GANDHI INSTITUTE OF TECHNOLOGY AND MANAGEMENT
(GITAM)
(Deemed to be University, Estd. u/s 3 of UGC Act 1956)

∗VISAKHAPATNAM ∗HYDERABAD ∗BENGALURU∗
Accredited by NAAC with 'A' Grade

REGULATIONS AND SYLLABUS

Bachelor of Science (HONOURS)
in
CHEMISTRY
(W.E.F. 2019 - 20 admitted batch)

Website: www.gitam.edu

B.Sc. (Hons.) CHEMISTRY
REGULATIONS

(W.e.f. 2019-20 admitted batch)

1.0 ADMISSIONS

Admissions into B.Sc. (Hons.) Chemistry program of GITAM University are governed by GITAM University admission regulations.

2.0 ELIGIBILITY CRITERIA

2.1 A pass in Intermediate with Chemistry as one of the Subject(s) and with a minimum aggregate of 50% marks or any other equivalent Examination approved by GITAM University.

2.2 Admissions into B.Sc. (Hons.) CHEMISTRY will be based on the marks obtained in intermediate or equivalent examination and the rule of reservation, wherever applicable.

3.0 CHOICE BASED CREDIT SYSTEM

Choice based credit system (CBCS) is introduced with effect from the admitted batch of 2015-16 based on UGC guidelines in order to promote:

- Student centered learning
- Cafeteria approach
- Inter-disciplinary learning.

Learning goals/objectives and outcomes are specified leading to what a student should be able to do at the end of the program.

4.0 STRUCTURE OF THE PROGRAMME

4.1 The program consists of:

(i) Ability enhancement compulsory core courses (AECC)
(ii) Core Courses (compulsory) (CC)
(iii) Discipline specific electives (DSE)
(iv) Generic electives (GE)
(v) Skill enhancement courses (SEC) are of general nature either related or unrelated to the discipline.
(vi) Practical Proficiency Courses: Laboratory work

4.2 Each course is assigned a certain number of credits depending upon the number of contact hours (lectures/tutorials/practical) per week.

4.3 In general, credits are assigned to the courses based on the following contact hours per week per semester.

- One credit for each lecture / tutorial hour.
- Two credits for three hours of practicals.

4.4 The curriculum of six semesters B.Sc. (Hons.) CHEMISTRY program is designed to have a total of 142 credits for the award of B.Sc. (Hons.) CHEMISTRY degree.

5.0 MEDIUM OF INSTRUCTION:

The medium of instruction (including examinations and project reports) shall be English.

6.0 REGISTRATION

Every student has to register himself/herself for each semester individually at the time specified by the Institute / University.

7.0 ATTENDANCE REQUIREMENTS

7.1 A student whose attendance is less than 75% in all the courses put together in any semester will not be permitted to attend the end - semester examination and he/she will not be allowed to register for subsequent semester of study. He /She have to repeat the semester along with his / her juniors.

7.2 However, the Vice Chancellor on the recommendation of the Principal/ Director of the University College / Institute may condone the shortage of attendance to the students whose attendance is between 66% and 74% on genuine medical grounds and on payment of prescribed fee.

8.0 EVALUATION

8.1 The assessment of the student's performance in a Theory course shall be based on two components: Continuous Evaluation (40 marks) and Semester-end examination (60 marks).

8.2 A student has to secure an aggregate of 40% in the course in the two components put together to be declared to have passed the course, subject to the condition that the candidate must have secured a minimum of 24 marks (i.e. 40%) in the theory component at the semester-end examination.

8.3 Practical/ Viva voce/ Seminar etc. course are completely assessed under Continuous Evaluation for a maximum of 100 marks, and a student has to obtain a minimum of 40% to secure Pass Grade. Details of Assessment Procedure are furnished below in Table 1.

Table 1: Assessment Procedure

S. No.	Component of assessment	Marks allotted	Type of Assessment	Scheme of Examination
1	Theory	40	Continuous evaluation	(i) Two mid semester examinations shall be conducted for 15 marks each. (ii) 5 marks are allocated for quiz. (iii) 5marks are allocated for assignments.
		60	Semester-end examination	The semester-end examination shall be for a maximum of 60 marks.
	Total	100		
2	Practicals	40	Continuous evaluation	Forty (40) marks for continuous evaluation is distributed among the components: regularity, preparation for the practical, performance, submission of records and oral presentations in the laboratory. Weightage for each component shall be announced at the beginning of the Semester.
		60	Continuous evaluation	Sixty (60) marks for two tests of 30 marks each (one at the mid-term and the other towards the end of the Semester) conducted by the concerned lab Teacher and another faculty member of the department who is not connected to the lab, as appointed by the HoD.
	Total	100		

9.0 REAPPEARANCE

9.1 A student who has secured 'F' grade in a Theory course shall have to reappear at the subsequent semester end examinations held for that course.

9.1.1 A student who has secured 'F' grade in a Practical course shall have to attend Special Instruction Classes held during summer.

9.1.2 A student who has secured 'F' Grade in Project work / Industrial Training etc shall have to improve his/her report and reappear for Viva – voce at the time of Special Examination to be conducted in the summer vacation.

10.0 SPECIAL EXAMINATION

A student who has completed his/her period of study and still has "F" grade in a maximum of four courses is eligible to appear for Special Examination normally held during summer vacation.

11.0 BETTERMENT OF GRADES

A student who has secured only a Pass or Second class and desires to improve his/her Class can appear for Betterment Examinations only in Theory courses of any Semester of his/her choice, conducted in Summer Vacation along with the Special Examinations. Betterment of Grades is permitted 'only once' immediately after completion of the program of study.

12.0 GRADING SYSTEM

12.1 Based on the student performance during a given semester, a final letter grade will be awarded at the end of the semester in each course. The letter grades and the corresponding grade points are as given in Table-2.

Table 2: Grades & Grade Points

Sl.No.	Grade	Grade Points	Absolute Marks
1	O (outstanding)	10	90 and above
2	A+ (Excellent)	9	80 to 89
3	A (Very Good)	8	70 to 79
4	B+ (Good)	7	60 to 69
5	B (Above Average)	6	50 to 59
6	C (Average)	5	45 to 49
7	P (Pass)	4	40 to 44
8	F (Fail)	0	Less than 40
9	Ab. (Absent)	0	-

12.2 "A student who earns a minimum of four grade points (P Grade) in a Course is declared to have successfully completed the course, subject to securing an average GPA (average of all GPAs in all the semesters) of 5 at the end of the Program to declare pass in the program".

"Candidates who could not secure an average GPA of 5 at the end of the program shall be permitted to reappear for a course(s) of their choice to secure the same'.

13.0 GRADE POINT AVERAGE

13.1 A Grade Point Average (GPA) for the semester/trimester will be calculated according to the formula:

$$GPA = \frac{\Sigma [C \times G]}{\Sigma C}$$

Where

C = number of credits for the course,

G = grade points obtained by the student in the course.

13.2 To arrive at Cumulative Grade Point Average (CGPA), a similar formula is used considering the student's performance in all the courses taken, in all the semesters up to the particular point of time.

13.3 CGPA required for classification of class after the successful completion of the program is shown in Table 3.

Table 3: CGPA required for award of Class

Distinction	≥ 8.0*
First Class	≥ 7.0
Second Class	≥ 6.0
Pass	≥ 5.0

* In addition to the required CGPA of 8.0, the student must have necessarily passed all the courses of every semester in **first attempt**.

14.0 ELIGIBILITY FOR AWARD OF THE B.Sc. DEGREE

14.1 Duration of the program: A student is ordinarily expected to complete B.Sc. program in six semesters of three years. However a student may complete the program in not more than five years including study period.

14.2 However the above regulation may be relaxed by the Vice Chancellor in individual cases for cogent and sufficient reasons.

14.3 A student shall be eligible for award of the B.Sc Degree if he / she fulfills all the following conditions.

a) Registered and successfully completed all the courses and projects.
b) Successfully acquired the minimum required credits as specified in the curriculum corresponding to the branch of his/her study within the stipulated time.
c) Has no dues to the Institute, hostels, Libraries, NCC / NSS etc, and
d) No disciplinary action is pending against him / her.

14.4 The degree shall be awarded after approval by the Academic Council

15.0 Discretionary Power:

Notwithstanding anything contained in the above sections, the Vice Chancellor may review all exceptional cases, and give his decision, which will be final and binding.

SEMESTER -1

Course	Catego	Title	Periods/ Week	C

Code	ry		L	T	P	
SFC 101	AECC	English Communication skills	3	0	0	2
SFC 103	AECC	Environmental Studies	3	0	0	2
SCY 101	CC	Inorganic Chemistry I: Atomic Structure & Chemical Bonding	4	0	0	4
SCY 103	CC	Physical Chemistry I: States of Matter & Ionic Equilibrium	4	0	0	4
SCY 105	GE	Mathematics for Science -I	2	1	0	3
SCY 121	PPC	Inorganic Chemistry -I Lab	0	0	3	2
SCY 123	PPC	Physical Chemistry -I Lab	0	0	3	2
SFC 121	PPC	English Lab	0	0	2	2
Total			16	1	8	21

SEMESTER -2

Course Code	Category	Title	Periods/ Week			C
			L	T	P	
SCY 102	CC	Organic Chemistry - I	4	0	0	4
SCY 104	CC	Physical Chemistry-II: Chemical Thermodynamics and its Applications	4	0	0	4
SCY XXX	GE	Generic Elective (SCY 106/110)	4	0	0	4
SCY 108	GE	Mathematics for Science –II	2	1	0	3
SCY 120	PPC	Organic Chemistry –I Lab	0	0	3	2
SCY 122	PPC	Physical Chemistry –II Lab	0	0	3	2
SCY XXX	PPC	Generic Elective Lab (124/126)$^{\$}$	0	0	3	2
		Total	14	1	9	21

This Laboratory should be taken in coherence with generic elective (GE)

SEMESTER -3

Course code	Category	Title	Periods/ Week		C
			L	P	
SCY 201	CC	Inorganic Chemistry II: s- and p-Block Elements	4	0	4
SCY 203	CC	Organic Chemistry - II	4	0	4
SCY XXX	GE	Generic Elective (SCY 205/207)	4	0	4
SCY XXX	DSE	Elective (SCY 241/243)	4	0	4
SSE XXX	SEC	Elective (SSE 251/253/255)	2	0	2
SCY 221	PPC	Inorganic Chemistry II Lab	0	3	2
SCY 223	PPC	Organic Chemistry II Lab	0	3	2
SCY XXX	PPC	Generic Elective Lab (SCY 225/ 231)$^{\$}$	0	3	2
SCY XXX	PPC	DSC-1 Lab (SCY 227/229)$^{\#}$	0	3	2
		Total	18	12	26

SEMESTER -4

Course code	Category	Title	Periods/ Week		C
			L	P	
SCY 202	CC	Organic Chemistry - III	4	0	4
SCY 204	CC	Physical Chemistry III: Phase Equilibria and Chemical Kinetics	4	0	4
SCY XXX	GE	Generic Elective (SCY 206/208)	4	0	4
SCY XXX	DSE	Elective (SCY 242/244/246)	4	0	4
SSE XXX	SEC	Elective (SSE 252/254/256/258)	2	0	2
SCY 220	PPC	Organic Chemistry III Lab	0	3	2
SCY 222	PPC	Physical Chemistry III Lab	0	3	2
SCY XXX	PPC	Generic Elective Lab (224/232)$^{\$}$	0	3	2
SCY XXX	PPC	DSE-2 Lab (SCY 226/228/230)$^{\#}$	0	3	2
		Total	18	12	26

$ This Laboratory should be taken in coherence with generic elective (GE)

This Laboratory should be taken in coherence with discipline specific elective (DSE)

SEMESTER- 5

Course Code	Category	Title	Periods/ Week		C
			L	P	
SCY 301	CC	Inorganic Chemistry III: Coordination Chemistry	4	0	4
SCY 303	CC	Organic Chemistry - IV	4	0	4
SCY 305	CC	Physical Chemistry IV: Electrochemistry	4	0	4
SCY XXX	DSE	Elective (DSE 341/343/345)	4	0	4
SCY 321	PPC	Inorganic Chemistry III Lab	0	3	2
SCY 323	PPC	Organic Chemistry IV Lab	0	3	2
SCY 325	PPC	Physical Chemistry IV Lab	0	3	2
SCY XXX	PPC	DSE-3 Lab SCY (327/329/331)#	0	3	2
		Total	16	12	24

SEMESTER -6

Course Code	Category	Title	Periods/week		C
			L	P	
SCY 302	CC	Inorganic Chemistry IV: Organometallic Chemistry	4	0	4
SCY 304	CC	Organic Chemistry - V	4	0	4
SCY 306	CC	Physical Chemistry V: Quantum Chemistry & Spectroscopy	4	0	4
SCY XXX	DSE	(DSE-4), SCY- 342/344	4	0	4
SCY 320	PPC	Inorganic Chemistry IV Lab	0	3	2
SCY 322	PPC	Organic Chemistry V Lab	0	3	2
SCY 324	PPC	Physical Chemistry V Lab	0	3	2
SCY XXX	PPC	DSE-4 Lab (SCY 326/328)	0	3	2
		Total	16	12	24

GENERIC ELECTIVES (GE)

Student should choose either Physics group or Computer Science group as Generic Elective

PHYSICS:

SCY 106	Physics-1: Applied Physics
SCY 205	Physics-2: Mechatronics-1
SCY 206	Physics-3: Mechatronics-2

COMPUTER SCIENCE:

SCY 110	Programming with C
SCY 207	Data Structures with C
SCY 208	Data Base Management Systems

Discipline Specific Electives (DSE)

DSE – 1 (One paper to be selected)

SCY 241	Analytical Methods in Chemistry
SCY 243	Anatomy, Physiology and pharmacology

DSE – 2 (One paper to be selected)

SCY 242	Basic Concepts of Medicinal Chemistry
SCY 244	Fundamentals of Instrumental Methods of Analysis
SCY 246	Green Chemistry

DSE – 3 (One paper to be selected)

SCY 341	Pharmaceutics – 1
SCY 343	Unit Operations in Chemical Engineering
SCY 345	Molecules of Life

DSE – 4 (One paper to be selected)

SCY 342	Pharmaceutics -2
SCY 344	Industrial Chemicals & Environment

SKILL ENHANCEMENT COURSES

SEC -1 (One paper to be selected)

SSE 251	Intellectual Property Rights
SSE 253	Regulatory Affairs & Quality Assurance
SSE 255	Web Designing

SEC -2 (One paper to be selected)

SSE 252	Industrial safety
SSE 254	Chemical Technology & Society
SSE 256	Python programming
SSE 258	Introduction to UNIX programming

Type of Course	No. of courses		Credits	
	Theory	Lab	Theory	Lab
Ability Enhancement Compulsory Courses	2	1	04	2
Core courses	14	14	56	28
Discipline Specific Electives	04	04	16	08
Generic Electives	05	03	18	06
Skill enhancement Courses	02	--	04	--
TOTAL	26	22	98	44

TOTAL CREDITS: 142 (Theory: 98 and Lab: 44)

SEMESTER -1

SFC 101: English - I (AEC)

Hours per week: 3 | Semester End Examination: 60 Marks
Credits:2 | Continuous Evaluation: 40 marks

UNIT- I

The eyes are not here – Ruskin Bond

Pronunciation: Consonants,**Grammar:** Nouns, **Vocabulary:**Roots forms of words**, Spelling:** Correcting wrong spelling, **Punctuation:**Capitalisation, **Conversation and Role Play:** Introducing oneself in formal or social contexts,

UNIT- II

Work Brings Solace – APJ Abdul Kalam

Pronunciation: Monophthongs **Grammar:** Pronouns, **Vocabulary:** Prefixes & Suffixes, **Spelling:** using 'un' and 'dis' to complete antonyms**, Punctuation:** Capitalisation, **Conversation and Role Play:** starting a conversation/controlling a conversation**,**

UNIT –III

Bangle Sellers – Sarojini Naidu

Pronunciation: Diphthongs **Grammar:** Helping verbs & auxiliary verbs, **Vocabulary:** Homophones, Homographs, Homonyms **Punctuation:** comma & full stop, **Conversation:** Describing one's college and course of study, **Writing:** Paragraph writing/ Descriptive Writing,

UNIT -IV

The Merchant of Venice (Extract) – William Shakespeare

Pronunciation: varied pronunciation of some letters of the alphabet**Grammar:** Main verbs & Tenses, **Vocabulary:** Collocations, **Punctuation:** Question mark and Exclamation mark, **Conversation:** Leaving a message and taking an appointment

UNIT- V **Vocabulary building:** Synonyms, Antonyms, One Word Substitutes, Phrasal Verbs, Idiomatic Expressions, Foreign Phrases

Text Books:
Part – 1 (English for Enhanced Competence (by Sumit Roy, A.Karunakar, A.Aruna Priya)

Supplementary Reading:

1. Communicative skills for Technical Students, M. Faratullah. Orient Longman
2. Rizvi,MAshraf. ***Effective Technical Communication.*** McGraw - Hill.

