B.Sc.(spl.) Chemistry

Course Content

2020 Batch

CHE1202FP VOLUMETRIC ANALYSIS

(LAB)

COURSE OUTCOMES: **4 hrs./wk.**

On successful completion of the course, the student will be able to

CO1: apply the knowledge on lab safety and precautionary measures while handling chemicals

CO2: utilize the skills for handling volumetric glassware

CO3: make use of different concentration units to prepare standard solutions

CO4: estimate chemical substances using titrimetric principles

CO5: design suitable methods for the quantitative analysis of chemical substances used in day-to day life

COURSE CONTENT: **60 hrs.**

Lab ethics and safety measures in a chemical laboratory − handling electronic analytical balance - calibration of volumetric glassware − basic concepts: discussion and problem solving - equivalent mass: acids - bases - oxidizing - reducing agents - normality - molarity - molality - ppm - percent solution - saturated unsaturated and supersaturated solutions.

EXPERIMENTS:

1. Preparation of standard solutions and dilutions
2. Estimation of sodium hydroxide
3. Estimation of acetic acid
4. Estimation of copper by Iodometry
5. Estimation of iron by Permanganometry
6. Estimation of magnesium by Complexometry
7. Estimation of Calcium by indirect method

REFERENCE BOOK(S):

Day R A., Underwood A I., (1991). *Quantitative Analysis*, (6th ed.,) New York: Pearson Emory University. Print.

Bassett J, Denney R.C, Jeffery G.H., and Mendham J., (1989). *Vogel's Textbook of Quantitative Chemical Analysis,* (5th ed.), New York: Longman Scientific &Technical. Print.

CHE1201FP VOLUMETRIC ANALYSIS	
Class: I B.Sc. Chemistry	**Semester: I**
Cognitive Level	**K-1** Remember
	K-2 Understand
	K-3 Apply

MAPPING: COs consistency with PSOs

CHE1201FP VOLUMETRIC ANALYSIS					
CO/PSO	**PSO**				
	1	**2**	**3**	**4**	**5**
CO1	2	2	1	1	1
CO2	2	2	2	1	1
CO3	2	3	2	2	2
CO4	2	3	2	2	3
CO5	2	3	3	3	3

Strongly correlated (3), Moderately correlated (2), Weakly correlated (1), No correlation (0)

CHE1402CM GENERAL CHEMISTRY

(THEORY)

COURSE OUTCOMES: **5 hrs./wk.**

On successful completion of the course, the student will be able to

CO1: relate the structure to the behavior of atom

CO2: interpret the gradation in the properties of elements in the periodic table

CO3: distinguish between chemical interactions through bonding

CO4: comprehend the nuclear transmutations

CO5: identify the applications of radioactive elements

COURSE CONTENT:

UNIT I: STRUCTURE OF ATOM **15 hrs.**

Discovery of electron - measurement of e/m for electrons − determination of charge on an electron – positive rays - protons − neutrons - sub-atomic particles − alpha particles − Rutherford's atomic model − Mosley's determination of atomic number - mass number - quantum theory of electromagnetic radiation - photoelectric effect and Compton effect − Bohr's theory of hydrogen atom - spectrum of hydrogen atom - Sommerfeld's extension of Bohr's theory.

UNIT II: PERIODIC TABLE AND ATOMIC PROPERTIES **15 hrs.**

The long form of periodic table - electronic configuration of atoms − division of elements − cause of periodicity − periodicity of atomic properties - covalent - van der Waals and ionic radii - ionization energy − electron enthalpy gain (electron affinity) and electronegativity − factors affecting the periodic properties - determination of electronegativity - Pauling's approach − Allred and Rochow's approach - Mulliken's approach − applications of electronegativity.

UNIT III: CHEMICAL BONDING–LEWIS CONCEPT **15 hrs.**

Chemical bond − types of bonds - ionic bond - factors favoring the formation of ionic compounds, Born-Haber cycle - properties of ionic compounds - electrovalency, covalency − variable valency - factors favouring the formation and properties of covalent compounds - comparison of ionic and covalent compounds - octet rule and failure of octet rule - polar and non-polar covalent bonds and molecules - transition from ionic to covalent character - Fajans' rule - applications of Fajan's rule – coordinate bond−properties of coordinate compounds - comparison between ionic − covalent and coordinate bonds − metallic bond - properties of metals - hydrogen bonding - types - consequences of hydrogen bonding - importance of hydrogen bonding in sustaining life − types of intermolecular interactions - electrostatic and van der Waals interactions.

UNIT IV: CHEMICAL BONDING – ORBITAL CONCEPT **15 hrs.**

Linnett's DQ theory − VSEPR theory - VBT of covalent bond - formation of sigma and pi bonds - resonance structures of CO, CO_2, CO_3^{2-}, O_3, SO_2,SO_3 − hybridisation - sp − sp^2 − sp^3 - sp^3d - sp^3d^2 hybridisation - molecular orbital theory - LCAO method - bonding and antibonding orbitals - formation of molecular orbitals (MO) and construction of MO diagram in H_2, C_2, N_2, O_2, F_2 and CO.

UNIT V: NUCLEAR CHEMISTRY **15 hrs.**

Composition of nucleus - nuclear size - nuclear forces - packing fraction - nuclear density - mass defect - binding energy of the nucleus - nuclear models - nuclear shell model - concept of nuclear spin - liquid drop model - collective model.

Radioactivity − rays from radioactive materials - range of alpha particles - Geiger-Müller counter - radioactive disintegration - radioactive decay and half-life - Geiger-Nuttal rule - radioactive equilibrium - steady state - transmutation of elements - group displacement rule - nuclear stability - radioactive series - applications of radioactivity - isotopes - isobars - isotones - separation of isotopes - determination of atomic masses - mass spectrographs - artificial radioactivity - induced radioactivity - transuranic elements - nuclear coulombic energy barrier − cyclotron - synchrocyclotron - linear electron accelerator - Q-values of nuclear reactions - nuclear fission - fission chain reaction - release of fission energy - uncontrolled and controlled - disposal of radioactive wastes from nuclear reactors − nuclear fusion - hydrogen bomb - controlled nuclear fusion - fusion in stars −nuclear energy as an alternative energy resource.

TEXTBOOK(S):

Madan R.D., (2011). *Modern Inorganic Chemistry*, (3rd ed.), New Delhi: S. Chand & Co. Ltd. Print. (Units II, III & IV)

Puri B.R., Sharma L.R. and Pathania S., (2012). *Principles of Physical Chemistry*, (46th ed.), New Delhi: Vishal Publishing Co. Print. (Units I & V)

REFERENCE BOOK(S):

Bahl A., Bahl B.S. and Tuli G.D., (2009). *Essentials of Physical Chemistry*, New Delhi: S. Chand and Co. Ltd. Print. (Unit I, II, III, V).

Lee J. D., (2002). *A New Concise Inorganic Chemistry*, (5th ed.), London: ELBS. Print.

CHE1402CM GENERAL CHEMISTRY	
Class: I B.Sc. Chemistry	**Semester: I**
Cognitive Level	K-1 Remember
	K-2 Understand
	K-3 Apply

MAPPING: COs consistency with PSOs

CHE1402CM GENERAL CHEMISTRY					
CO/PSO	**PSO**				
	1	**2**	**3**	**4**	**5**
CO 1	3	0	0	0	0
CO2	3	0	0	0	0
CO3	3	0	0	0	0
CO4	3	0	0	0	0
CO5	3	0	0	0	0

Strongly correlated (3), Moderately correlated (2), Weakly correlated (1), No correlation (0)

CHE1201FS FUNCTIONAL ENGLISH FOR CHEMISTS

(THEORY)

COURSE OUTCOMES: **2 hrs./wk.**

On successful completion of the course, the student will be able to

CO1: make use of the listening skills to grasp information from scientific lectures

CO2: construct theoretical and experimental procedures without grammatical errors

CO3: analyse the scientific articles and draw inferences

CO4: organize chemical terms to creatively express ideas in presentations

COURSE CONTENT:

UNIT I: LISTENING SKILLS **10 Hrs.**

Types of Listening – tips for effective listening – academic listening – listening to talks in chemistry and presentations – comprehension.

UNIT II: WRITING AND SPEAKING SKILLS **10 Hrs.**

Parts of Speech – noun–types of noun - verbs – types of tense – the sentence – the phrase – kinds of sentences – parts of sentence - adjectives - adverbs - preposition - Interjection - conjunction – punctuation marks - articles - paragraph – construction of paragraph – linkage and cohesion - summary - précis - writing – notes taking - report - abstracts – letter writing – barriers of communication. Examples and activities will involve chemistry concepts.

UNIT III: READING SKILLS **10 Hrs.**

Importance of reading – types of reading - skimming - scanning - reading for information - technique of reading - SQ3R (S-Survey Q-Question 3R-Read, Recite, Review.) Passages for reading to be selected from science and technology column (Newspaper) and simple everyday chemistry applications from books.

TEXTBOOK(S):

Essentials of Language - Instructor Manual, *Skilledge an initiative of ICT Academy of Tamil Nadu*, 2011.

Inthira S.R., Saraswathi V., (1995). *Enrich Your English Book I: Communication Skills*, New York: Oxford University Press, Print.

WEBSITE(S):

http://depssa.ignou.ac.in/wiki/images/c/ca/Communication_skills_in_English.pdf

http://eltvoices.in/Volume1/Issue1/EVI11.5.pdf

http://www.angrau.net/StudyMaterial/English/ENGL101.pdf

http://www.sharadavikas.com/CourceMeterials/btc34.PDF

CHE1201FS FUNCTIONAL ENGLISH FOR CHEMISTS	
Class: I B.Sc. Chemistry	**Semester: I**
Cognitive Level	**K-1** Remember
	K-2 Understand
	K-3 Apply

MAPPING: COs consistency with PSOs

CHE1201FS FUNCTIONAL ENGLISH FOR CHEMISTS					
CO/PSO	**PSO**				
	1	**2**	**3**	**4**	**5**
CO1	1	1	0	0	0
CO2	1	2	1	2	0
CO3	1	1	1	1	0
CO4	2	2	1	2	0

Strongly correlated (3), Moderately correlated (2), Weakly correlated (1), No correlation (0)

CHE2503CM BASICS OF ORGANIC CHEMISTRY

(THEORY)

COURSE OUTCOMES: **5 hrs./wk.**

On successful completion of the course, the student will be able to

CO1: apply the IUPAC rules to name organic compounds

CO2: explain the mechanisms involved in organic reactions

CO3: extend the knowledge of reaction mechanism to reactions of alkanes and alkenes

CO4: build suitable mechanism for the reactions of alkadienes

CO5: summarize the reactions of alkynes

COURSE CONTENT:

UNIT I: NOMENCLATURE OF ORGANIC COMPOUNDS **15 hrs.**

IUPAC nomenclature - rules for naming organic compounds: alkanes - alkenes - alkynes - cyclic aliphatic hydrocarbons - alkyl halides - alcohols - ethers - aldehydes - ketones - carboxylic acids and its derivatives - alkyl cyanides - nitroalkanes and amines - selected examples of monofunctional and polyfunctional organic compounds - structure of organic compound from its IUPAC name -common errors in writing IUPAC names.

UNIT II: FUNDAMENTALS OF ORGANIC REACTION MECHANISMS **15 hrs.**

Electronic displacements: inductive effect - electromeric effect - mesomeric effect - hyper conjugation - steric effects - heterolytic and homolytic cleavages. Reactive intermediates: carbocations - stability of carbocations - carbanions - stability of carbanions - free radicals - stability of free radicals - carbenes - nitrenes - electrophiles and nucleophiles - types of reactions -substitution - addition - elimination and rearrangement reactions.

UNIT III: ALKANES AND ALKENES **15 hrs.**

ALKANES: Introduction - chemical properties - free radical substitution reactions - halogenation (reactivity and selectivity) nitration - sulphonation - oxidation reactions.

ALKENES: Introduction - physical properties - preparation: reduction of alkynes - elimination reactions - Wittig reaction - Kolbe's electrolytic method - chemical properties - stability of alkenes - electrophilic addition reactions - addition of halogens - hydrogen halide - sulphuric acid - water -oxymercuration - demercuration reaction - hydroboration - peroxyacid - alkenes - carbenes - free radical addition reaction - addition of HBr (peroxide effect) - oxidation reactions - hydroxylation of alkenes with Baeyer's reagent - acidified and alkaline $KMnO_4$ - OsO_4 - $K_2Cr_2O_7$ - $Pb(OAc)_4$ -ozonolysis - allylic substitution reactions - polymerization of alkenes.

UNIT IV: ALKADIENES **15 hrs.**

Introduction - stability of dienes - preparation of buta-1,3-diene - molecular orbital picture of 1,3-

butadiene - chemical properties of buta-1,3-diene - reduction and oxidation reactions - electrophilic addition reaction (1,2-addition Versus 1,4-addition) - free radical addition reactions - Diels-Alder reaction - polymerization - isoprene - preparation - chemical properties - chloroprene – preparation - chemical properties

UNIT V: ALKYNES **15 hrs.**

Introduction - preparation (recall) - physical properties - chemical properties - addition of hydrogen - electrophilic addition reactions oxidation reactions - addition of halogens - hydrogen halides - water - nucleophilic addition reactions - reactions involving acetylenic hydrogens - reactions with sodamide - lithium amide and Grignard reagent - synthetic application of metal alkynides - reaction of terminal alkynes with ammoniacal cuprous chloride - silver nitrate - polymerization reactions - isomerization (Acetylenic Allene Rearrangement).

TEXTBOOK(S):

Jain, M. K. and Sharma, S. C., (2013). *Modern Organic Chemistry*, (4th ed.), New Delhi: Vishal Publishing. Print.

REFERENCE BOOK(S):

Bruice, P.Y., (2002). *Organic Chemistry*., (3rd ed.), New Delhi: Pearson education Inc., Print.

Ghosh, S.K., (1998). *Advanced General Organic Chemistry*, (2nd ed.), Calcutta: Books and Allied (P) Ltd., Print.

Mehta, B., and Mehta, M., (2011). *Organic Chemistry*, (6th ed.), New Delhi: PHI Learning Private Limited Print.

Morrison, R.T, Boyd, R. N. and Bhattacharjee S. K., (2011). *Organic Chemistry*, (7th ed.), New Delhi: Pearson. Print.

Solomons, T.W.G., Fryhle C. B.and Snyder S.A., (2016). *Organic Chemistry*, (11th ed.), United States: Wiley.

CHE2503CM BASICS OF ORGANIC CHEMISTRY	
Class: I B.Sc. Chemistry	**Semester: II**
Cognitive level	**K-2** Understand
	K-3 Apply

Mapping: COs consistency with PSOs

CHE2503CM BASICS OF ORGANIC CHEMISTRY					
CO/PSO	**PSO**				
	1	**2**	**3**	**4**	**5**
CO 1	2	0	1	2	0
CO2	2	0	1	0	0
CO3	2	2	1	0	0
CO4	2	0	1	0	0
CO5	2	0	1	0	0

Strongly correlated (3), Moderately correlated (2), Weakly correlated (1), No Correlation (0)

CHE2203CP SEPARATION AND PURIFICATION TECHNIQUES

(LAB)

COURSE OUTCOMES: **3 hrs./wk.**

On successful completion of this course, the student will be able to

CO1: apply the various techniques for the separation of organic compounds

CO2: find the suitable technique for the purification of organic compounds

CO3**:** choose the technique for the extraction of natural products

COURSE CONTENT:

TECHNIQUES FOR SEPARATION AND PURIFICATION: 45 hrs.

Purification of organic compounds by crystallization using the following solvents:

a. Water

b. Alcohol

c. Alcohol-Water

2. Determination of melting and boiling point

3. Distillation

a. Simple

b. Steam

c. Fractional

4. Soxhlet extraction

5. Solvent extraction technique for separation of organic mixture

6. Chromatographic techniques:

a. Column

b. Thin layer Chromatography

c. Paper - Ascending

d. Paper circular disc

REFERENCE BOOK(S):

Donald L. Pavia, Gary M. Lampman, George and Kritz S., (2009). *Organic Chemistry – A Lab Manual*

New Delhi: Sengage Learning. Print.

Furniss B.S., (1989). *Vogel's Textbook of Organic Chemistry*, (5th ed.), London: ELBS. Print.

CHE2203CP SEPARATION AND PURIFICATION TECHNIQUES	
Class: I B.Sc. Chemistry	**Semester: II**
Cognitive level	**K-1** Remember
	K-3 Apply

Mapping: COs consistency with PSOs

CHE2203CP SEPARATION AND PURIFICATION TECHNIQUES					
CO/PSO	**PSO**				
	1	**2**	**3**	**4**	**5**
CO1	2	3	2	2	1
CO2	2	3	2	2	1
CO3	2	3	2	2	1

Strongly correlated (3), Moderately correlated (2), Weakly correlated (1), No Correlation (0)

CHE2202FS DATA HANDLING AND PRESENTATION

(THEORY)

COURSE OUTCOMES: **2 hrs./wk.**

On successful completion of the course, the student will be able to

CO1: classify the various types of data

CO2: analyse and tabulate the data

CO3: make use of computers to represent the data

CO4: design a scientific report

COURSE CONTENT:

UNIT I: DATA CLASSIFICATION **6 hrs.**

Data- definition - types of data - categorical or qualitative and numerical or quantitative - categorical - nominal and ordinal - numerical - discrete and continuous, interval and ratio - classification of data - chronological - geographical - qualitative - quantitative - frequency distribution.

UNIT II: DATA ANALYSIS **6 hrs.**

Data collection - primary and secondary - variable - dependent and independent - accuracy and precision - significant figures - measure of central tendency - mean, median - mode - measures of dispersion - range, mean deviation, standard deviation.

UNIT III: DATA REPRESENTATION **10 hrs.**

Tabulation of data - conversion of table to diagrams and graphs - diagrams - bar and pie diagram - graphs - line and frequency distribution - linear graphs (identification of slope and intercept values) - use of error bars in presenting graphical data - using computers to prepare tables, spread sheets and graphs.

UNIT IV: REPORT PREPARATION **8 hrs.**

Data interpretation - preparation of report - presentation of report (written & oral) - use of computer in preparation and presentation of a scientific report - use of computer aided tools to represent chemical structures - effective usage of internet for literature search - plagiarism.

TEXTBOOK(S):

Gary D. Christian, (2011). *Analytical Chemistry*, (6th ed.), New York: John Wiley & Sons. Print.

REFERENCE BOOK(S):

Douglas A. Skoog and Donald M. West, F. (2011). James Holler, Stanley R. Crouch, *Fundamentals of Analytical Chemistry*, (9th ed.), United States: Cengage learning. Print.

Jeffery G.H., Bassett J., Mendham J., Denney R.C., (1989). *Vogel's Textbook of Quantitative Chemical Analysis*, (5th ed.), New York: Longman Scientific &Technical. Print.

Nirmala Jeyaraj (ed.td.), (2008). *Introduction to Research Methodology (A multidisciplinary approach),* Madurai: Lady Doak College. Print.

CHE2202FS DATA HANDLING AND PRESENTATION	
Class: I B.Sc. Chemistry	**Semester: I**
Cognitive Level	**K-2** Understand
	K-3 Apply
	K-4 Analyse
	K-6 Create

Mapping: COs consistency with PSOs

CHE2202FS DATA HANDLING AND PRESENTATION					
CO/PSO	**PSO**				
	1	**2**	**3**	**4**	**5**
CO1	0	1	4	4	0
CO2	0	2	4	4	0
CO3	0	2	4	4	0
CO4	2	2	1	1	2

Strongly correlated (3), Moderately correlated (2), Weakly correlated (1), No Correlation (0)

CHE2202NI ENVIRONMENTAL CHEMISTRY

(*THEORY*)

COURSE OUTCOMES: **2 hrs./wk.**

On successful completion of this course, the student will be able to

CO1: explain the facts, concepts and principles of environmental management

CO2: interpret the various energy resources available in the environment

CO3: identify basic environmental contaminants

CO4: analyse the threats and challenges for environment

COURSE CONTENT:

UNIT I: INTRODUCTION TO ENVIRONMENTAL STUDIES **8 hrs.**

The seven environmental principles - multidisciplinary nature of environmental studies - scope and importance - components of environment - concept of sustainable development - ecosystem - structure and function of ecosystem - ecosystem services - environmental laws - environment protection act - prevention and control of pollution act (air, water) - Montreal and Kyoto protocols - conservation of biological diversity (CBD).

Case study**:** Visit to an area to document environmental assets or locally polluted sites.

UNIT II: ENERGY SOURCES AND ENVIRONMENT **8 hrs.**

Classification of fuels and energy sources - conventional (coal - natural gas - fossil fuel) and non - conventional - renewable and non - renewable energy sources - geothermal energy - different types - origin and utilization - solar energy - introduction - direct utilization of solar energy as heat energy through collectors - ocean energy - biomass based energy - bio gas and gobar gas - special uses of biomass as fuels - hydropower.

Activities: Sensitize the students towards conservation of energy on campus.

UNIT III: ENVIRONMENTAL POLLUTION **7 hrs.**

Definition - causes - effects and control measures - air pollution - water pollution - soil pollution - noise pollution - radioactive pollution - solid waste management: control measuresof urban and industrial wastes - integrated waste management of plastics - disaster management: floods - earthquake - cyclone and landslides.

Activities:

- Analysis of fine particulate matter and water
- Collection of articles on environmental issues from magazines and newspaper
- Visit to the eco initiative units of the campus: vermiculture - paper recycling unit - herbal garden – incineration unit.

UNIT IV: SOCIAL ISSUES AND ENVIRONMENT **7 hrs.**

Carbon credits - introduction and significance - carbon footprint - carbon trading - water crisis- water conservation and rainwater harvesting - water recycling - wasteland reclamation - consumerism and waste products - energy crisis - nuclear energy - fusion vs fission for power generation - threats and challenges.

