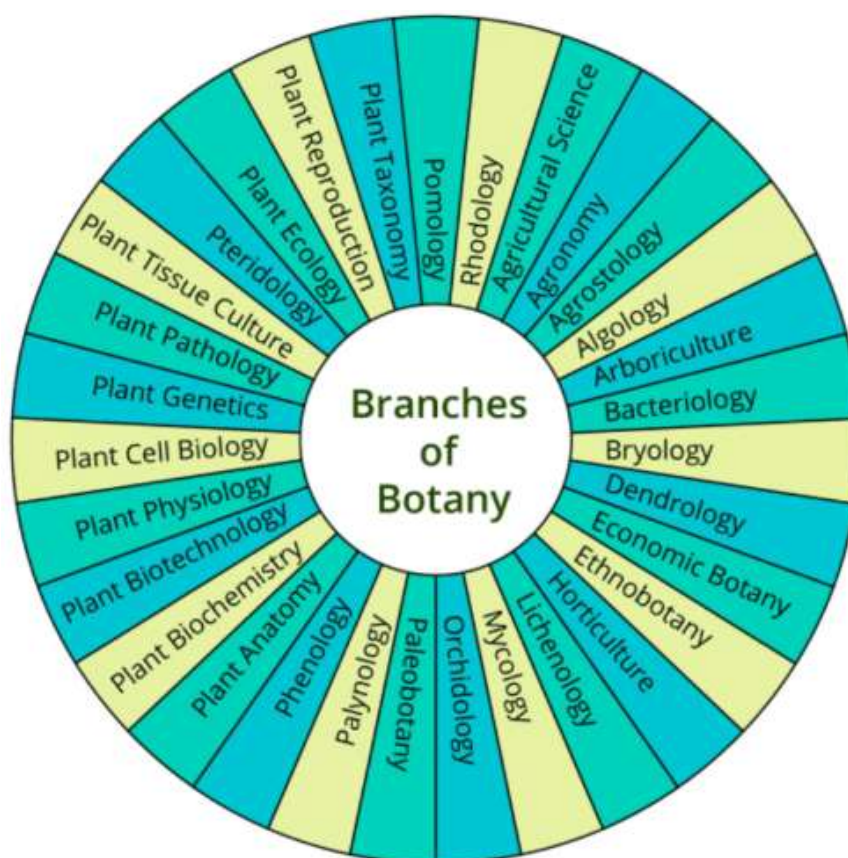


A Report on Course Outcomes encompassing all papers of the six semesters

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A bachelor's of science in botany is a three-year undergraduate programme in plant science, which aims at scientifically studying the life of a plant. This course includes practical as well as theoretical study of plants. There are several subfields of botany (*vide* above word diagram) that explore all the species of plants from unicellular plants to advanced courses like biotechnology.

In **CBCS** system, students would go through different courses of Botany. Total number of semesters is six and the time duration is exactly 6 months for each semester. Obviously, to cover the six semesters it takes total 3 years.

Here is the nutshell of the CBCS curriculum with the four types of courses:

- (I) Honours papers as **Core Courses (CC)**
- (II) General Papers as **Generic Elective (GE)**
- (III) **Ability enhancement compulsory Courses (AECC);**
- (IV) Two more subjects - **Skill Enhancement courses (SEC-A & SEC-B)**
- (V) Two more special papers-**Discipline Specific Elective subjects (DSE-A & DSE-B)**

Credit Points of the courses:

Course	Credit Point (individual paper)
CC-1, CC-2, CC-3, CC-4, CC-5, CC-6, CC-7, CC-8, CC-9, CC-10, CC-11, CC- 12, CC-13, CC-14, DSE-A, DSE-B	6
GE-1, GE-2, GE-3, GE-4	6
AECC-1, AECC-2	2
SEC-A, SEC-B	2

The CBCS curriculum designed as follows:

Semester-1	CC-1, CC-2	GE-1	AECC-1
Semester-2	CC-3, CC-4	GE-2	AECC-2
Semester-3	CC-5, CC-6, CC-7	GE-3	SEC-A
Semester-4	CC-8, CC-9, CC-10	GE-4	SEC-B
Semester-5	CC-11, CC-12	DSE-A(1)	DSE-B(1)
Semester-6	CC-13, CC-14, CC-14 (Practical)	DSE-A(2)	DSE-B(2)

Semester	Total Credits
1	20
2	20
3	26
4	26
5	24
6	24

- All students have to pass all the individual semester by scoring the total required credit points for each and every individual semester. If any student fails to score the total credits in any semester, the student will have to appear the semester again in the next year. Until and unless all semesters are cleared, the concerned student will not be passed the UG exam.

