual Misconduct, Fraudulent Use of Institutional Resources. Intellectual Property Rights and its uses. Whistle blowing and beyond, Case study.	**8 Hours**
Unit-3:	Harmony in the Family and Society- Harmony in Human-Human Relationship, Understanding harmony in the Family- the basic unit of human interaction. Understanding values in human-human relationship; meaning of Nyaya; Trust (Vishwas) and Respect (Samman) as the foundational values of relationship. Understanding the meaning of Vishwas; Difference between intention and competence. Understanding the meaning of Samman and other salient values in relationship.	**8 Hours**
Unit-4:	Understanding Harmony in the Nature and Existence – Whole existence as Co-existence. Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and self-regulation in nature. Understanding Existence as Coexistence (Sah-astitva) of mutually interacting units in all pervasive space. Holistic perception of harmony at all levels of existence.	**8 Hours**
Unit-5:	Implications of the above Holistic Understanding of Harmony on Professional Ethics. Natural acceptance of human values. Definitiveness of Ethical Human Conduct. Competence in professional ethics:	**8 Hours**

	a) Ability to utilize the professional competence for augmenting universal human order b) Ability to identify the scope and characteristics of people friendly and eco-friendly production systems c) Ability to identify and develop appropriate technologies and management patterns for above production systems.	
Text Book:	**1.** R R Gaur, R Sangal, G P Bagaria, A Foundation Course in Value Education.	
Reference Books:	**1.** Ivan Illich, Energy & Equity, The Trinity Press, Worcester, and HarperCollins, USA 2. E.F. Schumacher, Small is Beautiful: a study of economics as if people mattered, Blond & Briggs, Britain. **2.** A Nagraj, Jeevan Vidya ek Parichay, Divya Path Sansthan, Amarkantak. **3.** Sussan George, How the Other Half Dies, Penguin Press. Reprinted. **4.** PL Dhar, RR Gaur, Science and Humanism, Commonwealth Purblishers. **5.** A.N. Tripathy, Human Values, New Age International Publishers. **6.** E G Seebauer & Robert L. Berry, Fundamentals of Ethics for Scientists & Engineers, Oxford University Press. ***Latest editions of all the suggested books are recommended.**	
Additional electronics reference material	https://www.youtube.com/watch?v=Cnw1nK3K5qk https://www.youtube.com/watch?v=hTTCMrQyF8E	

Course Code: BAS527	B.Sc (H) Chemistry (Semester-V) Analytical Chemistry	L-4 T-0 P-0 C-4
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Remembering the Qualitative and quantitative aspects of analysis	
CO2.	Remembering & understanding the mechanism of Solvent extraction.	
CO3.	Understanding the basic principles of Optical methods of analysis.	
CO4.	Understanding the basic principles of thermal and Electroanalytical methods of analysis.	
CO4.	Understanding the mechanism of chromatographic separation.	
Course Content:		
Unit-1:	**Qualitative and quantitative aspects of analysis:** Sampling, evaluation of analytical data, errors, accuracy and precision, methods of their expression, normal law of distribution if indeterminate errors, statistical test of data; F, Q and t test, rejection of data, and confidence intervals	**8 Hours**
Unit-2:	**Optical methods of analysis:** Origin of spectra, interaction of radiation with matter, fundamental laws of spectroscopy and selection rules, validity of Beer-Lambert's law. UV-Visible Spectrometry: Basic principles of instrumentation (choice of source, monochromator and detector) for single and double beam instrument; Infrared Spectrometry: Basic principles of instrumentation (choice of source, monochromator& detector) for single and double beam instrument; sampling techniques, Effect and importance of isotope substitution. Flame Atomic Absorption and Emission Spectrometry: Basic principles of instrumentation (choice of source, monochromator, detector, choice of flame and Burner designs. Techniques of atomization and sample introduction.	**8 Hours**
Unit-3:	**Thermal and Electroanalytical methods of analysis:** Theory of thermogravimetry (TG), basic principle of instrumentation. Techniques for quantitative estimation of Ca and Mg from their mixture. Classification of electroanalytical methods, basic principle of pH metric, potentiometric and conductometric titrations. Techniques used for the determination of equivalence points. Techniques used for the determination of pKa values.	**8 Hours**
Unit-4:	**Separation techniques I:** Solvent extraction: Classification, principle and efficiency of the technique. Mechanism of extraction: extraction by solvation and chelation. Technique of extraction: batch, continuous and counter current extractions Qualitative and quantitative aspects of solvent extraction: extraction of metal ions from aqueous solution, extraction of organic species from the aqueous and non-aqueous media.	**8 Hours**

Unit-5:	**Separation techniques II:** Chromatography: Classification, principle and efficiency of the technique. Mechanism of separation: adsorption, partition & ion exchange. Development of chromatograms: frontal, elution and displacement methods. Qualitative and quantitative aspects of chromatographic methods of analysis: IC, GLC, GPC, TLC and HPLC.	**8 Hours**
Text Books:	**1.** Mendham, J., A. I. Vogel's Quantitative Chemical Analysis, Pearson.	
Reference Books:	**2.** Willard, H.H. et al.: Instrumental Methods of Analysis, Wardsworth Publishing Company, Belmont, California, USA. **3.** Christian, G.D. Analytical Chemistry, John Wiley& Sons, New York. **4.** Harris, D.C.: Exploring Chemical Analysis, New York, W.H. Freeman. **5.** Khopkar, S.M. Basic Concepts of Analytical Chemistry. New Age International Publisher. **6.** Skoog, D.A. Holler F.J. & Nieman, T.A. Principles of Instrumental Analysis, Cengage Learning India Ed. **7.** https://www.youtube.com/watch?v=PvHvx7k7UPU *** Latest editions of all the suggested books are recommended.**	

Course Code: BAS529	B.Sc (H) Chemistry (Semester-V) Molecular modeling & Drug Design	L-4 T-0 P-0 C-4
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Understanding the principles of Molecular modeling, information regarding the software and hardware related to it.	
CO2.	Understanding various force field used in Molecular modeling.	
CO3.	Understanding different methods of energy minimization and related methods.	
CO4.	Understanding principles of Molecular Dynamics Simulation methods.	
CO5.	Analyzing structure prediction, basic introduction to comparative modeling and Cheminformatics.	
Course Content:		
Unit-1:	**Introduction to Molecular Modelling:** Introduction. Useful Concepts in Molecular Modelling: Coordinate Systems. Potential Energy Surfaces. Molecular Graphics. Surfaces. Computer **Hardware and Software. The Molecular Modelling Literature.**	**8 Hours**
Unit-2:	**Force Fields:** Fields. Bond Stretching. Angle Bending. Introduction to nonbonded interactions. Electrostatic interactions. Van der Waals Interactions. Hydrogen bonding in Molecular Mechanics. Force Field Models for the Simulation of Liquid Water	**8 Hours**
Unit-3:	**Energy Minimization and Computer Simulation:** Minimization and related methods for exploring the energy surface. Non-derivative method, First and second order minimization methods. Computer simulation methods. Simple thermodynamic properties and Phase Space. Boundaries. Analyzing the results of a simulation and estimating Errors.	**8 Hours**
Unit-4:	**Molecular Dynamics & Monte Carlo Simulation:** Molecular Dynamics Simulation Methods. Molecular Dynamics using simple models. Molecular Dynamics with continuous potentials. Molecular Dynamics at constant temperature and pressure. Metropolis method. Monte Carlo simulation of molecules. Models used in Monte Carlo simulations of polymers	**8 Hours**
Unit-5:	**Structure Prediction and Drug Design:** Structure prediction – Introduction to comparative Modeling. Sequence alignment. Constructing and evaluating a comparative model. Predicting protein structures by 'Threading', Molecular docking. Structure based de novo ligand design, Drug Discovery – Chemoinformatics – QSAR.	**8 Hours**
Text Books:	**1.** A.R. Leach, *Molecular Modelling Principles and Application*, Longman, 2001.	
Reference Books:	1. J.M. Haile, *Molecular Dynamics Simulation Elementary Methods*, John	