Activities:

- Calculation of carbon and ecological footprint of campus
- Discussion on Organic farming as an alternative to fertilizers and pesticides.

REFERENCE BOOK(S):

Asim K. Das, (2010). *Environmental Chemistry with Green Chemistry*, Kolkata: Book and Allied Pvt. Ltd., Print.

Bhatia S.C., (2002). *Environmental Chemistry*, New Delhi: CBS publishers. Print.

Gary W. Van Loon & Stephen J. Duffy. (2003). *Environmental Chemistry*, New York: Oxford University Press. Print.

Gunaseeli R., Jebaselvi, J.R., and Priyatharsini, R., (Editors), (2014). *Essentials of Environmental Education, Madurai:* Lady Doak College Publication. Print.

Sodhi G.S., (2000). *Fundamental concepts of Environmental Chemistry*, New Delhi: Narosa Publishing House**.** Print.

CHE2202NI ENVIRONMENTAL CHEMISTRY	
Class: I B.A., B.Sc. & B.Com.	**Semester: II**
Cognitive level	**K-2** Understand
	K-3 Apply
	K-4 Analyse

CHE3504CM ORGANIC REACTION MECHANISM

(THEORY)

COURSE OUTCOMES: **5 hrs./wk.**

On successful completion of the course, the student will be able to

CO1: infer the rates of the reactions of alkyl halides using mechanistic details

CO2: describe the reactivity of alcohols, phenols, ethers and epoxides

CO3: identify the aromatic compounds and interpret its reactivity

CO4: illustrate the mechanism of electrophilic and nucleophilic substitution reactions in aromatic compounds

CO5: exhibit the reactions of polynuclear hydrocarbons

COURSE CONTENT:

UNIT I: ALKYL HALIDES **15 hrs.**

Nomenclature and classification of organic halogen compounds - preparation - Hunsdiecker reaction - Finkelstein reaction - Swart's reaction - halogenation of alkanes - free radical Mechanism (recall) - reactions of alkyl - vinyl and allyl halides - nucleophilic aliphatic substitution

- orientation - kinetics of nucleophilic aliphatic substitution - duality of mechanism - S_N2 & S_N1 reaction - mechanism - kinetics - stereochemistry - reactivity - rearrangement of carbonium ion - elimination - mechanisms: E1 - E2 and E1cB - reactivity - orientation (Saytzeff/ Hofmann) and stereoselectivity - elimination vs substitution.

UNIT II: ALCOHOLS, PHENOLS, ETHERS AND EPOXIDES: 15 hrs.

Alcohols: Physical properties - alcohols as an acid and as a base - reactions involving the acidic and basic characteristics of alcohols - relative reactivity of 1^0, 2^0, 3^0 alcohols and distinction - ascent and descent in alcohol series - comparison of alcohol with thiols.

Phenols: Preparation and properties - acidity and factors affecting it - ring substitution reactions - coupling with diazonium salts - Reimer-Tiemann and Kolbe-Schmitt reaction - Lederer-Manasse reaction - Gattermann synthesis - Houben-Hoesch reaction - Pechmann condensation with mechanism - reactions of analyticalimportance. Ethers: Preparation - Williamson ether synthesis - alkoxymercuration and demercuration of alkenes - reactions involving etheral oxygen and ether linkage - comparison of ethers with thioethers - crown ethers (introduction only). Epoxides: Ring opening reactions of epoxides.

UNIT III: CHEMISTRY OF BENZENE AND ITS DERIVATIVES 15 hrs.

Aromaticity - criteria for aromaticity - aromatic and non-aromatic cyclic - polycyclic and heterocyclic compounds - aromaticity and annulenes - chemical consequences of aromaticity - antiaromaticity - molecular orbital description of aromaticity and non-aromaticity - non-benzenoid aromatic compounds.

Benzene - **n**omenclature - structure of benzene - Kekule structure - reactions of benzene - arenes - reactions of alkyl benzenes - reduction - oxidation - substitution in ring and side chain - alkenyl benzene - reactions of alkenyl benzenes - substitution - addition - polymerization

Aryl Halides : Nucleophilic aromatic substitution - unimolecular - bimolecular displacement (s_NAr) mechanism - elimination - addition(benzyne) mechanism - alkyl halides Vs aryl halides.

UNIT IV: AROMATIC ELECTROPHILIC SUBSTITUTION 15 hrs.

General mechanism for electrophilic substitution - arenium ions - mechanism - halogenations - nitration - Friedel-Crafts alkylation - limitation - Friedel-Crafts acylation - Friedel-Crafts alkylation vs Friedel-Crafts acylation - sulphonation - orientation and reactivity in mono substituted and disubstituted benzene - introduction - effect of substituents - orientation - relative reactivity - classification of substituents - orientation in disubstituted benzenes - reactivity and orientation - theory of reactivity and orientation - electron release via resonance - effect of halogen on electrophilic substitution.

UNIT V: POLYNUCLEAR HYDROCARBONS 15 hrs.

Introduction - naphthalene - nomenclature - isomerism - structure - chemical properties - electrophilic aromatic substitution reactions - orientation of disubstitution - addition reactions - oxidation - derivatives of naphthalene - naphthols, naphthylamines - naphthoic acids - naphthaquinones - anthracene - nomenclature - isomerism - structure - chemical properties - reduction - oxidation - electrophilic substitution reactions - formylation - electrophilic addition - dimerization - Diels-Alder reaction - phenanthrene - nomenclature - isomerism - structure -

chemical properties - addition - oxidation - ozonolysis - reduction - sulphonation - nitration.

TEXTBOOK(S):

Jain. M. K. and Sharma, S. C., (2013). *Modern Organic Chemistry*, (4th ed.), New Delhi: Vishal Publishing.Print

Morrison R. T and Boyd R.N., (2008). *Organic Chemistry*, (7th ed.), New Delhi: Prentice Hall. Print

REFERENCE BOOK(S):

Mehta, B. & Mehta, M., (2005). *Organic Chemistry*, (1st ed.), New Delhi, PHI Learning Pvt. Ltd. Print.

Bruice P. Y., (2002). *Organic Chemistry*, (3rd ed.), New Delhi, Pearson education, Inc, Print.

Solomons T.W.G., (2004). *Organic Chemistry*, (8th ed.), Singapore, John Willey & Sons Inc., Print.

Wade L.G. & Singh. M.S., (2006). *Organic Chemistry*, (6th ed.), Delhi, Pearson education, Inc., Print.

WEBLINK(S):

Nelson Nuñez-Rodriguez. (2011). *Introduction to Organic Chemistry***.** Retrieved from https://guides.hostos.cuny.edu/che120/chapter2 CC BY-NC-SA 4.0 license.

Jeonghyeon Kim. (2016). *Organohalides: Nucleophilic Substitutions and Eliminations.* Retrieved from www.aseanoer.net/oer/contents/learningViewer.acu?svc=Y291cnNlLDE0MDU0LE4sTixBLDEwNDgy CC BY-NC-SA 4.0 license.

CHE3504CM ORGANIC REACTION MECHANISM	
Class: II B.Sc. Chemistry	**Semester: III**
Cognitive level	**K-2** Understand
	K-3 Apply

Mapping: COs consistency with PSOs

CHE3504CM ORGANIC REACTION MECHANISM					
CO/PSO	**PSO**				
	1	**2**	**3**	**4**	**5**
CO 1	3	2	1	1	1
CO2	3	2	1	1	1
CO3	3	1	1	1	1
CO4	3	2	1	1	1
CO5	3	1	1	1	1

Strongly correlated (3), Moderately correlated (2), Weakly correlated (1)

CHE3505CM THERMODYNAMICS AND CHEMICAL EQUILIBRIA

(THEORY)

COURSE OUTCOMES: **5 hrs./wk.**

On successful completion of the course, the student will be able to

CO1: relate the laws of thermodynamics to different thermodynamic processes

CO2: explain the energetics of chemical systems using the concepts of thermodynamics

CO3: deduce the significance of various thermodynamic parameters

CO4: analyze the equilibrium conditions for various types of chemical reactions

CO5: examine the behavior of acids, bases and salts in solutions

COURSE CONTENT:

UNIT I: FIRST LAW OF THERMODYNAMICS AND THERMOCHEMISTRY 15 hrs.

Importance and limitations of thermodynamics - terms and definitions: systems - boundary - surroundings - macroscopic properties - homogeneous and heterogeneous systems - thermodynamic equilibrium - intensive and extensive properties - state variables - thermodynamic processes - nature of work and heat - first law - internal energy and first law - state and path functions - exact and inexact differentials - enthalpy - heat capacity - expansion of an ideal gas - reversible and irreversible - work done in isothermal and adiabatic expansions - comparison of isothermal and adiabatic expansions - Joule-Thomson effect - Joule-Thomson coefficient in ideal gas − zeroth Law of thermodynamics Thermochemistry: exothermic and endothermic reactions - thermochemical equations − enthalpy of a reaction - variation of enthalpy of reaction with temperature - different types of enthalpy of reaction - Hess's law and applications – bond energy - measurement of heat of reaction.

UNIT II: SECOND LAW OF THERMODYNAMICS 15 hrs.

Limitations of the first law - spontaneous processes and criteria of spontaneity - cyclic processes - Carnot cycle - heat engine - efficiency - Carnot theorem - other forms of second law - concept of entropy from Carnot cycle - entropy changes: isothermal expansion - reversible and irreversible processes - phase change - mixture of ideal gases - standard entropy - physical significance of entropy - work and free energy functions - variation of free energy with temperature and pressure - Maxwell relations - criteria for reversible and irreversible processes - Gibbs-Helmholtz equation.

UNIT III: THERMODYNAMICS OF OPEN SYSTEMS AND THIRD LAW 15 hrs.

Partial molar properties - chemical potential - Gibbs-Duhem equation - Clausius-Clapeyron equation - differential and integrated forms - applications of the equation - concept of fugacity and activity − third law of thermodynamics - Nernst heat theorem - determination of absolute entropies of solids − liquids and gases - absolute entropies of elements and compounds - experimental verification of third law - limitations to the third law - entropy changes in chemical reactions – residual entropy.

UNIT IV: CHEMICAL EQUILIBRIUM 15 hrs.

Reversible reactions - nature and characteristics of chemical equilibrium - law of mass action - thermodynamic derivation of law of chemical equilibrium - van't Hoff reaction isotherm - equilibrium constant - equilibrium constant expression in terms of partial pressures -relationship between K_p and K_c - calculations involving K_p - units of equilibrium constant - temperature dependence of equilibrium constant - homogeneous and heterogeneous equilibria - van't Hoff equation – Le-Chatelier's principle.

UNIT V: IONIC EQUILIBRIUM 15 hrs.

Acid and base theories (recall) - Arrhenius concept - Lowry-Brønsted concept - Lewis concept -

dissociation of a weak acids and bases - dissociation constants of polybasic acids - dissociation of a weak base - ionic product of water - pH scale - common ion effect - buffer solutions - buffer mixtures of a weak acid/ weak base and its salt - Henderson's equation - hydrolysis of salts - hydrolysis constant - relation between K_h, K_a and K_w - degree of hydrolysis - pH of hydrolysed salt solutions - salts of weak acids and strong bases - strong acids and weak bases - weak acids and weak bases - degree of hydrolysis- pH of their salt solutions - determination of degree of hydrolysis - acid-base indicators - theories of indicators - pH titration - solubility product and its applications.

TEXTBOOK(S):

Arun Bahl, B.S. Bahl and G.D. Tuli, (2014). *Essentials of Physical Chemistry*, (revised ed.), India: S. Chand and company private limited. Print.

Puri, B.R., Sharma L.R. and M. S. Pathania. (2019). *Principles of Physical Chemistry*, (48th ed.), Jalandhar: Vishal Publishing Co. Print.

REFERENCE BOOK(S):

Paula, J. D. and Atkins, P., (2016). *Atkin's Physical Chemistry*, (10th ed.), New Delhi: Oxford University Press. Print.

WEBLINK(S):

Khan Academy. (2020). *Acid/Base Basics.* Retrieved from https://www.khanacademy.org/science/chemistry/acids-and-bases-topic. CC BY-NC-SA 3.0 license.

Paul Ellgen. (2020). Thermodynamics and chemical equilibrium. Retrieved from https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_TextbookMaps/Book%3A_Thermodynamics_and_Chemical_Equilibrium_(Ellgen). CC BY-NC-SA 3.0 license.

CHE3505CM THERMODYNAMICS AND CHEMICAL EQUILIBRIA	
Class: II B.Sc. Chemistry	**Semester: III**
Cognitive Level	**K-1** Remember
	K-2 Understand
	K-4 Analyze

Mapping: COs consistency with PSOs

CHE3505CM THERMODYNAMICS AND CHEMICAL EQUILIBRIA					
CO/PSO	**PSO**				
	1	**2**	**3**	**4**	**5**
CO1	3	1	2	1	1
CO2	3	1	2	1	1
CO3	3	2	3	1	1
CO4	3	1	3	1	1
CO5	3	2	2	1	2

Strongly correlated (3), Moderately correlated (2), Weakly correlated (1)

CHE3506CM CHEMISTRY OF s- AND p- BLOCK ELEMENTS

(THEORY)

COURSE OUTCOMES: **5 hrs./wk.**

On successful completion of the course, the student will be able to

CO1: apply the rules to balance redox reactions and concepts to understand acids and bases

CO2: illustrate the characteristics of hydrogen, hydrides and s- block elements

CO3: identify the significance of boron and carbon compounds

CO4: discuss the characteristics of nitrogen and oxygen compounds

CO5: explain the importance of the compounds formed by halogens and noble gases

COURSE CONTENT:

UNIT I: REDOX REACTION **15 hrs.**

Oxidation number and oxidation state - rules for calculating oxidation number - oxidation and reduction - redox and half reactions - oxidizing and reducing agents - autooxidation - induced oxidation - balancing redox equations by oxidation number and ion-electron methods.

Acids and bases: Concept of acids and bases - Arrhenius concept - Lowry-Brønsted concept - Lux-Flood concept - Cady-Elsey concept - Lewis concept - Usanovich - HSAB principle - strength of hydracids.

UNIT II: HYDROGEN AND s- BLOCK ELEMENTS **15 hrs.**

Position of hydrogen in the periodic table - resemblance of hydrogen with alkali metals and with halogens - nascent hydrogen - ortho and para hydrogen - isotopes of hydrogen - heavy water - hydrides - classification of hydrides: ionic - molecular - interstitial hydrides - applications of hydrogen and hydrides in fuel cells.

General characteristics and periodicity in the properties of group I and II elements - diagonal relationship of lithium and magnesium - beryllium and aluminium - comparison of lithium and beryllium with their respective group members - complexes of alkali and alkaline earth metals.

UNIT III: BORON AND CARBON GROUP **15 hrs.**

Compounds of boron and aluminium - comparative study: hydrides - oxides - halides - structure and bonding in Boranes: (B_2H_6, B_4H_{10}) - boron nitride - borazine - preparation, properties, structure and uses: Boric acid and borax - Lithium aluminium hydride.

Anomalous behaviour of carbon - comparison of carbon and silicon - allotropy of carbon - diamond - graphite - fullerene - graphene - intercalation compounds of graphite - structure of oxides - oxyacids and their salts - carbides and their classification - properties and uses of silica – classification and structure of silicates - preparation and properties of stannous chloride - white and red lead.

UNIT V: NITROGEN AND OXYGEN GROUP **15 hrs.**

Compounds of nitrogen group elements - hydrides - halides - oxohalides - oxides of nitrogen - (N_2O_3, N_2O_5, NO_2, N_2O) - oxoacids of nitrogen (HNO_2, HNO_3) - oxoacids of phosphorus (H_3PO_2, H_3PO_3, $H_4P_2O_6$, H_3PO_4) - structure of hydrazine - hydrazoic acid - urotropine - phosphazine - liquid NH_3.

Anomalous behaviour of oxygen - oxides and their classification - ozone - preparation and

properties - hydrogen peroxide - structure and properties of oxides (SO_2, SO_3) and oxoacids of Sulphur - (H_2SO_4, H_2SO_5, $H_2S_2O_8$) - structure of oxo halides of Sulphur ($SOCl_2$, SO_2Cl_2).

UNIT V: HALOGENS AND NOBLE GASES **15 hrs.**

Anomalous behaviour of fluorine - compounds of halogens - hydrogen halides - oxides - oxoacids – structure of interhalogen compounds: ICl, ClF_3, IF_5, IF_7 - poly halides (ICl_4^-) - pseudohalogens: cyanogen - pseudohalides - comparison of halogens and pseudo halogens - liquid HF.

Properties and uses of noble gases - compounds of noble gases: hydrates - clathrates - structure of xenon compounds: fluoride (XeF_2, XeF_4, XeF_6) - oxy fluorides ($XeOF_2$, $XeOF_4$, XeO_2F_2, XeO_2F_4, XeO_3F_2) - oxides (XeO_3, XeO_4) - compounds of krypton and radon.

TEXTBOOK(S):

Raj, G., (2015). *Advanced Inorganic Chemistry*, (35th ed.), Meerut: Krishna Prakashan Media Private limited. Print.

Puri, B. R., Sharma, L. R., and Kalia, K. C., (2017). *Principles of Inorganic Chemistry*, (31st ed.), Delhi: Vishal Publishing Co. Print.

REFERENCE BOOK(S):

Madan R. D., (2016). *Modern Inorganic Chemistry*, (3rd ed.), New Delhi: S. Chand and Company Private limited. Print.

WEBLINK(S):

Anthony Carpi., (2003) *Acids and Bases.* Retrieved from https://www.oercommons.org/courses/acids-bases-an-introduction/view . CC BY-NC-SA 4.0 license.

Miessler, Fischer, Tarr., (2020) *Inorganic Chemistry* Retrieved from https://chem.libretexts.org/Bookshelves/Inorganic_Chemistry/Map%3A_Inorganic_Chemistry. CC BY-NC-SA 4.0 license.

CHE3506CM CHEMISTRY OF s- AND p- BLOCK ELEMENTS	
Class: II B.Sc. Chemistry	**Semester: III**
Cognitive Level	**K-1** Remember
	K-2 Understand
	K-3 Apply

Mapping: Cos consistency with PSOs

CHE3506CM CHEMISTRY OF s- AND p- BLOCK ELEMENTS					
CO/PSO	**PSO**				
	1	**2**	**3**	**4**	**5**
CO1	3	2	1	1	1
CO2	3	2	1	1	1
CO3	3	3	2	1	1

CO4	3	2	1	1	1
CO5	3	2	1	1	1

Strongly correlated (3), Moderately correlated (2), Weakly correlated (1)

CHE3201CP EXPERIMENTAL ORGANIC CHEMISTRY I

(LAB)

COURSE OUTCOMES: **3 hrs./wk.**

On successful completion of the course, the student will be able to

CO1: estimate the organic compounds using titrimetry

CO2: apply the theoretical concepts to experiments

CO3: interpret the experimental results and draw conclusions

COURSE CONTENT: **45 hrs.**

I. ORGANIC ESTIMATION **15 hrs.**

a. Estimation of phenol/aniline

b. Estimation of Glucose –Lane and Enyon method

c. Estimation of ketone

II. GREEN SYNTHESIS: Solid state and Microwave assisted **25 hrs.**

a. Synthesis of Diazonium Dyes

b. Synthesis of Chalcone

c. Aldol condensation/Benzoin Condensation

d. Benzilic acid rearrangement

e. Synthesis of any one heterocyclic compound

III. Extraction of Natural product (anyone) **5 hrs.**

REFERENCE BOOK(S):

Brian S. Furniss, Antony J Hannaford, Peter W. G. Smith & Austin R. Tatchell, (1989). *Vogel's Textbook of Organic Chemistry*, (5th ed.), London: ELBS. Print.

Donald L Pavia, Gary M. Lampman & George S Kritz, (2009). *Organic Chemistry – A Lab Manual*, New Delhi: Sengage Learning. Print.

Gnanapragasam N.S, Ramamurthy G, (2013). *Organic Chemistry Lab Manual*, Chennai: S. Viswanathan (Printers and Publishers) PVT.LTD. Print.

WEBLINK(S):

Video(s)

Khan Academy. (2019). *Aldol Condensation* Retrieved From https://youtu.be/sjMsyk-rP8I CC BY-NC-SA 3.0 US license.

Tampines Meridian Junior College, Chemistry Department. (2019). *Iodometric Titration*, https://www.youtube.com/watch?v=vTCzhaDq-oE&t=12s CC BY- 3.0 license.

CHE3201CP EXPERIMENTAL ORGANIC CHEMISTRY I	
Class: II B.Sc. Chemistry	**Semester: III**
	K-3 Apply

Cognitive level	**K-4** Analyze
	K-5 Evaluate

Mapping: COs consistency with PSOs

CHE3201CP EXPERIMENTAL ORGANIC CHEMISTRY I					
CO/PSO	**PSO**				
	1	**2**	**3**	**4**	**5**
CO1	3	3	3	2	1
CO2	3	3	2	2	1
CO3	3	3	1	1	2

Strongly correlated (3), Moderately correlated (2), Weakly correlated (1)

CHE3202CP EXPERIMENTAL INORGANIC CHEMISTRY

(LAB)

COURSE OUTCOMES: **3 hrs./wk.**

On successful completion of this course, the student will be able to

CO1: classify acid and basic radicals

CO2: apply green principles for qualitative analysis of acid and basic radicals in salt mixture

CO3: examine the chemical reactions involved in the analysis of salt mixtures

CO4: identify the environmentally sensitive ions present in water samples

COURSE CONTENT: **45 hrs.**

1. Qualitative analysis of salt mixture - analysis of a salt mixture containing two acid radicals and two basic radicals - with one interfering acid radicals - discussion on heavy metal toxicity.