SFC 103: ENVIRONMENTAL STUDIES (AECC)

Hours per week: 3	Semester End Examination: 60 Marks
Credits: 3	Continuous Evaluation: 40 marks

No. of hours per week: 03 Credits: 02

UNIT-I

The Multidisciplinary nature of environmental studies–Definition, Scope and Importance, Need for Public awareness. Natural Resources: Classification – Renewable and Non Renewable Resources. Renewable Resources: Forest, Water and Energy Resources Non Renewable Resources: Mineral, Food and Land resources (Uses, reasons for over-utilization and effects)

UNIT-II

Eco-system: Structure of an Ecosystem, Producers, consumers and de-composers. Structure of Terrestrial Ecosystems (Forest ecosystem, Grassland ecosystem and Desert ecosystem) and Aquatic Ecosystems (Pond ecosystem and ocean ecosystem). Function of an ecosystem -food chains, food web and ecological pyramids - energy flow in the ecosystem. Environmental Pollution: Causes, effects and control measures of Air, Water,soil pollution, Thermal pollution and nuclear hazards. Municipal solid waste management.

UNIT-III

Environmental problems: Global Environmental Problems, Greenhouse effect, Ozone layer depletion, acid rains and Climate change. National Environmental Problems: Deforestation – Causes and Effects, Environmental Problems associated with dams. Mining and Environmental effects.

UNIT-IV

Social Issues and the Environment: Environmental ethics, Issues and possible solutions. Waste land reclamation, Consumerism and waste products. Environmental Legislation: Environment Protection Act, Air Act, Water Act, Wildlife Protection act and Forest conservation act.

UNIT-V

Human Population and the Environment: Population growth, variation among nations, Population explosion-Family welfare programme. Environment and human health. Human rights, Value education, HIV/AIDS, Women and Child welfare, Role of information technology in environment and human health.

Text Books:

1. Text Book of Environmental studies for Undergraduate courses by Bharucha Erach Published by V.G.C

2. Environmental Science: A Global Concern by William P.Cunningham and Baraba Woodworth Saigo.
3. A text book of Environmental Science by P.C.Joshi
4. A text book of Environmental Science by Arvind Kumar
5. A text book of Environmental Science by S.C.Santra
6. Ecology & Environment by P.D.Sharma

SCY 101: INORGANIC CHEMISTRY I - ATOMIC STRUCTURE & CHEMICAL BONDING (CC)

Hours per week: 4 | Semester End Examination: 60 Marks
Credits: 4 | Continuous Evaluation: 40 marks

Unit-I:Atomic Structure

Bohr's theory, its limitations and atomic spectrum of hydrogen atom. Wave mechanics: de Broglie equation, Heisenberg's Uncertainty Principle and its significance, Schrödinger's wave equation, significance of ψ and ψ^2. Quantum numbers and their significance.Normalized and orthogonal wave functions. 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. Contour boundary and probability diagrams.

Unit-II:Periodicity of *s, p, d, f* - block elements

*s, p,d,*and*f*-block elements, the long form of periodic table. Detailed discussion of the followingproperties of the elements, with reference to *s, p, d,* and *f*-block.

(a) Effective nuclear charge, shielding or screening effect, Slater rules, variation of effective nuclear charge in periodic table. (b) Atomic radii (van der Waals) (c) Ionic and crystal radii.
(d) Covalent radii (octahedral and tetrahedral) (e) Ionization enthalpy, Successive ionization enthalpies and factors affecting ionization energy. Applications of ionization enthalpy.
(f) Electronegativity, Pauling's/Mulliken's/ lectronegativity scales.

Unit-III: Chemical bonding
Chemical bonding-1

Ionic bond: General characteristics, types of ions, size effects, radius ratio rule and itslimitations. Packing of ions in crystals.Born-Landé equation with derivation and importance of Kapustinskii expression for lattice energy.Born-Haber cycle and its application, Solvation energy.Covalent bond**:** Lewis structure, Valence Bond theory (Heitler-London approach).Energetics of hybridization, equivalent and non-equivalent hybrid orbitals. Bent's rule.

Unit-IV:
Chemical bonding-2

Molecular Orabital Theory (MOT), molecular orbital diagrams of diatomic and simple polyatomic molecules N_2, O_2, C_2, B_2, F_2, CO, NO, and their ions; HCl, BeF_2, (idea of s-p mixing and orbital interaction to be given). Formal charge, Valence shell electron pair repulsion theory (VSEPR), shapes of simple molecules and ions containing lone pairs and bond pairs of electrons, multiple bonding (σ and π bond approach) and bond lengths.
Covalent character in ionic compounds, polarizing power and polarizability.Fajan's rules and

consequences of polarization. Ionic character in covalent compounds: Bond moment and dipole moment. Percentage ionic character from dipole moment and electronegativity difference.

Unit-V: Chemical bonding-3

Metallic Bond:Qualitative idea of valence bond and band theories. Semiconductors andinsulators, defects in solids.

Weak Chemical Forces:van der Waals forces, ion-dipole forces, dipole-dipoleinteractions, induced dipole interactions,. Repulsive forces, Hydrogen bonding (theories of hydrogen bonding, valence bond treatment)

Reference Books:

1. Lee, J.D. *Concise Inorganic Chemistry* ELBS, 1991.
2. Atkins, P.W. & Paula, J. *Physical Chemistry*, 10th Ed., Oxford University Press, 2014.
3. Rodger, G.E. *Inorganic and Solid State Chemistry*, Cengage Learning India Edition, 2002.

SCY 103: PHYSICAL CHEMISTRY I - STATES OF MATTER & IONIC EQUILIBRIUM (CC)

Hours per week: 4	Semester End Examination: 60 Marks
Credits: 4	Continuous Evaluation: 40 marks

UNIT-I: Gaseous state:

Kinetic molecular model of a gas: postulates and derivation of the kinetic gas equation; collision frequency; collision diameter; mean free path and viscosity of gases, relation between mean free path and coefficient of viscosity, Variation of viscosity with temperature and pressure, Molecular velocities (average, root mean square and most probable) and average kinetic energy.

Behaviour of real gases: Deviations from ideal gas behaviour, compressibility factor, *Z*, and its variation with pressure for different gases. Causes of deviation from ideal behaviour.van der Waals equation of state

UNIT-II: Liquid state

Qualitative treatment of the structure of the liquid state;physical properties of liquids; vapour pressure, surface tension and coefficient of viscosity, and their determination. Temperature variation of viscosity of liquids.Qualitative discussion of structure of water (in the ice form).

UNIT-III: 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, seven crystal systems and fourteen Bravais lattices; X-ray diffraction, Bragg's law.

UNIT-IV: Ionic equilibria-1

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.Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions- derivation of Henderson equation and its applications; and applications of buffers in analytical chemistry.

UNIT-V: Ionic equilibria-2

Solubility and solubility product of sparingly soluble salts – applications of solubility product principle. Qualitative treatment of acid – base titration curves (calculation of pH at various stages). Theory of acid–base indicators; selection of indicators and their limitations.

Reference Books:

1. Atkins, P. W. & Paula, J. de *Atkin's Physical Chemistry* 10th Ed., Oxford University Press (2014).
2 Ball, D. W. *Physical Chemistry* Thomson Press, India (2007).
3. Castellan, G. W. *Physical Chemistry* 4th Ed. Narosa (2004).
4. Mortimer, R. G. *Physical Chemistry* 3rd Ed. Elsevier: NOIDA, UP (2009).

SCY 105: MATHEMATICS FOR SCIENCE-I (GE)

Hours per week: 3 — Semester End Examination: 60 Marks
Credits: 3 — Continuous Evaluation: 40 marks

UNIT-I

Trigonometry: Measurement of angles, Trigonometric ratios of any angle, signs of the trigonometric ratios of allied angles, trigonometric identities and trigonometric ratios of compound angles.

UNIT-II

Trigonometry: Trigonometric ratios of multiple and sub multiple angles, Transformations, Inverse trigonometric functions, Hyperbolic functions.

UNIT-III

Limits: Real numbers, Intervals, Functions, Limit, and One sided limits, Infinite limits, standard limits, indeterminate forms, problems on limits

Continuity- definition and simple illustrations.

UNIT-IV

Differentiation: Derivative of a function, Derivative from first principles, Product and Quotient rule for derivatives, Derivatives of some standard functions, Derivatives of trigonometric functions, composite functions, hyperbolic functions Derivatives of inverse trigonometric functions, inverse hyperbolic functions, Implicit differentiation, Logarithmic differentiation, derivatives by trigonometrical substitution.

UNIT-V

Indefinite Integration: Indefinite integral, methods of integration, integration by substitution, integration of some standard functions, integration by parts, integration of rational functions

Definite Integration: Definite integrals, Properties of definite integrals.

Text Books:

1. A text book of Intermediate Mathematics: Vol I, V. Venkateswara Rao, N. Krishna Murty, B.V.S.S. Sarma, S.Chand & Co
2. A text book of Intermediate Mathematics: Vol II, V. Venkateswara Rao, N. Krishna Murty, B.V.S.S. Sarma, S.Chand & Co

SCY 121 INORGANIC CHEMISTRY-ILAB (CC/PPC)

Hours per week: 3 Credits: 2 Continuous Evaluation: 100 marks

(A) Titrimetric Analysis

(i) Calibration and use of apparatus
(ii) Preparation of solutions of different Molarity/Normality of titrants

(B) Acid-Base Titrations

(i) Estimation of carbonate and hydroxide present together in mixture.
(ii) Estimation of carbonate and bicarbonate present together in a mixture.

(C) Oxidation-Reduction Titrimetry

(i) Estimation of Fe(II) and oxalic acid using standardized KMnO4 solution.
(ii) Estimation of oxalic acid and sodium oxalate in a given mixture.
(iii) Estimation of Fe(II) with K2Cr2O7 using internal **external** (diphenylamine, anthranilic acid) and external indicator.

Reference text:

Mendham, J., A. I. Vogel's *Quantitative Chemical Analysis 6thEd.*, Pearson, 2009**SCY SCY 123:PHYSICAL CHEMISTRY-ILAB(CC/PPC)**

Hours per week: 3 Credits: 2 Continuous Evaluation: 100 marks

1. **Surface tension measurements.**
   Determination of the surface tension by drop number method.

2. **Viscosity measurement using Ostwald's viscometer**.
   Determination of viscosity of aqueous solutions of (i) ethanol and (ii) sugar at room temperature.

3. pHmetry

a. Study the effect on pH of addition of HCl/NaOH to solutions of acetic acid, sodium acetate and their mixtures.
b. Preparation of buffer solutions of different pH
   i. Sodium acetate-acetic acid
   ii. Ammonium chloride-ammonium hydroxide
c. pH metric titration of (i) strong acid vs. strong base, (ii) weak acid vs. strong base.

Reference Books

1. Khosla, B. D.; Garg, V. C. &Gulati, A. *Senior Practical Physical Chemistry*, R. Chand & Co.: New Delhi (2011).
2. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. *Experiments in Physical Chemistry8th Ed*.; McGraw-Hill: New York (2003).
3. Halpern, A. M. &McBane, G. C. *Experimental Physical Chemistry 3rdEd.;* W.H. Freeman & Co.: New York (2003).

SFC121: ENGLISH COMMUNICATION SKILLS Lab (AECC)

Hours per week: 2 Semester End Examination: 60 Marks
Credits: 2 Continuous Evaluation: 40 marks

Syllabus

- Phonetics, vowels, consonants & Diphthongs, Phonetic Transcription
- Stress/ Accent, syllable Division and pronunciation
- Intonation & Rhythm
- Building Vocabulary
- Oral Presentation
- Group Discussion
- Handling Job Interviews
- Telephone Etiquette

Reference Books:

1. Developing Communication Skills by Krishna Mohan and Meera Benarji , Macmillan Press.
2. Better English Pronunciation by JDO Connor Cubs , Cambridge University Press.
3. Oxford Grammar with answers by John Eastwood, Oxford University Press.
4. Hand Book if English Grammar and Usage by Mark Leaster and Larry Beason, Tata Mc GrawHill Company.
5. A Text book of English Phonetics for Indian Students by T.BalaSubramanian, Macmillan Press.

SEMESTER II
SCY 102: ORGANIC CHEMISTRY – I (CC)

Hours per week: 4 | Semester End Examination: 60 Marks
Credits: 4 | Continuous Evaluation: 40 marks

Unit - I: Basics of Organic Chemistry

***Organic Compounds*:** Classification, Nomenclature and Hybridization.

Electronic Displacements*:** Inductive, electromeric, resonance, mesomeric, hyperconjugation effect and their applications; Dipole moment, Bond fission (Homolytic and Heterolytic) with suitable examples; Curly arrow rules; Reactive Intermediates–Carbocation, Carbanion, Free radical and Carbene; Organic Reagents – Electrophile and Nucleophile; Nucleophlicity and basicity. ***Introduction to types of organic reactions and their mechanism – Addition, Elimination and Substitution reactions (Only Basics).

UNIT - II: Stereochemistry

***Classification*:** Configurational and Conformational isomers; Representation of three dimentional molecules – Wedge, Fischer, Newmann and Sawhorse Projection formulae and their interconversions; ***Optical Isomerism*:** Optical isomers, Optical Activity, Specific Rotation, Chirality – Conditions for optical activity, Molecules with one or two chiral centers– Enantiomers, Distereoisomers and meso compounds, Racemization and resolution (Basic only); Relative and absolute configuration – D/L and R/S designations; Geometrical isomerism – Cis & Trans and E/Z notations.

UNIT - III: Chemistry of Aliphatic Hydrocarbons-1

Carbon-Carbon sigma bonds:

***Chemistry of Alkanes*:** Formation of alkanes – Wurtz Reaction, Corey-House synthesis, Kolbe's electrolysis, Hydrogenation of alkenes & alkynes Properties of alkanes: Physical, Chemical – Free radical halogenation, oxidation, isomerization and aromatization.

***Conformational Analysis of alkanes*:** Factors effecting stability of conformational isomers, Conformation analysis of ethane, propane & n-butane – Eclipsed, Staggered, Gauche and Anti conformations.

***Conformational Analysis of cycloalkanes*:** Baeyer strain theory, Energy diagrams of cyclohexane: Chair, Boat and Twist boat conformations and their relative stabilities.

UNIT - IV Chemistry of Aliphatic Hydrocarbons-2

Carbon-Carbon pi bonds:

Formation of alkenes – By elimination reactions (From alcohols, alkyl halide), Mechanism of E1, E2, E1cb reactions, Saytzeff and Hofmann eliminations, hydrogenation of alkyne and Kolbe's electrolysis. ***Properties of alkenes***: Physical, chemical properties - Electrophilic additions following Markownikoff/Anti-Markovnikoff rules &mechanisms, oxymercuration-demercuration, hydroboration, ozonolysis, reduction, oxidation - syn and anti-hydroxylation.

Conjugated Dienes – 1,2-and 1,4-addition reactionsand Diels-Alder reaction; Allylic and benzylic bromination mechanism with NBS. ***Formation of alkynes*:** From Vicinal dihalide, CaC_2, Kolbe's Electrolysis ***Properties of alkynes*:** Physical, Chemical properties - Acidity, Electrophilic (X_2, HX and HOX) and Nucleophilic (H_2O) additions, Hydroboration, oxidation, ozonolysis, polymerization, Alkylation of terminal alkynes.

UNIT - V Aromatic Hydrocarbons

***Aromaticity*:** Hückel's rule, aromatic character of arenes, benzenoid and non benzenoid compounds. Electrophilic aromatic substitution – halogenation, nitration, sulphonation and Friedel-Craft's alkylation/acylation with their mechanisms. Directing effects of the groups– Ortho-para directing and meta directing groups.

Suggested Text Books:

1. A Textbook of Organic Chemistry: Book by R.K. Bansal, SBN: 9788122420258 Publisher: New Age International Year of publishing: 2007.
2. Agarwal, O.P. Unified Chemistry, Vol I, II, & III, Jai Prakashnath Publications, Fiftieth Edition, 2016.
3. Bahl. A & Bahl, B.S. *A text book of Organic Chemistry*, S. Chand & Company Pvt.Ltd. 2014.

Reference Books:

4. Morrison, R. N. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
5. Kalsi, P. S. *Stereochemistry Conformation and Mechanism*, New Age International, 2005.
6. McMurry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India Edition, 2013.
7. Finar, I. L. *Organic Chemistry* (*Volume 1*), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

SEMESTER II

SCY 104: PHYSICAL CHEMISTRYII - CHEMICAL THERMODYNAMICS AND ITS

APPLICATIONS(CC)

Hours per week: 4	Semester End Examination: 60 Marks
Credits: 4	Continuous Evaluation: 40 marks

Unit-I: Chemical Thermodynamics -1

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(ideal) under isothermal and adiabatic conditions.