	Wiley and Sons, 1997. 2. Satya Prakash Gupta, *QSAR and Molecular Modeling*, Springer - Anamaya Publishers, 2008. 3. https://www.ias.ac.in/article/fulltext/reso/009/05/0051-0060 *** Latest editions of all the suggested books are recommended.**	

Course Code: BAS563	B.Sc (H) Chemistry (Semester-IV) Analytical Chemistry (Lab)	L-0 T-0 P-4 C-2
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Understanding Paper chromatographic method of Fe^{3+}, Al^{3+}, and Cr^{3+}.	
CO2.	**S**eparation and identification of the monosaccharides present in the given mixture (glucose & fructose) by paper chromatography.	
CO3.	Understanding Chromatographic separation of the active ingredients of plants, flowers and juices by TLC.	
CO4.	Determining the pH of the given aerated drinks fruit juices, shampoos and soaps. Determination of Na, Ca, Li in cola drinks and fruit juices using fame photometric techniques.	
CO5.	Analyzing the soil (pH, Estimation of calcium, magnesium, phosphate, nitrate)	
CO6.	Determining of pK_a values of indicator using spectrophotometry.	
CO7.	Analyzing pre-recorded IR spectroscopic data of organic compounds.	
Course Content:		

List of Experiments:

I. Separation Techniques:

1. Chromatography:

(a) Separation of mixtures

i. Paper chromatographic separation of Fe^{3+}, Al^{3+}, and Cr^{3+}.

ii. Separation and identification of the monosaccharides present in the given mixture (glucose & fructose) by paper chromatography. Reporting the Rf values.

(b) Separate a mixture of Sudan yellow and Sudan Red by TLC technique and identify them on the basis of their Rf values.

(c) Chromatographic separation of the active ingredients of plants, flowers and juices by TLC

II. Solvent Extractions:

2. To separate a mixture of Ni^{2+}& Fe^{2+} by complexation with DMG and extracting the Ni^{2+}-DMG complex in chloroform, and determine its concentration by spectrophotometry.

i. Solvent extraction of zisconium with amberliti LA-1, separation from a mixture of irons and gallium.

3. Determine the pH of the given aerated drinks fruit juices, shampoos and soaps.
4. Determination of Na, Ca, Li in cola drinks and fruit juices using fame photometric techniques.
5. Analysis of soil:
   i. Determination of pH of soil.
   ii. Total soluble salt
   iii. Estimation of calcium, magnesium, phosphate, nitrate

6. Ion exchange:

   i. Determination of exchange capacity of cation exchange resins and anion exchange resins.

III Spectrophotometry:

7. Determination of pKa values of indicator using spectrophotometry.
8. Structural characterization of compounds by infrared spectroscopy.

Text &Reference Books:

1. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis, Pearson.
2. Willard, H.H. et al.: Instrumental Methods of Analysis, Wardsworth Publishing Company, Belmont, California, USA.
3. Christian, G.D. Analytical Chemistry, John Wiley & Sons, New York.
4. Harris, D.C. Exploring Chemical Analysis, New York, W.H. Freeman.
5. Khopkar, S.M. Basic Concepts of Analytical Chemistry. New Age International Publisher.
6. Skoog, D.A. Holler F.J. and Nieman, T.A. Principles of Instrumental Analysis, Cengage Learning India Edition.

*** Latest editions of all the suggested books are recommended**

Evaluation Scheme of Practical Examination:

Internal Evaluation (50 marks)

Each experiment would be evaluated by the faculty concerned on the date of the experiment on a 4-point scale which would include the practical conducted by the students and a Viva taken by the faculty concerned. The marks shall be entered on the index sheet of the practical file.

Evaluation scheme:

PRACTICAL PERFORMANCE & VIVA DURING THE SEMESTER (35 MARKS)				ON THE DAY OF EXAM (15 MARKS)		TOTAL INTERNAL (50 MARKS)
EXPERIMENT (5 MARKS)	FILE WORK (10 MARKS)	VIVA (10 MARKS)	ATTENDANCE (10 MARKS)	EXPERIMENT (5 MARKS)	VIVA (10 MARKS)	

External Evaluation (50 marks)

The external evaluation would also be done by the external Examiner based on the experiment conducted during the examination.

EXPERIMENT (20 MARKS)	FILE WORK (10 MARKS)	VIVA (20 MARKS)	TOTAL EXTERNAL (50 MARKS)

Course Code: BAS565	B.Sc (H) Chemistry (Semester-V) Molecular Modeling & Drug Design (Lab)	L-0 T-0 P-4 C-2
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Remembering methods of Structure editing and optimizations.	
CO2.	Analyzing and visualizing the electron density maps of different molecules	
CO3.	Analyzing and visualizing the electrostatic potential maps of different molecules	
CO4.	Building and minimizing organic compounds of your choice containing different functional groups.	
CO5.	Understanding the optimization of bond angles of H_2O, H_2S, and H_2Se.	
Course Content:		

List of Experiments:

1. Compare the optimized C-C bond lengths in ethane, ethene, ethyne and benzene. Visualize the molecular orbitals of the ethane σ bonds and ethene, ethyne, benzene and pyridine π bonds.
2. Perform a conformational analysis of butane. (b) Determine the enthalpy of isomerization of *cis* and *trans* 2-butene
3. Visualize the electron density and electrostatic potential maps for LiH, HF, N_2, NO and CO and comment. Relate to the dipole moments. Animate the vibrations of these molecules.
4. Relate the charge on the hydrogen atom in hydrogen halides with their acid character. (b) Compare the basicities of the nitrogen atoms in ammonia, methylamine, dimethylamine and trimethylamine.
5. Compare the shapes of the molecules: 1-butanol, 2-butanol, 2-methyl-1-propanol, and 2-methyl-2-propanol. Note the dipole moment of each molecule. (b) Show how the shapes affect the trend in boiling points: (118 ºC, 100 ºC, 108 ºC, 82 ºC, respectively).
6. Build and minimize organic compounds of your choice containing the following functional groups. Note the dipole moment of each compound: (a) alkyl halide (b) aldehyde (c) ketone (d) amine (e) ether (f) nitrile (g) thiol (h) carboxylic acid (i) ester (j) amide.
7. (a) Determine the heat of hydration of ethylene. (b) Compute the

resonance energy of benzene by comparison of its enthalpy of hydrogenation with that of cyclohexene.

8. Arrange 1-hexene, 2-methyl-2-pentene, (*E*)-3-methyl-2-pentene, (*Z*)-3-methyl-2- pentene, and 2,3-dimethyl-2-butene in order of increasingstability.
9. (a) Compare the optimized bond angles H_2O, H_2S, H_2Se. (b) Compare the HAH bond angles for the second row dihydrides and compare with the results from qualitative MO theory.

Note: **Software: ChemSketch, ArgusLab (www.planaria-software.com), TINKER 6.2 (dasher.wustl.edu/ffe), WebLab Viewer, Hyperchem, or any similar software.**

Evaluation Scheme of Practical Examination:
Internal Evaluation (50 marks)
Each experiment would be evaluated by the faculty concerned on the date of the experiment on a 4-point scale which would include the practical conducted by the students and a Viva taken by the faculty concerned. The marks shall be entered on the index sheet of the practical file.

Evaluation scheme:

PRACTICAL PERFORMANCE & VIVA DURING THE SEMESTER (35 MARKS)				ON THE DAY OF EXAM (15 MARKS)		TOTAL INTERNAL (50 MARKS)
EXPERIMENT (5 MARKS)	FILE WORK (10 MARKS)	VIVA (10 MARKS)	ATTENDANCE (10 MARKS)	EXPERIMENT (5 MARKS)	VIVA (10 MARKS)	

External Evaluation (50 marks)
The external evaluation would also be done by the external Examiner based on the experiment conducted during the examination.