In **Sem-1** the Honours papers CC1 and CC2 consist of Biomolecules, Cytology, Plant Morphology and Plant Anatomy. These provide the vision in both internal as well as external aspects of plant life; their internal cellular mechanisms (biomolecules & cell biology) to internal body (anatomy) to external body (morphology). Thus it is an interesting journey for student from internal to external regime of plant biology or vice-versa. These topics are

fundamental as well as compulsory to develop basic idea of botany for beginners and also useful throughout the honours curriculum.

In **Sem-2**, after botanical tuning of students in Sem -1, in depth study of different plant groups begins. Papers CC-3 and CC-4 of Sem-2 include the diversity of microbes, algae, fungi and plant pathology. Here, from evolutionary view point, students are going ahead with developing knowledge on ancestral to derived biological groups, thus evolution of knowledge is going on following nature.

In **Sem-3**, the afore-mentioned plant evolution directed journey continues. Core courses CC-5 and CC-6 include diversity of bryophyte, pteridophytes and gymnosperm. Suddenly, in CC6 the topic palaeobotany shows students the prehistoric events in plant life and their fossilized form. This retrospective study gives students a new impetus to study botanical history of plants and the Earth. CC-7 serves the reproductive biology of plants which is the most interesting part of life science answering how life comes from life

In addition to the above mentioned courses, one more course is taught, that is, SEC- A. Biofertilizer, B. Plant diversity & human welfare and C. Floriculture. From A, B or C, a student have to opt for an one. The moto of this paper is to prepare learners for applied parts of Botany, to connect them with the materialistic plant world.

In **Sem-4** CC-8 and CC-9 include taxonomy, systematics, ecology and phytogeography. Ecology, of these is the cause of diversity, for diversity taxonomy and systematics are needed. Thus, from this cluster, students should develop the cause and effect relationship between environment and plant diversity. CC-10 provides economic botany and pharmacognosy dealing with direct use of plant parts for medicinal and other purpose.

Form the SEC Paper - A. Medicinal Botany, B. Mushroom Culture C. Intellectual Property Rights, any one can be chosen. These papers, again, are oriented towards applied field.

In **Sem5** four more advanced courses are taught. CC-11 and CC-12 deal with Plant Physiology and Plant Metabolism; these two sister branches provide thorough detail knowledge on plant biochemistry and plant life science.

Now, two newly introduced DSE papers are dedicated to develop some special knowledge on applied and research oriented aspects of plant life.

DSE 1A. Analytical Techniques in Plant Science and DSE 1B. Industrial and Environmental Microbiology are mutually exclusive. DSE 1A. is research oriented while DSE 1B focusses on applied and natural aspect of microbes.

DSE 2A. Stress Biology and DSE 2B. Plant Breeding & Biometry are mutually exclusive. 2A provides knowledge on advanced and specialised physiology while 2B deals with specialised and applied plant reproductive biology and statistics. This statistics is needed to analyse plant variation and diversity.

In **Sem-6** four more courses of advanced level are taught. CC-13 and CC-14 deal with Genetics, Molecular Biology and Biotechnology. Here genetics provides base line knowledge, molecular biology emerges from advance part of genetics and biotechnology emerges from both those two as applied field. Thus it is an integrated study.

DSE 3A. Biodiversity & Conservation and DSE 3B. Coastal Biology are mutually exclusive. The first one is to aware students regarding nature and her conservation. Second one focuses on a specific ecosystem type as a case study.

DSE 4A. Research Methodology and DSE 4B. Dissertation / Project are mutually exclusive. Names indicate, this part is dedicated to develop knowledge on research aspects and methods.

✓ Parallel to the Honours papers, the **GE papers** (for students with honours other than botany) include:

GE1. Biodiversity of Microbes, Algae, Fungi and Archegoniate

GE2. Plant Ecology, Morphology and Taxonomy

GE3. Plant Cell, Anatomy, Embryology

GE4. Plant Phycology & Metabolism

The papers come one after another in successive semesters from 1st to 4th. These papers are adequately fit for developing a thorough but brief knowledge on plant science.