Unit-II: Chemical Thermodynamics -2

Thermochemistry: Heats of reactions: standard states; enthalpy of formation of molecules and ions, calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data.

Second Law: Concept of entropy; Carnot cycle, statement of the second law of thermodynamics; Calculation of entropy change for reversible and irreversible processes.

Unit-III: Chemical Thermodynamics -3

Third Law: Statement of third law, concept of residual entropy, calculation of absoluteentropy of molecules.

Free Energy Functions: Gibbs free energy and Helmholtz energy; variation of S, G, A with T, V, P; Freeenergy change and spontaneity. Gibbs-Helmholtz equation; Maxwell relations;

Unit-IV: Chemical Equilibrium:

Criteria of thermodynamic equilibrium,

chemicalequilibria in ideal gases, concept of fugacity. Thermodynamic derivation of relation between Gibbs free energy of reaction and reaction quotient.thermodynamic derivation of relations between the various equilibrium constants *Kp* , *Kc* and *Kx*. Le Chatelier principle and application to synthesis of NH_3(Haber's process) and SO_3(Contact process).

Unit-V:Solutions and Colligative Properties:

Dilute solutions; lowering of vapour pressure, Raoult's and Henry's Laws and their applications.Derive relations between the four colligative properties [(i) relative lowering of vapour pressure, (ii) elevation of boiling point, (iii) Depression of freezing point, (iv) osmotic pressure and amount of solute.

Reference Books

1. Peter, A. & Paula, J. de. *Physical Chemistry* 10th Ed., Oxford University Press (2014).
2. McQuarrie, D. A. & Simon, J. D. *Molecular Thermodynamics* Viva Books Pvt. Ltd.: New Delhi (2004).
3. Levine, I .N. *Physical Chemistry* 6th Ed., Tata McGraw Hill (2010).
4. Metz, C.R. *2000 solved problems in chemistry,*Schaum Series (2006).

SCY 106: PHYSICS I - APPLIED PHYSICS (GE)

Hours per week: 4	Semester End Examination: 60 Marks
Credits: 4	Continuous Evaluation: 40 marks

UNIT –I: Measurements

Physical quantities-standards and units-International systems of units-the standard of time-the standard length-the standard mass precession and significant figures.

Dimensional Homogeneity and Consistency-Dimensional analysis-Dimensionless groups and their use in chemical engineering-National Standards of Weights-Measurements & their calibration.

UNIT –II: Mechanics

Forces and Resolution of Forces-Composition of Coplanar Forces-friction-Centre of Gravity-Simple Lifting Machine-Work and Kinetic Energy Theorem-Conservative and non-conservative forces- Potential Energy-Energy diagram Stable and unstable equilibrium-Work & Potential energy-Work done by non-conservative forces-Law of conservation of Energy.

UNIT –III: Wave nature of light and Optical fibers

Introduction-Nature of light-Reflection and refraction-Total internal reflection- Definition and properties of wave front and ray - Huygens principle- Mathematical representation of plane wave-General wave equation-Optical Fibers-Numerical aperture- Acceptance angle-Step and Graded Indices (Concept and definitions only). Single and Multiple mode fibers (Concept and definition Only)-Applications of optical fibers

UNIT –IV: Waves-Interference and Diffraction

Division of amplitude and wave front-Young's double slit experiment-Phase change on reflection- Stokes' treatment-Interference in Thin films-parallel and wedge-shaped films-Fringes of equal inclination (Haidinger fringes). Newton's Rings: Measurement of wavelength and refractive index. Diffraction-types of diffraction-Diffraction grating and resolving power.

UNIT –V: LASER

Introduction-Absorption-Spontaneous and stimulated emissions-Meta stable state-population inversion-Lasing action-components of laser-Types of laser -Ruby laser -He-Ne laser -Semi conductor laser -Characteristics and applications of laser.

Text Books

1. Physics-D.Resnick and R.Halliday, Wiely Publishers
2. Text book of Engineering Physics-Dr. M N Avadhanulu & Dr.P G Kshirsagar, S Chand & Co Pvt Ltd, New Delhi
3. Optics-Brijlal Subrahmanyam, S Chand Co
4. Engineering Physics-R.K.Gaur and S.L.Gupta, Dhanpat Rai & Sons, Delhi

SCY 108: MATHEMATICS FOR SCIENCE-II(GE)

Hours per week: 3 | Semester End Examination: 60 Marks
Credits: 3 | Continuous Evaluation: 40 marks

UNIT-I

Matrices: Definition, addition and multiplication of matrices, various types of matrices, Determinant of a square matrix, Inverse of a matrix, Solution of system of non homogenous linear equations by Crammer‘s rule , matrix inversion method, Gauss-Jordan method

UNIT-II

Matrices: Minor of a matrix, rank of a matrix, Normal form of a matrix, Echelon form of a matrix Consistency of linear system of equations, solution of system of linear homogenous equations

UNIT-III

Statistical methods: Introduction, collection and classification of data, graphical representation, and measures of central tendency (Mean, Median & Mode).

UNIT-IV

Statistical methods: Measures of dispersion- Range, Quartile deviation, Mean deviation, Standard deviation, Coefficient of dispersion, Coefficient of variation, Moments, Skewness and Kurtosis.

UNIT-V

Theory of probability: Definition, Statistical probability, Addition law of probability, Multiplication law of probability, Condition law of probability, Independent events, Baye’s theorem.

Text Books:

1. A text book of Intermediate Mathematics: Vol I and Vol II, V. Venkateswara Rao, N. Krishna Murty, B.V.S.S. Sarma, S.Chand & Co
2. A text book of B.Sc. mathematics Vol. III , V. Venkateswara Rao, N.Krishna Murthy and BVSS Sharma, S.Anjaneya Sastry S. Chand & Co. Ltd.
3. Higher Engineering Mathematics by Dr. B.S.Grewal, Khanna publishers
4. The Chemistry Mathematics Book, Erich Steiner, Oxford University press, 2nd Ed. 2008

SCY-110 PROGRAMMING WITH C (GE)

Hours per week: 4	Semester End Examination: 60 Marks
Credits: 4	Continuous Evaluation: 40 marks

Unit I

Introduction to Programming, Algorithms and Flowcharts: Programs and programming, programming languages, compiler, interpreter, loader and linker, classification of programming languages, structured programming concept, algorithms and flowcharts.
Basics of C: Developing programs in C, structure of a C program, concept of variable, data types in C, program statements, declarations.

Unit II

Tokens: All tokens, operators and expressions, type conversions in C.
Input and Output: Introduction, non-formatted input and output, formatted input and output.
Control Statements: Introduction, conditional execution (if, if-else, nested if), and selection (switch), unconditional statements (break, continue, goto).

Unit III

Loops: Iteration and repetitive execution (for, while, do-while), nested loops. **Arrays and Strings:** Introduction, one dimensional array, one dimensional character arrays (strings), two dimensional arrays and character arrays (array of strings).

Unit IV

Functions: Concept of function, using functions, call by value and call by reference mechanism passing arrays to functions, scope and extent, storage classes, recursion.
Pointers: Dynamic memory allocation, understanding memory addresses, pointer operators (&) and pointers-declaration, initialization,1-d arrays and pointers, pointers and strings.

Unit V

Structures: Declaring structures and structure variables, accessing members of a structure, arrays of structures, arrays within a structure.
Union: Declaring union and its members, accessing and initializing members of a union, structure versus union.
Files: Using files in C: declaration of file pointers, opening a file, closing a file; Working with text files: reading from and writing into text files.

Text Book(s)

1. Pradip Dey and Manas Ghosh, Programming in C, 2/e, Oxford University Press, 2013.

References

1. E.Balagurusamy, Programming in ANSI C, 6/e, McGraw Hill.
2. Ashok N. Kamthane, Programming with ANSI and Turbo C, Pearson Education, India.
3. K.R.Venugopal and S.R.Prasad , Mastering C, McGraw Hill, 2009.
4. B.A. Forouzan and R.F. Gilberg, Computer Science: A Structured Programming Approach using C, 3/e, Cengage learning.

SCY 120: ORGANIC CHEMISTRY - I LAB (CC/PPC)

Hours per week: 3 Credits: 2 Continuous Evaluation: 100 marks

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

a. Water
b. Alcohol
c. Alcohol-Water

3. Determination of the melting points of above compounds and unknown organic compounds (Kjeldahl method and electrically heated melting point apparatus).
4. Effect of impurities on the melting point – mixed melting point of two unknown organic compounds
5. Determination of boiling point of liquid compounds. (boiling point lower than and more than 100 °C by distillation and capillary method)
6. Chromatography

a. Separation of a mixture of two amino acids by ascending and horizontal paper chromatography
b. Separation of a mixture of two sugars by ascending paper chromatography
c. Separation of a mixture of o-and p-nitrophenol or o-and p-aminophenol by thin layer chromatography (TLC)

Reference Books

1. **Text Book:** 1. Vogel‘s text book of Organic Analysis, Longmann Publishers
2. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry,* Pearson Education (2009)
3. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. *Practical OrganicChemistry, 5th Ed.,* Pearson (2012).

SCY 122: PHYSICAL CHEMISTRY -II LAB(CC/PPC)

Hours per week: 3 Credits: 2 Continuous Evaluation: 100 marks

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 basicity/proticity of a polyprotic acid by the thermochemical method in terms of the changes of temperatures observed in the graph of temperature versus time for different additions of a base. Also calculate the enthalpy of neutralization of the first step.
5. Determination of enthalpy of hydration of copper sulphate.

Reference Books

- Khosla, B. D.; Garg, V. C. &Gulati, A., *Senior Practical Physical Chemistry,* R. Chand & Co.: New Delhi (2011).
- Athawale, V. D. &Mathur, P. *Experimental Physical Chemistry* New Age International: New Delhi (2001).

SCY 124: APPLIED PHYSICS LAB (CC/PPC)

Hours per week: 3 Credits: 2 Continuous Evaluation: 100 marks

List of experiments:

1. Determination of thickness of wire by using Screw guage
2. Determination of volume of the cylinder or sphere by using Vernier calipers
3. Radius of curvature of curved surface using Spherometer
4. Determination of time period of Simple pendulum
5. Determination of Numerical aperture/Loss of Optical fiber
6. Determination of wavelength of LASER using grating
7. Determination of wavelength of monochromatic light with Newton's rings
8. Diffraction due to single slit/circular aperture
9. Study of characteristics of LASER

SCY 126 PROGRAMMING WITH C LABORATORY

Hours per week: 3 Credits: 2 Continuous Evaluation: 100 marks

A minimum of twelve experiments are to be performed

Develop C Programs for the following problems:

1. Conversion of an upper-case character to a lower-case character
2. Finding the Sizes and Ranges of different types.(Hint: Use sizeof() and limits.h)
3. Roots of a Quadratic Equation using 'if.
4. Print whether the given number is perfect (for a perfect number, the sum of divisors-except the number itself-will be equal to that number; Exs: 6,28,496, etc.).
5. First n terms of Fibonacci Sequence using (i) any loop and (ii) if statement (use 'switch'to decide the choice).
6. Generate one hundred random integers in the range of 1 to 100, store them in an array and print the average. (using any loop)
8. Print the average of the given numbers .
9. Converting a decimal value to binary.

10. Program to perform multiplication of two matrices.
11. Program to perform transpose of a given Matrix.
12. Determine if the given string is a Palindrome or not (use a function)
13. Sort the given array of strings in dictionary order (use a function).
14. Program that performs all the five arithmetic operations using Pointers.
15. Print the details of students of a class (the details may be : Roll number, name, department, class, address, marks in five subjects and average of marks) using nested structures (calculate average).
16. Program that demonstrates the memory allocation done by a structure and a union (declare Structure and Union in the same program).
17. Program to demonstrate member access in a union (declare three different types of variables in union, assign values and print them).
18. Program that illustrates the function fprintf() to write into a text file.
19. Program that illustrates the function fscanf() to read from a text file.
20. Program that accepts the names of two files and copies the first file into the second line by line using fgets() and fputs() functions.

SEMESTER III
SCY 201: INORGANIC CHEMISTRY II – S& P-BLOCK ELEMENTS(CC)

Hours per week: 4	Semester End Examination: 60 Marks
Credits: 4	Continuous Evaluation: 40 marks

Unit-I:

Acids and Bases: Brönsted-Lowry concept of acid-base reactions, solvated proton, relative strength of acids, types of acid-base reactions, levelling solvents, Lewis acid-base concept, Classification of Lewis acids, Hard and Soft Acids and Bases (HSAB) Application of HSAB principle,

Unit-II:

Chemistry of *s*and *p* Block Elements: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 andp*block elements.Hydrides and their classification ionic, covalent and interstitial.Basic beryllium acetate and nitrate.

Unit-III: Chemistry of *p*-block compounds

Study of the following compounds with emphasis on structure, bonding, preparation, properties and uses.Boric acid and borates, boron nitrides, borohydrides (diborane) carboranes, silanes, Oxides and oxoacids of nitrogen, Phosphorus and chlorine.Peroxo acids of sulphur, interhalogen compounds.

Unit-IV:

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).

Unit-V:

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.

Reference Books:

1. Lee, J.D. *Concise Inorganic Chemistry*, ELBS, 1991.
2. Cotton, F.A. & Wilkinson, G. *Advanced Inorganic Chemistry*, Wiley, VCH, 1999.

SEMESTER III
SCY 203: ORGANIC CHEMISTRY – II (CC)

Hours per week: 4 — Semester End Examination: 60 Marks
Credits: 4 — Continuous Evaluation: 40 marks

UNIT - I: Chemistry of Halogenated Hydrocarbons

***Alkyl halides*:** Methods of preparation–Preparation of $CH_3Cl/CHCl_3/C_2H_5Cl/ClCH_2CH_2Cl$ from alkanes & alkenes, alcohols and Hundsdiecker reaction; Chemical Properties – SN_1, SN_2 and SN_i mechanisms with stereo-chemical aspects; Nucleophilic substitution vs elimination; Preparation of Grignard reagent.

***Aryl halides*:** Preparation – From benzene, Sandmeyer reaction, Gattermann reaction; Chemical properties: Electrophilic aromatic substitutions – nitration, sulphonation and Friedel-Craft's alkylation; Nucleophilic substitution reaction with an example, Coupling reactions – Ullamann reaction, Wurtz-fitting; Benzyne mechanism.

Relative reactivity of alkyl, vinyl, allyl, aryl and benzyl halides towards nucleophilic substitution reactions.

UNIT - II: Alcohols, Phenols, Ethers and Epoxides

Alcohols: Preparation from – Alkyl halide hydrolysis, Hydration of alkenes, Hydroboration-

oxidation of alkenes, RMgX to carbonyls; Properties and relative reactivity of 1°, 2° and 3° alcohols – Dehydration, Dehydrogenation, Grignard reagents, Oxidation; Distinguish test between 1°, 2° and 3° alcohols; Hydrogen bonding.

Preparation of Glycol: From 1,2-dichloroethane, alkene; Physical and chemical properties – Reaction with Na, PCl_5, PI_3, oxidation with HIO_4, dehydration and Pinacol-Pinacolone rearrangement.

***Phenols*:** Preparation – Dow method, Cumene, Benzenediazonium salt; Properties – Acidity, Reimer-Tiemann reaction, Kolbe's-Schmidt reaction, Phthalic anhydride, Zn dust, oxidation; Effect of substituents on acidity.

***Ethers and Epoxides*:** Preparation and reactions with acids. Reactions of epoxides with alcohols, ammonia derivatives and $LiAlH_4$.

UNIT - III: Carbonyl Compounds

Aldehydes and ketones: Preparation – Oxidation of alcohols and alkenes, dehydrogenation of alcohols, hydration of alkynes; Properties – Nucleophilic additions: HCN, $NaHSO_3$, RMgX; Nucleophilic addition-elimination reactions with ammonia derivatives: NH_2OH, Hydrazine, 2,4-dinitrophenylhydrazine and semicarbazide; reduction with $LiAlH_4$, $NaBH_4$, Clemensen & Wolf-Kishner; Oxidation with PCC, PDC; Mechanisms of Aldol, Perkin, Benzoin condensation, Cannizzaro, Wittig reaction, Beckmann rearrangements, haloform reaction and Baeyer-Villiger oxidation.

Addition reactions of unsaturated carbonyl compounds: Michael addition.

Active methylene compounds: Keto-enol tautomerism. Preparation and synthetic applications of diethyl malonate and ethyl acetoacetate.