Acid radicals

CO_3^{2-}, NO_3^-, CH_3COO^-, Cl^-, Br^-, I^-, SO_4^{2-}, PO_4^{3-}, BO_3^{3-}, F^-, $C_2O_4^{2-}$, CrO_4^{2-}, $S_2O_3^{2-}$, $C_4H_4O_6^{2-}$.

Basic radicals

Pb^{2+}, Bi^{3+}, Cu^{2+}, Cd^{2+}, Sb^{3+}, Fe^{3+}, Al^{3+}, Cr^{3+}, Co^{2+}, Ni^{2+}, Zn^{2+}, Mn^{2+}, Ba^{2+}, Sr^{2+}, Ca^{2+}, Mg^{2+}, NH_4^+, K^+.

2. Qualitative analysis of environmentally sensitive ions present in water samples.

REFERENCE BOOK(S):

Mala Nath, (2016). *Inorganic Chemistry: A Laboratory Manual*, New Delhi: Narosa Publishing House Pvt. Ltd. Print.

Ramanujam, V. V. (2012). *Inorganic Semi Micro Qualitative Analysis,* (3rd ed.), Chennai: The National Publishing Company. Print.

Svehla, G. (1996). *Vogel's Qualitative Inorganic Analysis,* (7th ed.) India: Pearson. Print.

WEBLINK(S):

Shilpa Shrivastava (2016) *Qualitative analysis of Anions.* Retrieved from https://www.chemistrynotmystery.com/2016/02/qualitative-analysis-of-anions.html

CHE3202CP EXPERIMENTAL INORGANIC CHEMISTRY	
Class: II B.Sc. Chemistry	**Semester: III**
Cognitive Level	**K-1** Remember
	K-2 Understand
	K-3 Apply
	K-4 Analyze

Mapping: COs consistency with PSOs

CHE3202CP EXPERIMENTAL INORGANIC CHEMISTRY					
CO/PSO	**PSO**				
	1	**2**	**3**	**4**	**5**
CO1	3	2	2	2	2
CO2	3	3	3	3	3
CO3	3	2	2	2	2
CO4	3	2	2	2	2

Strongly correlated (3), Moderately correlated (2), Weakly correlated (1)

CHE4504CM STEREOCHEMISTRY AND CARBONYL COMPOUNDS

(THEORY)

COURSE OUTCOMES: **5 hrs./wk.**

On successful completion of the course, the student will be able to

CO1: identify stereoisomerism exhibited among organic compounds

CO2: explain the various conformations of conformational isomers

CO3: discuss nucleophilic addition reactions of carbonyl compounds

CO4: illustrate condensation reactions of carbonyl compounds

CO5: describe the properties of carboxylic acids and their derivatives

COURSE CONTENT:

UNIT I: STEREOISOMERISM I **15 hrs.**

Chirality - chiral centre - enantiomers - R and S - sequence rules - Fischer projection - Sawhorse & Newmann representations of 2,3-dibromobutane, 2,3-dihydroxybutane, 2-bromo-3- hydroxybutane - inter conversions - configuration - diastereomers - odd and even chiral centers - meso structure - resolution - racemic modification - substitution at chiral carbon - optical activity due to chiral axis - optical activity of allenes and spiranes - atropisomerism of biphenyls - chiral plane - cyclophanes and ansa compounds - molecular overcrowding - asymmetric synthesis.

E/Z notation for double bonded compounds (C=C) - physical and chemical methods used in distinguishing geometrical isomers.

UNIT II: STEREOISOMERISM II **15 hrs.**

Definition of conformation - configurational and conformational isomers - conformational isomerism in ethane - n-butane - 1,2-dibromoethane - ethylene glycol with energy profile diagrams - stability of conformers - Baeyer's strain theory - stereoisomerism of cyclohexane - monosubstituted

cyclohexanes.

UNIT III: ALIPHATIC AND AROMATIC CARBONYL COMPOUNDS 15 hrs.

Structure and reactivity of carbonyl group - nucleophilic addition reactions - reaction with carbon nucleophiles - oxygen nucleophiles - nitrogen nucleophiles - sulphur nucleophiles - oxidation reactions of aldehydes and ketones - distinguishing aldehydes from ketones - reduction reactions of carbonyl compounds - catalytic reduction - reduction with metal hydrides - MPV reduction - Wolff-Kishner reduction – Clemmenson's reduction.

UNIT IV: REACTIONS OF ALDEHYDES AND KETONES 15 hrs.

Acidity of a hydrogen - keto-enol tautomerism - acid catalysed halogenation - aldol condensation - dehydration of aldol products - crossed aldol condensation - reactions related to the aldol condensation with mechanism - Claisen condensation - crossed Claisen condensation - benzoin condensation - Claisen-Schmidt - Cannizaro's reaction - crossed Cannizzaro reaction - Mannich reaction - reactions of α,β-unsaturated compounds - Michael addition (recall) - Perkin - Knoevenagel – Stobbe condensations.

UNIT V: CARBOXYLIC ACIDS AND THEIR DERIVATIVES 15 hrs.

Preparation - physical properties and reactions of monocarboxylic acids: comparison of acidity of various carboxylic acids - preparation and reactions of acid chlorides - anhydrides - esters and amides comparative study of nucleophilic substitution at acyl group - mechanism of acidic and alkaline hydrolysis of esters - Dieckmann and Reformatsky reactions - Hofmann-bromamide degradation - Curtius rearrangement - sulphonic acid - acidity of substituted acids - typical reactions of dicarboxylic acids : succinic acid - phthalic acid - ketoacids: pyruvic acid - acetoacetic acid - hydroxy acids: lactic - malic - tartaric - citric - salicylic acid - unsaturated acids: maleic - fumaric - cinnamic acid.

TEXTBOOK(S):

Jain, M. K. Sharma, S. C; (2013). *Modern Organic Chemistry*, (4th ed.), New Delhi: Vishal Publishing Co. Print. UNITS (I, III & V).

Paula Yurkanis Bruice, (2002). *Organic Chemistry*, (3rd ed.), Delhi: Pearson education, Inc, Print. (UNITS II & IV).

REFERENCE BOOK(S)

Bhupinder Mehta, Manju Mehta, (2005). *Organic Chemistry*, (1st ed.), Delhi: PHI Learning Pvt. Ltd. Print.

Morrison, R. T., Boyd R. N., (2008). *Organic Chemistry*, (7th ed.), New Delhi: Prentice Hall. Print.

Solomons T. W. G., (2004). *Organic Chemistry*, (8th ed.), Singapore: John Willey & Sons Inc. Print.

WEBLINK(S):

Khan Academy. (2019, August 1). *Reactivity of aldehydes and ketones.* [Video file]. Retrieved from https://www.oercommons.org/authoring/52491-enhancing-integrated-persuasive-language- skills-am/view. CC BY license.

COs cognitive level and mapping with PSOs

CHE4504CM STEREOCHEMISTRY AND CARBONYL COMPOUNDS						
CO	**COGNITIVE LEVEL**	**PSO**				
		1	**2**	**3**	**4**	**5**
CO1	**K-1** Remember	3	1	2	1	2

CO2	**K-2** Understand	3	1	2	1	2
CO3	**K-2** Understand	3	2	2	2	2
CO4	**K-3** Apply	3	2	2	2	2
CO5	**K-2** Understand	3	2	2	2	2

Strongly correlated (3), Moderately correlated (2), Weakly correlated (1)

CHE4505CM BEHAVIOUR OF GASES AND LIQUIDS

(THEORY)

COURSE OUTCOMES: **5 hrs./wk.**

On successful completion of the course, the student will be able to

CO1: relate the gaseous laws with the behaviour of ideal gases

CO2: interpret the deviations of real gases from ideal behaviour

CO3: explain the properties of liquids through suitable methods

CO4: illustrate the behavior of solutions

CO5: describe colligative properties and nature of colloids

COURSE CONTENT:

UNIT I: IDEAL GASES **15 hrs.**

General characteristics of gases - parameters of a gas - gas laws - Boyle's law - Charle's law - combined gas law - Gay Lussac's law - Avogadro's law - ideal gas equation - Dalton's law of partial pressures - kinetic molecular theory of gases - derivation of kinetic gas equation - distribution of molecular velocities - different kinds of velocities - calculation of molecular velocities - collision parameters.

UNIT II: REAL GASES **15 hrs.**

Deviations from ideal behavior - compressibility factor - effect of temperature - explanation for deviations - equation of state of real gases - van der Waals' equation - other equations of state - limitations - critical phenomena - critical constants - critical temperature from P-V isotherms - continuity of state - van der Waals equation and critical constants - critical compressibility factor - law of corresponding states - experimental determination of critical constants - methods of liquefaction of gases.

UNIT III: LIQUIDS **15 hrs.**

Intermolecular forces of attraction (Recall) - vapour pressure - effect of temperature on vapour pressure - methods of determination of vapour pressure - effect of vapour pressure on boiling point - surface tension - effect of temperature on surface tension - methods of determination of surface tension - viscosity - measurement of viscosity - effect of temperature on viscosity - refractive index - specific and molar refraction - determination of refractive index - molar refraction and chemical constitution - optical activity - specific rotation - measurement of optical activity.

UNIT IV: SOLUTIONS **15 hrs.**

Solutions of liquids in liquids - ideal solutions - Raoult's law - vapour pressures of ideal solutions - activity of a component in an ideal solution - Gibbs-Duhem-Margules equation - thermodynamics of ideal solutions - real solutions - types of non-ideal solutions - completely miscible binary solutions and types

- fractional distillation of binary liquids of different types - lever rule - distillation of immiscible liquids - partially miscible liquids - phenol-water system - aniline-hexane system - triethylamine-water system - nicotine-water system - solutions of gases in liquids - factors influencing solubility of a gas - Henry's law - comparison of Henry's law and Raoult's law.

The distribution law - thermodynamic derivation - association of solute in one of the solvents - dissociation of solute in one of the solvents - solute entering into chemical combination with one of the solvents - applications of distribution law - solvent extraction.

UNIT V: COLLIGATIVE PROPERTIES AND COLLOIDS **15 hrs.**

Colligative Properties - lowering of vapour pressure - elevation in boiling point - depression in freezing point - osmotic pressure - determination of molecular weight - van't Hoff factor.

Colloids - types of colloids - lyophillic and lyophobic sols and their characteristics - preparation - dispersion - aggregation - purification - dialysis - optical properties - kinetic properties - electrical properties of colloids - gold number - stability of sols - associated colloids - cleansing action of soaps and detergents - emulsions - gels - applications of colloids.

TEXTBOOK(S):

Bahl A., Bahl B.S. and Tuli G.D., (2009). *Essentials of Physical Chemistry,* New Delhi: S. Chand and Co. Ltd. Print. (Unit III & V).

Puri B.R, Sharma L.R and Pathania S., (2012). *Principles of Physical Chemistry*, (46th ed.), New Delhi: Vishal Publishing Co. Print. (Unit I – II & IV).

REFERENCE BOOK(S):

Atkins P.W., (2014). Physical Chemistry, (10th ed.), New York: Oxford University Press. Print

WEBLINK(S):

https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps/Supplemental_Modules_(Physical_and_Theoretical_Chemistry)/Physical_Properties_of_Matter/States_of_Matter/Properties_of_Gases/Gas_Laws/Gas_Laws%3A_Overview CC BY-NC-SA 3.0.

COs cognitive level and mapping with PSOs:

CHE4505CM BEHAVIOUR OF GASES AND LIQUIDS						
CO	**COGNITIVE LEVEL**	**PSO**				
		1	**2**	**3**	**4**	**5**
CO1	**K-1** Remember	3	1	1	1	1
CO2	**K-3** Apply	3	1	3	1	1
CO3	**K-2** Understand	3	3	2	1	1
CO4	**K-3** Apply	3	3	3	1	1
CO5	**K-2** Understand	3	1	1	1	1

Strongly correlated (3), Moderately correlated (2), Weakly correlated (1)

CHE4404CM CHEMISTRY OF TRANSITION ELEMENTS

(THEORY)

COURSE OUTCOMES: **4 hrs./wk**.

On successful completion of the course, the student will be able to

CO1: identify the properties of d-block elements

CO2: describe the characteristics of first transition series

CO3: explain the chemistry of second and third transition series

CO4: outline the separation and properties of lanthanides and actinides

CO5: illustrate the importance of inorganic polymers

COURSE CONTENT:

UNIT I: GENERAL CHARACTERISTICS OF d-BLOCK ELEMENTS 12 hrs.

General properties - size - density - melting point - boiling point - reactivity of metals - ionisation potentials - colour - magnetic properties - paramagnetism - diamagnetism - ferromagnetism - antiferromagnetism - catalytic properties - variable valency - stability of various oxidation states - ability to form complexes - non-stoichiometry - position of the transition series in the periodic table.

UNIT II: FIRST TRANSITION SERIES 12 hrs.

Preparation - properties and uses - titanium compounds - titanium dioxide - titanium tetrachloride - chromium compounds - chromic oxide - chrome alum - potassium chromate - potassium dichromate - chrome red - chromyl chloride - iron compounds - ferrous sulphate - Mohr's salt - potassium ferrocyanide and ferricyanide - Prussian blue and Turnbull's blue - rusting of iron - nickel compounds - nickel sulphate - nickel dimethyl glyoximate - copper compounds - copper sulphate - verdigris - alloys of copper.

UNIT III: SECOND AND THIRD TRANSITION SERIES 12 hrs.

Preparation - properties and uses - molybdenum compounds - molybdenum blue - ammonium molybdate - tungsten compounds - tungstic acid - tungsten bronze - platinum compounds - chloroplatinic acid - complexes of platinum - mercury compounds - mercurous chloride - mercuric chloride - mercuric sulphide - mercuric iodide - Millon's base - Nessler's reagent - amalgams.

UNIT IV: LANTHANIDES AND ACTINIDES 12 hrs.

General discussion - occurrence - isolation - separation techniques - oxidation states - lanthanide contraction - colour - magnetic and spectral properties - actinides - general properties - comparison of lanthanides and actinides.

UNIT V: INORGANIC POLYMERS 12 hrs.

General properties - classification - phosphorus-based polymers - chain polymer - network polymer - phosphate glasses - crystalline polymetaphosphates - sulphur based polymers - polymeric sulphur nitrides - chalcogenides glasses - boron based polymers - polycarboranes - polymeric boron nitrides - silicon-based polymers - organosilicons - preparation - structures - applications.

TEXTBOOK(S):

Puri B.R., Sharma L. R. and Kalia K. C., (2017). *Principles of Inorganic Chemistry*, (31st ed.), Delhi: Vishal Publishing Co. Print.

REFERENCE BOOK(S):

Atkins P, Overton T., Rourke J., Weller M., Shriver F.A. and Atkins, (2014). *Inorganic Chemistry*, (6th ed.), New Delhi: Oxford University Press. Print.

Lee J.D, (2002). *New Concise Inorganic Chemistry*, (5th ed.), London: ELBS. Print.

WEBLINK(S):

Ji Kim., (2018) *Introductory Chemistry: Atoms and the Periodic Table*. Retrieved from https://www.oercommons.org/courseware/lesson/27262. CC BY-NC-SA 4.0 license.

Helen Njeri Njenga., (2018) *Industrial Chemistry*. Retrieved from

COs cognitive level and mapping with PSOs:

CHE4404CM CHEMISTRY OF TRANSITION ELEMENTS						
CO	**COGNITIVE LEVEL**	**PSO**				
		1	**2**	**3**	**4**	**5**
CO1	**K-1** Remember	2	1	1	1	1
CO2	**K-2** Understand	2	2	1	1	1
CO3	**K-2** Understand	2	2	1	1	1
CO4	**K-2** Understand	2	1	1	1	1
CO5	**K-3** Apply	2	2	2	1	2

Strongly correlated (3), Moderately correlated (2), Weakly correlated (1)

CHE4405CM INTRODUCTION TO CHEMINFORMATICS

(THEORY)

COURSE OUTCOMES: **4 hrs./wk**.

On successful completion of the course, the student will be able to

CO1: identify the different types of molecular representations

CO2: describe the features and applications of chemical and biological databases

CO3: illustrate the structure-activity relationship among molecules

CO4: discuss the process of drug design and discovery

CO5: recognize the various drug receptor interactions

COURSE CONTENT:

UNIT I: CHEMICAL REPRESENTATION OF MOLECULES **12 hrs.**

History and evolution of cheminformatics - use of cheminformatics - prospects of cheminformatics – representation of chemical compounds - line notations - WLN - ROSDAL - SMILES - SMARTS – SYBYL - InCHI - basics of graph theory - matrix representations -adjacency - distance - atom - connectivity and bond matrix - connection table - various file formats - structure of molfiles - sdfiles and PDB - library and toolkits - special notations of chemical structures - markush structures - fragment coding - fingerprints - hashed fingerprints - hash codes - representation of 3D structures - z-matrix - representation of chemical reactions - different electronic effects - reaction classification.

UNIT II: DATABASES AND CHEMICAL STRUCTURE SEARCHING **12 hrs.**

Molecular structure searching techniques - full structure - super structure - substructure and similarity searching methods - similarity based on 2D fingerprints - Tanimoto and Tversky - dice coefficient - cosine - Euclidean distance - properties of similarity and distance coefficient.

Databases: sources - contents - design - accessibility and use - chemical database - PUBCHEM – CHEMBANK - DRUGBANK - JCHEM - CAS registry - ZINC - MOLTABLE - literature database – PUBMED - biological database - chemPDB - KEGG - GenBank- NCI.

UNIT III: MOLECULAR DESCRIPTORS AND STRUCTURE-ACTIVITY RELATIONSHIP **12 hrs.**

Introduction - classification - descriptors calculated from 2D structure - simple counts - physicochemical properties - molar refractivity - topological indices - kappa shape indices - 2D

fingerprints - descriptors based on 3D representations - pharmacophore keys - quantitative structure-activity relationships (QSAR) - graphs and equations - physicochemical properties - hydrophobicity - electronic effects - steric effects - Hansch equation - craig plot - topliss scheme - bioisosteres - free Wilson approach - planning a QSAR study - case study - 3D QSAR - case studies: design of thymidylate synthase inhibitor - design of serotonin antagonist as a possible anxiolytic agent.

UNIT IV: INTRODUCTION TO DRUG DESIGN AND DISCOVERY **12 hrs.**

Drug discovery - historical perspective - identification and validation of therapeutic targets - enzymes - receptors - proteins - nucleic acids - lipids - carbohydrates - drug development process - discovery of drug candidates - natural products - lead development and optimization - rule of five - prediction of ADME properties - role of molecular recognition in drug design - thermodynamic consideration of drug binding - H-bonding - salt bridge interactions - stereochemistry in drug design.

UNIT V: DOCKING **12 hrs.**

Docking procedures - rigid docking - flexible docking - scoring functions: structure based de novo design techniques - molecular docking - active site characterization - case study of designing HIV I protease inhibitor - quantitative structure-property relationships (QSPR) - predicting melting point - solubility - boiling point - TPSA - quantitative structure toxicity relationships (QSTR) - aquatic toxicity - carcinogenicity - mutagenicity.

TEXTBOOK(S):

Patrick G.L., (2009). *An introduction to medicinal chemistry*, (4th ed.), United Kingdom: Oxford University Press. Print.

Larsen P.K, Stromgaard K., Madsen U., (2004). *Textbook of Drug Design and Discovery, (*4th ed.), London and New York: Taylor and Francis Group. Print.

REFERENCE BOOK(S):

Leach A.R, Gillet V.J., (2007). *An Introduction to Chemoinformatics*, (revised ed.), Netherland: Springer. Print.

Kar A, (2006). *Medicinal Chemistry*, New Delhi: New Age International publisher. Print.

Ganellin C.R, Roberts S.M., (1993). *Medicinal chemistry, the role of organic chemistry in drug research*, (2nd ed.), Elsevier. Print.

Gasteiger J, T. Engel, (2003). *Chemoinformatics: A Textbook,* Weinheim: Wiley VCH. Print.

A. R. Leach, (2001). *Molecular Modelling: Principles and applications*, (2nd ed.), New Delhi: Prentice Hall. Print.

G. L. Patrick, (2002). *Instant notes Medicinal chemistry*, Viva books private limited. Print.

WEBLINK(S):

Lindsay Malcolm., (2019) *Drug delivery innovation project*. Retrieved from https://www.oercommons.org/courseware/lesson/46294. CC BY-NC-SA 4.0 license.

Denise W. Carlson, Geoffrey Hill, Jane Evenson, Jessica., (2020) *The role of bioinformatics in drug discovery*. Retrieved from https://www.oercommons.org/courses/a-brief-about-the-role-of-bioinformatics-in-drug-discovery. CC BY-NC-SA 4.0 license.

COs cognitive level and mapping with PSOs

CHE4405CM INTRODUCTION TO CHEMINFORMATICS						
CO	**COGNITIVE LEVEL**	**PSO**				
		1	**2**	**3**	**4**	**5**
CO1	**K-1** Remember	2	2	1	1	1
CO2	**K-2** Understand	2	2	2	1	1
CO3	**K-3** Apply	2	2	2	1	1
CO4	**K-2** Understand	2	2	2	2	2
CO5	**K-2** Understand	2	2	2	2	2

Strongly correlated (3), Moderately correlated (2), Weakly correlated (1)

CHE4202CP EXPERIMENTAL ORGANIC CHEMISTRY II

(LAB)

COURSE OUTCOMES: **3 hrs./wk**.