EXPERIMENT (20 MARKS)	FILE WORK (10 MARKS)	VIVA (20 MARKS)	TOTAL EXTERNAL (50 MARKS)

Course Code: BAS561	B.Sc (H) Chemistry (Semester-V) Organic Chemistry-IV (Lab)	L-0 T-0 P-4 C-2
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Understanding estimation of amino acids & proteins.	
CO2.	Understanding estimation of glycine by Sorenson's formalin method.	
CO3.	Understanding the effect of temperature on the action of salivary amylase.	
CO4.	Determining saponification value & Iodine value of oil & fats.	
CO5.	Understanding the action of salivary amylase on starch.	
Course Content:		

List of Experiments:

1. Estimation of glycine by Sorenson's formalin method.
2. Estimation of proteins by Lowry's method.
3. Study of the action of salivary amylase on starch at optimum conditions.
4. Effect of temperature on the action of salivary amylase.
5. Saponification value of oil or a fat.
6. Determination of Iodine number of an oil/ fat.

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Text & Reference Books:

1. Manual of Biochemistry Workshop, Department of Chemistry, University of Delhi.
2. Arthur, I. V. Quantitative Organic Analysis, Pearson.

*** Latest editions of all the suggested books are recommended**

Evaluation Scheme of Practical Examination:
Internal Evaluation (50 marks)
Each experiment would be evaluated by the faculty concerned on the date of the experiment on a 4-point scale which would include the practical conducted by the students and a Viva taken by the faculty concerned. The marks shall be entered on the index sheet of the practical file.

Evaluation scheme:

PRACTICAL PERFORMANCE & VIVA DURING THE SEMESTER (35 MARKS)				ON THE DAY OF EXAM (15 MARKS)		TOTAL INTERNAL (50 MARKS)
EXPERIMENT (5 MARKS)	FILE WORK (10 MARKS)	VIVA (10 MARKS)	ATTENDANCE (10 MARKS)	EXPERIMENT (5 MARKS)	VIVA (10 MARKS)	

External Evaluation (50 marks)

The external evaluation would also be done by the external Examiner based on the experiment conducted during the examination.

EXPERIMENT (20 MARKS)	FILE WORK (10 MARKS)	VIVA (20 MARKS)	TOTAL EXTERNAL (50 MARKS)

Course Code: BAS562	B.Sc (H) Chemistry (Semester-IV) Physical Chemistry-V (Lab)	L-0 T-0 P-4 C-2
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	***Determining*** the concentration of $KMnO_4$/ $K_2Cr_2O_7$ and in its mixture by using colorimeter.	
CO2.	***Analyzing*** the kinetic study of iodination of propanone in acidic medium by using colorimeter.	
CO3.	***Determining*** the dissociation constant of an indicator.	
CO4.	***Analyzing*** the coloured compound and ***determining*** the λ_{max} of that compound by using UV-VIS spectrophotometer.	
CO5.	Understanding the kinetics of interaction of crystal violet/ phenolphthalein with sodium hydroxide.	
Course Content:		

List of Experiments:
UV/Visible spectroscopy:

i. Study the 200-500 nm absorbance spectra of KMnO4 and K2Cr2O7 (in 0.1 M H2SO4) and determine the λmax values. Calculate the energies of the two transitions in different units (J molecule^{-1}, kJ mol^{-1}, cm^{-1}, eV).
ii. Study the pH-dependence of the UV-Vis spectrum (200-500 nm) of K2Cr2O7.
iii. Record the 200-350 nm UV spectra of the given compounds (acetone, acetaldehyde, 2-propanol, acetic acid) in water. Comment on the effect of structure on the UV spectra of organic compounds.

Colourimetry:

i. Verify Lambert-Beer's law and determine the concentration of CuSO4/KMnO4/K2Cr2O7 in a solution of unknown concentration
ii. Determine the concentrations of KMnO4 and K2Cr2O7 in a mixture.
iii. Study the kinetics of iodination of propanone in acidic medium.
iv. Determine the amount of iron present in a sample using 1,10-phenathroline.
v. Determine the dissociation constant of an indicator (phenolphthalein).
vi. Study the kinetics of interaction of crystal violet/ phenolphthalein with sodium hydroxide.

Text &Reference Books

1. Khosla, B. D.; Garg, V. C. & Gulati, A., Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi.

2. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. Experiments in Physical Chemistry; McGraw-Hill: New York.

3. Halpern, A. M. & Mc. Bane, G. C. Experimental Physical Chemistry; W.H. Freeman & Co.: New York.

*** Latest editions of all the suggested books are recommended**

Evaluation Scheme of Practical Examination:

Internal Evaluation (50 marks)
Each experiment would be evaluated by the faculty concerned on the date of the experiment on a 4-point scale which would include the practical conducted by the students and a Viva taken by the faculty concerned. The marks shall be entered on the index sheet of the practical file.

Evaluation scheme:

PRACTICAL PERFORMANCE & VIVA DURING THE SEMESTER (35 MARKS)				ON THE DAY OF EXAM (15 MARKS)		TOTAL INTERNAL (50 MARKS)
EXPERIMENT (5 MARKS)	FILE WORK (10 MARKS)	VIVA (10 MARKS)	ATTENDANCE (10 MARKS)	EXPERIMENT (5 MARKS)	VIVA (10 MARKS)	

External Evaluation (50 marks)

The external evaluation would also be done by the external Examiner based on the experiment conducted during the examination.

EXPERIMENT (20 MARKS)	FILE WORK (10 MARKS)	VIVA (20 MARKS)	TOTAL EXTERNAL (50 MARKS)

Course Code: BAS598	B.Sc. (H)-Chemistry- Semester-V **Industrial Training & Presentation**	L-0 T-0 P-6 C-3
Course Procedure:		
	Students will have to undergo industrial training of six weeks in any industry or reputed organization after the II semester examination in summer. The evaluation of this training shall be included in the V semester evaluation. The student will be assigned a faculty guide who would be the supervisor of the student. The faculty would be identified before the end of the IV semester and shall be the nodal officer for coordination of the training. Students will prepare an exhaustive technical report of the training during the V semester which will be duly signed by the officer under whom training was undertaken in the industry/ organization. The covering format shall be signed by the concerned office in-charge of the training in the industry. The officer-in-charge of the trainee would also give his rating of the student in the standard University format in a sealed envelope to the Director/Principal of the college. The student at the end of the V semester will present his report about the training before a committee constituted by the Director/Principal of the College which would comprise of at least three members comprising of the Department Coordinator, Class Coordinator and a nominee of the Director/Principal. The students guide would be a special invitee to the presentation. The seminar session shall be an open house session. The internal marks would be the average of the marks given by each member of the committee separately in a sealed envelope to the Director/Principal. The marks by the external examiner would be based on the report submitted by the student which shall be evaluated by the external examiner and cross examination done of the student concerned. Not more than three students would form a group for such industrial training/ project submission.	
	The marking shall be as follows.	
Internal: **50 marks**	By the Faculty Guide – 25 marks. By Committee appointed by the Director/Principal – 25 marks.	
External: **50 marks**	By Officer-in-charge trainee in industry – 25 marks. By External examiner appointed by the University – 25 marks	
	Technical report will consist five chapter as per given format:	
Chapter 1:	Brief about organization	
Chapter 2:	Detail of business carried out by organization	
Chapter 3:	Specific contribution during the industrial training (not more than 500 words)	
Chapter 4:	Learning during the industrial training (not more than 200 words)	
Chapter 5:	Conclusion	

Course Code: BGP511	B.Sc.(H) Chemistry- Semester-V **Discipline & General Proficiency**	L-0 T-0 P-0 C-0

There shall be continuous evaluation of the student on the following broad parameters:

1. Observance of dress code.

2. Participation in Conferences /Workshops / Seminars.

3. Attendance in guest lectures, invited talks and special technical sessions organized from time to time.

4. Participation in community projects including NSS.

5. Exhibiting team spirit in different Culture & extra curriculum activities, Department Club activities of the University and College organized from time to time.

6. Observance of rule & regulations in the College/University, Behavior in Campus Premises, Bus, hostel mess and hostel.

7. Performance and awards received in different events (sports/ co-curricular activities) organized at College / University and other level.