UNIT - IV: Carboxylic Acids

Methods of Preparation – From 1° alcohols/aldehydes, Hydrolysis of nitriles, RMgX with CO_2; Properties – Reaction with NH_3, $SOCl_2$, dehydration, HVZ reaction; Acidity, Effects of substituent on Acidity; Typical reactions of dicarboxylic acids, hydroxy acids and unsaturated acids: succinic/phthalic, lactic, tartaric, maleic and fumaric acid.

UNIT - V: Carboxylic Acids Derivatives

Typical Preparation methods and reactions: For acid chlorides, anhydrides, esters, amides; Comparative study of nucleophilic substitution at acyl group; Mechanism of acidic and alkaline hydrolysis of esters, Claisen condensation, Dieckmann and Reformatsky reactions, Hofmann-bromamide degradation and Curtius rearrangement.

Sulphur containing compounds:

Preparation and reactions of thiols, thioethers and sulphonic acids.

Reference Books:

1. Bahl. A & Bahl, B.S. *A text book of Organic Chemistry*, S. Chand & Company Pvt.Ltd. 2014.
2. Agarwal, O.P. Unified Chemistry, Vol I, II, & III, Jai Prakashnath Publications, Fiftieth Edition, 2016.
3. Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

4. Finar, I. L. *Organic Chemistry* (*Volume 1*), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
5. McMurry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India Edition, 2013.

SEMESTER III
SCY 205: PHYSICS II -MECHATRONICS-I (GE)

Hours per week: 4	Semester End Examination: 60 Marks
Credits: 4	Continuous Evaluation: 40 marks

UNIT –I: Concepts of Electrical Energy

Electric current-Electric potential-potential difference-maintaining potential difference-concept of emf and potential difference resistance-factors upon which resistance depend-resistivity conductivity-effect of temperature on resistance-temperature coefficient of

resistance-temperature coefficients relations-Ohm's law-electrical power and electric energy.

UNIT –II: Sources of Electrical energy

Cells-types of cells-lead acid cell-chemical changes during discharging-chemical changes during recharging-construction of lead acid battery-characteristics-indications of fully charged cell-care of lead acid batteries and applications. D.C Motor principle-working-back emf-significance of back emf-voltage equation power equation-power equation-condition for maximum power and applications.

UNIT –III: Electrical power

Structure of electrical power system-electrical supply system-typical A.C power supply scheme- types of power plants-variable loads on power plants-base load and peak load on power station- method of meeting load-transmission of electrical energy-Distribution of electrical energy-systems and classification.

UNIT –IV: Basic Electronics

Semiconductor devices-diodes-Bipolar junction transistor-field effect transistor their structure symbol and characteristics.

Rectifiers-Classification-circuit diagrams-comparison-efficiency-ripple factor and nature of output of half and full wave rectifiers. Filters circuits-types of filter circuits

UNIT –V: Measurement, instrumentation and calibration

Measurement-instrument-instrumentation-classification of transducers-performance characteristics-static and dynamic characteristics-errors in measurement-gross error-systematic error-statistical analysis and random errors. Calibration and standards- process of calibration-classification of standards and standards for calibration.

Text Books

1. Principles of Electrical Engineering-V.K. Mehta, Rohit Mehta. S.Chand & Co.
2. Principles of Electronics-V.K.Mehta S.Chand & Co.
3. Transducers and Instrumentation D.V.S.murthy,PHI(2nd Ed).

SEMESTER III
SCY 207 DATA STRUCTURES WITH C

Hours per week: 4	Semester End Examination: 60 Marks
Credits: 4	Continuous Evaluation: 40 marks

Unit I

Data representation: Introduction, linear lists, array based representation and operations, linked representation and operations. Searching: Linear search, Binary search, Arrays: Arrays, matrices.

Unit II

Linked lists: Creation of single linked list, double linked list, circular linked list, and operations on it.

Unit III

Stacks: Definitions, operations and applications, array and linked representation of stacks.

Queues: Definitions and operations, array and linked representation of queues.

Unit IV

Graphs: Introduction, representation of graphs, graph traversals, applications

Introduction to Sorting: Insertion sort, selection sort, bubble sort, merge sort.

Unit V

Trees: Definitions and properties, representation of binary trees, operations, binary tree traversals, binary search trees.

Text Book(s)

1. Reema Thareja, Data structures using C, Oxford publications

References

1. Seymour Lipschutz, Data Structures with C, McGraw Hill, 2011.

SEMESTER III
SCY 241: ANALYTICAL METHODS IN CHEMISTRY (DSE)

Hours per week: 4	Semester End Examination: 60 Marks
Credits: 4	Continuous Evaluation: 40 marks

Unit -I: Qualitative and quantitative aspects of analysis:
Evaluation of analytical data: errors ,accuracy and precision. Types of errors and Methods for minimization of errors. Significant figures
Statistical test of data: F, Q and t test, rejection of data, and confidence intervals.

UNIT –II:
UV-Visible spectrophotometry: Interaction of radiation with matter. fundamental laws of spectroscopy: Beer-Lambert's law and its validity.**:** source of radiation, wavelength dispersion : monochromator :gratings, prisms, interference filters. Detection of signal : photocells, photomultipliers, diode arrays. Schematic diagrams of Single and Double Beam instruments. applications in the quantitative determination of cations (Fe^{2+}, Ni^{2+}, $Cr^{6+\ +}$) and anions (PO_4^{3-},NO^{3-} and NO^{2-})

UNIT –III:
Flame Emission and Flame Absorption Spectrometr*y:* Basic principle and instrumentation: source of excitation , atomization , nebulizer, types of burner, monochromator and detector. Interferences: Physical, Chemical and spectral.Quantitative estimation of metal ions in water samples by Flame emission and Flame absorption spectroscopy.

UNIT –IV:
Electroanalytical methods: Basic principle, Instrumentation and applications of pH metric, potentiometric and conductometric titrations.

UNIT –V: Separation techniques:
Solvent extraction:Principle of solvent extraction and efficiency of the technique. Technique of extraction: batch, continuous and counter current extractions. Solvent extraction systems: Metal chelates and ion association systems.

Chromatography: Principle and classification of the technique. Mechanism of separation: adsorption and partition. Development of chromatograms: frontal, elution and displacement methods.

Reference Books:

1. Mendham, J., *A. I. Vogel's Quantitative Chemical Analysis 6th Ed.*, Pearson, 2009.
2. Christian, G.D. *Analytical Chemistry*, 6th Ed. John Wiley & Sons, New York, 2004.
3. Harris, D.C.: *Exploring Chemical Analysis*, 9th Ed. New York, W.H. Freeman, 2016.
4. Khopkar, S.M. *Basic Concepts of Analytical Chemistry*. New Age International Publisher, 2009.
5. Skoog, D.A. Holler F.J. & Nieman, T.A. *Principles of Instrumental Analysis*, Cengage Learning India Ed.

SEMESTER III

SCY 243: ANATOMY, PHYSIOLOGY AND PHARMACOLOGY (DSE)

Hours per week: 4 Semester End Examination: 60 Marks
Credits: 4 Continuous Evaluation: 40 marks

UNIT –I: Scope of Anatomy and physiology. Definition of various terms used in Anatomy. Structure of cell, function of its components

Elementary tissues: Elementary tissues of the body, i.e. epithelial tissue, muscular tissue, connective tissue and nervous tissue.

Muscular System: Structure of skeletal muscle, physiology of muscle contraction. Names, positions, attachments and functions of various skeletal muscles. physiology of neuromuscular junction.

Skeltal System: Structure and function of Skelton .Classification of joints and their function. Joint disorders.

UNIT –II: Cardiovascular System: Composition of blood, functions of blood elements. Blood group and coagulation of blood. Brief information regarding disorders of blood. Name and functions of lymph glands. Structure and functions of various parts of the heart .Arterial and venous system with special reference to the names and positions of main arteries and veins. Blood pressure and its recording. Brief information about cardiovascular disorders.

Respiratory system: Various parts of respiratory system and their functions, physiology of respiration.

Urinary System: Various parts of urinary system and their functions, structure and functions of kidney. Physiology of urine formation. Patho-physiology of renal diseases and edema.

UNIT –III: Central Nervous System: Various parts of central nervous system, brain and its parts, functions and reflex action. Anatomy and physiology of automatic nervous system.

Sensory Organs: Elementary knowledge of structure and functions of the organs of taste, smell, ear, eye and skin. Physiology of pain.

Digestive System: names of various parts of digestive system and their functions. structure and functions of liver, physiology of digestion and absorption.

Endocrine System: Endocrine glands and Hormones. Location of glands, their hormones and functions. pituitary, thyroid. Adrenal and pancreas

UNIT –IV: General pharmacology

Definition and sources of drug, Routes of drug administration, their advantages and disadvantages, Pharmacokinetics and Biopharmaceutices - absorption, distribution, metabolism and excretion of drug, Adverse drug reactions, Manifestations of Adverse drug reactions

UNIT –V: Classification and therapeutic uses of the following: Analgesic, antipyretic and non steroidal anti inflammatory drugs (NSAIDS), Local anesthetics , Sedative and hypnotics , Anti epileptics

Recommended Books:

- Waugh and A. Grant Ed.: ―Ross and Wilson‘s Anatomy and Physiology – in Health and Illness‖, 10th edition (2nd reprint), Churchill Livingstone, Elsevier, Edinburg,

2008.
- Gray‘s Anatomy‖ 39th edition, Churchill Livingstone, London
- Gerard J. Tortora and Bryan H. Derrickson: ―Principles of Anatomy and Physiology‖, Vol. 1 & 2, 12th edition, John Willey & Sons, Inc., 2009.
- K. D. Tripathi: ―Essentials of Medical Pharmacology‖, 4th edition, Jaypee Publication, Delhi, 1999.
- H. P. Rang & M. M. Dale, ―Pharmacology‖ 4th edition, Churchill Livingstone, 1999.

SEMESTER III
SSE 251: INTELLECTUAL PROPERTY RIGHTS (IPR) (SEC)

Hours per week: 2
Credits: 2 Continuous Evaluation: 100 marks

Introduction to Intellectual Property:
Historical Perspective, Different Types of IP, Importance of protecting IP.

Copyrights
Introduction, How to obtain, Differences from Patents.

Patents
Historical Perspective, Basic and associated right, WIPO, PCT system, Traditional Knowledge, Patents and Healthcare – balancing promoting innovation with public health, Software patents and their importance for India.

Geographical Indications
Definition, rules for registration, prevention of illegal exploitation, importance to India.

Trade Secrets
Introduction and Historical Perspectives, Scope of Protection, Risks involved and legal aspects of Trade Secret Protection.

Different International agreements
(a) Word Trade Organization (WTO):
(i) General Agreement on Tariffs & Trade (GATT)
(ii) Trade Related Intellectual Property Rights (TRIPS) agreement
(iii) Madrid Protocol
(iv) Berne Convention
(v) Budapest Treaty

(b) Paris Convention
WIPO and **TRIPS, IPR** and Plant Breeders Rights, IPR and Biodiversity
IP Infringement issue and enforcement – Role of Judiciary, Role of law enforcement agencies – Police, Customs etc. Economic Value of Intellectual Property – Intangible assets and their valuation, Intellectual Property in the Indian Context – Various laws in India Licensing and technology transfer.

Reference Books:
1. Acharya, N.K. *Textbook on intellectual property rights*, Asia Law House (2001).
2. Ganguli, P. *Intellectual Property Rights: Unleashing the Knowledge Economy,* Tata McGraw-Hill (2001).
3. Miller, A.R. & Davis, M.H. *Intellectual Property: Patents, Trademarks and Copyright*

in a Nutshell, West Group Publishers (2000).
4. Watal, J. *Intellectual property rights in the WTO and developing countries*, Oxford University Press, New Delhi.

SEMESTER III
SSE 253: REGULATORY AFFAIRS AND QUALITY ASSURANCE (SEC)

Hours per week: 2
Credits: 2 Continuous Evaluation: 100 marks

1. Guidelines for Drug Master File: Types
2. Introduction to ICH
3. Abbreviated New Drug Application (ANDA): Hatch – Waxman amendment, patent term restoration, types of ANDA
4. Manufacturing premises
5. Equipment and Raw Materials
6. Manufacture and QC of Dosage Forms
7. Quality audit of Manufacturing process and facilities
8. Quality Control in Laboratory
9. Validation of Analytical Methods
10. Regulatory considerations in Validation
11. Validation
12. Process Validation
13. Globalization & Intellectual Property Rights
14. Drug Approval

SEMESTER III
SSE-255 WEB DESIGNING (SEC)

Hours per week: 2
Credits: 2 Continuous Evaluation: 100 marks

Introduction to HTML : Basic syntax, HTML document structure, text formatting, images, lists, links, tables, forms, frames, section, article, range and date.

Cascading Style Sheets: Levels of style sheets, style specification formats, selector forms, font properties, list properties, color properties, alignment of text, background images, span and div tags.

Introduction to Java Script: Overview of java script, syntactic characteristics, primitives, operator and expression, control statements, arrays, functions, errors in scripts, Document Object Model(DOM), event driven computation, element access in java script, the navigator object. Dynamic

Document with Java Script: Element positioning, moving elements, changing colors and fonts, dynamic content, locating the mouse cursor, slow movements of elements, dragging and dropping elements.

Introduction to XML: Syntax of XML, document structure, and document type definition, namespaces, XML schemas, document object model, presenting XML using CSS.

Text Book(s)

1. Robert W.Sebesta, Programming the World Wide Web, 4/e, Pearson, 2007.
2. Chris Bates, Web Technologies, 2/e, Wiley, 2002.

References

1. Dietel and Nieto, Internet and World Wide Web - How to program, PHI/Pearson Education, 2006.
2. Herbert Schildt, JAVAThe Complete References, 8/e, McGraw Hill, 2014

SEMESTER III
SCY 221: INORGANIC CHEMISTRY -II LAB (CC/PPC)

Hours per week: 3 Credits: 2 Continuous Evaluation: 100 marks

(A) Iodo / Iodimetric Titrations

(i) Estimation of Cu(II) and $K_2Cr_2O_7$ using sodium thiosulphate solution (Iodimetrically).

(ii) Estimation of available chlorine in bleaching powder iodometrically.

(B) Inorganic preparations

(i) Cuprous Chloride, Cu_2Cl_2

(ii) Preparation of Manganese(III) phosphate, $MnPO_4.H_2O$

(iii) Preparation of Aluminium potassium sulphate$KAl(SO_4)_2.12H_2O$ (Potash alum) or Chrome alum.

Reference Books:

Mendham, J., *A. I. Vogel's Quantitative Chemical Analysis 6thEd.*, Pearson, 2009.

SEMESTER III
SCY 223: ORGANIC CHEMISTRY - II LAB (CC/PPC)

Hours per week: 3 Credits: 2 Continuous Evaluation: 100 marks

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) and phenols (salicylic acid) by any one method:
   (a). Using conventional method.
   (b). Using green approach

ii. Benzolyation of amines (aniline) and phenols (β-naphthol) by Schotten-Baumann reaction.
iii. Oxidation of ethanol/ isopropanol (Iodoform reaction).
iv. Bromination of any one of the following:
    (a). Acetanilide by conventional methods
    (b). Acetanilide using green approach (Bromate-bromide method)
v. Nitration of any one of the following:
    (a). Acetanilide/nitrobenzene by conventional method
    (b). Salicylic acid by green approach (using ceric ammonium nitrate).
vi. Selective reduction of meta dinitrobenzene to m-nitroaniline.
vii. Reduction of p-nitrobenzaldehyde by sodium borohydride.
viii. Hydrolysis of amides and esters.
ix. Semicarbazone of any one of the following compounds: acetone, ethyl methyl ketone, cyclohexanone, benzaldehyde.
x. S-Benzylisothiouronium salt of one each of water soluble and water insoluble acids (benzoic acid, oxalic acid, phenyl acetic acid and phthalic acid).
xi. Aldol condensation using either conventional or green method.
xii. 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.

At least 6-8 experiments to be performed under S. No 2.

Reference Books

1. **Text Book:** 1. Vogel's text book of Organic Analysis, Longmann Publishers
2. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry,* Pearson Education (2009)
3. Ahluwalia, V.K. & Aggarwal, R. *Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis,* University Press (2000).
4. Ahluwalia, V.K. & Dhingra, S. *Comprehensive Practical Organic Chemistry: QualitativeAnalysis,* University Press (2000).

SEMESTER III

SCY 225: PHYSICS-II - MECHATRONICS-1 LAB (GE/PPC)

Hours per week: 3 Credits: 2 Continuous Evaluation: 100 marks

List of Experiments:

1. Verification of Ohm's law of conductor.
2. AC through Resistance, inductance and capacitance.
3. LCR circuit series/parallel resonance, Q factor.
4. LCR circuits in series and parallel.
5. Half wave rectifier and full wave rectifier.
6. Characteristics of junction diode.
7. Characterstics of Bipolar junction transistor.
8. Calibration of voltmeter and ammeter.
9. Low pass and high pass filters

SEMESTER III

SCY227: ANALYTICAL METHODS IN CHEMISTRYLAB (DSE/PPC)

Hours per week: 3 Credits: 2 Continuous Evaluation: 100 marks

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:

(i) 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.