On successful completion of the course, the student will be able to

CO1: classify the nature of the organic compound

CO2: identify the elements other than carbon, hydrogen and oxygen present in the compound

CO3: analyze the functional groups present in the organic compound

CO4: prepare a suitable derivative to confirm the presence of a functional group

COURSE CONTENT:

QUALITATIVE ANALYSIS OF THE FOLLOWING ORGANIC COMPOUNDS **45 hrs.**

- Phenol
- Aldehydes
- Ketones
- Carboxylic acids
- Esters
- Nitro compounds
- Amine
- Amide
- Diamide
- Carbohydrates (mono- and di- saccharides)

REFERENCE BOOK(S):

Gnanapragasam N.S., G. Ramamurthy, (2013). *Organic Chemistry Lab Manual*, Chennai: S. Viswanathan (Printers and Publishers) Pvt. Ltd. Print.

WEBLINK(S):

Professor Marietta Schwartz., (2011) *Organic Chemistry I.* Retrieved from https://www.oercommons.org/courses/organic-chemistry-i. CC BY -NC -SA 4.0 license.

COs cognitive level and mapping with PSOs:

CHE 4202CP EXPERIMENTAL ORGANIC CHEMISTRY II						
CO	**COGNITIVE LEVEL**	**PSO**				
		1	**2**	**3**	**4**	**5**

CO1	**K-1** Remember	3	2	3	2	2
CO2	**K-2** Understand	3	2	3	2	2
CO3	**K-4** Analyse	3	3	3	2	2
CO4	**K-6** Create	3	3	3	3	2

Strongly correlated (3), Moderately correlated (2), Weakly correlated (1)

CHE4203CP EXPERIMENTAL PHYSICAL CHEMISTRY I

(LAB)

COURSE OUTCOMES: **3 hrs./wk.**

On successful completion of the course, the student will be able to:

CO1: apply theoretical principles to perform experiments

CO2: make use of instruments to acquire data

CO3: analyze and interpret data

CO4: design experiments based on the concepts

COURSE CONTENT: **45 hrs.**

CONCEPT & EXPERIMENT

Viscosity of liquids

1. Determination of viscosity of solvents using Ostwald's viscometer

Optical activity

2. Determination of specific rotation of sugar solution by polarimeter

Miscibility of liquids

3. Critical solution temperature of partially miscible liquid system

4. Effect of electrolytes on CST

Partition coefficient

5. Partition coefficient for the distribution of Iodine between water and CCl_4

Buffers

6. Preparation of buffer mixtures and determination of pH of various buffer mixtures

Acid–base indicators

7. Determination of working range of indicators

pH–acidity Vs. alkalinity

8. pH titration of a strong acid with a base

9. One self–designed experiment by the student based on any one of the above concepts.

TEXTBOOK(S):

Viswanathan B. and Raghavan P.S., (2017). *Practical Physical Chemistry*, New Delhi: Viva Books Pvt. Ltd. Print.

WEBLINK(S):

https://vlab.amrita.edu/index.php?sub=2&brch=190&sim=339&cnt=1

COs cognitive level and mapping with PSOs

CHE4203CP EXPERIMENTAL PHYSICAL CHEMISTRY I						
CO	**COGNITIVE LEVEL**	**PSO**				
		1	**2**	**3**	**4**	**5**

CO1	**K-3** Apply	3	2	2	2	1
CO2	**K-3** Apply	3	3	2	2	1
CO3	**K-4** Analyse	3	2	3	3	1
CO4	**K-6** Create	3	2	2	2	2

Strongly correlated (3), Moderately correlated (2), Weakly correlated (1)

CHE4204SP CHEMINFORMATICS LAB

(Lab)

COURSE OUTCOMES: **2 hrs./wk.**

On successful completion of the course, the student will be able to

CO1: build molecules and optimize its geometry

CO2: represent the molecules in file formats

CO3: identify the nature of molecular orbitals

CO4: analyse the properties and toxicity of drug molecules

COURSE CONTENT:

***IN-SILICO* EXPERIMENTS:** **30 hrs.**

1. Construction of molecules
2. Retrieving the SMILES notation of the molecules
3. Converting the molecules into different file
4. Calculation of isoelectric point of amino acids
5. Determination of solubility of drug molecules
6. Determination of log P
7. Energy optimization
8. Determination of HOMO/LUMO band gap energy in benzene
9. Prediction of drug likeliness
10. Retrieving toxicological data from web sources for QSAR, QSPR and QSTR related studies
11. Docking a lead compound into the active site of the target

REFERENCE BOOK(S):

Andrew R, Leach, Valerie J. Gillet, (2009). *An Introduction to Chemoinformatics*, (revised ed.), Netherland: Springer. Print.

Gasteiger J.(ed.), Engel T (ed.), (2003). *Chemoinformatics: A Textbook,* Weinheim: Wiley VCH. Print.

Leach A.R, (2001). *Molecular Modelling: Principles and applications*, (2nd ed.), New Delhi: Prentice Hall. Print.

WEBLINK(S):

Robert E. Belford., (2017) *Cheminformatics*. Retrieved from https://chem.libretexts.org/Courses/Intercollegiate_Courses/Cheminformatics_OLCC_(2019)/2._Representing_Small_Molecules_on_Computers/2.4%3A_Line_Notation. CC BY-NC-SA 4.0 license.

Allison Soult., (2019) *Amino Acids***.** Retrieved from https://chem.libretexts.org/Bookshelves/Introductory_Chemistry/Book%3A_Chemistry_for_Allied_Health_(Soult)/13%3A_Amino_Acids_and_Proteins/13.01%3A_Amino_Acids. CC BY-NC-SA 4.0

license.

COs cognitive level and mapping with PSOs:

CHE4204SP CHEMINFORMATICS LAB						
CO	**COGNITIVE LEVEL**	**PSO**				
		1	**2**	**3**	**4**	**5**
CO1	**K-3** Apply	2	1	3	2	1
CO2	**K-2** Understand	2	1	3	2	1
CO3	**K-2** Understand	2	1	3	2	1
CO4	**K-4** Analyse	1	3	2	2	1

Strongly correlated (3), Moderately correlated (2), Weakly correlated (1)

CHE5504CM CHEMISTRY OF NITROGEN COMPOUNDS AND REARRANGEMENTS

(THEORY)

COURSE OUTCOMES: **5 hrs./wk.**

On successful completion of the course, the student will be able to

CO1: summarise the reactions of amines and nitro compounds

CO2: examine the structure, synthesis and reactions of nitrogen containing biomolecules

CO3: illustrate the synthesis and reactivity of heterocyclic compounds

CO4: outline the mechanistic details of rearrangements exhibited in organic compounds

CO5: relate the structure of the dyes and pigments to their properties

COURSE CONTENT:

UNIT I: AMINES AND NITRO COMPOUNDS **15 hrs.**

Amines: Nomenclature - structure of amines - physical properties - preparation - Gabriel phthalimide synthesis - basicity - effect of substituent and solvent on the basicity of aliphatic and aromatic amines - basicity and steric effects - Libermann nitroso test - Schotten-Baumann reaction - carbylamine reaction - distinction between 1º, 2º and 3º amines - Hofmann's method - Hinsberg reagent and nitrous acid - conversion of amines into substituted amides.

Diazonium Salts: Preparation - coupling reactions - synthetic applications of diazonium salts.

Nitro compounds: Preparation and reactions of nitroalkanes - Nef reaction and Mannich reaction leading to Michael addition and reduction - tautomerism of nitroalkanes - distinction between nitroalkanes and alkylnitrites.

UNIT II: NUCLEIC ACIDS, AMINOACIDS AND PROTEINS **15 hrs.**

Components of nucleic acids - nucleosides and nucleotides - ATP - role as energy carrier - kinetic stability of ATP in cell - ATP coupled reactions − structure, synthesis and reactions of: Adenine - Guanine - Cytosine - Uracil and Thymine - structure of polynucleotides - amino acids - peptides and their classification - α-amino acids - synthesis - ionic properties and reactions - Zwitterions - pKa values - isoelectric point and electrophoresis - study of peptides: determination of their primary structures - end group analysis - methods of peptide synthesis - synthesis of peptides using N-protecting - C-protecting and C-activating groups - solid-phase synthesis.

UNIT III: HETEROCYCLIC COMPOUNDS **15 hrs.**

Introduction - nomenclature - five membered rings: preparation & structure of furan - pyrrole Thiophene - electrophilic substitution - reactivity and orientation - derivatives - Knorr-pyrrole

synthesis - Paal-Knorr synthesis - indole - preparation - Fischer-Indole synthesis - properties Six membered rings: Pyridine - synthesis - structure - basicity of pyridine - electrophilic substitution - nucleophilic substitution - Chichibabin reaction.

UNIT IV: REARRANGEMENTS **15 hrs.**

Types of molecular rearrangements - rearrangement involving migration of a group or atom - pinacol-pinacolone rearrangement - Wagner-Meerwein - Benzil-benzilic acid rearrangement - rearrangement to electron deficient nitrogen: Beckmann - Schmidt - Hofmann - Lossen and Curtius rearrangement - rearrangement involving migration of a group from oxygen to aromatic ring - Fries and Claisen rearrangement - rearrangement to electron - deficient oxygen: Baeyer-Villiger oxidation - hydroperoxide rearrangement - Dakin reaction - Hofmann-Martius rearrangement - Fischer-Hepp rearrangement - Diazoamino − aminoazo rearrangement - Benzidine rearrangement.

UNIT V: DYES and PIGMENTS **15 hrs.**

Theories of colour and chemical constitution - dyes-classification - chemistry of dyes - triphenyl amine dyes - nitro and nitroso dyes - azo dyes - phthalein and xanthene dyes - anthraquinone dyes - indigoid dyes - fluorescent brightening agents - pigments-anthocyanins - flavones - phthalocyanines - carotenoids - chlorophyll - food colours - certified colorants - natural non-toxic pigments – spurious colours.

TEXTBOOK(S):

Jain, M. K. and Sharma, S. C., (2013). *Modern Organic Chemistry*, (4th ed.), New Delhi: Vishal Publishing, Print. (Unit I & IV).

Morrison, R. T. and Boyd, R.N., (2008). *Organic Chemistry*, (7th ed.), New Delhi: Prentice Hall, Print. (UNITS II, III & V).

REFERENCE BOOK(S):

Agarwal, O. P., (2007). *Chemistry of natural products,* (32nd ed. / Vol. II), Meerut: Goel Publishing House. Print.

Chatwal Gurdeep, (2008). *Chemistry of natural products,* (5th ed./ Vol. II). Delhi: Himalaya publishing House. Print

Finar, I. L., (2011). *Organic Chemistry, (*Vol. I & II, 8th ed.) Pearson Education. Print

Paula Yurkanis Bruice, (2002). *Organic Chemistry*, (3rd ed.), Delhi, Pearson education, Inc. Print

Solomons, T.W.G., (2004). *Organic Chemistry*, (8th ed.), Singapore, John Willey & Sons Inc. Print

Wade, L.G. and Singh, M.S., (2006). *Organic Chemistry,* (6th ed.), Delhi, Pearson education, Inc. Print.

WEBLINK(S):

https://chem.libretexts.org/Bookshelves/Introductory_Chemistry/The_Basics_of_GOB_Chemistry_(Ball_et_al.)/15%3A_Organic_Acids_and_Bases_and_Some_of_Their_Derivatives/15.10%3A_Amines_-_Structures_and_Names CC BY-NC-SA 3.0.

Amritacreate. (2016, June 04). Tests for Amines - MeitY OLabs [Video file]. Retrieved from https://www.youtube.com/watch?v=j5jgMUWri8U&t=39s CC BY license.

COs cognitive level and mapping with PSOs

CHE5504CM CHEMISTRY OF NITROGEN COMPOUNDS AND REARRANGEMENTS						
Class: III B.Sc. Chemistry			Semester: V			
CO/PSO	**Cognitive Level**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	**K-2** Understand	3	2	2	2	1
CO2	**K-4** Analyse	3	2	1	1	2
CO3	**K-3** Apply	3	2	1	2	1
CO4	**K-2** Understand	3	2	2	2	1
CO5	**K-2** Understand	3	2	2	2	2

Strongly correlated (3), Moderately correlated (2), Weakly correlated (1)

CHE5505CM CHEMICAL KINETICS, CATALYSIS AND ELECTROCHEMISTRY

(THEORY)

COURSE OUTCOMES: **5 hrs./wk.**

On successful completion of the course, the student will be able to

CO1: deduce the kinetics of chemical reactions

CO2: describe the theories of reaction rates and mechanism of adsorption

CO3: demonstrate the importance of catalysts in chemical and biological reactions

CO4: explain the types of conductance and its applications

CO5: examine the efficiency of electrochemical cells based on electrochemical and thermodynamic parameters

COURSE CONTENT:

UNIT I: CHEMICAL KINETICS I **15 hrs.**

Introduction - rate of reaction - rate equation - rate constant - order of reaction - unit of rate constant - integration of rate expressions - first - second - third - zero order reactions - half-life time of first - second - n^{th} order reactions - methods of determining the order of a reaction - order and molecularity of simple and complex reactions - mechanism of a complex reaction - equilibrium approximation - steady - state approximation.

UNIT II: CHEMICAL KINETICS II AND SURFACE CHEMISTRY **15 hrs.**

Theories of reaction rates - collision theory of bimolecular gaseous reactions - effect of temperatureon reaction rates - activation energy - effect of catalyst - activated complex theory of bimolecular reactions - Lindemann theory of unimolecular gaseous reactions and limitations - Surface Chemistry: Adsorption vs. absorption - types of adsorption - physisorption and chemisorption - adsorption of gases by solids - factors affecting adsorption - Freundlich and Langmuir isotherms - different types of adsorption isotherms - applications of adsorption.

UNIT III: CHEMICAL CATALYSIS **15 hrs.**

General characteristics of catalytic reactions - catalysis - negative catalysis - promoters - catalytic poisons - autocatalysis - types of catalysis - homogeneous catalysis - acid-base catalysis - enzyme catalysis - effect of temperature on enzyme catalysis - Michaelis-Menten equation - heterogeneous

catalysis - Langmuir-Hinshelwood mechanism - kinetics of surface reactions - unimolecular and bimolecular surface reactions - pH dependence of catalyzed reactions.

UNIT IV: ELECTROCHEMISTRY I **15 hrs.**

Faraday's law of electrolysis - Ohm's law - conductance - specific conductance - equivalent conductance - molar conductance - determination of electrical conductance - cell constant - variation of molar conductance with dilution - ionic mobility −Hittorf's theoretical device - transport number - determination of transport number - Hittorf's and moving boundary method - Kohlrausch's law and its applications - diffusion and ionic mobility - applications of conductance measurements - Ostwald's dilution law - Debye-Hückel theory of strong electrolytes - Debye-Falkenhagen and Wien effects - Onsager's equation (no derivation) - mean ionic activity coefficient - ionic strength.

UNIT V: ELECTROCHEMISTRY II **15 hrs.**

Galvanic cells - Daniel cell - reversible electrodes: metal-metal ion - gas electrode - metal-insoluble metal salt - oxidation − reduction electrodes - single electrode potential - standard electrode potentials - electrochemical series - electromotive force of galvanic cell - representation of a cell - determination of standard emf of a cell - effect of concentration on electrode potential - Nernst equation - relation between emf and thermodynamic parameters - emf and equilibrium constant - concentration cells - electrode-concentration cells - electrolyte-concentration cells - liquid junction potential - application of emf measurements - determination of pH of a solution - potentiometric titrations.

TEXTBOOK(S):

Arun Bahl, B.S. Bahl and G.D. Tuli, (2014). *Essentials of Physical Chemistry*, (revised ed.), India: S. Chand and company private limited. Print.

Puri, B.R., Sharma, L.R. and Pathania, M. S., (2019). *Principles of Physical Chemistry*, (48th ed.), Jalandhar: Vishal Publishing Co. Print.

REFERENCE BOOK(S):

Peter Atkins and Julio de Paula, (2016). *Atkin's Physical Chemistry*, (10th ed.), New Delhi: Oxford University Press. Print.

WEBLINK(S):

https://openstax.org/details/books/chemistry-2e. Creative Commons Attribution License v4.0

e-Content-Science. (2020, March 22). Conductance 1 Equivalent and molar conductivity and effect of dilution [Video file]. Retrieved from https://www.youtube.com/watch?v=GYdYmtyI7lU#action=share. CC BY 4.0 License

e-Content-Science. (2020, March 22). Electrochemistry 1 Basic of electrochemistry [Video file]. Retrieved from https://www.youtube.com/watch?v=Y7oyMSEciPc#action=share. CC BY 4.0 License e-Content-Science. (2020, March 22). Electrochemistry 5 Types of electrodes, pH determination and concentration cell [Video file]. Retrieved from https://www.youtube.com/watch?v=89Hl1ji8v7c#action=share. CC BY 4.0 License

COs cognitive level and mapping with PSOs:

CHE5505CM CHEMICAL KINETICS, CATALYSIS AND ELECTROCHEMISTRY						
Class: III B.Sc. Chemistry			Semester: V			
CO/PSO	**COGNITIVE LEVEL**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	**K-4** Analyse	3	3	2	2	1
CO2	**K-2** Understand	3	2	2	2	1
CO3	**K-3** Apply	3	2	2	2	1
CO4	**K-2** Understand	3	2	2	2	1
CO5	**K-4** Analyse	3	2	2	2	2

Strongly correlated (3), Moderately correlated (2), Weakly correlated (1)

CHE5506CM COORDINATION AND BIOINORGANIC CHEMISTRY

(THEORY)

COURSE OUTCOMES: **5 hrs./wk.**

On successful completion of the course, the student will be able to

CO1: analyse the different types of crystal structure and interpret the change in properties due to crystal defects

CO2: explain the bonding theories in coordination compounds

CO3: determine the electronic and magnetic properties of coordination compounds

CO4: relate the role of metals to the toxicity in biological systems

CO5: illustrate the structural aspects of carbonyls and nitrosyls

COURSE CONTENT:

UNIT I: SOLID STATE CHEMISTRY **15 hrs.**

Types of solids - isotropy and anisotropy - symmetry of crystals - Miller indices - crystal structure cubic unit cells - X-ray crystallography - Bragg's equation - methods of determination of diffraction angle - classification of crystals on the basis of bonds - ionic crystals (NaCl, CsCl) - molecular crystals - network covalent crystals - metallic crystals - structure of metallic crystals –close packing limiting radius ratio - crystal defects - Schotky and Frenkel defects.

UNIT II: CO-ORDINATION CHEMISTRY I **15 hrs.**

Introduction - Werner's theory - types of ligands - nomenclature - isomerism - types - stability of complexes - bonding in complexes - valence bond theory: inner and outer orbital complexes - Crystal field theory: octahedral - tetrahedral - square planar complexes - high spin and low spin complexes - CFSE: Factors affecting crystal field splitting - Jahn –Teller effect - nephelauxetic effect - MOT: octahedral complexes - tetrahedral - square planar complexes - spectrochemical series - comparison of VBT, CFT & MOT.

UNIT III: CO-ORDINATION CHEMISTRY II **15 hrs.**

Spectral and magnetic properties of metal complexes: term symbols - electronic spectra of complexes (d^1 and d^9) – electronic absorption spectrum of $[Ti(H_2O)_6]^{3+}$ ion - elementary treatment of Orgel diagrams - types of magnetic behavior - spin-only formula - calculation of magnetic moments.

Reactivity of metal complexes - labile and inert complexes - ligand substitution reactions - S_N1, S_N2 and S_N1CB substitution reactions of square planar complexes - trans effect.

UNIT IV: BIO - INORGANIC CHEMISTRY **15 hrs.**

Role of alkali and alkaline earth metals in biological systems - Na^+/K^+ pump - structure of heme - role of hemoglobin and myoglobin in biological systems - structure of chlorophyll - biological functions and toxicity of metals: Cr, Mn, Fe, Co, Cu, Mo, Zn - nitrogen fixation.

UNIT V: CARBONYLS AND NITROSYLS **15 hrs.**

Carbonyls - classification - general methods of preparation - properties - structure and bonding - mononuclear carbonyls: $Cr(CO)_6$, $Fe(CO)_5$, $Ni(CO)_4$ - binuclear carbonyls: $Mn_2(CO)_{10}$, $Co_2(CO)_8$, $Fe_2(CO)_9$, $Fe_3(CO)_{12}$ - EAN and 18 electron rule as applied to carbonyls.

Nitrosyls - types - nitrosyl compounds - preparation – properties - structure - sodium nitroprusside - nitroferrous sulphate - EAN and 18 electron rule as applied to nitrosyls.

TEXTBOOK(S):

James, E. Huheey, Ellen, A. Keiter, Richard, L. Keiter and Okhil, K. Medhi, (2013). *Inorganic Chemistry*, (4th ed.), New Delhi: Pearson Education. Print. (Units II, & IV)

Lee, J. D., (2002). *A New Concise Inorganic Chemistry*, (5th ed.), London: ELBS. Print. (Unit III)

Puri, B. R, Sharma, L. R and Kalia, K. C., (2013). *Principles of Inorganic Chemistry*, (31st ed.) New Delhi: Vallabha publications. Print. (Units I & V)

REFERENCE BOOK(S):

Azaroff, L., (2000). *Introduction to Solids*, (19th reprint), New Delhi: Tata McGraw Hill Publishing Company. Print.

Madan, R. D., (2016). *Modern Inorganic Chemistry*, (3rd ed.), New Delhi: S. Chand and Company Private limited. Print.

Malik, U., Madan, R. D and Tuli, G. D., (2007). *Selected Topics in Inorganic Chemistry*, New Delhi: S. Chand and company. Print.

Mark Weller, Tina Overton, Jonathan Rourke and Fraser Armstrong. (2016). *Inorganic Chemistry*, (6th ed.) New Delhi: Oxford University Press. Print.

WEBLINK(S):

Chemistry, Donald Sadoway (2019) Retrieved from https://www.oercommons.org/courses/introduction-to-solid-state-chemistry/view CC BY-NC-SA 4.0 license.