8. General behavior

9. Any extraordinary achievement.

The above is an indicative list of parameters on which the students shall be continuously evaluated. The college may evaluate the student on the specific parameters by informing them through a notice displayed on the notice board before evaluation. There shall be no external examination for this course; however, the marks shall be included for calculation of cumulative Performance Index (CPI).

Head of Department would be display GP marks on notice board in prescribed format after IInd & IIIrd CT in semester:

S No		Enroll No.	Student Name	Dress code	Participation in Conferences /Workshops / Seminars	Participation in guest lectures, invited talks and special technical sessions	Participation in community Services	Participation in Culture & extra curriculum activities, Department Club Activities	Participation in sports/ co-curricular activities	General Behavior	Any Extra Achievement
				(5)	**(15)**	**(20)**	**(10)**	**(20)**	**(20)**	**(5)**	**(5)**
	Responsible for marks			Mentor	Head	Head	Mentor	Cultural Events Coordinator & Department Club Coordinator	Sports Coordinator	Mentor	Director or Principal

Course Code: BAS624	B.Sc (H) Chemistry (Semester-VI) Inorganic Chemistry-IV	L-4 T-0 P-0 C-4
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Remembering the symbols of acidic and basic radicals.	
CO2.	Understanding the classification of acidic, basic radicals, group reagents used in the analysis of inorganic mixture.	
CO3.	Understanding of organo-metallic compounds, synthesis of ionic and non ionic compounds.	
CO4.	Understanding the reaction mechanism, types of reactions and kinetics of tetrahedral and octahedral complexes.	
CO5.	Applying organo-metallic compounds as catalyst in the production of industrial products.	
Course Content:		
Unit-1:	**Theoretical Principles in Qualitative Analysis**: Basic principles involved in analysis of cations and anions, solubility products, common ion effect. Principals involved in separation of cations into groups and choice of group reagents. Interfering anions (fluoride, borate, oxalate and phosphate	**8 Hours**
Unit-2:	**Organometallic Compounds I:** Definition and classification of organometallic compounds, hapticity of organic ligands, 18 electron rules in metal carbonyls. General methods of preparation of mono and binuclear carbonyls of 3d series. Structures of mononuclear and binuclear carbonyls of Cr, Mn, Fe, Co and Ni using VBT. acceptor behaviour of CO (MO diagram of CO to be discussed), synergic effect. Zeise's salt: Preparation and structure, evidences of synergic effect.	**8 Hours**
Unit-3:	**Organometallic Compounds II:** Metal Alkyls: Important structural features of methyl lithium (tetramer) and trialkyl aluminium (dimer), concept of multicentre bonding in these compounds. Role of triethylaluminium in polymerisation of ethene (Ziegler – Natta Catalyst). Ferrocene: Preparation and reactions (acetylation, alkylation, metallation, Mannich Condensation). Structure and aromaticity. Comparison of aromaticity and reactivity with that of benzene	**8 Hours**
Unit-4:	**Reaction Kinetics and Mechanism:** Introduction to inorganic reaction mechanisms. Substitution reactions in square planar complexes, Trans- effect, theories of trans effect, Mechanism of nucleophilic substitution in square planar complexes, Thermodynamic and Kinetic stability, Kinetics of octahedral substitution, Ligand field effects and reaction rates, Mechanism of substitution in octahedral complexes.	**8 Hours**

Unit-5:	**Catalysis by Organometallic Compounds:** General principles, properties and types of catalysts; Role of catalyst in industrial processes: Alkene hydrogenation (Wilkinsons Catalyst), Hydroformylation (Co salts), Wacker Process, Synthetic gasoline (Fischer Tropsch reaction),Synthesis gas by metal carbonyl complexes Deactivation or regeneration of catalysts Phase transfer catalysts,	**8 Hours**
Text Books:	**1.** Cotton, F.A.G.; Wilkinson &Gaus, P.L. Basic Inorganic Chemistry; Wiley India,	
Reference Books:	**1.** Svehla, G. Vogel's Qualitative Inorganic Analysis, Prentice Hall. **2.** Huheey, J. E.; Keiter, E.A. &Keiter, R.L. Inorganic Chemistry, Principles of Structure and Reactivity, Harper Collins. **3.** Sharpe, A.G. Inorganic Chemistry, Pearson Education. **4.** Lee, J.D. Concise Inorganic Chemistry, John Wiley and sons. **5.** Powell, P. Principles of Organometallic Chemistry, Chapman and Hall. **6.** https://www.sciencedirect.com/topics/materials-science/organometallic-catalysis *** Latest editions of all the suggested books are recommended.**	

Course Code: BAS625	B.Sc (H) Chemistry (Semester-VI) Organic Chemistry-V	L-4 T-0 P-0 C-4
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Remembering enough knowledge of principles of UV Spectroscopy.	
CO2.	Understanding Knowledge in IR Spectroscopy.	
CO3.	Understanding UV and IR application in characterize & interpretation the spectra of organic compounds.	
CO4.	Remembering enough knowledge of principles of NMR Spectroscopy and to interpret the 1H NMR spectra of unknown organic compounds.	
CO5.	Students can gain enough knowledge regarding dyes, polymers, lipids & its industrial application.	
Course Content:		
Unit-1:	UV Spectroscopy: General principles Introduction to absorption and emission spectroscopy Types of electronic transitions, λmax, Chromophores and Auxo chromes, Bathochromic and Hypsochromic shifts, Intensity of absorption; Application of Woodward Rules for calculation of λmax for the following systems: α,β unsaturated aldehydes, ketones, carboxylic acids and esters; Conjugated dienes: alicyclic, homoannular and heteroannular; Extended conjugated systems (aldehydes, ketones and dienes); distinction between cis and trans isomers.	**8 Hours**
Unit-2:	IR Spectroscopy: Fundamental and non-fundamental molecular vibrations; IR absorption positions of O, N and S containing functional groups; Effect of H-bonding, conjugation, resonance and ring size on IR absorptions; Fingerprint region and its significance; application in functional group analysis.	**8 Hours**
Unit-3:	NMR Spectroscopy**:** Basic principles of Proton Magnetic Resonance, chemical shift and factors influencing it; Spin – Spin coupling and coupling constant; Anisotropic effects in alkene, alkyne, aldehydes and aromatics, Interpretation of NMR spectra of simple compounds. Applications of IR, UV and NMR for identification of simple organic molecules.	**8 Hours**
Unit-4:	**Dyes:** Classification, Colour and constitution; Mordant and Vat Dyes; Chemistry of dyeing; Synthesis and applications of: Azo dyes – Methyl Orange and Congo Red (mechanism of Diazo Coupling); Triphenyl Methane Dyes -Malachite Green, Rosaniline and Crystal Violet; Phthalein Dyes – Phenolphthalein and Fluorescein; Natural dyes – structure elucidation and synthesis of Alizarin and Indigotin; Edible Dyes with examples.	**8 Hours**

Unit-5:	Introduction and classification, Number average molecular weight, Weight average molecular weight, Degree of polymerization, Addition and condensation -Mechanism of cationic, anionic and free radical addition polymerization; Ziegler-Natta polymerisation of alkenes; Preparation and applications of plastics – thermosetting (phenol-formaldehyde, Polyurethanes) and thermosoftening (PVC, polythene); Fabrics – natural and synthetic (acrylic, polyamido, polyester); Rubbers – natural and synthetic: Buna-S, Chloroprene and Neoprene; Vulcanization.	**8 Hours**
Text Books:	**1.** Kalsi, P. S. Textbook of Organic Chemistry, New Age International (P) Ltd. Pub. **2.** Morrison, R. T. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).	
Reference Books:	**3.** Billmeyer, F. W. Textbook of Polymer Science, John Wiley & Sons, Inc. **4.** Gowariker, V. R.; Viswanathan, N. V. & Sreedhar, J. Polymer Science, New Age International (P) Ltd. Pub. **5.** Finar, I. L. Organic Chemistry, Stereochemistry and the Chemistry ofNatural Products), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education). **6.** McMurry, J.E. Fundamentals of Organic Chemistry, Cengage Learning India Edition. **7.** Clayden, J.; Greeves, N.; Warren, S.; Wothers, P.; Organic Chemistry, Oxford University Press. **8.** Kemp, W. Organic Spectroscopy, Palgrave **9.** https://www.youtube.com/watch?v=sfiQFQYgJuQ *** Latest editions of all the suggested books are recommended.**	