(ii) 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.

(ii) Separation of metal ions from their binary mixture.

(iii) Separation of amino acids from organic acids by ion exchange chromatography.

III Spectrophotometry

1. Determination of pKa values of indicator using spectrophotometry.
2. Structural characterization of compounds by infrared spectroscopy.
3. Determination of dissolved oxygen in water.
4. Determination of chemical oxygen demand (COD).
5. Determination of Biological oxygen demand (BOD).
6. Determine the composition of the Ferric-salicylate/ ferric-thiocyanate complex by Job's method.

Reference Books:

1. Mendham, J., *A. I. Vogel's Quantitative Chemical Analysis 6th Ed.*, Pearson, 2009.
2. Willard, H.H. *et al.*: *Instrumental Methods of Analysis*, 7th Ed. Wardsworth Publishing Company, Belmont, California, USA, 1988.
3. Christian, G.D. *Analytical Chemistry*, 6th Ed. John Wiley & Sons, New York, 2004.
4. Khopkar, S.M. *Basic Concepts of Analytical Chemistry*. New Age International Publisher, 2009.
5. Skoog, D.A. Holler F.J. and Nieman, T.A. *Principles of Instrumental Analysis*, Cengage Learning India Edition.

SEMESTER III

SCY 229: ANATOMY, PHYSIOLOGY AND PHARMACOLOGY LAB (DSE/PPC)

Hours per week: 3 Credits: 2 Continuous Evaluation: 100 marks

1. Study of route of drug administration in laboratory animals
2. Study of drug action on the eye of the rabbit- Miotics and Mydriatics (software)
3. Study of effect of drugs on intestinal motility using frog's esophagus model (software)
4. Study of analgesic property of the drug using anlgesiometer (software)

5. Study of anti inflammatory property of the drug using rat paw edema method(software)
6. Study of effect of drugs on locomotor activity using actophotometer and rotorod (software)

SEMESTER III
SCY – 231 DATA STRUCTURES WITH C LABORATORY

Hours per week: 3 Credits: 2 Continuous Evaluation: 100 marks

1. Write a program to read a linear list of items and store it in array.
   • Copy the contents from one array to another array
   • Copy the contents from one array to another in reverse order
2. Perform Linear Search and Binary Search on a list stored in array. Compare and contrast.
3. Write programs for:
   • Reading and printing matrices
   • Matrix addition
   • Matrix transpose
   • Matrix multiplication
4. Write a program to
   • Create a singly linked list.
   • Insert, delete nodes at various positions in a singly linked list
5. Write a program to perform the following operations to single linked list, double linked list and circular linked list
   - Insert, delete nodes at various positions
   - Display the list
6. Write a program to create a stack and perform various operations on it.
   - push
   - Pop
7. Write a program to create a queue and perform various operations on it.
   - Enque
   - deque
8. Represent the graph in adjacency matrix form.
9. Implement various sorting techniques: a. Insertion sort, b. selection c. Bubble,
10. Write a program to create a binary search tree and perform search operation.

SEMESTER - IV
SCY 202: ORGANIC CHEMISTRY – III (CC)

Hours per week: 4 Semester End Examination: 60 Marks
Credits: 4 Continuous Evaluation: 40 marks

UNIT - I: Nitrogen Containing Functional Groups

Preparation and important reactions of nitro, nitrile and isonitrile compounds: (Preparation methods from alkyl halides).

Amines: Preparation methods – From alkyl halide, nitriles, nitroalkanes, amides (Hofmann's rearrangement), Gabriel phthalimide synthesis; Properties – Effect of substituent and solvent on basicity; Carbylamine reaction, Mannich reaction; Distinction between 1°, 2° and 3° amines with Hinsberg reagent and nitrous acid reaction.

Diazonium Salts: Preparation and their synthetic applications.

UNIT - II: Polynuclear Hydrocarbons

Naphthalene, Phenanthrene and Anthracene – Preparation by Haworth Synthesis; Structure elucidation by Kekule-Type formula. Reactions (oxidation & reduction) and important derivatives of naphthalene and anthracene.

UNIT - III: Heterocyclic Compounds

Classification and nomenclature, structure, aromaticity in 5-membered and 6-membered rings containing one heteroatom and fused systems; Synthesis of Furan, Pyrrole (Paal-Knorr synthesis), Thiophene, Pyridine (Hantzsch synthesis); Indole (Fischer synthesis); Quinoline and isoquinoline (Skraup synthesis and Bischler-Napieralski synthesis); Chemical reactions and mechanism of substitution reactions.

UNIT - IV: Alkaloids

Classification of alkaloids, 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, Morphine, Cocaine and Reserpine.

UNIT - V: Terpenes

Classification, occurrence, isoprene rule, elucidation of structure and synthesis of Citral, α-terpineol and camphor.

Reference Books:

1. Bahl. A & Bahl, B.S. *A text book of Organic Chemistry*, S. Chand & Company Pvt.Ltd. 2014.
2. Agarwal, O.P. Unified Chemistry, Vol I, II, & III, Jai Prakashnath Publications, Fiftieth Edition, 2016.
3. Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
4. Finar, I. L. *Organic Chemistry* (*Volume 1*), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
5. Finar, I. L. *Organic Chemistry* (*Volume 2: Stereochemistry and the Chemistry ofNatural Products*), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
6. Bahl. A & Bahl, B.S. *A text book of Organic Chemistry*, S. Chand & Company Pvt.Ltd. 2014.
7. Kalsi, P. S. *Textbook of Organic Chemistry 1stEd.*, New Age International (P) Ltd. Pub.
8. Singh, J.; Ali, S.M. & Singh, J. *Natural Product Chemistry*, Prajati Parakashan (2010).

SEMESTER IV

SCY 204: PHYSICAL CHEMISTRY III - PHASE EQUILIBRIA AND CHEMICAL KINETICS(CC)

Hours per week: 4 | Semester End Examination: 60 Marks
Credits: 4 | Continuous Evaluation: 40 marks

Unit-I: Phase Equilibria-1

Concept of phases, components and degrees of freedom, derivation of Gibbs Phase Rule for nonreactive systems; Clausius-Clapeyron equation and its applications to solid-liquid, liquid-vapour and solid-vapourequilibria, phase diagram for one component systems, with applications.Phase diagrams for systems of solid-liquid equilibria involving eutectic points.

Unit-II: Phase equilibria-2

Three component systems, water-chloroform-acetic acid system.
Binary solutions: Gibbs-Duhem-Margules equation, its derivation, partial miscibility of liquids, CST, Nernst distribution law and its deviations.

Unit-III:Chemical Kinetics

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 order of reaction. Temperature dependence of reaction rates; Arrhenius equation; activation energy. Collision theory of reaction rates,

Unit-IV: Catalysis:

Definition of catalyst, types of catalysts -Homogeneous and heterogeneous catalysis - acid-base catalysis – prototropic and protolytic mechanism and derivation of rate law, Enzyme catalysis, Michaelis-Menten kinetics.

Unit-V: Surface chemistry:

Physical adsorption, chemisorption, adsorption isotherms – types- Langmuir and Freundlichisotherms.Surface active agents- classification- critical micellar concentration (CMC) - factors affecting the CMC of surfactants- determination of cmc. Solubilisation-factors influencing the solubilization.

Reference Books:

1. Peter Atkins & Julio De Paula, *Physical Chemistry* 10th Ed., Oxford University Press (2014).
2. Mortimer, R. G. *Physical Chemistry 3rd Ed.,* Elsevier: NOIDA, UP (2009).
3. Levine, I. N. *Physical Chemistry 6th Ed.,* Tata McGraw-Hill (2011).

SEMESTER- IV
SCY 206: PHYSICS III –MECHATRONICS II (GE)

Hours per week: 4	Semester End Examination: 60 Marks
Credits: 4	Continuous Evaluation: 40 marks

UNIT –I: Kinematic analysis of mechanisms

Introduction to mechanisms-Kinematic pairs and chains-velocity analysis-Relative velocity method-Slider crank and four bar mechanism-Instantaneous center method-Arnold Kennedy theorem. Acceleration analysis-procedure to draw acceleration polygon of mechanism-coriolis acceleration and analytical method.

UNIT –II: Synthesis of Mechanisms

Straight line motion-Mechanisms: Exact straight line generating mechanisms-Peaucellier approximate Straight Line Generating Mechanisms-Watt-Grasshopper and Tchebicheff's. Compliant mechanisms-Flexure based straight line mechanism. Offset slider crank mechanisms-Pantograph.

UNIT –III: Fluid Kinematics

Introduction methods of describing fluid motion-types of fluid flow-rate of flow or discharge-continuity equation and continuity equation in three dimensions-velocity and acceleration-velocity potential functions and stream function and type of motion.

UNIT –IV: Fluid Dynamics

Introduction, equations of motion-Euler's equation of motion-Bernoulli's equation from Euler's equation-Bernoulli's equation for real fluid-momentum equation-force exerted by flowing fluid on pipe bend-moment of momentum equation Applications of momentum equations-Fluid flow measurements-Introduction venturimeter-orifice plate and pitot tube.

UNIT –V: Hydraulic Pumps

Introduction-pumps-centrifugal pump-effect of vane shape and operating variables performance characteristics of centrifugal pump-Hydraulic turbine-Pelton turbine-performance characteristics of hydraulic turbines-Reciprocating pump-inertia effect on pressure head and effect of friction pressure head

Text Books

1. Theory of Mechanisms and Machines C.S.Sharma and Kamalesh Purohit PHI 2006
2. A text book of Fluid Mechanics R.K. Bansal Laxmi Publications
3. Fluid Mechanics and Hydraulic Machines S.C Gupta Pearson Education

SEMESTER- IV
SCY- 208: DATABASE MANAGEMENT SYSTEMS

Hours per week: 4	Semester End Examination: 60 Marks
Credits: 4	Continuous Evaluation: 40 marks

Unit I

Introduction to DBMS: Overview, File system vs DBMS, advantages of DBMS, storage data, queries, transaction management, DBMS structure.

Data Models: Data modelling and data models, the importance of data models, data model basic building blocks, the evolution of data models, degree of data abstraction.

E-R model: Entities, attributes and entity sets, relationship and relationship sets, mapping cardinalities, keys, features of ER model, conceptual database design with ER model.

Unit II

Relational model: Integrity constraints over relations and enforcement, querying relation data, logical database design, views, destroying/altering tables and views.

Relational Algebra and Relational Calculus.

Unit III

Structured Query Language (SQL): Introduction to SQL, data definition commands, data manipulation commands, SELECT queries, advanced data definition commands-advanced SELECT queries, creating a view, joining database tables.

Unit IV

Advanced SQL: Relational set operators, SQL join operators, sub queries and correlated queries, SQL functions, procedural SQL, embedded SQL, cursors, ODBC and JDBC, triggers and active database, designing active databases

Unit V

Normalization of database tables: Database tables and normalization, the need for normalization, the normalization process, improving the design, higher level normal forms, normalization and database design, schema refinement, FDs, FDs reasoning normal forms, decomposition, normalization, denormalization.

Transaction Management and Concurrency Control: What is a transaction? transaction state implementation of atomicity and durability.

Text Book(s)

1. Raghu Ramakrishnan and Johannes Gehrke, Database Management Systems, McGrawHill, 2002.

2. H.F.Korth and A.Silberschatz, Database System Concepts, McGrawHill, 2002.

References

1. Ramez Elmasri, Shamkant B. Navathe, Fundamentals of Database Systems, 2008.

2. Elmasri, Navathe, Somayajulu Gupta, Fundamentals of Database Systems, Pearson Education,
2007.

SEMESTER- IV
SCY 242: BASIC CONCEPTS OF MEDICINAL CHEMISTRY (DSE)

Hours per week: 4 — Semester End Examination: 60 Marks
Credits: 4 — Continuous Evaluation: 40 marks

UNIT-I : Drug structure and biological activity: Pharmaceutically important functional groups-alcohols, carboxylic acid, amines, sulfonamides and carbonyl compounds. Basic reactions for drug molecule synthesis: Aldol, Diels-Alder, Claisen, Grignard, Michael, and Mannich reactions

UNIT-II: Chemistry of drug metabolism- absorption distribution, drug metabolism and excretion site specificity, stability, prolong release, minimum toxicity, patient acceptance.

UNIT-III : Vitamines : Structure, physiological role and uses of Vitamins A ,Vitamin D Thiamine (B1) and Pyridoxine (B6).

UNIT-IV :
Chemistry of selected drugs- Synthesis and basic concept of action for the following drugs
(i) Anticancer: 5-Fluorouracil
(ii) Antimalarial**s :** Chloroguanide
(iii) Anti-inflammatory**:** Diclofenac Sodium
(iv) Sedatives: Phenobarbital

UNIT-V :
Chemistry of selected drugs- Synthesis and basic concept of action for the following drugs
(i) Antiulcers and antacids: Omeprazolee
(ii) Antiviral: Acyclovir
(iii) Antihistaminic: Cinnarizine
(iv) Antiasthmatic agents : Salbutamol

Books Recommended
1. Medicinal Chemistry, A. Burger, Vol. I-III, Wiley Interscience Publications, New York, 1995.

4. Medicinal Chemistry, A. Kar, Wiley Eastern Ltd., New Delhi, 1993.
5. The Organic Chemistry of Drug design and Drug action, Richard B. Silverman; II Ed.; Elsevier Acadmic Press, 2004
6. Medicinal Chemistry; Rama Rao Nadendla; PharmaMed Press, 2013

Reference book

1. Essentials of Medicinal Chemistry, Andrejus Korolkovas ;,II Ed. ,Wiely India, 2008
2. Medicinal Chemistry: A molecular and Biochemical approach; Thomas Nogrady,Donald F.Weaver;III Ed.:Oxford University Press , 2007

SEMESTER- IV
SCY 244: FUNDAMENTALS OF INSTRUMENTAL METHODS OF ANALYSIS (DSE)

Hours per week: 4 — Semester End Examination: 60 Marks
Credits: 4 — Continuous Evaluation: 40 marks

UNIT- I

Spectrofluorimetry:). Theory of fluorescence, phosphorescence, instrumentation, application with reference to thiamine (B1) and riboflavin (B2)

Infrared spectroscopy - Interactions with molecules, source of excitation, separation of spectrum (wavelength dispersion, time resolution), detection of the signal (heat, differential detection).qualitative interpretation of spectrum.

Unit II: Mass spectroscopy: Principle and Instrumentation: Ionization methods: Electron impact ionization , chemical ionization, electrical discharge, laser desorption, fast atom bombardment. Separation of ions on basis of mass to charge ratio: Magnetic sector analyzer, Time of flight and quadrupole analyzer, Detector.

NMR spectroscopy: **P**rinciple, Instrumentation, Factors affecting chemical shift, spin- spin coupling, Applications.

Unit III - Separation techniques

High performance liquid chromatography: Theory and instrumentation: pumps, column, detectors-UV detector, refractive index detector, Fluorescence detector, photo diode array detector, applications.

Gas liquid chromatography: Theory and instrumentation: columns (packed and capillary columns), detector: thermal conductivity detector, flame ionization detector, electron capture detector, nitrogen-phosphorus detector, photo ionization detector and applications.

Unit IV -

Induced Couple Plasma Optical Emission Spectroscopy : source of Excitation: plasma. Nebulizer, Wavelength separation and resolution, Detection of radiation. matrix effects, ,chemical & spectral interferences.

Thermal methods of analysis: Thermogravimetry (TG): Basic principle and

Instrumentation. Thermogram of $CuSO_4.5H_2O$ and $CaC_2O_4.2H_2O$

Unit V: Radiochemical Methods: Detection and measurement of radioactivity. Applications of tracer technique: Isotope dilution analysis and applications.

Neutron activation analysis and applications. Radio Carbon dating technique

X-ray Fluoroscence spectroscopy (surface analysis): Theory, instrumentation: x-ray tube, Energy dispersive and wavelength dispersive spectrometers, matrix effect and general applications.

Suggested books:

1. D.A. Skoog, F.J. Holler & S. Crouch (ISBN 0-495-01201-7) Principles of Instrumental Analysis, Cengage Learning India Edition, 2007.
2. Willard, Merritt, Dean, Settle, Instrumental Methods of Analysis, 7th ed, IBH Book House, New Delhi.
3. Atkins, P.W & Paula, J.D. Physical Chemistry, 10th Ed., Oxford University Press (2014).
4. Kakkar, R. Atomic and Molecular Spectroscopy: Concepts and Applications. Cambridge University Press, 2015.
5. Castellan, G. W. Physical Chemistry 4th Ed., Narosa (2004).
6. Banwell, C. N. & McCash, E. M. Fundamentals of Molecular Spectroscopy 4th Ed. Tata McGraw-Hill: New Delhi (2006).
7. Smith, B.C. Infrared Spectral Interpretations: A Systematic Approach. CRC Press, 1998.
8. Moore, W.J., Physical Chemistry Orient Blackswan, 1999.