Chemistry, John Ombasa (2011) Retrieved from https://www.oercommons.org/courses/density-of-solid-objects/view CC BY-NC-SA 4.0 license

Electronic Technology, Physics (Dr. R. Ishihara, 2011) Retrieved from https://www.oercommons.org/browse?f.material_types=lecture-notes CC BY-NC-SA 4.0 license.

COs cognitive level and mapping with PSOs:

CHE5506CM COORDINATION AND BIOINORGANIC CHEMISTRY						
Class: III B.Sc. Chemistry			**Semester: V**			
CO/PSO	**Cognitive Level**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	**K-4** Analyse	3	3	2	2	1
CO2	**K-2** Understand	3	2	1	2	2
CO3	**K-5** Evaluate	3	2	2	2	2
CO4	**K-3** Apply	3	2	2	2	2
CO5	**K-3** Apply	3	2	2	2	1

Strongly correlated (3), Moderately correlated (2), Weakly correlated (1)

CHE5203CP EXPERIMENTAL PHYSICAL CHEMISTRY II

(LAB)

COURSE OUTCOMES: **3 hrs./wk.**

On successful completion of the course, the student will be able to

CO1: apply the principles of electrochemistry, chemical kinetics, phase equilibria and spectrophotometry to perform experiments

CO2: make use of instruments to acquire the experimental data

CO3: analyse and interpret the acquired data

CO4: design experiments based on the concepts

COURSE CONTENT:

EXPERIMENTS / LAB: **45 hrs.**

Theoretical concepts and experiments 6 hrs.

Electrochemical conductance 15 hrs.

1. Determination of cell constant, specific conductance and molar conductance of a strong electrolyte
2. Determination of dissociation constant of a weak electrolyte (acetic acid)
3. Determination of solubility, solubility product of sparingly soluble salts
4. Conductometric titration of strong /weak acid vs weak/strong base

Beer-Lambert's law 3 hrs.

5. Determination of λ_{max} and concentration of potassium permanganate solution

Electromotive force 3 hrs.

6. Determination of standard reduction potential and cell emf

Chemical kinetics 6 hrs.

7. Determination of rate constant of acid catalyzed hydrolysis of ester

Phase Diagram 6 hrs.

8. Construction of Phase Diagram of a simple system

9. One self-designed experiment by the student based on any one of the following concepts: 6 hrs.

Electrochemical conductance/ Beer-Lambert's law/ Electromotive force/ Chemical kinetics/ Phase Diagram

REFERENCE BOOK(S):

Ahluwalia, V.K., Sumitha Dingra and Adarsh Gulati, (2005). *College Practical Chemistry*, Hyderabad, India: University Press Pvt. Ltd. Print.

Gary, D. Christian, (2011). *Analytical Chemistry*, (6th ed.), Kundli: John Wiley & Sons. Print. Peter Mathews G., (1985) *Experimental Physical Chemistry*, Oxford: Clarendon Press. Print.

Raghavan, P. S., Viswanathan B., (2017). *Practical Physical Chemistry*, New Delhi: Viva books Private limited. Print.

WEBLINK(S):

https://vlab.amrita.edu/?sub=2&brch=190&sim=361&cnt=1

https://vlab.amrita.edu/?sub=3&brch=206&sim=569&cnt=975

https://vlab.amrita.edu/?sub=3&brch=193&sim=575&cnt=1

COs cognitive level and mapping with PSOs:

CHE5203CP EXPERIMENTAL PHYSICAL CHEMISTRY II						
Class: III B.Sc. Chemistry		Semester: V				
CO/PSO	**COGNITIVE LEVEL**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	**K-3** Apply	3	2	2	2	1
CO2	**K-3** Apply	3	3	3	2	1
CO3	**K-4** Analyse	3	2	3	3	1
CO4	**K-6** Create	3	2	2	2	2

Strongly correlated (3), Moderately correlated (2), Weakly correlated (1)

CHE5201CM INTRODUCTION TO RESEARCH METHODOLOGY

(THEORY)

COURSE OUTCOMES: **2 hrs./wk.**

On successful completion of the course, the student will be able to

CO1: apply the scientific methods to prepare a research proposal

CO2: make use of e-resources for literature search

CO3: analyse the data statistically and compare the results

CO4: write a scientific report based on the ethics of research

COURSE CONTENT:

UNIT I: INTRODUCTION AND CHOICE OF THE PROBLEM **7 hrs.**

Introduction to research process - scientific methods - characteristics of scientific method - formulation of hypothesis - classification of research - fundamental, applied and action - selection of Problem - preparing a proposal - research design - methods of research - experimental, historical, case study and survey.

UNIT II: LITERATURE SEARCH **8 hrs.**

Introduction to chemical abstracts - subject index, substance index, author index, and formula index and other indices - uses of these indices with examples - methods of using the titles and index - Importance of impact factor of journals - impact factor analysis - use of e-resources for literature

search and downloading - basics of internet services - various sources of abstracts, articles and papers of browsing and downloading, techniques of conversion from one format to another.

UNIT III: DATA ANALYSIS **8 hrs.**

Statistical analysis of data - mean - median - mode (recall) - mean deviation and standard deviation - Gaussian distribution - comparison of results - student's *t*-test - F test - propagation of error - rejection of data - linear least square fit - correlation coefficient.

UNIT IV: PRESENTATION OF REPORT **7 hrs.**

Ethics of research - plagiarism - planning the introduction - body of the report - footnotes - endnotes - page and chapter format - margin - indentation - placement of tables and figures and numbering of tables and figures - writing bibliography - books, journals and websites - concepts of patents and patenting.

TEXTBOOK(S):

Dawson and Catherine, (2002). *Practical Research Methods,* New Delhi: UBS, Publishers Distributors. Print.

Christian, G.D., (2011). *Analytical Chemistry*, (6th ed.), Kundli: John Wiley & Sons. Print.

Gurumani, N., (2010). *Scientific thesis writing and paper presentation*, Chennai: MJP Publishers. Print.

Best, J.W., (1978) *Research and education*, (3rd ed.), New Delhi: Prentice Hall of India private Ltd. Print.

Kumar and Ranjit, (2005), *Research Methodology-A Step-by-Step Guide for Beginners*, (2nd ed.), Singapore: Pearson Education. Print.

WEBLINK(S):

https://www.youtube.com/watch?v=yDC4EyKfa9I CC BY-NC 4.0

https://www.youtube.com/watch?v=c3tV8g70YuU CC BY-NC (Reuse allowed)

COs cognitive level and mapping with PSOs:

CHE5201CM INTRODUCTION TO RESEARCH METHODOLOGY						
Class: III B.Sc. Chemistry		**Semester: V**				
CO/PSO	**COGNITIVE LEVEL**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	**K-3** Apply	3	3	2	2	3
CO2	**K-3** Apply	3	3	2	2	2
CO3	**K-4** Analyse	3	3	3	3	2
CO4	**K-6** Create	3	3	3	3	3

Strongly correlated (3), Moderately correlated (2), Weakly correlated (1)

CHE0602LM FOOD ANALYSIS

(Sem. V: 4 hrs./wk. & Sem. VI: 4 hrs./wk.)

COURSE OUTCOMES:

On successful completion of the course, the student will be able to

CO1: outline the principles of community engagement and plan for strategies to address the prevailing issues ethically

CO2: identify the nutrients and examine the presence of additives and adulterants in food products

CO3: investigate the food habits and foodborne diseases in the community

CO4: analyse the chemical constituents and contaminants in food products using analytical techniques

CO5: propose remedial measures for food related issues and sensitise the community through awareness programme

PROJECTED BENEFITS OF COMMUNITY PARTNERS:

The community partners will be able to

1. imbibe and sensitise the importance of a healthy diet
2. appreciate and analyse the safety and quality of food

COURSE CONTENT:

SECTION I: COMMON UNIT **15 hrs.**

Understanding Life Frontier Engagement

a. Service-Learning and Life Frontier Engagement
b. Principles – engagement, reflection, reciprocity, public dissemination
c. Meaning of community and understanding of community dynamics
d. Programme planning in Life Frontier Engagement – stages: Need analysis, Problem identification, Goal setting, Concept finalization, planning for stages of research, research and analysis, reflection and dissemination of results
e. Ethical concerns in Life Frontier Engagement – Confidentiality, Conflict of interest, Informed consent

ACTIVITY MODULE FOR SECTION I:

a) (i) Facilitate students to understand the concept of Service-Learning and Life Frontier Engagement based on the information in the reading material given using student centered learning activities.
(ii) Interaction with a local community (Example: Children, adolescents, adults within or outside college) to identify community dynamics.
(iii) Need based analysis to be done on the community by framing a questionnaire for base line socio-economic survey.

b) (i) Students to prepare a programme plan based on the sub-themes and target group identified by the department.
(ii) Presentation by teams by refining the ideas of students based on program planning stages.
Activity based on case studies relevant to ethical issues in community engagement.

SECTION II: THEMATIC CONCEPTS **15 hrs.**

Site Assessment and Planning: A Conceptual Approach Classification concept:

- Classification of food products based on the nutritional values
- List of food additives (preservatives, nutritional additives, coloring agents, flavoring agents, emulsifiers and stabilizers, artificial sweetener) in processed food
- List of adulterants in various food products
- Types of pesticide residues in food

Correlation concept:

- If the amount of food additives exceeds the acceptable daily intake (ADI), it may lead to harmful health effects
- Long-term consumption of pesticide contaminated food product leads to acute and chronic health effects
- Malnutrition results in diet-related noncommunicable diseases

Theoretical concept:

- Food plays a major role for the well-being of a person. The health of a person gets affected by excess intake of processed food which contains additives while consuming food with pesticide residue by consuming adulterated food
- Effective remedial measures through healthy dietary plan can help the person to overcome malnutrition and the ill-effects of harmful chemicals

ACTIVITY MODULE FOR SECTION II:

- Identification of the various food additives present in processed food
- Quick tests for common food adulterants: milk and milk products, oils and fats, sugars and confectionaries, food grains and its products, spices and condiments
- Analysis of various nutrients present in food products
- Detection of presence of pesticides residues in food
- Sensitization of the community through awareness programme

SECTION III: COMMUNITY ENGAGEMENT PROCESS **90 hrs.**

- A community which needs to be sensitized about the food related issues will be identified
- Survey will be carried out in the selected community
- Detection/determination of additives, adulterants and pesticide residues in food samples and comparison with the standard values (permissible limit) will be carried out
- The data will be analysed, based on the results effective remedial measures will be suggested to the community

The student will document her engagement with the community through this process in the form of a report with supporting evidences (geo-tagged photographs, video, community feedback etc.).

The student will present her outcome of learning process in the form of an oral presentation.

REFERENCE BOOK(S):

Begum, R. (2008). A Textbook of Food, Nutrition and Dietetics, (3rd revised ed.), New Delhi: Sterling publishers Pvt. Ltd. Print.

Branen, A. L., Davidson, P. M., Salminen, S. and Thorngate III, J. H. (2002) Food Additives, (2nd ed. Revised and Expanded), New York: Basel, Marcel Dekker, Inc. Print.

Meyer, L. H. (1987) Food Chemistry, Delhi: CBS Publishers& distributors. Print. Mudambi & Rao, (2006) Food Science, New Delhi: Wiley Eastern limited. Print.

WEBLINK(S):

https://med.libretexts.org/Courses/American_Public_University/APUS%3A_An_Introduction_to_Nutrition_(Byerley)/Text/01%3A_Nutrition_and_You_An_Introduction_and_How_to_Achieve_a_Healthy_Diet/1.03%3A_What_Are_Nutrients CC BY-NC-SA 3.0.

FSSAI video library. Adultration in foods, common adultrants and simple methods of detection [Video file]. Retrieved from https://fssai.gov.in/fssaivideolibrary/playEpisode?episodeId=541 CC BY-NC-SA 4.0.

FSSAI video library. Testing Common Salt Adulteration with Chalk [Video file]. Retrieved from https://fssai.gov.in/fssaivideolibrary/playEpisode?episodeId=642 CC BY-NC-SA 4.0

FSSAI video library. Testing Green Vegetables adulteration with Malachite Green [Video file]. Retrieved from https://fssai.gov.in/fssaivideolibrary/playEpisode?episodeId=647 CC BY-NC-SA 4.0

Cos Cognitive level and mapping with PSOs

CHE0602LM FOOD ANALYSIS						
Class: III B. Sc. Chemistry				Semester: V & VI		
CO / PSO	**Cognitive level**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	K-2 Understand	2	3	2	2	3
CO2	K-3 Apply	3	3	3	2	2
CO3	K-4 Analyse	3	3	3	3	2
CO4	K-4 Analyse	3	3	3	3	3
CO5	K-6 Create	3	3	3	3	3

Strongly correlated (3), Moderately correlated (2), Weakly correlated (1)

CHE6508CM ORGANIC SYNTHESIS AND SPECTROSCOPY

(THEORY)

COURSE OUTCOMES: **5 hrs./wk.**

On successful completion of the course, the student will be able to

CO1: utilise the knowledge of reaction mechanism in organic synthesis

CO2: illustrate the role of synthetically important compounds

CO3: explain the significance of green synthesis

CO4: interpret the structure of organic compounds using UV-visible and Mass spectral techniques

CO5: deduce the structure of organic compounds using IR and NMR spectral techniques

COURSE CONTENT:

UNIT I: ORGANIC SYNTHESIS **15 hrs.**

Importance of Organic synthesis – steps involved in synthetic planning (one illustration each) – carbon-carbon bond formation (Michael addition, aldol condensation, Wittig reaction, enolate alkylation, Diels Alder reaction) – functional group interconversion (from carbonyl, nitro, amino to other functional groups) – Introduction to disconnection approach (Terms and definitions) – protecting groups (Carbonyl and diol protection).

UNIT II: SYNTHETICALLY IMPORTANT COMPOUNDS AND REAGENTS **15 hrs.**

Active methylene compounds – Preparation and synthetic uses of diazomethane, malonic ester, acetoacetic ester, diazoacetic ester, cyanoacetic ester.

Organometallic compounds – Organomagnesium compound – Grignard reagent – preparation, reactions, synthetic applications – nucleophilic addition reactions, nucleophilic substitution reactions – Organolithium compounds – n-butyllithium – phenyllithium – preparation, synthetic applications – Organocopper compound – Gilman reagent – preparation – synthetic applications.

UNIT III: GREEN SYNTHESIS **15 hrs.**

Introduction to green chemistry – principles of green synthesis – green catalysts (Zeolites, montmorillonite, clay) – green solvents – water, supercritical CO_2, ionic liquids (imidazolium salts) – solvent less reactions – phase transfer catalysts – types of biocatalyst in organic synthesis – microwave assisted green synthesis – ultra sound assisted synthesis.

UNIT IV: ORGANIC SPECTROSCOPY I **15 hrs.**

Electronic spectroscopy – Electronic transitions – designation of various transitions – Chromophores, Auxochromes – bathochromic, hypsochromic, hyperchromic and hypochromic shifts – solvent effects – Woodward rules for calculation of λmax for dienes, polyenes and carbonyl compounds.

Mass Spectrometry – Mass spectrum – determination of molecular weight, molecular formulae – isotopic abundance – molecular ion – metastable ions – fragmentation routes – fragmentations associated with hydrocarbons – hydroxyl compounds, ethers, ketones, aldehydes, acids, halogen compounds with one Cl / Br atoms (both aliphatic and aromatic compounds to be done simultaneously).

UNIT V: ORGANIC SPECTROSCOPY II **15 hrs.**

IR spectroscopy – Skeletal vibrations of organic molecules – factors influencing vibrational frequency of bonds – hydrogen bonding, electronic effect, mass effect, conjugation, ring size – identification of functional groups using IR data. NMR – Nuclear spin states and NMR active nuclei – nuclear magnetic moments – mechanism of resonance absorption – population of nuclear spin states, proton NMR – interaction of spin magnetic moment of a proton with external magnetic moment, chemical shift and shielding, chemical equivalence, chemical environment and chemical shift, magnetic anisotropy, spin-spin splitting – proton NMR spectra of organic molecules –applications – structural elucidation of organic molecules using proton NMR spectral data – introduction to ^{13}C NMR – ^{13}C chemical shifts – proton decoupled ^{13}C spectra.

TEXT BOOK(S):

Mohan, Jag. (2004). *Organic spectroscopy: principles and applications (*2nd ed.). New Delhi: Narosa Publishing House. Print.

Jain, M. K., and Sharma, S. C. (2005). *Modern organic chemistry (*4th ed.). New Delhi: Vishal Publication Co. Print.

REFERENCE BOOK(S):

Mackie, R. K., and Smith, D. M. (1982). *Guidebook to Organic Synthesis*. England: ELBS. Print.

Pavia, Chapman and Kriz, (2007). *Introduction to Spectroscopy (*3rd ed.). Asia: Thomson. Print.

Robert E. Ireland, (1969). *Organic Synthesis.* India: Prentice-Hall of India Pvt. Ltd. Print. Silverstein, Bassler and Morril, (1991). *Spectrometric Identification of Organic Compounds (*5th ed.). New York: John Wiley and Sons.Print.

Stuart Warren, (2004). *Organic Synthesis. The Disconnection Approach.* New York: John Wiley & Sons. Print.

William Kemp, (1991). *Organic Spectroscopy (*4th ed.). England: ELBS. Print.

WEBLINK(S):

https://chem.libretexts.org/Courses/University_of_Illinois_Springfield/Introduction_to_Organic_Spectroscopy CC BY-NC-SA 3.0.

COs cognitive level and mapping with PSOs

CHE6508CM ORGANIC SYNTHESIS AND SPECTROSCOPY						
Class: III B.Sc. Chemistry			Semester: VI			
CO/PSO	**Cognitive Level**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	**K-3** Apply	3	2	2	1	2
CO2	**K-3** Apply	3	2	2	1	1
CO3	**K-2** Understand	3	2	1	1	3
CO4	**K-3** Apply	3	2	3	2	1
CO5	**K-4** Analyse	3	2	3	2	1

Strongly correlated (3), Moderately correlated (2), Weakly correlated (1)

CHE6509CM MOLECULAR SPECTROSCOPY, QUANTUM CHEMISTRY AND GROUP THEORY (THEORY)

COURSE OUTCOMES:

5 hrs./wk.

On successful completion of the course, the student will be able to

CO1: describe the behaviour of quantum mechanical systems

CO2: explain the characteristics of wave functions and statistical thermodynamics of molecules

CO3: apply the principles of microwave and infrared spectroscopy to molecules

CO4: analyse Raman, electronic and electron spin resonance spectrum of molecules

CO5: deduce the symmetry of elements, point groups and character tables of different molecules

COURSE CONTENT:

UNIT I: QUANTUM MECHANICS I **15 hrs.**

Planck's quantum theory – black body radiation – photoelectric effect – wave-particle duality of light and matter – de Broglie equation – Heisenberg uncertainty principle – mathematical concepts: method of separation of variables – differential equations – linear and non-linear operators – eigen functions and eigen values – quantum mechanical operators – Hermitian operators – commuting and non-commuting operators –– setting up the Schrödinger wave equation: particle in 1D and 3D box.

UNIT II: QUANTUM MECHANICS II **15 hrs**.

Wave functions – characteristics – wave functions of particle in 1D and 3D box – wave function and probability – normalisation of wave function – quantization of energy – allowed energies – degeneracy of energy levels – average momentum and position – postulates of quantum mechanics – orthogonality – orthonormal wave functions – Hamiltonian for the hydrogen and helium atoms.

Introduction to statistical thermodynamics – micro and macro states – ensembles – probability distribution using Maxwell-Boltzmann – Bose-Einstein – Fermi-Dirac statistics (no derivation).

UNIT III: PHYSICAL PRINCIPLES OF MOLECULAR SPECTROSCOPY I **15 hrs.**

Introduction to electromagnetic radiation (EMR) – regions of EMR and types of spectroscopy – basic features of spectrometers – signal to noise ratio – resolving power – line width and Intensity of spectral lines – microwave spectroscopy – classification of rotators – rotational spectra of rigid and non-rigid diatomic molecules – determination of bond length – isotopic mass – dipole moment of molecules – Infra-Red spectroscopy – vibrations

in a molecule – energy of a diatomic molecule – vibrational spectrum of simple harmonic and anharmonic oscillators – fundamentals – overtones and hot bands – fundamental vibrations and symmetry in polyatomic molecules.

UNIT IV: PHYSICAL PRINCIPLES OF MOLECULAR SPECTROSCOPY II **15 hrs.**

Raman Spectroscopy – Rayleigh and Raman scattering – classical and quantum theories – rotation – Raman and rotation – vibration Raman spectrum of a diatomic molecule – rule of Mutual Exclusion. Electronic Spectroscopy – Born-Oppenheimer approximation – Franck Condon Principle –dissociation and predissociation.

Electron spin resonance (ESR) – principle of resonance absorption – ESR spectrum of an unpaired electron – Hyperfine structure – ESR spectra of Hydrogen atom and methyl radical.

UNIT V: GROUP THEORY **15 hrs.**

Symmetry and geometry (recall VSEPR theory) – Symmetry elements and symmetry operations – products of symmetry operations – symmetry point groups – Schönflies notations – properties of a group – group multiplication tables – sub groups – classes – similarity transformations – representation of a group matrix representation of symmetry operations – reducible and irreducible representations – properties of the characters of representation – great orthogonality theorem – construction of character tables – C_{2V} (H_2O, *cis*-N_2F_2) and C_{2h} (*trans*-N_2F_2) point groups.

TEXTBOOK(S):

Banwell. N & Mc Cash. M., (1994). *Fundamentals of Molecular Spectroscopy*, New Delhi: Tata McGraw Hill Publishing Co Ltd. Print. (Units III & IV)

Donald A Mc Quarrie, (2011). *Quantum Chemistry*, India: Viva Books Pvt. Ltd. Print. (Units I & II).