Course Code: BAS637	B.Sc (H) Chemistry (Semester-VI) Polymer Chemistry	L-4 T-0 P-0 C-4
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Remembering the introduction & basic concepts of polymers.	
CO2.	Understanding the classification & properties of polymers.	
CO3.	Understanding the kinetics & mechanism of polymerization reaction.	
CO4.	Understanding the preparation & application of industrial & natural polymers.	
CO5.	Analyzing the molecular weight determination of polymers.	
Course Content:		
Unit-1:	**Basic Concepts:** Classification – Nomenclature and isomerism – functionality – Molecular forces and chemical bonding in polymers – Molecular weight – Linear, branched and cross-linked polymers. Thermoplastic and thermosetting polymers – Elastomers, Fibers and resins.Techniques of polymerization– emulsion, bulk, solution and suspension.	**8 Hours**
Unit-2:	**Kinetics and Mechanism:** Kinetics and Mechanism of polymerization – free radical, cationic, anionic and co-ordination polymerization (Ziegler - Natta Catalyst).Copolymerization – Kinetics (Detailed Study).General characterization–Kinetic chain length–degree of polymerization, chain transfer - initiators – inhibitors – retarders.	**8 Hours**
Unit-3:	**A) Structure and Properties** Structure - property relationship – Mechanical properties, Thermal properties – Glass transition temperature – Factors affecting Glass transition temperature – crystallinity and melting point – related to structure. **B) Polymer characterization and analysis** Crystalline nature – X-Ray diffraction – Differential Scanning Calorimetry (DSC) – Thermo Gravimetric Analysis – molecular weight determination – Osmometry (membrane), Viscosity, Ultra centrifuge and Gel Permeation Chromatography.	**8 Hours**
Unit-4:	**Industrial Natural Polymers:** Important industrial polymers – preparation and application of polyethylene, poly vinyl chloride, poly urethanes, polytetrafluro ethylene	**8 Hours**

	(TEFLON), Nafion and ion – exchange resins. Importance of natural polymers – application and structures of starch, cellulose and chitosin derivatives.	
Unit-5:	**Specialty Polymers:** Bio polymers – biodegradable polymers – biomedical polymers – poly electrolytes - conducting polymers – high temperature and fire-retardant polymers - polymer blend – polymer composites – polymer nanocomposites – IPN inter penetrating network polymers – Electroluminescent polymers.	**8 Hours**
Text Books:	**1.** V. R. Gowarikar, B. Viswanathan, J. Sridhar, Polymer Science – Wiley eastern.	
Reference Books:	**1.** F.W. Bill Meyer. Text book of polymer science, John Wiley and sons, New York. P. J. Flory. Principles of Polymer Chemistry, Cornell Press. **2.** G. S. Misra – Introduction to Polymer Chemistry, Wiley Eastern Ltd., **3.** P. Bahadur, N. V. Sastry, Principles of Polymer Science, Narosa Publishing House. **4.** G. Odian, Principles of Polymerization, McGraw Hill Book Company, New York. *** Latest editions of all the suggested books are recommended.**	

Course Code: BAS638	B.Sc (H) Chemistry (Semester-VI) Novel Inorganic Solids	L-4 T-0 P-0 C-4
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Understanding the synthesis of inorganic solids and their modification by various physical and chemical methods.	
CO2.	Understanding the importance and types of inorganic solids like Electrolytes , molecular, colored compounds and inorganic liquid crystals.	
CO3.	Understanding the preparation, structure , classification of Nano particles , nano tubes , nano-architecture and different types of nano materials.	
CO4.	Analyzing the chemical composition, mechanical and fabricating characteristics of metals, non metals and alloys.	
CO5.	Applying the various types of composites as engineering materials and environmental effects on composites.	
CO6.	Applying various types of polymers, ceramics and refractory materials and their commercial manufacturing.	
Course Content:		
Unit-1:	**Synthesis and modification of inorganic solids**: Conventional heat and beat methods, Co-precipitation method, Sol-gel methods, Hydrothermal method, Ion-exchange and Intercalation methods. Inorganic solids of technological importance: Solid electrolytes – Cationic, anionic, mixed Inorganic pigments – coloured solids, white and black pigments. Molecular material and fullerides, molecular materials & chemistry – one-dimensional metals, molecular magnets, inorganic liquid crystals. **Inorganic solids of technological importance:** Solid electrolytes – Cationic, anionic, mixed Inorganic pigments – coloured solids, white and black pigments. Molecular material and fullerides, molecular materials & chemistry – one-dimensional metals, molecular magnets, inorganic liquid crystals.	**8 Hours**
Unit-2:	**Nanomaterials:** Overview of nanostructures and nanomaterials: classification. Preparation of gold and silver metallic nanoparticles, self-assembled nanostructures-control of nanoarchitecture-one dimensional control. Carbon nanotubes and inorganic nanowires. Bio-inorganic nanomaterials, DNA and nanomaterials, natural and antisical nanomaterials, bionano composites.	**8 Hours**
Unit-3:	**Introduction to engineering materials for mechanical construction:** Composition, mechanical and fabricating characteristics and applications of various types of cast irons, plain carbon and alloy steels, copper, aluminum and their alloys like duralumin, brasses and bronzes cutting tool materials, super alloys thermoplastics, thermosets and composite materials.	**8 Hours**
Unit-4:	**Composite materials:** Introduction, limitations of conventional engineering materials, role of matrix in composites, classification, matrix materials, reinforcements, metal-matrix composites, polymer-matrix composites, fibre-reinforced composites, environmental effects on composites, applications of	**8 Hours**

	composites.	
Unit-5:	**Speciality polymer:** Conducting polymers – Introduction, conduction mechanism, polyacetylene, polyparaphenylene and polypyrrole, applications of conducting polymers, Ion-exchange resins and their applications. Ceramic & Refractory: Introduction, classification, properties, raw materials, manufacturing and applications.	**8 Hours**
Text Books:	1. Adam, D.M. *Inorganic Solids: An introduction to concepts in solid-state structural chemistry*. John Wiley & Sons, 1974.	
Reference Books:	2. Shriver & Atkins. *Inorganic Chemistry*, Peter Alkins, Tina Overton, Jonathan Rourke, Mark Weller and Fraser Armstrong, 5th Edition, Oxford University Press (2011-2012) 3. Poole, C.P. & Owens, F.J. *Introduction to Nanotechnology* John Wiley & Sons, 2003. 4. Rodger, G.E. *Inorganic and Solid State Chemistry*, Cengage Learning India Edition, 2002.. 5. https://nptel.ac.in/courses/118/104/118104008/ *** Latest editions of all the suggested books are recommended.**	

Course Code: BAS671	B.Sc (H) Chemistry (Semester-IV) Polymer Chemistry (Lab)	L-0 T-0 P-4 C-2
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Synthesizing different types of industrial polymers.	
CO2.	Determination of molecular weight & hydroxyl number of polymers.	
CO3.	Estimation of the amount of HCHO in the given solution.	
CO4.	Understanding the mechanical properties of Polymers.	
CO5.	Determination of hydroxyl number of a polymer using colorimetric method.	
Course Content:		

List of Experiments:

Polymer synthesis:

1. Free radical solution polymerization of styrene (St) / Methyl Methacrylate (MMA) / Methyl Acrylate (MA) / Acrylic acid (AA).
   - **a)** Purification of monomer
   - **b)** Polymerization using benzoyl peroxide (BPO) / 2,2'-azo-bis-isobutylonitrile (AIBN)
2. Preparation of nylon 66/6
3. Precipitation polymerization of acrylonitrile
4. Preparation of urea-formaldehyde resin
5. Preparations of novalac resin/ resold resin.
6. Microscale Emulsion Polymerization of Poly(methylacrylate).