SEMESTER- IV
SCY 246: GREEN CHEMISTRY (DSE)

Hours per week: 4 — Semester End Examination: 60 Marks
Credits: 4 — Continuous Evaluation: 40 marks

UNIT-I: Introduction to Green Chemistry

Green chemistry - Introduction - need for green chemistry - goals of green chemistry - Anastas' twelve principles of green chemistry - Designing a green synthesis (tools) - choice of starting materials, solvents, catalysts, reagents, processes with suitable examples.

UNIT -II: Ionic liquids - synthesis, physical properties of ionic liquids - applications in alkylation, epoxidation, Friedal-Crafts reaction - Diels-Alder reactions – Knoevengal condensations and Wittig reactions.

Phase Transfer Catalyst (PTC) - Definition - advantages, types of PTC reactions - synthesis of PTC, applications of PTC in organic synthesis - Michael reaction - alkylation of aldehydes and ketones. Wittig, generation of dihalocarbene, elimination reaction

UNIT -III: Supercritical CO_2 - phase diagram - uses in extracting natural products, dry cleaning, bromination, Kolbe-Schmidt synthesis - Friedel-crafts reaction. Dimethyl carbonate as a methylating agent in green synthesis

UNIT- IV: Microwave and Ultrasound Assisted Reactions

Microwave activation - advantages of microwave exposure - Microwave assisted reactions, condensation reactions - oxidation, reduction reactions, multicomponent reactions.

Sonochemistry - use of ultrasound in organic synthesis (alternate source of energy) - saponification - substitution, addition, oxidation reactions, reductions.

UNIT-V: Green Analytical Techniques

Micelle mediated extraction- Cloud point extraction and adsorptive miceller flocculation methods. Solid Phase Micro Extraction (SPME)

Text books:

1. Paul T. Anastas and John C. Warner, "Green Chemistry", Oxford University Press, Indian Edition, 2008.
2. V. K. Ahluwalia and M. Kidwai, "New Trends in Chemistry", Anamaya Publishers, 2nd Edition, 2007.
3. V. Kumar, "An Introduction to Green Chemistry", Vishal Publishers, 1st Edition, 2007.
4. V. K. Ahluwalia and R. S. Varma, "Green Solvents", Narosa Publishing, 1st Edition, 2009.
5. V.K.Ahluwalia and Renu Aggarwal, "Organic Synthetic Special Techniques", Narosa, 2nd Edition, 2009.
6. V. K. Ahluwalia, "Green Chemistry - Environmentally Benign Reactions", Ane books, India, 2006.
7. Matlack, A.S. *Introduction to Green Chemistry*, Marcel Dekker (2001).

SEMESTER- IV
SSE 252: INDUSTRIAL SAFETY (SEC)

Hours per week: 2
Credits: 2 Continuous Evaluation: 100 marks

Introduction to Industrial Hygiene & Historical views, Definitions and professionals involved in industrial Hygiene work.

Safety and Hygiene aspects related to
i. Transport, handling & storage of inflammable liquids & gases & toxic materials
ii. Process equipment including piping (fire, static electricity, pressure, temperature etc.) safety aspects at process development & design stage.
Threshold Limit Value (TLV) and Permissible Exposure Limits (PEL) for chemicals, Industrial toxicology and the basics, Classification of toxic agents.

SEMESTER- IV
SSE 254: CHEMICAL TECHNOLOGY & SOCIETY (SEC)

Hours per week: 2
Credits: 2 Continuous Evaluation: 100` marks

Chemical Technology
Basic principles of distillation, solvent extraction, solid-liquid leaching and liquid-liquid extraction, separation by absorption and adsorption. An introduction into the scope of different types of equipment needed in chemical technology, including reactors, distillation columns, extruders, pumps, mills, emulgators. Scaling up operations in chemical industry. Introduction to clean technology.

Society
Exploration of societal and technological issues from a chemical perspective. Chemical and scientific literacy as a means to better understand topics like air and water, energy from natural sources (i.e. solar and renewable forms), from fossil fuels and from nuclear fission; materials like plastics and polymers and their natural analogues, proteins and nucleic acids.

Reference Book:
John W. Hill, Terry W. McCreary & Doris K. Kolb, *Chemistry for changing times* 13th Ed, Prentice-Hall (2012).

SEMESTER- IV
SSE-256 PYTHON PROGRAMMING (SEC)

Hours per week: 2 Continuous Evaluation: 100 marks
Credits: 2

GETTING STARTED WITH PYTHON
Introduction to python,Installation, python interpreter and its environment, variables, expressions and statements, conditional execution.

FUNCTIONS
Function calls, built-in functions, type conversion functions, definitions and uses, flow of executions, parameters and arguments.

ITERATIONS

Updating variables,the while statement, infinite loops and break, loop patterns.

STRINGS

String slices, looping and counting, the in operator, string comparison, string methods.

TUPLES&DICTIONARIES

Comparing tuples, tuple assignment, dictionaries and tuples, multiple assignments with dictionaries, using tuples as keys in dictionaries.

LISTS

A list in a sequence, traversing a list, list operations, list methods, deleting elements, lists and functions, lists and strings, parsing lines, aliasing, list arguments

Textbooks:

1) Timothy A. Budd 'Exploring Python' – TATA McGRAW-HILL Edition- 2011
2) Charles Severance 'Python for Everybody'

SEMESTER- IV
SSE-258 INTRODUCTION TO UNIX PROGRAMMING (SEC)

Hours per week: 2
Credits: 2 Continuous Evaluation: 100 marks

UNIX- An Introduction – Functions of operating system, History of Unix, Features and Structure of UNIX System, Unix Environment, Unix File System Structure, Basic Unix Commands, Directory handling System calls- mkdir, rmdir, chdir; File Access Permissions, Input Output Redirection in Unix, Pipe operator, Advanced Unix Commands - cut,

paste,split,wc,sort, head, tail, diff, cmp, uniq, comm,grep, time, calendar, man commands; File related System Calls – chown, chmod, umask; File Management and Compression Techniques – Computer Devices, Disk Related Commands, Compressing and Uncompressing Files – zip, unzip, compress, uncompress, pack, unpack, bzip, bunzip commands, Important Unix System Files,Dealing with Files – file, find, locate; Process -Basics , states, zombie process, ps, fg,bg, cron at, kill,batch commands, Networking & Communication Commands – telnet,ping,arp,ftp, mail command**s;** Day toDay Commands – date, time.

Shell Programming- Introduction, Types of Shell, Steps to create and run shell script, echo, variables, expr, let, bc, Writing Shell Scripts using read, if, for, while, until commands,Command Line Parameters.

TextBook:

Unix & Shell Programming , B.M. Harwani, Oxford Press, 2013.

References:

Unix Concepts by Sumitaba Das, TMH Publications, 4th edition, 2006.

SEMESTER- IV
SCY 220 ORGANIC CHEMISTRY- III LAB (PPC)

Hours per week: 3 Credits: 2 Continuous Evaluation: 100 marks

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)

Reference Books

1. **Text Book:** 1. Vogel's text book of Organic Analysis, Longmann Publishers
2. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry,* Pearson Education (2009)
3. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. *Practical OrganicChemistry, 5th Ed.,* Pearson (2012)
4. Ahluwalia, V.K. & Aggarwal, R. *Comprehensive Practical Organic Chemistry:Preparation and Quantitative Analysis,* University Press (2000).
5. Ahluwalia, V.K. & Dhingra, S. *Comprehensive Practical Organic Chemistry:Qualitative Analysis,* University Press (2000).

SEMESTER- IV
SCY 222 PHYSICAL CHEMISTRY III LAB (PPC)

Hours per week: 3 Credits: 2 Continuous Evaluation: 100 marks

I. Determination of critical solution temperature and composition of the

II Study the effect of impurities on phenol-water system

III. Distribution of acetic/ benzoic acid between water and cyclohexane.

IV. 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) $Cu^{2+}(aq) + nNH_3 \rightarrow Cu(NH_3)_n$

V. Study the kinetics of the acid hydrolysis of methyl acetate with hydrochloric acid through Integrated rate method:

Reference Books:

1. Khosla, B. D.; Garg, V. C. &Gulati, A. *Senior Practical Physical Chemistry,* R. Chand & Co.: New Delhi (2011).
2. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. *Experiments in Physical Chemistry8th Ed.*; McGraw-Hill: New York (2003).
3. Halpern, A. M. &McBane, G. C. *Experimental Physical Chemistry 3rdEd.;* W.H. Freeman & Co.: New York (2003).

SEMESTER- IV
SCY 224: PHYSICS III- MECHATRONICS-2 LAB

Hours per week: 3 Credits: 2 Continuous Evaluation: 100 marks

List of Experiments:
1. Calibration of small orifice
2. Calibration mouthpiece by constant head method and falling head method.
3. Calibration of orifice meter and nozzle meter,
4. Verification of Bernoulli's equation
5. Calibration of Venturimeter
6. Performance characteristics of centrifugal pump
7. Performance characteristics of reciprocating pump
8. Performance characteristics of Pelton wheel turbine
9. Pitot tube

SEMESTER- IV
SCY 226: MEDICINAL CHEMISTRY Lab (PPC)

Hours per week: 3 Credits: 2 Continuous Evaluation: 100 marks

(1) Assay of Ibuprofen by alkalimetry.
(2) Assay of Diclofenac by alkalimetry.
(3) Assay of Analgin by iodimetry
(4) Assay of Lidocaine HCl by nonaqueous titrimetry
(5) Assay of Metronidazole by nonaqueous titrimetry
(6) Preparation of Benzimidazole from O-phenyline diamine
(7) Preparation of Benzotriazole from O-phenyline diamine
(8) Preparation of Para amino salicylic acid from p-nitro salicylic acid
(9) Preparation of Chlorbutol
(10) Preparation of Benzil from benzoin
(11) Preparation of Phenytoin from benzyl
(12) Preparation of Benzocaine from p-amino benzoic acid
(13) Preparation of 7-hydroxy, 4-methyl coumarin
(14) Preparation of paracetamol
(15) Preparation of Aspirin
At least 8-10 of the above (Assay:3-4 and Preparations:5-6)

SEMESTER- IV

SCY 228: INSTRUMENTAL METHODS OF ANALYSIS Lab (PPC)

Hours per week: 3 Credits: 2 Continuous Evaluation: 100 marks

1. Safety Practices in the Chemistry Laboratory
2. Titration curve of an amino acid.
3. Determination of a Mixture of Cobalt and Nickel (UV/Vis spec.)
4. IR Absorption Spectra (Study of Aldehydes and Ketones)
5. Determination of Calcium, Iron, and Copper in Food by Atomic Absorption
6. Quantitative Analysis of Mixtures by Gas Chromatography (i.e., chloroform and carbon tetrachloride)
7. Separation of Carbohydrates by HPLC
8. Potentiometric Titration of a Chloride-Iodide Mixture
9. Laboratory analysis to confirm anthrax or cocaine
10. Detection in the field and confirmation in the laboratory of flammable accelerants or explosives
11. Detection of illegal drugs or steroids in athletes
12. Detection of pollutants or illegal dumping

At least 8-10 experiments to be performed.

Reference Books:

1. Skoog, D.A. Holler F.J. & Nieman, T.A. *Principles of Instrumental Analysis*, Cengage Learning India Ed.
2. Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. *Instrumental Methods of Analysis*, 7th Ed. Wadsworth Publishing Company Ltd., Belmont, California, USA, 1988.

SEMESTER- IV
SCY 230: GREEN CHEMISTRY LAB

Hours per week: 3 Credits: 2 Continuous Evaluation: 100 marks

1. Safer starting materials

- Preparation and characterization of nanoparticles of gold using tea leaves.

2. Using renewable resources

- Preparation of biodiesel from vegetable waste cooking oil.

3. Avoiding waste

Principle of atom economy.

- Use of molecular model kit to stimulate the reaction to investigate how the atom economy can illustrate Green Chemistry.
- Preparation of propene by two methods can be studied

(I) Triethylamine ion + OH^- → propene + trimethylpropene + water

(II) 1-propanol $\xrightarrow{H_2SO_4/\square}$ propene + water

- Other types of reactions, like addition, elimination, substitution and rearrangement should also be studied for the calculation of atom economy.

4. Use of enzymes as catalysts

- Benzoin condensation using Thiamine Hydrochloride as a catalyst instead of cyanide.

5. Alternative Green solvents

Extraction of D-limonene from orange peel using liquid CO2 prepared form dry ice.
Mechanochemical solvent free synthesis of azomethines

6. Alternative sources of energy

- Solvent free, microwave assisted one pot synthesis of phthalocyanine complex of copper (II).
- Photoreduction of benzophenone to benzopinacol in the presence of sunlight.

Reference Books:

1. Anastas, P.T & Warner, J.C. *Green Chemistry: Theory and Practice,* Oxford University Press (1998).
2. Sharma, R.K.; Sidhwani, I.T. & Chaudhari, M.K. I.K. *Green Chemistry Experiment: A monograph International Publishing House Pvt Ltd. New Delhi*. Bangalore CISBN 978-93-81141-55-7 (2013).
3. Cann, M.C. & Connelly, M. E. *Real world cases in Green Chemistry*, American Chemical Society (2008).

SEMESTER- IV

SCY- 232: DATABASE MANAGEMENT SYSTEMS LAB

Hours per week: 3 Continuous Evaluation: 100 marks
Credits: 2

1. Developing a sample ER model for the specified database.
2. Familiarization of SQL DDL commands
   - Create table
   - Alter table
   - Drop
   - Rename and truncate tables

3. Use of DML commands-
   - Select –Where with aggregate operators
   - Insert
   - Update
   - Delete rows
4. Use of different of operators for nested sub-queries.
5. Creating Views, grouping functions and performing joins.
6. Declaring triggers and use of cursors.

References

1.James, Paul and Weinberg, Andy Oppel, SQL: The Complete References, 3/e, Tata McGraw -Hill, 2011.
2. Michael McLaughlin, Oracle Database l lg PL/SQL Programming, Oracle Press, 2001.

SEMESTER V

SCY 301: INORGANIC CHEMISTRYIII - COORDINATION CHEMISTRY(CC)

Hours per week: 4	Semester End Examination: 60 Marks
Credits: 4	Continuous Evaluation: 40 marks

Unit-I: Transition Elements:

General group trends with special reference to electronic configuration, colour, variable valency, magnetic and catalytic properties, ability to form complexes.

Chemistry of Ti, V, Cr Mn, Fe and Co in various oxidation states (excluding their metallurgy)

Unit-II: Lanthanoids and Actinoids:

Electronic configuration, oxidation states, colour, spectral and magnetic properties of lanthanides and actinides.

lanthanide contraction, separation of lanthanides (ion-exchange method only).

Unit-III: Coordination Chemistry-I

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.

Unit-IV: Coordination Chemistry-II

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,

Unit-V: Bioinorganic Chemistry

Metal ions present in biological systems, Geochemical effect on the distribution of metals. Sodium / K-pump, carbonic anhydrase and 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, Haemoglobin; Storage and transfer of iron.

Reference Books:

1. Huheey, J.E., *Inorganic Chemistry*, Prentice Hall, 1993.
2. Basolo, F, and Pearson, R.C. *Mechanisms of Inorganic Chemistry*, John Wiley & Sons, NY, 1967.
3. Greenwood, N.N. &Earnshaw A. *Chemistry of the Elements*, Butterworth-Heinemann, 1997.

SEMESTER V

SCY 303: ORGANIC CHEMISTRY – IV (CC)

Hours per week: 4 | Semester End Examination: 60 Marks
Credits: 4 | Continuous Evaluation: 40 marks

UNIT I: Amino Acids

Amino acids, Peptides and their classification.

Synthesis of α – Amino Acids – Strecker, Gabriel Phthalimide, Koop Synthesis; Zwitterions – pKa values, isoelectric point and principle of electrophoresis; Chemical properties of amino acids – Reduction, esterification, acylation, diazotization, dehydration, ninhydrin test .

Structure of peptide, Structural organization of proteins (1°, 2°, 3° & 4°); Overview of catabolic pathways of protein.

Nucleic Acids: Components of nucleic acids – Nucleotides and nucleosides; Structure, synthesis of Adenine, Guanine, Cytosine, Uracil and Thymine; Structure of polynucleotides – RNA & DNA.

UNIT II: Enzymes

Introduction, classification and remarkable properties of enzymes; coenzymes and cofactors and their role in biological functions. Salient features of active site of enzymes; Mechanism of action of trypsin; factors affecting enzyme action, Enzyme inhibitors – Reversible and irreversible; Allosteric regulation of enzymes.