✓ Parallel to the Honours and GE Course, Botany 3 Years Program Course also is there. The papers are as follows:

CC1. Biodiversity of Microbes, Algae, Fungi and Archegoniate

CC2. Plant Ecology, Morphology and Taxonomy

CC3. Plant Cell, Anatomy, Embryology

CC4. Plant Phycology & Metabolism

In 3rd Sem SEC Paper - 1A. Medicinal Botany or 1B. Mushroom Culture has to be taken.

In 4th Sem, SEC- 2A. Biofertilizer or 2B. Plant diversity & human welfare has to be taken.

In 5th Sem DSE 1A. Analytical Techniques in Plant Sciences or DSE 1B. Industrial and Environmental Microbiology has to be taken. SEC 3A. Herbal Technology or SEC 3B. Floriculture has to be taken.

In 6th Sem DSE 2A. Biodiversity and Conservation or DSE 2B. Genetics and Biotechnology has to be taken. SEC 4A. Ethnobotany or SEC 4B. Intellectual Property Rights has to be taken.

The topics covered in Botany B. Sc. Curriculum are adequate for the competitive examinations like NET, GATE, SLET and also for the admission tests of various national level examinations for M. Tech, MSc, MCA and also for research in various institutes like IIT, IISER, NIT etc.

B.Sc. Chemistry Hons (CBCS)

Programme outcome (PO):

Chemistry as a subject is interdisciplinary in nature and has a broad scope. The CBCS syllabus is very enriching and full of versatile knowledge in chemical science. A student acquires basic knowledge in the key areas of organic, inorganic, and physical chemistry from the core papers (CC) of B.Sc. Chemistry Hons. Students also become familiarized with specialized areas of pharmaceutical chemistry and analytical chemistry from the Skill Enhancement courses (SEC). Chemistry Hons graduates become aware of the environmental aspects of chemical processes and realize the need to develop greener chemical reactions from the Discipline specific (DSE) course on green chemistry. Students gain knowledge about the applied chemistry useful in chemical industries. Students will learn to setup physicochemical experiments, analyse the data, draw plots, calculate physical constants and interpret the results. From the qualitative and quantitative practical courses included in core, SEC and DSE papers students learn to detect chemical species, to estimate different chemical entities, to synthesize and purify new compounds. Attending practical classes also develop skill for safe handling of chemicals and apparatus in a chemical laboratory. Chemistry graduates are enabled for higher studies (M.Sc) in the subject and to further engage themselves in different emerging areas of research in science and technology. Chemistry Hons graduates are equipped to join industries as well as academics in future. In fact, a Chemistry Hons graduate achieves communication skill, problem solving skill, team management and organization skill and can find a suitable position in any profession.

Course outcome (CO) paper wise

Semester	Paper	Course outcome
I	CC-1	<ul style="list-style-type: none"> To know about the extranuclear structure of the atom To know how the chemical properties of elements change with their position in periodic table To learn about the 1st and zeroth laws of Chemical Thermodynamics and the related terms; to get idea about thermo-chemistry and thermodynamic parameters related to chemical reactions. To understand the basic concept of kinetic theory of gases and differential behavior of ideal and real gases To learn experimentally to estimate salts in solution by acid -base titration method To learn experimentally to determine pH of buffer solution; To learn to determine heat change involved in a chemical process
	CC-2	<ul style="list-style-type: none"> To know about basic concepts of organic chemistry specially physical properties, bonding, Molecular orbital approach of bonding. To know about classification of organic reactions from mechanistic aspects and the reaction intermediates. To understand the basic concepts of stereochemistry To learn experimentally to detect some organic solid and liquid compounds To learn to determine melting and boiling point To learn experimentally to separate a solid binary mixture based on different solubility of the components
II	CC-3	<ul style="list-style-type: none"> To know the basic concepts of redox reactions To understand acid base reactions and properties of solvent To know about 2nd law of thermodynamics, concept of entropy and thermodynamic relations To understand rate laws, rate equations of different types of reactions, determine rate constant values, order of reactions, effect of temperature and other factors on reaction rate and homogeneous catalysis To learn experimentally to quantitatively estimate different metal ion in solution by titration To study experimentally the reaction kinetics of 1st order reactions
	CC-4	<ul style="list-style-type: none"> To learn stereochemistry of chiral compounds arises due to presence of stereo-axis; concept of prostereoisomerism and concept of conformations of stereo isomers. To understand reaction kinetics, reaction thermodynamics and tautomerism of organic compounds. To know the concept, types, reaction mechanism and examples of elimination, free-radical and nucleophilic substitution reactions. To learn experimentally how to synthesize, calculate the yield and determine the melting point of pure organic compounds in the laboratory.
III	CC-5	<ul style="list-style-type: none"> To understand the transport processes of fluid: viscosity and conductance To understand application of thermodynamics; to gain knowledge about chemical potential, chemical equilibrium, properties of ideal substances and condensed phase To study the fundamentals of Quantum Mechanics To learn experimentally to determine viscosity of liquid; partition coefficient of a solute in different solvent and equilibrium constant; To study reaction kinetics by conductometric titration.
	CC-6	<ul style="list-style-type: none"> To gain knowledge about ionic and covalent bond in detail To know about extraction and purification of different metals from their ore