Polymer characterization:

1. Determination of molecular weight by viscometry:
   - **a.** Polyacrylamide-aq.$NaNO_2$ solution
   - **b.** (Poly vinyl proplylidine (PVP) in water
2. Determination of the viscosity-average molecular weight of poly(vinyl alcohol) (PVOH) and the fraction of "head-to-head" monomer linkages in the polymer.
3. Determination of molecular weight by end group analysis: Polyethylene glycol (PEG) (OH group).
4. Testing of mechanical properties of polymers.
5. Determination of hydroxyl number of a polymer using colorimetric method.

Polymer analysis:

1. Estimation of the amount of HCHO in the given solution by sodium sulphite method

Text &Reference Books:

1. M.P. Stevens, Polymer Chemistry: An Introduction, Oxford University Press.
2. H.R. Allcock, F.W. Lampe & J.E. Mark, Contemporary Polymer Chemistry, Prentice-Hall.
3. F.W. Billmeyer, Textbook of Polymer Science, Wiley-Inter-science.
4. J.R. Fried, Polymer Science and Technology, Prentice-Hall.
5. M.P. Stevens, Polymer Chemistry: An Introduction, Oxford University Press.

*** Latest editions of all the suggested books are recommended**

Evaluation Scheme of Practical Examination:

Internal Evaluation (50 marks)
Each experiment would be evaluated by the faculty concerned on the date of the experiment on a 4-point scale which would include the practical conducted by the students and a Viva taken by the faculty concerned. The marks shall be entered on the index sheet of the practical file.

Evaluation scheme:

PRACTICAL PERFORMANCE & VIVA DURING THE SEMESTER (35 MARKS)				ON THE DAY OF EXAM (15 MARKS)		TOTAL INTERNAL (50 MARKS)
EXPERIMENT (5 MARKS)	FILE WORK (10 MARKS)	VIVA (10 MARKS)	ATTENDANCE (10 MARKS)	EXPERIMENT (5 MARKS)	VIVA (10 MARKS)	

External Evaluation (50 marks)
The external evaluation would also be done by the external Examiner based on the experiment conducted during the examination.

EXPERIMENT (20 MARKS)	FILE WORK (10 MARKS)	VIVA (20 MARKS)	TOTAL EXTERNAL (50 MARKS)

Course Code: BAS672	B.Sc (H) Chemistry (Semester-IV) Novel Inorganic Solids (Lab)	L-0 T-0 P-4 C-2
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Determining the mechanism of cation exchange method.	
CO2.	Evaluating the total difference of solids.	
CO3.	Understanding the synthesis of hydrogel by co-precipitation method.	
CO4.	Understanding the synthesis of silver metal nanoparticles	
CO5.	Understanding the synthesis of gold metal nanoparticles	
Course Content:		

List of Experiments:

1. Determination of cation exchange method
2. Determination of total difference of solids.
3. Synthesis of hydrogel by co-precipitation method.
4. Synthesis of silver metal nanoparticles.
5. Synthesis of gold metal nanoparticles.

Reference Book:

1. Fahlman, B.D. *Materials Chemistry,* Springer, 2004.

*** Latest editions of all the suggested books are recommended**

Evaluation Scheme of Practical Examination:
Internal Evaluation (50 marks)
Each experiment would be evaluated by the faculty concerned on the date of the experiment on a 4-point scale which would include the practical conducted by the students and a Viva taken by the faculty concerned. The marks shall be entered on the index sheet of the practical file.

Evaluation scheme:

PRACTICAL PERFORMANCE & VIVA DURING THE SEMESTER (35 MARKS)				ON THE DAY OF EXAM (15 MARKS)		TOTAL INTERNAL (50 MARKS)
EXPERIMENT (5 MARKS)	FILE WORK (10 MARKS)	VIVA (10 MARKS)	ATTENDANCE (10 MARKS)	EXPERIMENT (5 MARKS)	VIVA (10 MARKS)	

External Evaluation (50 marks)
The external evaluation would also be done by the external Examiner based on the experiment conducted during the examination.

EXPERIMENT (20 MARKS)	FILE WORK (10 MARKS)	VIVA (20 MARKS)	TOTAL EXTERNAL (50 MARKS)

Course Code: BAS626	B.Sc (H) Chemistry (Semester-VI) Green Chemistry	L-4 T-0 P-0 C-4
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Remembering & understanding the Principles and Concepts of Green Chemistry and need of green chemistry in our day to day life.	
CO2.	Understanding the Measuring and Controlling Environmental Performance. and Emerging Green Technology and Alternative Energy Sources in green chemistry.	
CO3	Understanding the Emerging Green Technology and Alternative Energy Sources in green chemistry.	
CO4.	Remembering the renewable resources of energy.	
CO5.	Understanding industrial case studies to prepare the different products using greener approach..	
Course Content:		
Unit-1:	**Principles & Concept of Green Chemistry:** Introduction–Concept and Principles - development of Green Chemistry- Atom economy reactions–rearrangement reactions, addition reactions- atom uneconomic-sublimation-elimination-Wittig reactions-toxicity measures- Need of Green Chemistry in our day to day life.	**8 Hours**
Unit-2:	**Measuring and Controlling Environmental Performance-** Importance of measurement – lactic acid production-safer Gasoline – introduction to life cycle assessment-four stages of Life Cycle Assessment (LCA) –Carbon foot printing-green process Matrics-eco labels -Integrated Pollution and Prevention and Control (IPPC)-REACH (Registration, Evaluation, Authorization of Chemicals)**.**	**8 Hours**
Unit-3:	**Emerging Green Technology and Alternative Energy Sources-** Design for Energy efficiency-Photochemical reactions- Advantages-Challenge faced by photochemical process. Microwave technology on Chemistry- Microwave heating –Microwave assisted reactions-Sono chemistry and Green Chemistry – Electrochemical Synthesis-Examples of Electrochemical synthesis.	**8 Hours**
Unit-4:	**Renewable Resources-**Biomass –Renewable energy – Fossil fuels-Energy from Biomass-Solar Power- Other forms of renewable energy-Fuel Cells-Alternative economics-Syngas economy- hydrogen economy-Bio refinery chemicals from fatty acids-Polymer from Renewable Resources –Some other natural chemical resources.	**8 Hours**
Unit-5:	**Industrial Case Studies-** Methyl Methacrylate (MMA)-Greening of Acetic acid manufacture-Vitamin C-Leather manufacture –Types of Leather –Difference between Hide and Skin-Tanning –Reverse tanning – Vegetable tanning –Chrome tanning-Fat liquoring –Dyeing –Application-Polyethylene- Ziegler Natta Catalysis-Metallocene Catalysis-Eco friendly Pesticides-Insecticides.	**8 Hours**
Text Books:	**1.** T.E Graedel, Streamlined Life cycle Assessment, Prentice Hall, New Jersey. **2.** V.K. Ahluwalia, Green Chemistry, Environmentally Benign Reaction **3.** Mike Lancaster, Green Chemistry and Introductory text, II Edition	
Reference Books:	**1.** P.T. Anastas and J.C Warner, Green Chemistry theory and Practice, Oxford University press, Oxford.	