Salahuddin Kunju A. & Krishnan G., (2015). *Group theory and its applications in Chemistry*, (2nd ed.) Delhi: PHI Learning Pvt. Ltd. Print. (Unit V)

REFERENCE BOOK(S):

Ramakrishnan V. & Gopinathan M.S., (1998). *Group Theory In Chemistry*, Vishal Publications, Print.

Swarnalakshmi S., Saroja T., Ezhilarasi R. M., (2008). *A simple approach to group theory in chemistry*, Hyderabad: University Press. Print.

WEBLINK(S):

https://chem.libretexts.org/Bookshelves/Analytical_Chemistry/Molecular_and_Atomic_Spectroscopy_(Wenzel), CC BY-NC-SA 3.0 license.

https://chem.libretexts.org/Courses/Pacific_Union_College/Quantum_Chemistry, CC BY-NC-SA 3.0 license.

COs cognitive level and mapping with PSOs

CHE6509CM MOLECULAR SPECTROSCOPY, QUANTUM CHEMISTRY AND GROUP THEORY						
Class: III B.Sc. Chemistry				**Semester: VI**		
CO/PSO	**COGNITIVE LEVEL**	**PSO**				
		1	**2**	**3**	**4**	**5**
CO1	**K-2** Understand	3	1	2	1	1
CO2	**K-2** Understand	3	1	2	1	1
CO3	**K-3** Apply	3	1	2	2	1
CO4	**K-4** Analyze	3	1	2	2	1
CO5	**K-4** Analyze	3	1	2	3	1

Strongly correlated (3), Moderately correlated (2), Weakly correlated (1)

CHE6507CM CHEMISTRY OF NATURAL PRODUCTS

(THEORY)

COURSE OUTCOMES: **5 hrs./wk.**

On successful completion of the course, the student will be able to

CO1: discuss the structure, properties and biological significance of carbohydrates

CO2: analyse the structure and properties of alkaloids and terpenoids

CO3: illustrate the structure and significance of steroids and hormones

CO4: describe the structure and properties of lipids

CO5: explain the structure and importance of vitamins

COURSE CONTENT:

UNIT I: CARBOHYDRATES **15 hrs.**

Monosaccharides – classification – family tree of saccharides – configuration of aldoses in relation to glyceraldehyde – constitution of glucose and fructose – stereochemistry of glucose – oxidation – interconversions – lower aldose to higher aldose – Kiliani synthesis – Ruff degradation – conversion of an aldose into its epimer – aldose into ketose – mutarotation of glucose – configuration of glucose – absolute configuration – cyclic structure of D+) glucose – configuration about anomeric carbon – methylation – determination of ring size – conformations of glucose – disaccharides – General study of cellobiose – sucrose – (structure and specific properties) Haworth structure.

UNIT II: ALKALOIDS AND TERPENOIDS **15 hrs.**

Alkaloids – definition – extraction – general properties – general methods of determining structure classification – structural elucidation and synthesis of pyridine and piperidine group – piperine pyridine and pyrrolidine group – Cocaine.

Terpenoids – Introduction – classification – isolation – isoprene rule and special isoprene rule– general methods of determining the structure – structure and synthesis of acyclic terpenoid – citral bicyclic terpenoid– camphor.

UNIT III: STEROIDS AND HORMONES **15 hrs.**

Classification and biological importance of steroids – Diels' hydrocarbon – cholesterol – occurrence properties – test and physiological activity – structure of steroid hormones – progesterone – androsterone – adrenocortical hormones – bile acids – phytosterols – non steroid hormones – structure and functions of thyroid gland hormones – adrenal gland hormones.

UNIT IV: LIPIDS **15 hrs.**

Biological functions – classification – natural fats – difference between fats and oil – fats – nomenclature – physical and chemical properties – rancidity – analysis of fats and oils – acid value – saponification value – iodine value – Reichert – Meissl value – distinction between animal and vegetable fats – uses – compound lipids – phospholipids :lecithins – cephalins –plasmalogens – phosphoinositides – phophosphingosides – glycolipids.

UNIT V: VITAMINS **15 hrs.**

Classification – vitamin A and vision – structure – function and deficiency diseases – vitamin D, E, K, B_1, B_3, B_c, B_6, niacin and B_{12} – structural elucidation and synthesis of vitamin A, B_2 and K.

TEXTBOOK(S):

Jain, M. K. and Sharma, S. C., (2013). *Modern Organic Chemistry*, (4^{th} ed.), New Delhi: Vishal Publishing. Print.

Morrison, R.T, Boyd, R. N. and Bhattacharjee S. K., (2011). *Organic Chemistry*, (7^{th} ed.), New Delhi: Pearson. Print.

REFERENCE BOOK(S):

Agarwal, O. P, (2007). *Chemistry of natural products*, *Vol. II*, (32nd ed.), Meerut: Goel Publishing House. Print

Chatwal Gurdeep, (2008). *Chemistry of natural products , Vol. II*, (5th ed.), Delhi: Himalaya publishing House. Print.

Finar I. L., (2011). *Organic Chemistry, Vol. I & II*, (8th ed.), Delhi: Pearson Education. Print.

WEBLINK(S):

https://chem.libretexts.org/Bookshelves/Organic_Chemistry/Book%3A_Radical_Reactions_of_Carbohydrates_(Binkley) CC BY-NC-SA 3.0.

COs cognitive level and mapping with PSOs

CHE6507CM CHEMISTRY OF NATURAL PRODUCTS						
Class: III B.Sc. Chemistry			Semester: VI			
CO/PSO	**Cognitive Level**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	**K-2** Understand	3	2	2	2	1
CO2	**K-4** Analyse	3	2	1	1	2
CO3	**K-3** Apply	3	2	1	2	1
CO4	**K-2** Understand	3	2	2	2	1
CO5	**K-2** Understand	3	2	2	2	2

Strongly correlated (3), Moderately correlated (2), Weakly correlated (1)

CHE6503CT PHOTOCHEMISTRY, PHASE EQUILIBRIA AND INSTRUMENTAL ANALYSIS (LAB CUM THEORY)

COURSE OUTCOMES: **4T + 2L hrs./wk.**

On successful completion of the course the student will be able to

CO1: explain the laws of photochemistry, kinetics of photochemical reactions and their applications

CO2: identify the various phases, components and degrees of freedom to describe a system

CO3: describe the classification, characteristics and applications of polymers

CO4: discuss the electric and magnetic properties of molecules

CO5: plan and carry out experiments based on the instruments methods of analysis

COURSE CONTENT:

UNIT I: PHOTOCHEMISTRY **15 hrs.**

Principles of photochemistry – consequences of light absorption – Jablonski diagram – light absorption by solutions – laws of photochemistry – quantum yield and its determination – primary and secondary processes – photochemical reactions – photochemical rate law – kinetics of photochemical reactions – formation of hydrogen chloride and hydrogen bromide – photophysical processes – chemiluminescence – bioluminescence – photosensitization – quenching – applications of photochemistry – laser action.

UNIT II: PHASE EQUILIBRIA **15 hrs.**

Difference between phase and state of matter – definition of terms – phase – components and degrees of freedom – derivation of Gibb's phase rule – phase diagrams of one component systems – water – sulfur – liquid Helium – two component systems – simple eutectic systems – thermal analysis and cooling curves – phase diagrams of Pb-Ag and KI – water systems – freezing mixtures – formation of compounds with congruent and incongruent melting points – Ferric chloride-water – sodium sulphate-water systems.

UNIT III: POLYMER CHEMISTRY **15 hrs.**

Introduction – classification of polymers – degree of polymerization – polydispersity and polydispersity index – molecular weight of polymers – number average and mass average molecular weight – determination of molecular weight of polymers – osmometry – viscometry – gel permeation chromatography – types of polymerization – kinetics of addition and condensation polymerization – industrially important polymers – preparation and applications of Nylon 66 – Nylon 6 – Dacron – bakelite – melamine – neoprene – vulcanization of rubber – buna-N – buna-S – Teflon – biopolymers – natural and synthetic – natural: protein based – collagen – carbohydrates based – cellulose and chitosan – synthetic biopolymers: poly lactic acid – structure and applications.

UNIT IV: ELECTRIC AND MAGNETIC PROPERTIES **15 hrs.**

Electric properties of molecules – polarization in an electric field – Clausius – Mosotti equation – Debye equation – symmetry and dipole moment – measurement of dipole moment – dependence of polarisability on frequency – bond moments – group moments – dipole moments and molecular structure – magnetic properties of molecules – magnetic permeability – magnetic susceptibility – para and dia magnetism – molecular interpretation of para and dia magnetism – measurement of magnetic susceptibility – ferro and antiferromagnetism**.**

UNIT V: INSTRUMENTAL METHODS OF ANALYSIS **30 hrs.**

Principles and method of analysis using Atomic Absorption Spectroscopy – Fluorimetry – Thermo Gravimetric Analysis (TGA) – Differential Thermo gravimetric Analysis (DTGA) – Differential Thermal Analysis (DTA) – Differential Scanning Calorimetry (DSC) – Voltammetry – Amperometry – Coulometry.

The students will be trained in the following instruments with respect to the principle – working and applications.

1. TDS analyser – Determination of total dissolved salts in water samples
2. Flame photometer – Determination of Na and K in different samples
3. Nephelometer – Determination of sulphate ion in different samples
4. UV-Visible Spectrophotometer – Determination of λ_{max} of coloured samples
5. UV-Photoreactor – Photocatalytic degradation of natural and synthetic dye samples

TEXTBOOK(S):

R.D. Madan, (2011). *Modern Inorganic Chemistry*, (3rd ed.), New Delhi: S. Chand & Co. Ltd. Print.

Arun Bahl, B. S. Bahl and G. D. Tuli G.D, (2009). *Essentials of Physical Chemistry*, New Delhi: S. Chand and Co. Ltd. Print.

Gowariker, Viswanathan and Jayadev Sreedhar, (1986). *Polymer Science,* New Delhi: Wiley Eastern Ltd. Print.

B. R. Puri, L. R. Sharma and S. Pathania, (2012). *Principles of Physical Chemistry*, (46th ed.), New Delhi: Vishal Publishing Co. Print.

D.A. Skoog, D. M. West, F. J. Holler, S. R. Crouch, (2014). *Fundamentals of Analytical Chemistry,* India: Cengage Learning. Print.

WEB LINKS:

Chemistry, Ralph Cox, Sabina Schill (2017) Retrieved from https://www.oercommons.org/courses/magnetic-fields-and-distance/view CC BY-NC-SA 4.0 license.

vlab.amrita.edu,. (2012). Flame Photometry. Retrieved 17 December 2021, from vlab.amrita.edu/?sub=2&brch=294&sim=1351&cnt=2 https://vlab.amrita.edu/?sub=2&brch=294&sim=1351&cnt=2964

vlab.amrita.edu, (2012). Soil Analysis-Determination of Specific conductivity of Soil. Retrieved 17 December 2021, from vlab.amrita.edu/index.php?sub=2&brch=193&sim=1315&cnt=1 https://vlab.amrita.edu/index.php?sub=2&brch=193&sim=1315&cnt=1

Retrieved from https://www.oercommons.org/courses/analytical-chemistry-5/view CC BY-NC-SA 3.0 license.

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http://chemcollective.org/chem/scenariobased/foodcolor/

MAPPING: COs cognitive level and mapping with PSOs

CHE6503CT PHOTOCHEMISTRY, PHASE EQUILIBRIA AND INSTRUMENTAL ANALYSIS						
Class: III B.Sc. Chemistry			**Semester: VI**			
CO/PSO	**COGNITIVE LEVEL**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO1	**K-5 Evaluate**	**3**	**2**	**2**	**2**	**3**
CO2	**K-3 Apply**	**2**	**2**	**2**	**2**	**2**
CO3	**K-2 Understand**	**3**	**2**	**2**	**2**	**3**
CO4	**K-2 Understand**	**3**	**2**	**1**	**1**	**1**
CO5	**K-6 Create**	**3**	**3**	**3**	**3**	**3**

Strongly correlated (3), Moderately correlated (2), Weakly correlated (1)

CHSS3201EI CRIMINOLOGY AND FORENSICS

(THEORY)

COURSE OUTCOME: **2 hrs./wk.**

On successful completion of the course, the student will be able to

CO1: describe the nature of crime and explain the discipline of criminology

CO2: analyze the causation, types of crime and criminals

CO3: summarize the techniques involved in the field of criminology and forensics

CO4: examine the biological evidences from the crime scene

COURSE CONTENT:

UNIT I: NATURE OF CRIMINOLOGY AND CRIME **7 hrs.**

Criminology – penology and criminal law – definition and characteristics – crime definitions and characteristics – theories of criminology – classical and neo-classical and positive – history and development of forensic science – services of the crime laboratory – functions of forensic scientists.

UNIT II: CAUSATION AND PREVENTION OF CRIME **7 hrs.**

Crime Causes: heredity – biophysical – psychological and sociological – types of Crimes: organized white collar and cybercrime – types of criminals – habitual – professional and white collar criminals – the crime scene – securing and recording the crime scene – evidence collection techniques – chain of custody – crime prevention and problems in prevention.

UNIT III: FORENSIC INVESTIGATION OF PHYSICAL EVIDENCES: **8 hrs.**

Definition of physical evidence – classification of physical evidence – types of physical evidences.

Glass and Soil: Physical properties – comparing glass fragments – collection and preservation of glass evidence – forensic characteristics of soil – collection and preservation of soil evidence.

Fingerprints: Fundamental principles of fingerprints – classification of fingerprints – methods of detecting fingerprints – preservation of developed prints.

Document and Voice Examination: Collection of handwriting exemplars – typescript comparisons – inks and papers – alterations – erasures and obliterations – voice examination.

UNIT IV: FORENSIC INVESTIGATION BASED ON BIOLOGICAL PHYSICAL EVIDENCES: **8 hrs.**

Hair and Fibre: Morphology of hair – identification and comparison of hair – collection and preservation of hair evidence – types of fibre – collection and preservation of fibre evidence.

Forensic Serology: blood typing – forensic characterization of bloodstains – paternity testing – forensic characterization of semen – collection of rape evidence – **DNA: The indispensable forensic science tool** – recombinant DNA – DNA typing.

Forensic Toxicology: Toxicology of alcohol – breath test instruments (breath analyzer).

REFERENCE BOOK(S):

Ram, A., (2000). *Criminology,* Jaipur: Rawat Publications. Print.

Giddens, A., (2000). *Sociology,* UK: Poetry Press Cambridge. Print.

William, E. G., (1996). *Introduction to Forensic Sciences*, (2nd ed.), New York, Washington: CRC Press. Print.

Paranjape, N. V., (2010). *Criminology and Penology*, Allahabad: Central Law Publications. Print.

Sutherland, E. H., Cressey, D. R. and Luckenbill, D. F., (1992). *Principles of Criminology*, (11th ed.), U.S.A: Rowman & Littlefiled Publishers. Print.

Saferstein, Richard., (1995). *Criminalistics – An Introduction to Forensic Science*, (5th ed.), Prentice Hall. Print.

WEBLINK(S):

Video(s)

Denver Police Crime Lab. (2017, March 27). *Inside the crime lab- Forensic chemistry* unit [Video file]. Retrieved from https://www.youtube.com/watch?v=8AnRtHHwxYc. CC BY license.

license.

Fuse School- Global Education. (2019, November 19). *DNA Fingerprinting* [Video file]. Retrieved from https://www.youtube.com/watch?v=7onjVBsQwQ8. CC BY-NC license.

CHSS3201EI CRIMINOLOGY AND FORENSICS	
Class: II UG AIDED	**Semester: III**
Cognitive Level	**K-2** Understand
	K-4 Analyze

CHZO3201EI FOOD, NUTRITION AND HEALTH CARE

(THEORY)

COURSE OUTCOMES: **2 hrs./wk.**

On successful completion of the course, the student will be able to

CO1: categorize food items based on the functions and nutritive value of foods

CO2: explain the methods of cooking and its effect on food

CO3: identify the additives and adulterants in food

CO4: plan proper supplements and diet for deficiency diseases

COURSE CONTENT:

UNIT I: FUNCTIONS AND COMPONENTS OF FOOD **7 hrs.**

Sources and functions of nutrients – calorific value of food balanced diet – daily requirements. Activity: BMI calculation and preparation of balanced diet.

UNIT II: FOOD PREPARATION METHODS **7 hrs.**

Medium of cooking food – water, steam and oil – methods of cooking food – heating – boiling – stewing – roasting – frying – baking – microwave cooking – nutritional changes upon cooking of food. Activity: Cooking using different methods.

UNIT III: FOOD ADDITIVES AND ADULTERANTS **8 hrs.**

Additives – antioxidants (BHA, BHT and Curcumin) and their roles – coloring agents – sweetening agents (natural and artificial additives) – flavouring agents – preservation methods – natural and chemical preservatives – adulteration – common adulterants in food – effect of adulteration. Activity: Detection of adulterants in food.

UNIT IV: NUTRITIONAL DEFICIENCY DISEASES **8 hrs.**

Malnutrition – over nutrition – under nutrition – effects of excess nutrients – fast food and efficiency diseases – nutritional deficiency diseases – Xerophthalmia – Keratomalacia – Night blindness – scurvy – Anemia – Rickets – Protein Energy Malnutrition, (Marasmus, Kwashiorkor). Activity: Chart preparation on deficiency diseases and food supplements.

REFERENCE BOOKS:

Begum R., A (1997). *Textbook of Food, Nutrition and Dietetics*, (2nd revised ed.), New Delhi, Sterling. Print.

Joshi A.S., (1998). *Nutrition and Dietetics*, New Delhi, Tata McGraw Hill, Print.

Meyer L. H., (1987). *Food Chemistry*, Delhi, CBS Publishers and distributors. Print.

Mudambi R, (2006). *Food Science*, New Delhi, Wiley Eastern limited, Print.

Wong, N.P, Jenness R, Keney M, Marth E.H, (1988). *Fundamentals of Dairy Chemistry*, New Delhi, CBS Publishers and distributors, Print.

HANDOUT(S):

Food Nutrition and Health Care, Prepared by Department of Chemistry, Lady Doak College. Print.

WEBLINK(S):

Ball, G.F.M. (2004). *Vitamins: Their role in the human body* Retrieved from: https://www.pdfdrive.com/vitamins-their-role-in-the-human-body-e176987756.html

Duyff, R.L. (2007). *American Dietetic Association complete food and nutrition guide*, 3rd Edition. Retrieved from: https://www.pdfdrive.com/complete-food-and-nutrition-guide-e13023246.html

Gibney, M.J, Lanham-New, S.A, Cassidy, A., and Vorster, H.H. (2009). *Introduction to human nutrition*, (2nd ed.), Retrieved from: https://www.pdfdrive.com/introduction-to-human-nutrition-2nd-edition-e1688125.html

CHZO3201EI FOOD, NUTRITION AND HEALTH CARE	
Class: II UG AIDED	**Semester: III**
Cognitive Level	K-2 Understand
	K-3 Apply
	K-4 Analyze

CHCO4202EI WEALTH FROM WASTE

(THEORY)

COURSE OUTCOMES: **2 hrs./wk.**

On successful completion of the course, the student will be able to

CO1: classify the different types of waste

CO2: choose the methods of collection and storage of waste

CO3: describe the process of waste recycling and reuse

CO4: analyze waste management and e-waste

COURSE CONTENT:

UNIT I: CLASSIFICATION OF WASTE **8 hrs.**

Definition of waste –classification of waste – general solid waste (putrescible & non- putrescible) – special waste – biomedical waste – asbestos waste – waste tyres – hazardous waste – liquid waste – e-waste – classification of waste using chemical assessment – methods for determining specific contaminant concentration (SCC) and toxicity characteristics leaching procedure (TCLP) – classifying a waste using SCC and TCLP.

Activity: Field visits.

UNIT II: COLLECTION, SEGREGATION AND STORAGE OF WASTE **8 hrs.**

Collection – methods of collection – primary & secondary collection and facilities for processing segregation – principles – planning – colour coding of the segregated waste –packaging storage – primary and secondary storage of wastes.

UNIT III: RECYCLING AND REUSE OF WASTE **7 hrs.**

Hierarchy – 5R concept and current practices – waste treatment – physical methods – chemical methods – biological methods – thermal methods – waste to energy – resource recovery from solid wastes – composting – refuse derived fuel – plastic to petroleum – pavement blocks – textile products – plastic waste in road construction.

Activity: Art from waste.

UNIT IV: WASTE MANAGEMENT AND e-WASTE **7 hrs.**

Waste management – Definition – e-Waste – Meaning- Role and responsibilities of producers and consumers – innovative ways to eliminate waste from Production activity– Converting waste to wealth – Job opportunities – commercialization of waste at regional – state and national level – Waste Management Act in India – Tamil Nadu Pollution Control Board .

Activity: Analyze Indian startup's trash to treasure.

REFERENCE BOOK(S):

Mahadevi, D., Wolfe, J. M;(2008). *Solid Waste Management in Indian Cities: Status and Emerging Practices, New Delhi: Concept Publishing Company*. Print.

Pichtel, J; (2014). *Waste management practices, Municipal, Hazardous and Industrial, USA:* CRC press Taylor and Francis group. Print.

Langmore, K; (2005). *Minimum Requirements for The Handling, Classification and Disposal of Hazardous Waste*, (3rd ed.), Republic of South Africa: Department of Water Affairs & Forestry. Print.

WEBLINK(S):

Amy Kolenbrander., (2005). *3RC (Reduce, Reuse, Recycle and Compost).* Retrieved from https://www.oercommons.org/courses/3rc-reduce-reuse-recycle-and-compost/view. CC BYNC-SA 4.0 license.

John Snider., (2019). *Waste Management.* Retrieved from https://www.oercommons.org/courseware/lesson/52882/overview. CC BY-NC-SA 4.0 license

"Segregation of waste" Youtube uploaded by Paulina 30 January, 2018 https://youtu.be/QW7- aS4dkXQ. CC BY License.