		<ul style="list-style-type: none"> To learn to estimate different metal ions separately from their mixture by titrimetric methods.
	CC-7	<ul style="list-style-type: none"> To know about addition reactions of alkene and alkyne To learn about electrophilic and nucleophilic substitution reaction of aromatic compounds To know about addition reaction, nucleophilic substitution reaction and reactions exploiting acidity of α hydrogen of carbonyl compounds. To gain elementary idea about green chemistry To learn about use of organometallic compounds in organic synthesis To learn experimentally to detect the functional group of an organic compound and determine the melting point; To learn to prepare derivative of the compound and finally identify the compound from literature survey
III	SEC	<p><u>IT Skill for Chemist</u></p> <ul style="list-style-type: none"> Helps to understand functions, differential equations, probability, matrices and determinants To learn about qualitative and quantitative aspects of analysis and helps to understand how to present a data after analysis To learn numerical differentiation, integration, and root of the equations Helps to understand about the basics of computer programming (FORTRAN), creating and application of spreadsheet software (MS Excel) Helps to know about statistical data analysis. To learn how to prepare graphs by using spreadsheet, help to determine rate constant, equilibrium constant, molar extinction coefficient value, concentration of ions at equilibrium and molar enthalpy of vapourisation. To study about the Acid-Base Titration Curve, Plotting of First and Second derivative Curve for pH metric and Potentiometric titrations, Calculation and Plotting of a precipitation titration Curve with MS Excel To learn numerical differentiation and integration, and root of the equations using MS Excel <p><u>Basic Analytical Chemistry</u></p> <ul style="list-style-type: none"> To study about the strategies of analytical chemistry, protocol of sampling, variability and validity of analytical measurement. To know the complexometric titrations and use of different indicators. To gain an in-depth knowledge of soil analysis, water analysis and different cosmetic analysis. To learn about the different chromatographic processes including TLC, paper chromatography, ion-exchange chromatography etc.
IV	CC-8	<ul style="list-style-type: none"> Helps to understand about the applications of Thermodynamics in Colligative Properties and Phase Equilibrium To know experimentally how to study phase diagram of a Phenol-Water system, kinetic study of inversion of cane sugar, determination of partition co-efficient value, pH of an unknown solution and pH metric titration of an acid against strong base. To study the fundamentals of Quantum Mechanics Helps to understand the fundamental concept, basic terms, derivation and application of Quantum Mechanics To know about the necessary laws, rules, terms, expressions and derivations statistical thermodynamics To learn in detail about the first and second laws of Chemical Thermodynamics and the related terms; to get idea about thermo-chemistry and thermodynamic relationships and system of variable compositions. To gain vast knowledge on chemical equilibrium and electrochemistry. To learn experimentally how to do the potentiometric and conductometric titrations of different compositions, determine the K_a of weak acid and heat of neutralization of a