	2. P. Tundoet. Al., Green Chemistry, Wiley –Blackwell, London. ProttiD. Dondi et.al., Green Chemistry 3. https://www.acs.org/content/acs/en/greenchemistry/principles/12-principles-of-green-chemistry.html *** Latest editions of all the suggested books are recommended.**	

Course Code: BAS627	B.Sc (H) Chemistry (Semester-VI) Chemistry of Drugs, Cosmetics & Perfumes	L-4 T-0 P-0 C-4
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Understanding the preparation and uses of various types of dyes, Shampoo's , cosmetics, antiperspirants and artificial flavours.	
CO2.	Understanding the importance of artificial and natural essential oils in cosmetic industries	
CO3.	Understanding the synthesis and design of various analgesic, Antipyretic , anti –inflammatory and anti-biotic drugs.	
CO4.	Understanding the nature of various drugs like antiviral, anti leprosy Drugs.	
CO5.	Applying the use of drugs for central nervous system. HIV- AIDS.	
CO6.	Applying the concept of fermentation for the production of Chemicals, drugs and vitamins.	
Course Content:		
Unit-1:	A general study including preparation and uses of the following: Hair dye, hair spray, shampoo, suntan lotions, face powder, lipsticks, talcum powder, nail enamel, creams (cold, vanishing and shaving creams), antiperspirants and artificial flavours.	**8 Hours**
Unit-2:	Essential oils and their importance in cosmetic industries with reference to Eugenol, Geraniol, sandalwood oil, eucalyptus, rose oil, 2-phenyl ethyl alcohol, Jasmone, Civetone, Muscone.	**8 Hours**
Unit-3:	Drug discovery, design and development; Basic Retrosynthetic approach. Synthesis of the representative drugs of the following classes: analgesics agents, antipyretic agents, anti- inflammatory agents (Aspirin, paracetamol, lbuprofen); antibiotics (Chloramphenicol); antibacterial and antifungal agents (Sulphonamides; Sulphanethoxazol, Sulphacetamide, Trimethoprim);	**8 Hours**
Unit-4:	Antiviral agents (Acyclovir), Central Nervous System agents (Phenobarbital, Diazepam), Cardiovascular (Glyceryl trinitrate), antilaprosy (Dapsone), HIV-AIDS related drugs (AZT-Zidovudine).	**8 Hours**
Unit-5:	**Fermentation:** Aerobic and anaerobic fermentation. Production of (i) Ethyl alcohol and citric acid, (ii) Antibiotics; Penicillin,	**8 Hours**

	Cephalosporin, Chloromycetin and Streptomycin, (iii) Lysine, Glutamic acid, Vitamin B2, Vitamin B12 and Vitamin C.	
Text Books:	**1.** Sharma, B.K. & Gaur, H. Industrial Chemistry, Goel Publishing House, Meerut.	
Reference Books:	**2.** E. Stocchi: Industrial Chemistry, Vol-I, Ellis Horwood Ltd. UK. **3.** R. Gopalan, D. Venkappayya, S. Nagarajan: Engineering Chemistry, Vikas Publications, New Delhi **4.** https://www.ias.ac.in/article/fulltext/reso/009/04/0030-0041 *** Latest editions of all the suggested books are recommended.**	

Course Code: BAS663	B.Sc (H) Chemistry (Semester-VI) Green Chemistry (Lab)	L-0 T-0 P-4 C-2
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Preparing gold nanoparticles using tea leaves.	
CO2.	Preparing propene by green chemical methods.	
CO3.	Analysing the gold nanoparticles by UV/Visible spectrophotometer and other techniques.	
CO4.	Applying Benzoin condensation, mechanochemical solvent free synthesis, solvent free, microwave assisted one pot synthesis and photoreduction.	
CO5.	To study photoreduction of benzophenone to benzopinacol in the presence of sunlight.	
Course Content:		

List of Experiments:

1. Preparation and characterization of nanoparticles of gold using tea leaves.
2. Preparation of propene by two methods can be studied
   - **i.** Triethylamine ion + OH^- → propene + trimethylpropene + water
   - **ii.** (II) 1-propanol ⟶ propene + water
3. Benzoin condensation using Thiamine Hydrochloride as a catalyst instead of cyanide.
4. Mechanochemical solvent free synthesis of azomethines
5. Solvent free, microwave assist ed one pot synthesis of phthalocyanine complex of copper (II).
6. Photoreduction of benzophenone to benzopinacol in the presence of sunlight.

Text & Reference Books:

1. Anastas, P.T & Warner, J.C. Green Chemistry: Theory and Practice, Oxford University Press.
2. Kirchoff, M. & Ryan, M.A. Greener approaches to undergraduate chemistry experiment. American Chemical Society, Washington DC.
3. Ryan, M.A. Introduction to Green Chemistry, Tinnesand, American Chemical Society, Washington DC.
4. Cann, M.C. & Connelly, M. E. Real world cases in Green Chemistry, American Chemical Society.

*** Latest editions of all the suggested books are recommended**

Evaluation Scheme of Practical Examination:

Internal Evaluation (50 marks)

Each experiment would be evaluated by the faculty concerned on the date of the experiment on a 4-point scale which would include the practical conducted by the students and a Viva taken by the faculty concerned. The marks shall be entered on the index sheet of the practical file.

Evaluation scheme:

PRACTICAL PERFORMANCE & VIVA DURING THE SEMESTER (35 MARKS)				ON THE DAY OF EXAM (15 MARKS)		TOTAL INTERNAL (50 MARKS)
EXPERIMENT (5 MARKS)	FILE WORK (10 MARKS)	VIVA (10 MARKS)	ATTENDANCE (10 MARKS)	EXPERIMENT (5 MARKS)	VIVA (10 MARKS)	

External Evaluation (50 marks)
The external evaluation would also be done by the external Examiner based on the experiment conducted during the examination.

EXPERIMENT (20 MARKS)	FILE WORK (10 MARKS)	VIVA (20 MARKS)	TOTAL EXTERNAL (50 MARKS)

Course Code: BAS664	B.Sc (H) Chemistry (Semester-VI) Chemistry of Drug, Cosmetics & Perfumes (Lab)	L-0 T-0 P-4 C-2
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Preparing Aspirin and analyzing it.	
CO2.	Preparing magnesium bisilicate (Antacid) & Talcum Powder.	
CO3.	Preparing shampoo & Enamels	
CO4.	Preparing hair remover & face cream.	
CO5.	Preparing nail polish and nail polish remover.	
Course Content:		

List of Experiments:

1. Preparation of Aspirin and its analysis.
2. Preparation of magnesium bisilicate (Antacid).
3. Preparation of talcum powder.
4. Preparation of shampoo.
5. Preparation of enamels.
6. Preparation of hair remover.
7. Preparation of face cream.
8. Preparation of nail polish and nail polish remover.

Reference Books:

1. Patrick, G. L. *Introduction to Medicinal Chemistry, Oxford University* Press, UK, 2013.
2. Singh, H. & Kapoor, V.K. *Medicinal and Pharmaceutical Chemistry,* Vallabh Prakashan, Pitampura, New Delhi, 2012.
3. Foye, W.O., Lemke, T.L. & William, D.A.: *Principles of Medicinal Chemistry*, 4th ed., B.I. Waverly Pvt. Ltd. New Delhi.
4. Stocchi, E. *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK (1990).
5. Jain, P.C. & Jain, M. *Engineering Chemistry* Dhanpat Rai & Sons, Delhi.
6. Sharma, B.K. & Gaur, H. *Industrial Chemistry,* Goel Publishing House, Meerut (1996).
7. http://www.egyankosh.ac.in/bitstream/123456789/15907/1/Experiment-18.pdf

*** Latest editions of all the suggested books are recommended**

Evaluation Scheme of Practical Examination:
Internal Evaluation (50 marks)
Each experiment would be evaluated by the faculty concerned on the date of the experiment on a 4-point scale which would include the practical conducted by the students and a Viva taken by the faculty concerned. The marks shall be entered on the index sheet of the practical file.
Evaluation scheme:

PRACTICAL PERFORMANCE & VIVA DURING THE SEMESTER (35 MARKS)				ON THE DAY OF EXAM (15 MARKS)		TOTAL INTERNAL (50 MARKS)
EXPERIMENT (5 MARKS)	FILE WORK (10 MARKS)	VIVA (10 MARKS)	ATTENDANCE (10 MARKS)	EXPERIMENT (5 MARKS)	VIVA (10 MARKS)	

External Evaluation (50 marks)
The external evaluation would also be done by the external Examiner based on the experiment conducted during the examination.