UNIT III: Lipids

Introduction to oils and fats; Common fatty acids present in oils and fats; Hydrogenation of fats and oils; Saponification value, Iodine value, Reversion and rancidity. Overview of catabolic pathways of fat.

UNIT IV: Pharmaceutical Compounds: Structure and Importance

Classification, structure and therapeutic uses of antipyretic: Paracetamol (with synthesis), Analgesic: Ibuprofen (with synthesis), Anti-malarial: Chloroquine (with synthesis). An elementary treatment of Antibiotic: Chloramphenicol (with synthesis); Medicinal values of curcumin (haldi), azadirachtin (neem), vitamin C and antacid (ranitidine).

UNIT V: Carbohydrates

Occurrence, classification and biological importance.

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.

Disaccharides – Structures of maltose, lactose and sucrose; Structure elucidation of sucrose.

Polysaccharides – Outline of catabolic pathways of carbohydrate - glycolysis, fermentation, Krebs cycle.

Reference Books:

1. Bahl. A & Bahl, B.S. *A text book of Organic Chemistry*, S. Chand & Company Pvt.Ltd. 2014.

2. Berg, J.M., Tymoczko, J.L. & Stryer, L. (2006) *Biochemistr*y. 6th Ed. W.H. Freeman and Co.
3. Nelson, D.L., Cox, M.M.& Lehninger, A.L. (2009) *Principles of Biochemistry. IVEdition.* W.H. Freeman and Co.
4. Murray, R.K., Granner, D.K., Mayes, P.A. & Rodwell, V.W. (2009) *Harper'sIllustrated Biochemistry.* XXVIII edition. Lange Medical Books/ McGraw-Hill.

SEMESTER V
SCY 305: PHYSICAL CHEMISTRY IV - ELECTROCHEMISTRY (CC)

Hours per week: 4 — Semester End Examination: 60 Marks
Credits: 4 — Continuous Evaluation: 40 marks

Unit –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.

Unit –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.

Unit –III:
Quantitative aspects of Faraday's laws of electrolysis, rules of oxidation/reduction of ions based on half-cell potentials.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.
Application of EMF measurements in determining(i) free energy, enthalpy and entropy of a cell reaction, (ii) equilibrium constants

Unit -IV
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).

Unit –V
Basic ideas of electrostatics, Electrostatics of dielectric media, Dipole moment and molecular polarizabilities and their measurements.Diamagnetism, paramagnetism, magnetic susceptibility and its measurement.

Reference Books:
1. Atkins, P.W & Paula, J.D. *Physical Chemistry*, 10th Ed., Oxford University Press (2014).
2. Rogers, D. W. *Concise Physical Chemistry* Wiley (2010).

SEMESTER V
SCY 341: PHARMACEUTICS – 1 (DSE)

Hours per week: 4 Semester End Examination: 60 Marks
Credits: 4 Continuous Evaluation: 40 marks

UNIT –I:

Study of the following dosage forms including the definition, types, formulation design,development , scale up and testing of Monophasic liquid dosage forms: Mouth Washes, Ear Drops, Nasal Drops, Lotions. Only Definition of Gargles, Throat Paints, Liniments, Enemas and Colloids Biphasic Liquid dosage forms - Suspensions and Emulsions

UNIT – II:

Tablets: definition, types, formulation design and development with details functions excipeints , manufacturing process and scale up of unit operations , problems in manufacturing, quality control testing and machinery involved in preparation of tablets

Tablet coating: introduction, reasons for coating tablets, types of tablet coating, sugar, film ideal characteristics, formulation design and development with details functions of coating component, process details & equipments used in film coating and scale up of unit operations, defects in coating.

UNIT – III:

Capsules: Introduction, sizes of capsules, raw materials required for empty capsules shell manufacturing, properties of Gelatin, process of preparation, equipment.

Hard Gelatin Capsule: Formulation design and development with details functions of excipeints used in capsule preparation, Capsule filling & Machines used in filling, filling of Powder, Pellet, Semisolid & Liquid into empty shell.

Soft Gelatin Capsules: Introduction to soft gelatin capsule dosage form, Rationale for the selection of softgels as a dosage form, Manufacture of soft gels.

UNIT –IV:

Semi solid preparations: Classification - topical formulations and their application, ointment bases and their application. Unit operations involved in the manufacturing of ointment, cream, paste, lotion and gel formulations, CQA for ointment, cream, paste and gel formulations, CPP and CMA for ointment, cream, paste and gel manufacturing process.

UNIT – V:

Sustained and Controlled Release Dosage Forms: Definition, types, formulation design of matrix dosage form and pellets and evaluation.

Introduction to labelling & Packaging, types of packaging materials, factors effecting selection of containers, materials used for containers & closures, drug-container considerations, quality control tests for packaging materials .

Recommended Books:

1. Leon Lachman, H. A. Lieberman & J. L. Kanig: ―The Theory and Practice of Indusrtrial Pharmacy‖, 3rd edition, Varghese Publishing House, Bombay, 1991.
2. M. E. Aulton: ―Pharmaceutics – The Science of Dosage Form Design‖, 2nd edition, Churchill Livingstone, 2002.
3. L. V. Allen, N. G. & Popovich H. C. Ansel: ―Ansel's Parmaceutical Dosage Forms and Drug Delivery Systems‖, 8th edition, Lipincott William & Wilkins, USA, 2005
4. Rawlins, Ed.: ―Remington's The Science and Practice of Pharmacy‖, 20th edition, Lippincott William & Wilkins, USA, 2000.
5.Indian Pharmacopoeia‖ Government of India, Ministry of Health & Family Welfare, the Indian Pharmacopoeial Commission, Ghaziabad, 2007
6. British Pharmacopoeia, Vol. III, 2009.
7.United States Pharmacopoeia‖, USP 32 – NF 27, Vol1 & 2, Asian Edition, 2008.

SEMESTER V

SCY 343: UNIT OPERATIONS IN CHEMICAL ENGINEERING (DSE)

Hours per week: 4 Semester End Examination: 60 Marks
Credits: 4 Continuous Evaluation: 40 marks

UNIT –I:

Filtration : Types of filters batch, continuous filtration, Centrifugation-batch, continuous and basket, inverting bag, bottom discharge, micron, and cartridge filters, Factors affecting filtration and selection of filtration equipment. Microfiltration

Extraction and Leaching: Introduction-extract, raffinate, choice of solvent for extraction, single stage, multistage extraction, Equipment for extraction operation: lipid liquid extractor, factors affecting extraction and leaching, leaching and its applications.

UNIT –II:

Distillation: Binary systems relative volatility, Ideal solutions, Steam distillation, continuous distillation, azeotropic distillation, extractive distillation, batch distillation, flash distillation, distillation under reduced pressure – FEE, ATFE t.

Crystallization : principles, super saturation cooling crystallization, reactive crystallization, seeding, formation of polymorph, type of agitators, factors affecting crystallization classification of crystallizers, equipment – crystallization in batch reactors.

UNIT –III:

Drying : Definition, Applications, purpose of drying, classification of dryers, drying equipment-Tray dryer, rotary dryers, pneumatic dryer, spray dryer, drum dryer, VTD, FBD, RCVD, RCVD, ATFD, ANFD, Spherical dryer. (Basic theoretical concepts with more practical applications)

UNIT –IV:

Size separation/reduction: Grinders –types-circuit, screening-industrial screens, gyratory and vibratory screens-air jet mail, multi mail, Co mail, bantam mill, hammer mill, sifter Mixing-Homogenous, Heterogeneous.

Blending – types of blender octagonal, hexagonal, double cone type.

UNIT –V:

Reactor studies : Basic functions of a ractor, autoclave types –batch, CSTR, semi batch, body construction, types of agitators- Spargers, gas induction turbine, anchor, PBT, propeller

Unit processes and operations: Oxidation, reduction, dehydration, condensation, Hydrolysis hydrogenation, neutralization, fridel – craft reaction, basis of pH, evaporation, column chromatography, membrane separation, bromination, chlorination humidification, basics of organic chemistry, absorption, adsorption.

Recommended books:

1. Author: Julian C. Smith , Warren L. McCabe , Peter Harriott Unit Operations of Chemical Engineering (English), 7th Edition, Mcgraw Hil Education

2. Author: Shyamal K Sanyal , Salil K Ghosal , Siddhartha Introduction to Chemical Engineering (English), 1st Edition, Mcgraw Hill Education

SEMESTER V
SCY 345: MOLECULES OF LIFE (DSE)

Hours per week: 4 Semester End Examination: 60 Marks

Credits: 4 Continuous Evaluation: 40 marks

Unit-1:

Carbohydrates: Classification of carbohydrates, reducing and non-reducing sugars, General properties of glucose and fructose, their open chain structure. Epimers, mutarotation and anomers. Determination of configuration of Glucose (Fischer proof). Cyclic structure of glucose. and fructose. Linkage between monosachharides, structure of disacharrides (sucrose, maltose, lactose) and polysacharrides (starch and cellulose) excluding their structure elucidation.

Unit -2

Amino Acids, Peptides and Proteins Classification of Amino Acids, Zwitterion structure and Isoelectric point. Overview of Primary, Secondary, Tertiary and Quaternary structure of proteins. Determination of primary structure of peptides, determination of N-terminal amino acid (by DNFB and Edman method) and C–terminal amino acid (by thiohydantoin and with carboxypeptidase enzyme).

Unit-3

Enzymes and correlation with drug action Mechanism of enzyme action, factors affecting enzyme action, Coenzymes and cofactors and their role in biological reactions, Specificity of enzyme action (including stereo specificity), Enzyme inhibitors and their importance

Nucleic Acids Components of nucleic acids: Adenine, guanine, thymine and Cytosine (Structure only), other components of nucleic acids, Nucleosides and nucleotides (nomenclature), Structure of polynucleotides; Structure of DNA (Watson-Crick model) and RNA (types of RNA)

Unit-4

Lipids Introduction to lipids, classification. Oils and fats: Common fatty acids present in oils and fats, Omega fatty acids, Trans fats, Hydrogenation, Saponification value, Iodine number. Biological importance of triglycerides, phospholipids, glycolipids, and steroids (cholesterol).

Unit-5

Concept of Energy in Biosystems Calorific value of food. Standard caloric content of carbohydrates, proteins and fats. Oxidation of foodstuff (organic molecules) as a source of energy for cells. Introduction to Metabolism (catabolism, anabolism), ATP: the universal currency of cellular energy, ATP hydrolysis and free energy change. Conversion of food into energy. Outline of catabolic pathways of Carbohydrate- Glycolysis, Fermentation, Krebs Cycle.

RECOMMENDED TEXTS:

Morrison, R. T.• & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd.• (Pearson Education).
Finar, I. L. Organic Chemistry (Volume 2), Dorling Kindersley (India) Pvt. Ltd.• (Pearson Education).
Nelson, D. L.• & Cox, M. M. Lehninger's Principles of Biochemistry 7th Ed., W. H. Freeman. Berg, J.M., Tymoczko, J.L.• & Stryer, L. Biochemistry, W.H. Freeman, 2002.

SCY 321: INORGANIC CHEMISTRY - III LAB (CC/PPC)

Hours per week: 3 Credits: 2 Continuous Evaluation: 100 marks

Gravimetric Analysis:

i. Estimation of nickel (II) using Dimethylglyoxime (DMG).
ii. Estimation of Al (III) by precipitating with oxine and weighing as $Al(oxine)_3$ (aluminium oxinate).

Inorganic Preparations:

i. Tetraamminecopper (II) sulphate, [Cu(NH3)4]SO4.H2O
ii. *Cis* and *trans* K[Cr(C2O4)2. (H2O)2] Potassium dioxalatodiaquachromate (III)
iii. Tetraamminecarbonatocobalt (III) ion
iv. Potassium tris(oxalate)ferrate(III)

Infrared spectroscopy

Characterization of few inorganic complexes using FT-IR spectrophotometer

Reference Book:

Mendham, J., *A. I. Vogel's Quantitative Chemical Analysis 6th Ed.*, Pearson, 2009.

SEMESTER V

SCY 323: ORGANIC CHEMISTRY – IV LAB (CC/PPC)

Hours per week: 3 Credits: 2 Continuous Evaluation: 100 marks

1. Estimation of glycine by Sorenson's formalin method.
2. Study of the titration curve of glycine.
3. Estimation of proteins by Lowry's method.
4. Study of the action of salivary amylase on starch at optimum conditions.
5. Effect of temperature on the action of salivary amylase.
6. Saponification value of an oil or a fat.
7. Determination of Iodine number of an oil/fat.
8. Isolation and characterization of DNA from onion/cauliflower/peas.

Reference Books:

1. **Text Book:** 1. Vogel's text book of Organic Analysis, Longmann Publishers
2. Arthur, I. V. *Quantitative Organic Analysis,* Pearson.
3. Manual of Biochemistry Workshop, 2012, Department of Chemistry, University of Delhi.

SEMESTER V

SCY 325: PHYSICAL CHEMISTRY-IV LAB (CC/PPC)

Hours per week: 3 Credits: 2 Continuous Evaluation: 100 marks

Conductometry

I. Determination of cell constant
II. Determination of equivalent conductance, degree of dissociation and dissociation constant of a weak acid.
III. Conductometrictitrations of
    i. Strong acid vs. strong base
    ii. Weak acid vs. strong base
    iii. Mixture of strong acid and weak acid vs. strong base

Potentiometry

i. potentiometric titration of Potassium dichromate vs. Mohr's salt

Reference Books:

1. Khosla, B. D.; Garg, V. C. &Gulati, A. *Senior Practical Physical Chemistry,* R. Chand & Co.: New Delhi (2011).
2. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. *Experiments in Physical Chemistry8th Ed.;* McGraw-Hill: New York (2003).
3. Halpern, A. M. &McBane, G. C. *Experimental Physical Chemistry 3rdEd.;* W.H. Freeman & Co.: New York (2003).

SEMESTER V
SCY 327: PHARMACEUTICS – 1 Lab(DSE/PPC)

Hours per week: 3 Credits: 2 Continuous Evaluation: 100 marks

1. Preparation & Evaluation of granules loaded with Active Pharmaceutical Ingredients
2. Preparation & Evaluation of Tablets
3. Preparation & Evaluation of Film Coated Tablets
4. Preparation & Evaluation of Capsules
5.-Preparation and evaluation of semi solid dosage forms.

SEMESTER V

SCY 329: UNIT OPERATIONS IN CHEMICAL ENGINEERING Lab(DSE/PPC)

Hours per week: 3 Credits: 2 Continuous Evaluation: 100 marks

1. Bioreactor components & its operation
2. Mixing time in a bioreactor
3. Simple distillation technique
4. Steam distillation technique
5. Filtration techniques
6. Evaporation techniques
7. Centrifugation techniques
8. Product purification techniques
9. Chromatographic techniques
10. Product extraction techniques
11. Size reduction techniques
12. Heat exchangers
13. Sterilization techniques

SEMESTER V

SCY 331: MOLECULES OF LIFE LAB (DSE/PPC)

Hours per week: 3 Credits: 2 Continuous Evaluation: 100 marks

Minimum eight experiments are to be performed.

1. Separation of amino acids by paper chromatography
2. To determine the concentration of glycine solution by formylation method.
3. Study of titration curve of glycine
4. Action of salivary amylase on starch
5. Effect of temperature on the action of salivary amylase on starch.
6. To determine the saponification value of an oil/fat.
7. To determine the iodine value of an oil/fat
8. Differentiate between a reducing/ nonreducing sugar.
9. Extraction of DNA from onion/cauliflower
10. To synthesise aspirin by acetylation of salicylic acid and compare it with the ingredient of an aspirin tablet by TLC.

Recommended Texts:

- Furniss, B.S.; Hannaford, A.J.; Rogers, V.; Smith, P.W.G.; Tatchell, A.R. Vogel's Textbook of Practical Organic Chemistry, ELBS.
- Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry, Universities Press

SEMESTER VI

SCY 302: INORGANIC CHEMISTRYIV - ORGANOMETALLIC CHEMISTRY(CC)

Hours per week: 4	Semester End Examination: 60 Marks
Credits: 4	Continuous Evaluation: 40 marks

Unit-I: Theoretical Principles in Qualitative Analysis (H_2S Scheme)

Basic principles involved in analysis of cations and anions and solubility products, common ion effect. Principles involved in separation of cations into groups and choice of group reagents. Interfering anions (fluoride, borate, oxalate and phosphate) and need to remove them after Group II.

Unit-II: Organometallic Compounds-1

Definition and classification of organometallic compounds on the basis of bond type.Zeise's salt: Preparation and structure, evidences of synergic effect and comparison of synergic effect with that in carbonyls.