CHCO4202EI WEALTH FROM WASTE CHCO4202EI WEALTH	
Class: II UG	**Semester: IV**
Cognitive level	**K-2** Understand
	K-1 Remember
	K-2 Understand

CHTA4202EI இயற்கை உணவும் வேதியியலும்

CHTA4202EI NATURAL FOOD AND CHEMISTRY

(THEORY)

பாடத்தின் விளைபயன்கள்: **2 மணிநேரம் / வாரம்**

இப்பாடத்தை முழுமையாகக் கற்றபின் மாணவியர் பெறுவன,

CO 1: இயற்கை உணவின் நன்மைகளைப் புரிந்துகொள்வர்

CO2: இயற்கை மருத்துவ முறைகளின் வகைகளை அறிந்து கொள்வர்

CO3: இயற்கை உணவு தயாரிக்கும் முறைகளையும் வேதியியல் மாற்றங்களையும் பகுத்துணர்வர்

CO4: மூலிகைகளின் மருத்துவக் குணங்களைத் தெரிந்து கொள்வர்

COURSE OUTCOMES: **2 hrs./Wk.**

On successful completion of the course, the student will be able to

CO1: recognize the benefits of natural food

CO2: identify the types of natural medicine

CO3: relate the natural food and chemical changes

CO4: explain the medicinal benefits of natural food

பாடத்திட்டம்:

அலகு 1: இயற்கை உணவும் வேதியியல் மாற்றங்களும் (NATURAL FOOD AND CHEMICAL CHANGES) **8 மணிநேரம்**

இயற்கை உணவு அறிமுகம் – உணவேமருந்து – மருந்தேஉணவு – இயற்கையின்தத்துவம் – உணவுப்பழக்கமும் உடலுறுப்புகளின் செயல்பாடுகளும் – நோய்க்கான காரணங்களும் பருவத்திற் கேற்ற உணவு முறைப்பழக்கங்களும் – இயற்கை மருத்துவ முன்னோடிகள்

Introduction – food as medicine – medicinal foods – natural philosophy – food habits – functions of body parts – reasons for diseases – seasonal food habits – pioneers of natural food

அலகு 2: மருத்துவ முறைகளும் ஐம்பூத உணவு முறைகளும்

(MEDICINAL METHODS BASED ON FIVE ELEMENTS OF NATURE) **7 மணிநேரம்**

இயற்கை மருத்துவ முறைகள் (சித்தா – ஆயுர்வேதம் – யுனானி) – ஐம்பூத உணவு முறைகளும் ஆரோக்கிய வாழ்வும்

Method of natural medicines (siddha – ayurveda -unani) – five elements of nature and healthy living.

அலகு 3: சத்தான உணவுகள் – வேதியியல் பயன்கள் (NUTRITIOUS FOOD – BENEFITS OF CHEMICALS) **8 மணிநேரம்**

தவிர்க்க வேண்டிய உணவும் சேர்க்க வேண்டிய உணவும் – கீரைகள் காய்கறிகள் – பழங்கள் – தானியங்கள் ஆகியவற்றின் பயன்கள் – உணவைச் சமைப்பதால் ஏற்படும் வேதியியல் மாற்றங்கள் – பச்சைஉணவின்நலன்கள்

Foods to be avoided – nutritious foods – benefits of vegetables – fruits – grains – Chemical changes involved in cooking – benefits of raw foods.

அலகு 4: மருந்து (Medicines) **7 மணிநேரம்**

மூலிகைமருந்து – மலர் மருந்து – மருந்தாகும் எண்ணெய் –இயற்கை சிகிச்சை முறைகள் –உணவு, மருந்து இவற்றில் உள்ள வேதியியல் பொருட்கள் – மருந்தே உணவாகும் போது ஏற்படும் வேதியியல் மாற்றங்கள் – உடல்நலம் பேணும் முறைகள் – உடற்பயிற்சியும் உடல் வேதியியல் மாற்றங்களும்.

Herbal medicines – medicinal flowers – chemicals in oil - food – chemical changes involved when medicine becomes food - health care methods – chemical changes during exercise.

பாடநூல் :

சிவகாமி, தி. ***இயற்கை நெறியே இனிய மருந்து***, சென்னை: நியூசெஞ்சுரி புக் ஹவுஸ் லிமிடெட், 2013.

பார்வை நூல்கள்:

இராஜம்மாள், பா.தேவதாஸ். ***நமது உணவைப் பற்றிய உண்மைகள்.*** சென்னை: நியூசெஞ்சுரி புக் ஹவுஸ் (பி) லிமிடெட், 2000.

சிவராமன், கு. ***இனிப்பு தேசம்.***சென்னை: தமிழ்திசை, 2019.

தமிழழகன், வெ. ***இனிதே வாழ இயற்கை உணவுகள்.*** சென்னை: விகடன் பிரசுரம், 2013.

சதாசிவம், சுப. ***வீட்டு மருத்துவத்தில் நாட்டு மூலிகைகள்.*** சென்னை: வானதி பதிப்பகம், 2004.

இரதிலோகநாதன், ***ஆரோக்கியமே ஆனந்தம்.*** மதுரை: தமிழ்நாடு இயற்கை மருத்துவச்சங்கம், 2012.

WEBLINK(S):

NIEHS WGBH Educational Foundation., (2011) Food Justice. Retrieved from https://www.oercommons.org/courses/food-justice. CC BY -NC -SA 4.0 license.

CHTA4202EI NATURAL FOOD AND CHEMISTRY	
Class	**Non Major Elective SEMESTER : IV**
Cognitive level	K – 1 Remember
	K – 3 Apply
	K – 4 Analyze
	K – 2 Understand

3 – மிகுந்ததொடர்புடையது, 2 – ஓரளவுதொடர்புடையது, 1 –குறைந்த தொடர்புடையது

BOCH5402DT MEDICINAL PHYTOCHEMISTRY

(LAB CUM THEORY)

COURSE OUTCOMES: **3T + 1L hrs. / wk.**

On successful completion of the course, the student will be able to

CO1: classify Indian traditional medicine and sources of drugs

CO2: explain the structure and properties of phytochemical

CO3: identify the useful morphological parts of medicinal plants and their therapeutic uses

CO4: analyse the methods used in the preparation of crude drugs and their adulterants

CO5: evaluate the active components of plants through qualitative and quantitative analysis

COURSE CONTENT

UNIT I: INTRODUCTION TO PHARMOCOGNOSY AND SOURCES OF DRUGS **12 hrs.**

Pharmocognosy: definition – history – scope and importance – Indian system of medicine in brief: ayurveda – siddha – unani – homeopathy – aromatherapy – natural sources of drugs from plants – marine organisms – microbes – classification of crude drugs: alphabetical – morphological – taxonomical – chemical – pharmacological – chemo-taxonomical.

UNIT II: CLASSIFICATION, SOURCES AND FUNCTIONS OF PHYTOCHEMICALS **12 hrs.**

Classification of phytochemicals – structure and properties: carbohydrates – lipids – glycosides – tannins – alkaloids – flavonoids – terpenoids – sources of phytochemicals – functions of phytochemicals in the living organisms – phytochemicals as nutraceuticals – classification – health benefits – examples of nutraceuticals currently available in market – therapeutic uses of phenolics – flavonoids – carotenoids – polyunsaturated fatty acids – phytosterols.

UNIT III: PLANTS AS MEDICINE **12 hrs.**

Geographical distribution – morphology of the useful part – chemical constituents and therapeutic uses: underground plant parts: *Curcuma longa* L. (Turmeric) – *Zingiber officinale Roscoe* (Ginger) – *Alpinia officinarum* Hance (Chitharathai) – *Allium cepa* (Onion) – *Allium sativum* L.(Garlic) – Leaves: *Azadirachta indica* A. Juss (Vembu) – *Eucalyptus globulus* Labill (*Eucalyptus*) – *Ocimum sanctum* L. (Thulasi) & *Solanum trilobatum* Linn (Thoothuvalai) – Flower: *Cassia auriculata* Linn (Avarum) & *Hibiscus rosa-sinensis* L. (Semparuthi) – Fruits & Seeds : *Carica papaya* L. (Papaya) – *Emblica*

officinalis Gaertn. (Gooseberry) – *Piper nigrum* Linn. (Pepper) – *Piper longum* L. (Thipili).

UNIT IV: PREPARATION OF CRUDE DRUGS AND DRUG ADULTERATION 12 hrs.

Process involved in the preparation of crude drugs: collection and harvesting – drying – garbling – packing – storage – processing – evaluation: physical methods – chemical methods – methods of preparation of crude drugs: decoction – maceration – infusion – juice extraction – solvent extraction and steam distillation – biological method – study of sensory characters – colour – taste – odour – texture – observation of powdered drugs – Lycopodium spore method – standardization of drugs (GMP & GAP) – drug adulteration: faulty collection – imperfect preparation – incorrect storage – deliberate adulteration – substitution of exhausted drugs – confusion of common vernacular nomenclature – gross substitution by different materials – Quality control

UNIT V: LAB 12 hrs.

I. Extraction, purification, and qualitative analysis of phytochemicals

- Collection and preparation of dried powder of a medicinal plant
- Extraction of phytochemicals from the dried powder with organic or aqueous solvents using soxhlet apparatus
  - Qualitative tests to identify the different primary and secondary metabolites *viz*. – carbohydrates (Molish test – Fehling test) – fats, oils, and lipids (identification of castor oil, sesame oil and volatile oils) – alkaloids (Wagner's reagent – Dragendorff's reagent) – glycosides (Anthroquinone test – Borntnager's test) – tannins ($FeCl_3$ test – Gelatin test) – flavanoids (Lead acetate solution test – Alkali test)
  - Purification of the extracted secondary metabolites using thin layer chromatography and column chromatography
  - UV-Visible spectrophotometric analysis of the active component

II. Demonstration on quantitative determination of phytochemicals using HPTLC.

III. Activity: Lab visit – Siddha / Ayurveda formulation-based industries / Herbal Garden**.**

TEXT BOOK(S):

Mohammed Ali. (1994). *Textbook of Pharmacognosy*, (1st ed.), Delhi: CBS publishers & Distributors. Print.

Egbuna, C., Ifemeje, J.C., Udedi, S. C., Kumar, S. (2019). *Phytochemistry,* USA*:* Apple academic Press. Print.

REFERENCE BOOK (S):

Rosaline A. (2011). *Pharmacognosy*, Chennai: MJP Publishers. Print.

Bhattacharjee S. K. (2001). *Handbook of Medicinal Plants*, (3rd ed.), Jaipur: Pointer Publishers. Print.

Mehta, S. C., Ashutosh Kar, (2011). *Pharmaceutical Pharmacology*, New Delhi: New Age International Publishers, Print.

Shah R. M. & Nayak, R. T. (2012). *Pharmacognosy*, Delhi: Global Academic Publishers and Distributors. Print.

Sukh Dev., (2006). *A Selection of Prime Ayurvedic Plants Drugs Ancient – Modern Concordance*, New Delhi: Anamaya Publishers. Print.

WEBLINK(S):

Vikrant Arya (2013) *Ayurveda: from traditional use to scientific research.* Retrieved from http://www.oercommons.org/courses/ayurveda-from-traditional-use-to-scientific-research/view CC

BY-NC-SA 3.0. license.

vlab.amrita.edu,. (2011). Spectrophotometry. [Video file]. Retrieved from https://vlab.amrita.edu/?sub=2&brch=190&sim=338&cnt=1

COs cognitive level:

BOCH5402DT MEDICINAL PHYTOCHEMISTRY	
Class: III B. Sc., Botany & Chemistry	**Semester: V**
Cognitive level	K2 Understand
	K2 Understand
	K3 Apply
	K4 Analyse
	K5 Evaluate

BSPS5402DM CONCEPTS AT NANOSCALE

(Theory)

COURSE OUTCOMES: **4 hrs./wk.**

On successful completion of the course, the student will be able to

CO1: outline the fundamentals of nanoscience

CO2: recognize the bio-nanomaterials found in the environment

CO3: explain the synthesis of nanomaterials

CO4: interpret the effect of size and shape on the properties of nanomaterials

CO5: analyse the characterization techniques for nanomaterials

COURSE CONTENT:

UNIT I: FUNDAMENTALS OF NANOSCIENCE AND NANOTECHNOLOGY **12 hrs.**

Historical perspectives – ancient – medieval – modern periods in nanoscience and nanotechnology – terms and definitions – scale of material – macro – meso – micro and nanoscale – size dependent properties of materials – surface and volume – surface energy – band gap in metals and semiconductors – bulk vs nano – confinement and delocalization dimensions of excitons – quantum nanostructures – classification of nanomaterials – importance of nanoscience.

UNIT II: BIO-NANOMATERIALS **12 Hrs.**

Natural – inorganic origin – clays – microbial origin – bacterial fibers – unicellular origin – diatoms – animal origin – shells – insect origin – chitin structures – plant origin – cell wall of lotus flower – fibers – spider silk – synthetic – chaperones – liposomes – nanosomes – nucleic acid wires – biopolymers – PHA.

UNIT III: SYNTHESIS OF NANOMATERIALS **12 hrs.**

Synthesis of nanomaterials – top-down and bottom-up approaches – principles and types – physical methods – milling – etching – electroexplosion – sputtering – LASER ablation – chemical methods – chemical reduction – precipitation – sol- gel method – solvothermal synthesis – sonochemical synthesis – biological methods – microbial synthesis – phytosynthesis – synthesis of metal nanoclusters – semiconductor quantum dots – carbon based nanomaterials – graphenes – fullerenes – carbon nanotubes – single walled and multi walled – bionanocomposites.

UNIT IV: SIZE DEPENDENT PROPERTIES OF NANOMATERIALS **12 hrs.**

Thermal properties: melting point, heat capacity, Curie temperature, coefficient of thermal expansion – electrical properties: lattice constant, phase transformation – mechanical properties: elastic modulus, hardness and strength, toughness – optical properties – magnetic properties – biological properties – antimicrobial activity and toxicity – structure and properties of supramolecular assemblies – dendrimers – surfactants and micelles.

UNIT V: CHARACTERISATION AND SEPARATION TECHNIQUES **12 hrs.**

Electron probe methods: SEM, TEM – scanning probe methods: AFM, STM – spectroscopic methods: UV-Visible absorption and emission spectroscopy, IR spectroscopy, X-ray methods – particle size determination – SPR – separation of proteins and nucleic acids – PAGE and AGE – toxicity study – chromosomal aberration assay.

Demonstration of AFM/STM using standard samples

TEXT BOOK(S):

Goyal, R.K., (2018). *Nanomaterials and Nanocomposites: Synthesis, Properties, Characterization*, New York: Taylor & Francis Group. CRC Press.

Hornyak L.G., Tibbals H.F., Dutta J., and Moore J.J., (2009). *Introduction to Nanoscience & Nanotechnology*, New York: CRC press. Print.

Sharon M., Pandey S., & Oza G., (2012). *Bionanomaterials: Concepts and Applications*, New Delhi: Ane Books Pvt. Limited. Print.

Kumar N., & Kumbhat S., (2016). *Essentials in nanoscience and nanotechnology*, New Jersey: John Wiley & Sons., Inc.

REFERENCE BOOK(S):

Balaji, S., (2010). *Nanobiotechnology*, Chennai: MJP Publishers. Print.

Cao, G. & Wang, Y., (2011). *Nanostructures and Nanomaterials:(Synthesis, Properties and Applications),* New Delhi: World Scientific Publishing Co. Pvt. Ltd. Print.

Poole, C.P., & Owens F.J., (2010). *Introduction to Nanotechnology*, New Delhi: John Wiley and Sons (Asia) Pvt. Ltd. Print.

WEBLINK(S):

Andrew, R. Barron, (2015). *Physical Methods in Chemistry and Nano Science*. Retrieved From https://www.oercommons.org/courses/physical-methods-in-inorganic-and-nano-chemistry/view. CC-BY 4.0 license.

Patricia Schank, Tina Stanford., (2012). *NanoSense Student Materials.* Retrieved from https://www.oercommons.org/courses/nanotechnology-nano-sense-student-s-edition/view. CC BY license.

Shankarmurthy G.J., Suresh Kumara T. H., (2007). *Nanomaterials*. Retrieved from https://www.oercommons.org/courseware/module/17686/overview. CC BY-NC-SA 4.0 license.

Sam Kinyera Obwoya., (2017). *Solid State Physics*. Retrieved from https://oer.avu.org/bitstream/handle/123456789/792/PHY%2008_EN%20Solid%20State%20Physics.pdf?sequence=1&isAllowed=y. CC-BY, SA 4.0 International License.

Tina B.Jones.(2019). *Boundless Biology*. Retrieved from https://www.oercommons.org/authoring/54851-boundless-biology-textbook/1/view. CC BY license.

COs cognitive level:

BSPS5402DM CONCEPTS AT NANOSCALE	
Class: III B.Sc. (Special) Physics, III B. Sc. (Special) Chemistry, III B. Sc Botany & III B. Sc. Zoology	**Semester:** V

CO	**Cognitive Level**
CO1	K-2 Understand
CO2	K-2 Understand
CO3	K-2 Understand
CO4	K-3 Apply
CO5	K-4 Analyse

CHPH5403DM FUNDAMENTALS OF ENERGY CONVERSION AND STORAGE

(THEORY)

COURSE OUTCOMES: **4 hrs./Wk.**

On successful completion of the course, the student will be able to

CO1: apply the electrochemical principles to fuel cells

CO2: analyze the properties of energy storage systems

CO3: determine the operation of secondary batteries and electrochemical capacitors

CO4: interpret the characteristics of a solar cell and obtain its cell parameters

CO5: describe the working of nuclear reactors and effects of nuclear radiation

COURSE CONTENT:

UNIT I: FUEL CELLS AND HYDROGEN STORAGE **12 hrs.**

Fuel cells: history – classification – alkaline fuel cells – phosphoric acid fuel cells – solid oxide fuel cells – molten carbonate fuel cells – direct methanol fuel cells – proton exchange membrane fuelcells – microbial fuel cells-description, working and components of alkaline fuel cell and direct methanol fuel cells – applications – stationary power plants – fuel cells in electric vehicles – hydrogen vehicles – portable power systems. Hydrogen storage**:** hydrogen production – hydrogen as engine fuel – methods of hydrogen storage – storage via chemical reactions – hydrogen energy economy – hydrogen storage technologies.

UNIT II: PRIMARY BATTERIES **12 hrs.**

Components of cells and batteries – operation of a cell – theoretical cell voltage, capacity, and energy (concepts only) – electrochemical principles and reactions – types and characteristics of primary batteries – voltage and discharge profile – specific energy and specific power – zinc/air batteries: general characteristics – construction (basic details) – performance characteristics – lithium batteries: general characteristics.

UNIT III: SECONDARY BATTERIES AND ELECTROCHEMICAL CAPACITORS **12 hrs.**

Types and characteristics of secondary batteries: Lead acid batteries, alkaline secondary batteries: Nickel-cadmium batteries, Lithium-ion batteries – voltage-discharge profile – effect of discharge rate on performance – lead acid batteries: introduction (general characteristics only) – lithium-ion batteries: introduction (general characteristics only) – intercalation processes – capacity fade in $C/LiMn_2O_4$ cells – electrochemical capacitors (ECs): introduction – EC operation.

UNIT IV: PHOTOVOLTAIC SYSTEMS **12 hrs.**

Properties of solar radiation – solar constant – spectrum of the sun – air mass – band model of semiconductors – charge transport in semiconductors – doping of semiconductors – pn Junctions – structure and characteristics of a photodiode – method of function of the solar cell – photocurrent – characteristic curve and characteristic dimensions – crystalline silicon cells – amorphous silicon cells – thin film cells: cadmium telluride – applications: space PV cells.

Unit V: NUCLEAR REACTORS AND RADIATION PROTECTION **12 hrs.**

Nuclear fission – fission chain reaction – nuclear reactor fuels – components of nuclear reactors – power reactors and nuclear steam supply systems: light water reactors and pressurized water reactors – nuclear cycles: LWR once-through fuel cycle – radiation units: exposure, the Roentgen, exposure rate, imparted energy, adsorbed dose, adsorbed dose rate, Kerma, equivalent dose,

equivalent dose rate, population dose – quantitative effects of radiation on the human species – calculations of radiation effects – computations of exposure and dose: dose from neutrons – external exposure – nuclear reactor shielding.

TEXTBOOK(S):

Martens, K., (2014). *Photovoltaics: Fundamentals, Technology and Practice,* (1st ed.), West Sussex: John Wiley & Sons.

(Unit IV) Relevant sections in Chap 3, 4, 5 (2.1,3.2,3.3,3.4,3.5,4.1.1,4.2,4.3,4.4,5.1,5.2,5.3,5.3.1)

Lamarsh, J. R. & Baratta, A. J., (2001). *Introduction to Nuclear Engineering,* (3rd ed.), New Jersey: Prentice-Hall Inc. Print.

(Unit V) Relevant sections in Chap 3 (3.7), 4 (4.1, 4.2, 4.4, 4.5 (up to Pg. 143), 4.6 (up to Pg. 188)), 9,10 (9.2, 9.5, 9.6, 9.9 (Pg. 516 – 520),10.6)

Linden, D. & Reddy, T. B., (2002). *Handbook of Batteries,* (3rd ed.), McGraw Hill.

(Unit II) Relevant sections in Chap 1, 2, 7, 13, 14 (1.1, 1.3, 1.4, 2.1, 2.2, 2.3, 2.4, 7.2, 7.3.2, 7.3.3, 13.1, 13.2, 13.3 (up to Pg. 13.4), 13.4.1 - 13.4.5, 14.1, 14.2)

(Unit III) Relevant sections in Chap 22, 23, 35 (22.2, 22.3.2, 22.3.3, 23.1 (up to Pg. 23.3), 23.2.1, 35.1 (up to Pg. 35.3), 35.2.1, 35.2.3)

Puri, B.R., Sharma L.R. & Pathania S., (2015). *Principles of Physical Chemistry*, (47th ed.), Jalandhar: Vishal Publishing Co. Print.