EXPERIMENT (20 MARKS)	FILE WORK (10 MARKS)	VIVA (20 MARKS)	TOTAL EXTERNAL (50 MARKS)

Course Code: BAS661	B.Sc (H) Chemistry (Semester-IV) Inorganic Chemistry-IV (Lab)	L-0 T-0 P-4 C-2
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Remembering the acidic and basic radicals, symbols and group wise classification of radicals.	
CO2.	Understanding the use of group reagents and qualitative confirmation Individual acidic /basic radical.	
CO3.	Understanding the interfering acid radicals/ insoluble salts. The removal of interfering radicals/insoluble salt before the III group of basic radicals analysis.	
CO4.	Analyzing the inorganic mixture for two acidic / two basic radicals in presence of interfering radicals/insoluble salt.	
CO5.	Applying chemical methods for the laboratory preparation of metals.	
Course Content:		

List of Experiments:

Qualitative semimicro analysis of mixtures containing 3 anions and 3 cations. Emphasis should be given to the understanding of the chemistry of different reactions. The following radicals are suggested:

CO_3^{2-}, NO_2^-, S^{2-}, SO_3^{2-},$S_2O_3^{2-}$, CH_3COO^- , F^-,Cl^-, Br^-, I^-, NO_3^-, BO_3^{3-}, $C_2O_4^{2-}$, PO_4^{3-}, NH_4^+, Pb^{2+}, Cu^{2+}, Cd^{2+}, Bi^{3+}, Sn^{2+}, Sb^{3+}, Fe^{3+}, Al^{3+}, Cr^{3+}, Zn^{2+}, Mn^{2+}, Co^{2+}, Ni^{2+}, Ba^{2+},Sr^{2+}, Ca^{2+}, Mg^{2+}

Mixtures should preferably contain one interfering anion, **or** insoluble component ($BaSO_4$, $SrSO_4$, $PbSO_4$, CaF_2 or Al_2O_3) **or** combination of anions e.g. $CO_3^{2-}$and SO_3^{2-}, NO_2^- and NO_3^-, Cl^- and Br^-, Cl^- and I^-, $Br^-$and I^-, NO_3^- and Br^-, NO_3^- and I^-.

Spot tests should be done whenever possible.

i. Controlled synthesis of two copper oxalate hydrate complexes.

ii. Preparation of acetylacetanato complexes of Cu^{2+}/Fe^{3+}. Find the λmax of the complex.

iii. Synthesis of ammine complexes of Ni(II) and its ligand exchange reactions (e.g. bidentate ligands like acetylacetone, DMG, glycine) by substitution method.

Text &Reference Books:

1. Vogel's Qualitative Inorganic Analysis, Revised by G. Svehla. Pearson Education.
2. Marr & Rockett Practical Inorganic Chemistry. John Wiley & Sons.
3. https://byjus.com/chemistry/salt-analysis/

*** Latest editions of all the suggested books are recommended**

Evaluation Scheme of Practical Examination:

Internal Evaluation (50 marks)

Each experiment would be evaluated by the faculty concerned on the date of the experiment on a 4-point scale which would include the practical conducted by the students and a Viva taken by the faculty concerned. The marks shall be entered on the index sheet of the practical file.

Evaluation scheme:

PRACTICAL PERFORMANCE & VIVA DURING THE SEMESTER (35 MARKS)	ON THE DAY OF EXAM (15 MARKS)	TOTAL

EXPERIMENT (5 MARKS)	FILE WORK (10 MARKS)	VIVA (10 MARKS)	ATTENDANCE (10 MARKS)	EXPERIMENT (5 MARKS)	VIVA (10 MARKS)	INTERNAL (50 MARKS)

External Evaluation (50 marks)

The external evaluation would also be done by the external Examiner based on the experiment conducted during the examination.

EXPERIMENT (20 MARKS)	FILE WORK (10 MARKS)	VIVA (20 MARKS)	TOTAL EXTERNAL (50 MARKS)

Course Code: BAS662	B.Sc (H) Chemistry (Semester-IV) Organic Chemistry-V (Lab)	L-0 T-0 P-4 C-2
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Understanding the extraction of caffeine from tea leaves.	
CO2.	Preparation of sodium polyacrylate, urea formaldehyde & methyl orange.	
CO3.	Analysis of Carbohydrate: aldoses and ketoses, reducing and non-reducing sugars.	
CO4.	Qualitative analysis of unknown organic compounds containing monofunctional groups (carbohydrates, aryl halides, aromatic hydrocarbons, nitro compounds, amines and amides) and simple bifunctional groups, for e.g. salicylic acid, cinnamic acid, nitrophenols, etc	
CO5.	Identification of simple organic compounds by IR spectroscopy.	
CO6.	Understanding the mechanism of preparation of Methyl Orange.	
Course Content:		

List of Experiments:

1. Extraction of caffeine from tea leaves.
2. Preparation of sodium polyacrylate.
3. Preparation of urea formaldehyde.
4. Analysis of Carbohydrate: aldoses and ketoses, reducing and non-reducing sugars.
5. Qualitative analysis of unknown organic compounds containing monofunctional groups (carbohydrates, aryl halides, aromatic hydrocarbons, nitro compounds, amines and amides) and simple bifunctional groups, for e.g. salicylic acid, cinnamic acid, nitrophenols, etc.
6. Identification of simple organic compounds by IR spectroscopy (Spectra to be provided).
7. Preparation of methyl orange.

Text &Reference Books:

1. Vogel, A.I. Quantitative Organic Analysis, Part 3, Pearson.
2. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education.
3. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry, Pearson.
4. Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, University Press.
5. Ahluwalia, V.K. & Dhingra, S. Comprehensive Practical Organic Chemistry: Qualitative Analysis, University Press.
6. https://www.youtube.com/watch?v=sPhJWBL17OQ

*** Latest editions of all the suggested books are recommended**

Evaluation Scheme of Practical Examination:

Internal Evaluation (50 marks)
Each experiment would be evaluated by the faculty concerned on the date of the experiment on a 4-point scale which would include the practical conducted by the students and a Viva taken by the faculty concerned. The marks shall be entered on the index sheet of the practical file.

Evaluation scheme:

PRACTICAL PERFORMANCE & VIVA DURING THE SEMESTER (35 MARKS)				ON THE DAY OF EXAM (15 MARKS)		TOTAL INTERNAL (50 MARKS)
EXPERIMENT (5 MARKS)	FILE WORK (10 MARKS)	VIVA (10 MARKS)	ATTENDANCE (10 MARKS)	EXPERIMENT (5 MARKS)	VIVA (10 MARKS)	

External Evaluation (50 marks)
The external evaluation would also be done by the external Examiner based on the experiment conducted during the examination.

EXPERIMENT (20 MARKS)	FILE WORK (10 MARKS)	VIVA (20 MARKS)	TOTAL EXTERNAL (50 MARKS)

Course Code: BGP611	B.Sc.(H) Chemistry- Semester-VI **Discipline & General Proficiency**	L-0 T-0 P-0 C-0

There shall be continuous evaluation of the student on the following broad parameters:

1. Observance of dress code.

2. Participation in Conferences /Workshops / Seminars.

3. Attendance in guest lectures, invited talks and special technical sessions organized from time to time.

4. Participation in community projects including NSS.

5. Exhibiting team spirit in different Culture & extra curriculum activities, Department Club activities of the University and College organized from time to time.

6. Observance of rule & regulations in the College/University, Behavior in Campus Premises, Bus, hostel mess and hostel.

7. Performance and awards received in different events (sports/ co-curricular activities) organized at College / University and other level.

8. General behavior

9. Any extraordinary achievement.

The above is an indicative list of parameters on which the students shall be continuously evaluated. The college may evaluate the student on the specific parameters by informing them through a notice displayed on the notice board before evaluation. There shall be no external examination for this course; however, the marks shall be included for calculation of cumulative Performance Index (CPI).

Head of Department would be display GP marks on notice board in prescribed format after IInd & IIIrd CT in semester:

S No		Enroll No.	Student Name	Dress code	Participation in Conferences /Workshops / Seminars	Participation in guest lectures, invited talks and special technical sessions	Participation in community Services	Participation in Culture & extra curriculum activities, Department Club Activities	Participation in sports/ co-curricular activities	General Behavior	Any Extra Achievement
				(5)	**(15)**	**(20)**	**(10)**	**(20)**	**(20)**	**(5)**	**(5)**
	Responsible for marks			Mentor	Head	Head	Mentor	Cultural Events Coordinator & Department Club Coordinator	Sports Coordinator	Mentor	Director or Principal