		strong acid by a strong base.
IV	CC-9	<ul style="list-style-type: none"> To study the radiation chemistry of different radioactive nucleus. To gain an in-depth knowledge of different nuclear models, classification of nucleus and different types of nuclear reactions. Helps to understand several important applications of radioactive isotopes. To learn the basic coordination chemistry of transition metals including IUPAC nomenclature and isomerism of coordination complexes. To learn experimentally the quantitative estimation method of different metal ions in a given mixture by redox titration.
	CC-10	<ul style="list-style-type: none"> To gain knowledge about the synthesis of aliphatic and aromatic amine, nitro compounds, nitrile, diazonium salts and their utility in organic synthesis. To acquire knowledge about mechanistic details and stereochemical features of organic rearrangement reactions. To learn retrosynthetic analysis of small organic molecules and to design the synthetic route To determine the structure of a organic molecule in detail by UV, IR, NMR spectroscopy To learn experimentally measure different organic compound (such as Glucose, Phenol, aniline, formaldehyde etc.) by quantitative method.
	SEC	<p><u>Pharmaceutical Chemistry</u></p> <ul style="list-style-type: none"> To learn about the use and retrosynthetic path of different representative pharmaceutical molecule of different class such as antibiotic, antiviral, analgesic etc. To know about fermentation process and fermentative production of different commercially important compounds, drugs and vitamins. To learn experimentally to prepare aspirin and magnesium bisilicate. <p><u>Analytical Clinical Biochemistry</u></p> <ul style="list-style-type: none"> To study the basic concepts of carbohydrates, proteins, enzymes and lipids. To learn the diagnostic approach of disease by blood or urine analysis. To Identify and to estimate various substances like carbohydrates, lipids, iodine number and saponification number of oil, cholesterol, proteins, nucleic acids etc.
V	CC-11	<ul style="list-style-type: none"> To study the effect of ligands around a transition metal ion in terms of splitting of degenerate d-orbitals in different energy levels with respect to the number of incoming ligands, their strong and weak electronic field effect to explain the color and magnetic properties of the metal complexes with the light of CFSE. To understand the mechanistic pathways of ligand substitution reactions in metal-ligand complexes of different geometry and the characterization of mechanistic pathways. To get an idea of the basic complexation chemistry of d- and f-block elements. To get a core knowledge of magnetic properties of several magnetic substances. To study the available chlorine in bleaching powder and available oxygen in pyrolusite experimentally. To study the estimation of Cu in brass and Fe in cement and Ni(II) and chlorine gravimetrically.
	CC-12	<ul style="list-style-type: none"> To learn details about molecular spectroscopy such as UV-Visible, IR, NMR, and Raman spectroscopy in detail. To understand about the basic principles and laws of Photochemistry and also get idea about the theory of reaction rate. To know details about surface energy and surface tension; Classification, Adsorption

V		<p>Isotherms and applications of Adsorption; Classification, rules and properties of Colloids.</p> <ul style="list-style-type: none"> To know how to determine surface tension of a liquid; Indicator constant of an acid base indicator; pH of an unknown buffer solution and CMC of a micelle experimentally. To study the kinetics of $K_2S_2O_8 + KI$ reaction and Verification of Beer and Lambert's Law for $KMnO_4$ and $K_2Cr_2O_7$ solution experimentally.
	DSE-1	<p><u>Polymer Chemistry</u></p> <ul style="list-style-type: none"> To learn about the history, classification of polymeric materials. To acquire knowledge about functionality of polymeric materials. To know about the kinetics of polymerization. To get idea about details on crystallization and morphology of crystalline polymers. To understand the structure-property relationships of polymer. To understand the nature and structure of polymers, determination of molecular weight of polymers and thermodynamics of polymer solution. To get knowledge about glass transition temperature. To learn about thermodynamics of polymer solution. To know how to prepare polymers by using free radical polymerization, redox polymerization, interfacial polymerization, precipitation polymerization, addition polymerization and condensation polymerization process. To get knowledge experimentally about the polymer synthesis via different methods. To characterize polymer and to determine the molecular weight by viscometry experimentally. To learn experimentally how to estimate polymer by sodium sulphite method. <p><u>Inorganic Materials of Industrial Importance</u></p> <ul style="list-style-type: none"> To understand about the manufacture, properties, compositions, classes and applications of industrially important materials such as ceramics, glasses, cements, fertilizers, surface coating materials and batteries. To know about alloys, manufacture of steel, composition and properties of different types of steels. To learn about the general principles, properties, classification, industrial use, deactivation and regeneration of catalysis. To understand about the preparation and explosive properties of organic and inorganic explosives and the basic idea of rocket propellant. To learn how to analyze the composition of cement, composition of percentage of metals in alloy, electroless metallic coatings on ceramic and plastic. To know how to determine free acidity in ammonium sulphate fertilizer, estimation of Calcium in Calcium ammonium nitrate fertilizer and phosphoric acid in superphosphate fertilizer.
	DSE-2	<p><u>Analytical Methods in Chemistry</u></p> <ul style="list-style-type: none"> To study about the principle of sampling, evaluation of analytical data, errors, accuracy and precision. To learn about different optical methods of analysis. To know about the electro-analytical methods and thermal methods of analysis including thermogravimetry. To gain an in-depth knowledge of solvent extraction method. <p><u>Instrumental methods of chemical analysis</u></p> <ul style="list-style-type: none"> To study the fundamental laws of spectroscopy and Selection rules To study UV-Visible, IR, Mass spectroscopy, Flame photometry, Atomic adsorption spectroscopy and NMR spectroscopy in detail and their practical uses. To learn about the gas and liquid Chromatographic separation techniques. To know the basic idea of X-ray analysis and Electroanalytical techniques. To understand the safety practices in the chemistry laboratory.