Metal carbonyls: 18 electron rule, electron count of mononuclear, polynuclear and substituted metal carbonyls of 3d series. General methods of preparation (direct combination, reductive carbonylation, thermal and photochemical decomposition) of mono and binuclear carbonyls of 3d series.Structures of mononuclear and binuclear carbonyls of Cr, Mn, Fe, Co and Ni of using VBT.π-acceptor behaviour of CO (MO diagram of CO to be discussed).

Unit-III: Organometallic Compounds-2

Metal Alkyls: Important structural features of methyl lithium (tetramer) and trialkylaluminium (dimer), concept of multicentre bonding in these compounds. Role of triethylaluminium in polymerisation of ethene (Ziegler – Natta Catalyst). Species present in ether solution of Grignard reagent and their structures, Schlenk equilibrium.

Ferrocene: Preparation and sturctures of ferrocene. Structure and aromaticity.Comparison of aromaticity and reactivity with that of benzene.

Unit-IV: Catalysis by Organometallic Compounds

Study of the following industrial processes and their mechanism:

1. Alkene hydrogenation (Wilkinsons Catalyst)
2. Hydroformylation (Co salts)
3. Wacker Process
4. Synthetic gasoline (Fischer Tropsch reaction)
5. Synthesis gas by metal carbonyl complexes

Unit-V: 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.

Reference Books:

1. Svehla, G. *Vogel's Qualitative Inorganic Analysis*, 7th Edition, Prentice Hall, 1996.
2. Huheey, J. E.; Keiter, E.A. &Keiter, R.L. *Inorganic Chemistry, Principles ofStructure and Reactivity 4th Ed.*, Harper Collins 1993, Pearson,2006.
3. Lee, J.D. *Concise Inorganic Chemistry 5thEd.*, John Wiley and sons 2008.
4. Powell, P. *Principles of Organometallic Chemistry*, Chapman and Hall, 1988.
5. Basolo, F. & Pearson, R. *Mechanisms of Inorganic Reactions: Study of MetalComplexes in Solution 2nd Ed.*, John Wiley & Sons Inc; NY.

SEMESTER VI
SCY 304: ORGANIC CHEMISTRY - V (CC)

Hours per week: 4 | Semester End Examination: 60 Marks
Credits: 4 | Continuous Evaluation: 40 marks

UNIT - I: UV Spectroscopy

Introduction, general principles of absorption and emission spectroscopy.

Types of electronic transitions; λ_{max}, Intensity of absorption; Chromophores and Auxochromes; Bathochromic, Hypsochromic shift, Hyperchromic shift and Hypochromic shift; Application of Woodward-Fieser rules for calculation of λ_{max} for the following systems: α,β unsaturated aldehydes, ketones and conjugated dienes (alicyclic, homoannular and heteroannular).

UNIT- II: 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.

UNIT III: NMR Spectroscopy

Basic principles of Proton Magnetic Resonance spectroscopy, chemical shift and factors influencing it; Spin-Spin coupling and coupling constant; Anisotropic effects in alkene, alkyne, aldehydes and aromatics; Interpretation of ^{1}H NMR spectra of simple compounds.

Applications of IR, UV and NMR spectroscopy for identification of ethyl alcohol, cinnamic acid, acetanilide and benzaldehyde.

UNIT-IV: Dyes

Colour and constitution: Chromophore-Auxochrome theory; Classification – 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 and Rosaniline; Phthalein Dyes – Phenolphthalein and Fluorescein; Natural dyes – Structure elucidation and synthesis of Alizarin and Indigotin.

UNIT- V: Polymers

Introduction and classification; Number average molecular weight, Weight average molecular weight, Degree of polymerization; Polymerization reactions - Addition and condensation; Mechanism of cationic, anionic and free radical addition polymerization; Metallocene-based Ziegler-Natta polymerization of alkenes; Preparation and uses of polythene, polystyrene, Teflon, PVC and nylon.

Reference Books:

1. Elementary Organic Spectroscopy, Principles and Chemical applications, Revised Version: Y.R.Sharma, SChand Publications
2. Applications of Absorption spectroscopy of organic compounds by John. R. Dyer.
3. Kalsi, P. S. *Textbook of Organic Chemistry 1st Ed.*, New Age International (P) Ltd. Pub.
4. Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
5. Billmeyer, F. W. *Textbook of Polymer Science*, John Wiley & Sons, Inc.
6. Gowariker, V. R.; Viswanathan, N. V. & Sreedhar, J. *Polymer Science*, New Age International (P) Ltd. Pub.
7. Kemp, W. *Organic Spectroscopy*, Palgrave.
8. Pavia, D. L. *et al. Introduction to Spectroscopy* 5th Ed. Cengage Learning India Ed. (2015).

SEMESTER-VI

SCY 306: PHYSICAL CHEMISTRY V - QUANTUM CHEMISTRY & SPECTROSCOPY (CC)

Hours per week: 4 | Semester End Examination: 60 Marks
Credits: 4 | Continuous Evaluation: 40 marks

Unit –I:Basics of Quantum Chemistry

Postulates of quantum mechanics, quantum mechanical operators, Schrödinger equation and its application to free particle and "particle-in-a-box", quantization of energy levels, zero-point energy and Heisenberg Uncertainty principle.

Qualitative treatment of simple harmonic oscillator model of vibrational motion: Setting up of Schrödinger equation. Vibrational energy of diatomic moleculesand zero-point energy.

Unit-II: Molecular Spectroscopy-1

Characteristics of electromagnetic radiation, interaction of electromagnetic radiation with molecules and various types of spectra.

Rotation spectroscopy: Selection rules, intensities of spectral lines, rotational energy of diatomic molecule (rigid rotator model), determination of bond lengths of diatomic molecules form its rotational spectra, Isotopic substitution

Vibrational spectroscopy: Classical equation of vibration, computation of force constant, fundamental frequencies, overtones

Unit-III: Molecular Spectroscopy-2

Raman spectroscopy: Raman effect, Stokes and anti-Stokes lines; their intensity difference, Pure rotational Raman spectra and Vibrational Raman spectra (Diatomic molecule), rule of mutual exclusion.

Electronic spectroscopy: Franck-Condon principle, electronic transitions, singlet and triplet states.

UNIT-IV: Molecular Spectroscopy-3

Nuclear Magnetic Resonance (NMR) spectroscopy: principles of NMR spectroscopy, chemical shift, different scales, spin-spin coupling

Electron Spin Resonance (ESR) spectroscopy: its principle, hyperfine structure, ESR of simple radicals: hydrogen and methyl

Unit-V: Photochemistry

Lambert-Beer's law and its limitations, physical significance of absorption coefficients. Laws of photochemistry, quantum yield, examples of low and high quantum yields, photochemical equilibrium photosensitized reactions, quenching, fluorescence and phosphorescence.

Reference Books:

1. Banwell, C. N. &McCash, E. M. *Fundamentals of Molecular Spectroscopy* 4th Ed. Tata McGraw-Hill: New Delhi (2006).
2. Chandra, A. K. *Introductory Quantum Chemistry* Tata McGraw-Hill (2001).
3. House, J. E. *Fundamentals of Quantum Chemistry* 2nd Ed. Elsevier: USA (2004).
4. Kakkar, R. *Atomic & Molecular Spectroscopy*: *Concepts & Applications*, Cambridge University Press (2015).
5. Lowe, J. P. & Peterson, K. *Quantum Chemistry*, Academic Press (2005).

SEMESTER VI
SCY 342: PHARMACEUTICS -II (DSE)

Hours per week: 4	Semester End Examination: 60 Marks
Credits: 4	Continuous Evaluation: 40 marks

UNIT –I:
Parenterals: Definition, types, vehicles, used and quality control tests for parenterals. Formulation design, development and scale up of SVP and LVP

UNIT –II:
Sterilization and Depyrogenation:
Unit operations in Aseptic manufacturing, Moist heat sterilization and autoclaving cycle, Importance of F and Z value, Sterility Assurance Level (Overkill approach) and D value, Loading pattern and biological indicators, Mechanism of sterilization using Dry Heat and F_H Value, bacterial endotoxin,
De pyrogenation, sterile filtration and filter media, Filter integrity testing and bubble point
UNIT-III:
Aseptic Processing & Interventions: compounding for sterile filtration, aseptic processing and aseptic interventions, aseptic process simulation and regulatory expectation, lyophilisation and freeze drying, fibre and explain impact of extraneous matter in the final product, Visual inspection and factors
UNIT-IV:
Cleaning and Sanitization: Define and classify microorganism, impact of microbial contamination on sterile product, various sources of microbial contamination, clean room behaviour and aseptic gowning, cleaning in aseptic area, decontamination of isolators using VHP, Physical and Chemical means of Disinfection, Environment Monitoring.

UNIT-V:
Visual Inspection: Personal Qualification as per SOP OPR 012
Environment Monitoring: Personal Qualification as per SOP FT7QC084

Recommended books:
1. Leon Lachman, H. A. Lieberman & J. L. Kanig: ―The Theory and Practice of Indusrtrial Pharmacy‖, 3rd edition, Varghese Publishing House, Bombay, 1991.
2. M. E. Aulton: ―Pharmaceutics – The Science of Dosage Form Design‖, 2nd edition, Churchill Livingstone, 2002.
3. Rawlins, Ed.: ―Remington‘s The Science and Practice of Pharmacy‖, 20th edition, Lippincott William & Wilkins, USA, 2000.
4.Indian Pharmacopoeia‖ Government of India, Ministry of Health & Family Welfare, the Indian Pharmacopoeial Commission, Ghaziabad, 2007
5. British Pharmacopoeia, Vol. III, 2009.
6.United States Pharmacopoeia‖, USP 32 – NF 27, Vol1 & 2, Asian Edition, 2008.
7.Carter, Ed.: ―Cooper & Gunn‘s Tutorial Pharmacy,‖ 6th edition., CBS Publishers, 1972.
8. S.J. Cartar Ed.: ―Cooper & Gunn‘s Dispensing for Pharmaceutical Students‖, 12th edition, CBS Publisher, New Delhi, 1987.

SEMESTER VI

SCY 344: INDUSTRIAL CHEMICALS AND ENVIRONMENT (DSE)

Hours per week: 4	Semester End Examination: 60 Marks
Credits: 4	Continuous Evaluation: 40 marks

UNIT –I: Industrial Gases and Inorganic Chemicals

Industrial Gases: Large scale production, uses, storage and hazards in handling of the following gases: oxygen, nitrogen, argon, neon, helium, hydrogen, acetylene, carbon monoxide, chlorine, fluorine, sulphur dioxide and phosgene.

Inorganic Chemicals: Manufacture, application, analysis and hazards in handling the following chemicals: hydrochloric acid, nitric acid, sulphuric acid, caustic soda, common salt, borax, bleaching powder, sodium thiosulphate, hydrogen peroxide, potash alum, chrome alum, potassium dichromate and potassium permanganate.

UNIT –II: Environment and its segments

Ecosystems. Biogeochemical cycles of carbon, nitrogen and sulphur.

Air Pollution: Major regions of atmosphere. Chemical and photochemical reactions in atmosphere. Air pollutants: types, sources, particle size and chemical nature; Photochemical smog: its constituents and photochemistry. Environmental effects of ozone, Major sources of air pollution. Pollution by SO2, CO2, CO, NOx, H2S. Methods of estimation of CO, NOx, SOx and control procedures.

UNIT –III:

Greenhouse effect and Global warming, Ozone depletion by oxides of nitrogen, chlorofluorocarbons and Halogens, removal of sulphur from coal. Control of particulates.

Water Pollution : Hydrological cycle, water resources, aquatic ecosystems, Sources and nature of water pollutants, Techniques for measuring water pollution, Impacts of water pollution on hydrological and ecosystems.

UNIT –IV:

Water purification methods. Effluent treatment plants (primary, secondary and tertiary treatment). Industrial effluents from the following industries and their treatment: textile, tannery, dairy, petroleum and petrochemicals.

Industrial waste management, incineration of waste. Water treatment and purification (reverse osmosis, electro dialysis, ion exchange). Water quality parameters for waste water, industrial water and domestic water.

UNIT –V: Energy & Environment

Sources of energy: Coal, petrol and natural gas. Nuclear Fusion / Fission, Solar energy, Hydrogen, geothermal, Tidal and Hydel, etc.

Nuclear Pollution: Disposal of nuclear waste, nuclear disaster and its management.

Reference Books:

1. J. A. Kent: Riegel's *Handbook of Industrial Chemistry*, CBS Publishers, New Delhi.
2. S. S. Dara: *A Textbook of Engineering Chemistry*, S. Chand & Company Ltd. New Delhi.
3. K. De, *Environmental Chemistry*: New Age International Pvt., Ltd, New Delhi.
4. S. M. Khopkar, *Environmental Pollution Analysis*: Wiley Eastern Ltd, New Delhi.
5. S.E. Manahan, *Environmental Chemistry*, CRC Press (2005).
6. G.T. Miller, *Environmental Science* 11th edition. Brooks/ Cole (2006).
7. A. Mishra, *Environmental Studies*. Selective and Scientific Books, New Delhi (2005).

SEMESTER VI

SCY 320: INORGANIC CHEMISTRY IV LAB (CC/PPC)

Hours per week: 3 Continuous Evaluation: 100 marks
Credits: 2

Qualitative semimicro analysis of mixtures containing 2 anions and 2cations. 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-},CH_3COO^- , F^-,Cl^-, Br^-, I^-, NO_3^-, BO_3^{3-}, NH_4^+, K^+, 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+}

Spot tests should be done whenever possible.

i. Measurement of 10 Dq by spectrophotometric method
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.

Reference Books

1. Vogel's *Qualitative Inorganic Analysis,* Revised by G. Svehla. Pearson Education, 2002.
2. Marr &Rockett*Practical Inorganic Chemistry.* John Wiley & Sons 1972.

SEMESTER VI
SCY 322: ORGANIC CHEMISTRY - V LAB (CC/PPC)

Hours per week: 3 Credits: 2 Continuous Evaluation: 100 marks

1. Analysis of Carbohydrate: aldoses and ketoses, reducing and non-reducing sugars.
2. Qualitative analysis of unknown organic compounds containing mono functional groups (carbohydrates, aryl halides, aromatic hydrocarbons, nitro compounds, amines and amides) and simple bifunctional groups, for e.g. salicylic acid, cinnamic acid, nitrophenols, etc.
3. Identification of simple organic compounds by IR spectroscopy and NMR spectroscopy (Spectra to be provided).
4. Preparation of methyl orange.

Reference Books:

1. Vogel, A.I. *Quantitative Organic Analysis,* Part 3, Pearson (2012).
2. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry,* Pearson Education (2009)
3. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. *Practical OrganicChemistry, 5th Ed.,* Pearson (2012)
4. Ahluwalia, V.K. & Aggarwal, R. *Comprehensive Practical Organic Chemistry:Preparation and Quantitative Analysis,* University Press (2000).
5. Ahluwalia, V.K. & Dhingra, S. *Comprehensive Practical Organic Chemistry:Qualitative Analysis,* University Press (2000).

SEMESTER VI

SCY 324: PHYSICAL CHEMISTRY VLAB (CC/PPC)

Hours per week: 3 Credits: 2 Continuous Evaluation: 100 marks

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. Calculation of the energies of the two transitions in different units (J molecule^{-1}, kJ mol^{-1}, cm^{-1}, eV).

Colorimetry

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. Determine the amount of iron present in a sample using 1,10-phenathroline.
IV. Determine the dissociation constant of an indicator (phenolphthalein).

Reference Books

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

SEMESTER VI
SCY 326: PHARMACEUTICS -II LAB (DSE/PPC)

Hours per week: 3 Credits: 2 Continuous Evaluation: 100 marks

1. Sterilization using Autoclave
2. Sterilization using Dry Heat Sterilizer
3. Preparation and evaluation of isotonic solution
4. Filling and crimping of vials
5. Filling and sealing of ampoules
6. Sterile filtration of isotonic solution
7. Collection of Air Sample using Agar Plate
8. Performance of test for sterility of marketed parenteral preparations
9. Aseptic gowning
10. Preparation & Evaluation of Ascorbic acid injection I.P.
11. Preparation of Sodium chloride infusion

SEMESTER VI

SCY 328: INDUSTRIAL CHEMICALS & ENVIRONMENT LAB (DSE/PPC)

Hours per week: 3 Credits: 2 Continuous Evaluation: 100 marks

1. Determination of dissolved oxygen in water.
2. Determination of Chemical Oxygen Demand (COD)
3. Determination of Biological Oxygen Demand (BOD)
4. Percentage of available chlorine in bleaching powder.
5. Measurement of chloride, sulphate and salinity of water samples by simple titration method (AgNO3 and potassium chromate).
6. Estimation of total alkalinity of water samples ($CO3^{2-}$, $HCO3^{-}$) using double titration method.
7. Measurement of dissolved CO2.
8. Study of some of the common bio-indicators of pollution.
9. Estimation of SPM in air samples.
10. Preparation of borax/ boric acid.