V		<ul style="list-style-type: none"> To gain an in-depth knowledge of analysis of illicit drugs and fiber, detection of steroids and pollutants from wastes, determination of the void volume of a gel filtration column and caffeine in beverages by HPLC, Cyclic voltammetry of the Ferrocyanide/Ferricyanide couple, use of fluorescence to identify blood and other body fluids, collection, preservation, and control of blood evidence being used for DNA testing, use of capillary electrophoresis with laser fluorescence detection for nuclear DNA, use of sequencing for the analysis of mitochondrial DNA. <p><u>Green Chemistry</u></p> <ul style="list-style-type: none"> To learn about green chemistry and its necessity. To study about the principles of green chemistry & designing the green synthetic routes. To learn about microwave-assisted and ultrasound-assisted green reactions; and to know about alternative greener synthesis of commercially important compounds To know about the examples of green reactions and future trends in green reaction. To learn experimentally to carry out organic reaction in greener solvents, using alternating source of energy, using enzyme as catalysts and avoiding waste.
VI	CC-13	<ul style="list-style-type: none"> To learn about Bioinorganic Chemistry and Organometallic Chemistry To know about the catalytic role of organometallic compounds in different types of industrial processes. To study experimentally the qualitative detection of known and unknown radicals and insoluble materials in a mixture. To understand the basic concept of molecular symmetry and point group Helps to understand about the role of metal ions in living system To get idea about proteins, enzymes and ionophores To understand about the basic principles & classifications of organometallic compounds. To learn about the synthesis and application of catalyst
	CC-14	<ul style="list-style-type: none"> To acquire knowledge about the structure, synthesis and reactivity of carbocycles, five and six membered heterocyclic compounds. To get knowledge about stereochemistry of alicyclic compounds and their reactivity in different organic reactions of various mechanism. To learn about mechanism, regioselectivity and stereochemistry of different pericyclic reaction such as electrocyclic reaction, cycloaddition reaction and sigmatropic reaction. To get knowledge about the linear and ring structure of monosaccharide, disaccharide and polysaccharide and to learn about their reactions. To get knowledge about structure, synthesis and reaction of amino acid, peptides and nucleic acids. To learn separation of different organic compounds by TLC experimentally. To learn experimentally spectroscopic analysis of organic compounds.
	DSE-3	<ul style="list-style-type: none"> Helps to know the Bravais Lattice and Laws of Crystallography, Crystal Planes and Specific Heat of Solid To learn in detail about the third law of Thermodynamics and the related terms Helps to understand about Boltzmann distribution, thermodynamic probability and partition function. To learn about the history, classification and functionality of polymeric materials. To know about the kinetics of polymerization, details on crystallization and morphology of crystalline polymers, determination of crystalline melting point of a crystalline material and the factors effecting crystalline melting point. To understand the nature and structure of polymers, determination of molecular weight of polymers and thermodynamics of polymer solution. To study the preparation, structure, properties and application of different types of addition and condensation polymers. To know how to prepare polymers by using free radical polymerization, redox polymerization, interfacial polymerization, precipitation polymerization, addition

VI		<p>polymerization and condensation polymerization process.</p> <ul style="list-style-type: none"> • To learn experimentally how to find roots of equations, entropy change from heat capacity data, potentiometric titration, change in pressure for small change in volume of a van der Waals gas. • To develop the practical concept of using of software such as Chemdraw.
	DSE-4	<ul style="list-style-type: none"> • To know how to do research work and write a review article on a particular topic as assigned by the teacher. • To know how to handle the technical devices for presenting research works.