(Unit I) Chap 24.

Viswanathan, B. & Aulie Scibioh M., **(**2006). *Fuel Cells Principles and applications*, University Press PVT Ltd. Print.

(Unit I) Relevant sections in Chap 1, 3, 7, 10, 11(1.2, 1.6, 3.1, 3.2, 3.3, 7.4, 7.5, 7.6, 10.1,10.3, 10.4.4, 11.6, 11.7)

Winter M., Brodd R. J., Chemical Reviews, (2004). *What Are Batteries, Fuel Cells, and Supercapacitors?*

(Unit III) *pages: 4266,4268*

REFERENCE BOOK(S):

Singal, R. K., (2014). *Nuclear Reactors,* (1st ed.), New Delhi: New Age International (P) Ltd. Print.

Vaidyanathan, G., (2013). *Nuclear Reactor Engineering, (Principles and Concepts),* (1st ed.), New Delhi: S. Chand and Co. Pvt. Ltd. Print.

WEBLINK(S):

Ballard, J. S. (2020). *Radiation safety.* Retrieved from https://openoregon.pressbooks.pub/radsafety130/ CC BY 4.0 license.

National Science Foundation WGBH Educational Foundation. (2004). *Nuclear fission*. Retrieved from https://www.oercommons.org/courses/get-close-to-a-nuclear-fission-reaction CC BY-NC-SA 4.0 license.

Prof. Jefferson W. Tester, Prof. Mujid S. Kazimi, Prof. Yang Shao-Horn, Prof. Ahmed F. Ghoniem. (2004). *Fundamentals of Advanced Energy Conversion*. Retrieved from https://ocw.mit.edu/courses/mechanical-engineering/2-60-fundamentals-of-advanced-energy-conversion-spring-2004/syllabus/ CC BY-NC-SA 4.0 license.

Segarra, J., Jorro, J., Kray, Z., (2016). *Photovoltaic energy*. Retrieved from https://core.ac.uk/download/pdf/92992315.pdf CC BY-NC-SA license.

COs cognitive level:

CHPH5403DM FUNDAMENTALS OF ENERGY CONVERSION AND STORAGE	
Class: III B.Sc. (Special) Physics & III B.Sc. (Special) Chemistry	**Semester:** V
CO	**Cognitive Level**
CO1	K-3 Apply
CO2	K-4 Analyse
CO3	K-5 Evaluate
CO4	K-5 Evaluate
CO5	K-2 Understand

CHMA6402DM APPLICATIONS OF GRAPH THEORY IN CHEMISTRY (THEORY)

COURSE OUTCOMES: **4 hrs./wk.**

On successful completion of the course, the student will be able to

CO1: define the basic terms of graph theory

CO2: apply the IUPAC rules for naming the hydrocarbons

CO3: construct molecular graphs for organic compounds and chemical reactions

CO4: discuss concepts in connectedness and apply Polya's enumeration theorem

CO5: predict the properties of chemical compounds using topological indices

COURSE CONTENT:

UNIT I: INTRODUCTION TO GRAPH THEORY **12 hrs.**

Definitions and examples: vertices - edges - graphs - adjacent - incidence - degree - loop - types of graphs - multiple graphs - pseudo graphs - complete graphs - bigraphs - complete biograph - degree - isolated points - regular graphs - subgraphs - spanning subgraphs - induced subgraph - isomorphism - complementary graphs - operation on graphs - union - sum - product - composition of graphs - matrices - planar graphs.

UNIT II: NOMENCLATURE, STRUCTURE AND ISOMERISM OF ORGANIC COMPOUNDS **12 hrs.**

IUPAC nomenclature and structure of hydrocarbons - alkanes - alkenes - alkynes (cyclic and acyclic) - aromatic compounds - substituted - fused - bridged and hetero aromatic compounds - isomerism - structural - positional and geometrical isomers.

UNIT III: CONSTRUCTION OF CHEMICAL GRAPHS **12 hrs.**

Molecular Graphs for alkanes - alkenes - alkynes (cyclic and acyclic) and aromatic compounds - substituted - fused - bridged and hetero aromatic compounds - isomerism: constitutional - steric - valence - isomorphic graphs - condensed polycyclic aromatic hydrocarbons - introduction to reaction graphs - types of chemical reactions - union of molecular graphs to give products (*eg* Diels-Alder reaction and Intramolecular rearrangements) - synthon graphs.

UNIT IV: CONNECTEDNESS AND POLYA'S ENUMERATION THEOREM **12 hrs.**

Walk - trials and paths - disconnected graphs- cut points - bridges - block - trees: tree - eccentricity - radius - center - Polya's enumeration theorem (statement only) - problems related to Polya's enumeration theorem.

UNIT V: PREDICTION OF PROPERTIES OF COMPOUNDS **12 hrs.**

Prediction of properties of compounds using topological indices – definition and calculation of Weiner Index - Randic and Hosaya index of chemical structures - prediction of physical and chemical properties of organic compounds - correlation between Isomorphism and type of isomers.

REFERENCE BOOK(S):

Arumugam S. and Ramachandran S, (2003). *Invitation to Graph theory*, Chennai: Scitech Publication (India) Pvt. Ltd. Print. Unit I

Alexandru T. (1985). *Balaban Applications of Graph Theory in Chemistry J. Chem. Inf. Comput. Sci,* Print. Unit III and IV

Bhupinder Mehta, Manju Mehta, (2005). *Organic Chemistry*, 1st edition, PHI Learning Pvt. Ltd. Print. Unit II

Bonchev, (1991). *Chemical Graph Theory: Introduction and Fundamentals (Mathematical Chemistry) Vol 1*, Taylor & Francis Ltd, Print. Unit III and V

Ivanciuc Ovidiu , *Graph Theory in Chemistry and Drug Design*, United Sates:Taylor & Francis Ltd. Print. Unit III and V

Johann Gasteiger(ed.)**,** Thomas Engel (ed.)**,**(2003). *Chemoinformatics: A Textbook*, Wiley VCH, Weinheim. Print. Unit III and IV

WEBLINK(S):

Videos:

ATARC Chennai. (2021, Oct 1). *Crossing into Quantum.*[Video file]. Retrieved from https://www.tutorialspoint.com/graph_theory/graph_theory_quick_guide.htm. CC BY license.

Kimberly. (2008, Aug 1). *Chemical Graph theory.*[Video file]. Retrieved from https://www.maa.org/external_archive/joma/Volume8/Burch/index.html. CC BY license.

CHMA6402DM APPLICATIONS OF GRAPH THEORY IN CHEMISTRY	
Class: III B.Sc. Chemistry& III B.Sc. Mathematics	**Semester: VI**
Cognitive Level	**K-1** Remember
	K-3 Apply
	K-3 Apply
	K-2 Understanding
	K-6 Create

CHPH6401DM ORGANIC ELECTRONICS

(THEORY)

COURSE OUTCOMES: **4 hrs./wk.**

On successful completion of the course, the student will be able to

CO1: compare organic and inorganic semiconductor devices

CO2: explain the charge transport in organic molecules and materials

CO3: describe the synthesis and properties of conjugated molecules and polymers

CO4: apply the principles of electronics to organic solar cells and organic light emitting devices

CO5: analyse the electrical characteristics of organic field effect transistors

COURSE CONTENT:

UNIT I: ELECTRONICS CONCEPTS: AN OVERVIEW **12 hrs.**

Electrons and conduction - semiconductors : role of electrons & holes - junction diode - depletion region - forward and reverse biasing - majority and minority carriers - terminal current - breakdown region - bipolar junction transistor - base and collector characteristic curve - amplifier - MOSFET - characteristic curves - IC's - printed circuits - organic semiconductor – differences from conventional one.

UNIT II: CHARGE TRANSPORT IN ORGANIC MOLECULES AND MATERIALS **12 hrs.**

Chemical bonding in organic molecules: electron delocalization in molecules with p - conjugated systems - molecular orbital view of covalent bond - molecules with several multiple bonds (cumulative, conjugated) - electronic structure - MO representation of linear - cyclic conjugated systems - charge generation and transport - molecules - bulk materials: band models from the perspective of organic chemistry - degenerate ground states in poly (acetylene) - formation of solitons in crystalline conjugated polymers - bands in crystals of conjugated molecules – crystalline organic semiconductors.

UNIT III: SYNTHESIS AND PROPERTIES OF CONJUGATED MOLECULES AND POLYMERS **12 hrs.**

Conjugated oligomers and polymers - general methods of synthesis - physical - electronic properties of conducting polymers: poly(acetylene)s - oligo(phenylene)s - poly(phenylene)s - oligo(thiophene)s - poly(thiophene)s - macromolecules: pentacenes - porphyrins - nanomaterials: fullerenes - carbon nanotubes - graphene.

UNIT IV: PLASTIC ELECTRONICS **12 hrs.**

Introduction to solar cells - energy levels in molecular materials - comparison with inorganic semiconductor - excited states in molecular material - basics process of organic solar cell - light absorption - exciton transport - charge separation - charge transport - charge collection - organic solar cells - dye sensitized solar cells - double layer cells - bulk heterojunction cells - metal insulator semiconductor structures - idealized MIS devices - organic MIS structures - field effect transistors - organic light emitting devices - device efficiency - full colour displays - electronic paper.

UNIT V: PHYSICAL & CHEMICAL ASPECTS OF OFET **12 hrs.**

Assembly - structure - performance of an organic field effect transistor (OFET) of oligothiophenes - optical and thermal properties - OFET studies - pentacene - layout of pentacene organic field effect transistors - analysis of the electrical characteristics - overview of VD-ID characteristics - temperature dependence of the mobilities - detailed analysis of the field effect mobilities as a function of VD and VG and CNTs - physical - electronic structure of CNT - role of capacitances - doping.

TEXT BOOK(S):

Woll C., (2009), *Physical and Chemical Aspects of Organic Electronics: from fundamental to functioning devices*, (1st ed.), Weinheim: WILEY-VCH Verlag GmbH & Co. KGaA, Chapters: 1.1,5,8,26. Print.

Krenz J. H., (2005) *Electronic Concepts An Introduction*, (2nd ed.), Cambridge,UK: Cambridge University Press, Chapters: 1.7, 2.1-2.4, 3.1. Print.

Clayden J., Greeves N., & Warren S., (2012) *Organic Chemistry,* New York: Oxford University Press Inc., Chapters: 7, 8. Print.

Petty M. C., (2008) *Molecular Electronics from Principles to Practice*, (1st ed.), England: John Wiley & Sons, Ltd, Chapters: 9. Print.

Hu W., Bai F., Gong X., Zhan X., Fu H. & Bjornholm T., (2013) *Organic Optoelectronics,* (1st ed.), Weinheim: WILEY-VCH Verlag GmbH & Co. KGaA, Chapters: 1, 3, 5. Print.

WEBLINK(S):

eBook:

Tim Grebner (2019) *Introduction to Electronics*. Retrieved from https://opendora.minnstate.edu/islandora/object/MINNSTATErepository%3A365 CC BY-NC 4.0 license.

Video:

Nanohubtechtalks. (2011, September 2) *Solar Cells Lecture 5: Organic Photovoltaics* [Video file]. Retrieved from https://www.youtube.com/watch?v=5laLM2YM48M CC BY license.

CHPH6401DM ORGANIC ELECTRONICS	
Class: III B. Sc., Chemistry & Physics	**Semester: VI**
Cognitive level	**K-2** Understand
	K-2 Understand
	K-2 Understand
	K-3 Apply
	K-4 Analyze

BSPS6402DM APPLICATIONS OF NANOMATERIALS

(THEORY)

COURSE OUTCOMES: **4 hrs./wk.**

On successful completion of the course, the student will be able to

CO1: explain the basic concepts involved in nanotechnology

CO2: analyse the significant role of nanomaterials in environment

CO3: illustrate the role of nanomaterials in energy devices

CO4: infer the applications of nanomaterials in electronic devices

CO5: apply the knowledge gained and suggest various applications of nanobiotechnology

COURSE CONTENT:

UNIT I: Basic Concepts in Nanoscience **12 hrs.**

Processes at solid surfaces - adsorption - types - isotherms - desorption - types of catalysts - properties - photocatalytic activity – photodegradation.

Conductor, semiconductor and Insulators - energy bands - Fermi surface - donors and acceptors - mobility – excitons - quantum Hall effect - resonant tunneling - interband absorption in semiconductor nanostructures – light absorption and emission processes.

Overview on Bio-synthesis of nanomaterial - biological nanomaterials - DNA - protein - lipid - carbohydrate – advantages - applications of biologically synthesized nanomaterials.

UNIT II: Environmental applications **12 hrs.**

Nanomaterials and environmental applications - TiO_2 based nanoparticles (water purification) - iron-based nanoparticles (treatment of contaminated solid wastes and water purification) - bimetallic nanoparticles (remediation for halogenated organic compounds) - nanoclays and carbon nanotubes(removal of heavy metals) - dendrimers and nanosponges (soil treatment) - magnetic nanoparticles (water treatment) - nanoproducts in the market and their commercial applications.

.UNIT III: Nanomaterial based energy devices **12 hrs.**

Principles - constructions - working of energy devices - secondary batteries - nanomaterials in energy storage – conversion devices - Li-ion batteries: carbon-coated silicon nanowires - carbon nanotubes - $LiMnO_2$ / $LiCo_2O_4$ nanoparticles - silicon - carbon - iron oxide based nanomaterials - supercapacitors: metal oxide nanoparticles – carbon nanotubes (CNTs) - graphene - fuel cells: TiN - platinum based - platinum bimetallic electrocatalysts – solar cells: ZnO nanowires - TiO_2 nanotubes - carbon based materials in solar energy conversions.

UNIT IV: Nanomaterial based electronic devices **12 hrs.**

Classification of nanomaterials based on the dimension - quantum confinement in one dimension, two dimension and three dimension - superlattices - electronic density of states - electronic materials - transistors - single electron tunneling - FET & MOSFET - coulomb blockade devices - field emission emitters - sensors - magnetic storage devices - solar cells - DSSC - quantum lasers - single photon sources - quantum dots memory devices.

UNIT V: Nanobiotechnology **12 hrs.**

Concept of Nanomedicines - rationale for designing of nanomedicines - reclinical and clinical considerations of nanomedicines - nanofibers for tissue engineering - biodegradable polymers and polymer scaffold processing -tissue engineering case studies: artificial skin, artificial blood vessels - applications of nanotechnology in foods - engineering nanocrystalline food ingredients to improve bioavailability - nano emulsions - risk analysis and risk management of nanotechnology in the food industry - nanotechnology in agriculture: nano fertilizer - insecticides using nanotechnology - nano pesticides - nano herbicides - nanotechnology in cosmetics industry: formulation of gels - shampoos - nanomaterials in sun-screen UV protection - color cosmetics.

TEXTBOOK(S):

Goyal, Rajendra Kumar, (2017). *Nanomaterials and nanocomposites: synthesis, properties, characterization techniques, and applications*. CRC Press. Print.

Hornyak, L.G., Tibbals, H.F., Dutta, J., and Moore, J.J., (2009). *Introduction to Nanoscience & Nanotechnology*, New York: CRC Press. Print.

Kelsall, R., Hamley, I., Geoghegan, M., (2005). Nanoscale science and technology, England: John wiley & sons Ltd. Print.

Poole, C.P., and Owens, F.J., (2010). *Introduction to Nanotechnology*, New Delhi: Wiley India (P) Ltd. Print.

Rotello, V.M., (2010). *Nanoparticles Building blocks for nanotechnology*: Rakmo Press Pvt., Ltd. Print.

Sharon M., Sharon M., Pandey S., Oza G., (2012). *Bionanomaterials: Concepts and applications*, New Delhi: Ane Books Pvt. Ltd. Print.

Viswanathan, B., (2011). *Nanomaterials*, New Delhi: Narosa Publishing House Pvt. Ltd. Print.

REFERENCE BOOK(S):

Balaji S, (2010). *Nanobiotechnology*, Chennai: MJP Publishers. Print.

Cao, G. and Wang, Y., (2011). *Nanostructures and Nanomaterials:(Synthesis, Properties and Applications)*, New Delhi: World Scientific Publishing Co. Pvt. Ltd. Print.

Kumar N., & Kumbhat S., (2016). Essentials in nanoscience and nanotechnology, New Jersey: John Wiley & Sons.Print.

WEBLINK(S):

All about electronics. (2019, January 18). *FET* [Video file]. Retrieved from https://www.youtube.com/watch?v=cOICDYuY-gA&t=232s CC by license.

Circuit bread. (2020, April 10). *MOSFET* [Video file]. Retrieved from https://www.youtube.com/watch?v=Bfvyj88Hs_o CC by license.

Anandh Subramaniam, Kantesh Balani. NPTEL HRD. (2014, September 18). *Surface effects and physical properties of nanomaterials*, [Video file]. Retrieved from https://www.youtube.com/watch?v=qKBnLqFn_X8 CC-BY-NC-SA 4.0 License

Redwing, R., (2019). *Materials in today's world*. Retrieved from https://www.oercommons.org/courses/materials-in-today-s-world-4. CC BY -NC -SA 4.0 license.

Jones, T., B., (2019). *Boundless Biology*. Retrieved from https://www.oercommons.org/authoring/54851-boundless-biology-textbook/1/view.CC by license.

U.S. Department of Energy. (2011, February 11). *Energy 101: Solar PV* [Video file]. Retrieved from https://youtu.be/0elhIcPVtKE. CC by license.

BSPS6402DM APPLICATIONS OF NANOMATERIALS	
Class: III B.Sc. Chemistry, Physics, Botany, Zoology	**Semester: VI**
Cognitive Level	**K-2** Understand
	K-4 Analyse
	K-3 Apply
	K-2 Understand
	K-3 Apply

CHE0404CD DAIRY CHEMISTRY

(THEORY)

COURSE OUTCOMES:

On successful completion of the course, the student will be able to

CO1: describe the composition and properties of milk and milk products

CO2: discuss the steps involved in processing of milk and milk products

CO3: identify the nature of milk proteins

CO4: explain the properties of milk lipids

CO5: analyse the milk samples using suitable methods and instruments

COURSE CONTENT:

UNIT I: COMPOSITION OF MILK

Constituents of milk – factors affecting the composition of milk – Minor components of milk – salts and ash – trace elements – enzymes – non-protein nitrogenous substance – physical properties of milk – density, surface and interfacial tension – freezing point – electrical conductivity – refractiveindex.

UNIT II: PROCESSING OF MILK AND MILK PRODUCTS

Cooling and agitation – separation – standardization – pasteurization – vacuum removal of off-flavours – homogenization – packaging & distribution – fluid milks and creams – flavoured fluid milk products – fermented and acidified milks – butter milks – concentrated milk products – dried milk products – butter – cheese – yogurt – frozen desserts – ice cream.

UNIT III: MILK PROTEINS

Casein – derivatives of casein – browning reaction – precipitation of casein – fractions and components of casein-whey proteins – lactoglobulin – lactalbumin and immunoglobin – affecting ion-exchange equilibria – technique and applications.

UNIT IV: MILK LIPIDS

Chemical properties – neutral glycerolipids – cholesterol in milk – free fatty acids – phospholipids in milk – methods of examination – factors affecting oxidative deterioration in milk and milk products.

UNIT V: LACTOSE

Physical properties – manufacture of lactose – lactose-determination of lactose – chemical reactions – nutritional and physiological effects of lactose – adulteration in milk and milk products testing the purity – use of lactometer and butyrometers.

Assignment I: Determination of fat, SNF and acidity of milk samples

Assignment II: Determination of moisture content in butter.

REFERENCE BOOK(S):

Wong, N. P, Jenness, R, Keeney, M. and Marth, E. H., (1988). *Fundamentals of Dairy Chemistry,* New Delhi: CBS Publishers & Distributors. Print.

Johnson, W. and Alford (2005). *Fundamentals of Dairy Chemistry,* (2nd ed.), New Delhi: CBS Publishers and Distributors. Print.

WEBLINK(S):

Video(s)

Institute for Industrial Development. *(2018, March 9). Dairy Process* [Video file]. Retrieved from https://www.youtube.com/watch?v=RRHCG7S5IpQ. CC-BY License.

CHE0404CD DAIRY CHEMISTRY	
Class: I / II / III B.Sc.	**Semester: II / III / IV / V / VI**
Cognitive Level	**K-1** Remember
	K-2 Understand
	K-3 Apply

CHE0405CD CHROMATOGRAPHIC TECHNIQUES

(THEORY)

COURSE OUTCOMES:

On successful completion of the course, the student will be able to

CO1: discuss the principle and applications of partition and column chromatography

CO2: utilize the knowledge of paper and thin layer chromatography

CO3: describe the concepts of exclusion chromatography

CO4: represent the theory and instrumentation involved in gas chromatography

CO5: explain the principles of HPLC in separation of compounds

COURSE CONTENT:

UNIT I: INTRODUCTION AND THIN LAYER CHROMATOGRAPHY

Definitions – theory – classification techniques – development of chromatograms – plate theory – Partition chromatography – procedure – movement of solute – Liquid-liquid partition chromatography – reversed phase partition chromatography – applications.

Thin layer Chromatography – principle of TLC technique – locating agents – types – applications – superiority of TLC – HPTLC – important features.

UNIT II: PAPER AND COLUMN CHROMATOGRAPHY

Theory – R_f value – Technique – 2D paper chromatography – quantitative estimation – sources of error, precautions in paper chromatography – applications – Paper Electrophoresis – types – technique – factors affecting migration of ions – applications - Column chromatography: Types –principle of adsorption – experimental requirements – factors affecting column efficiency – adsorbents – characteristics and classification – solvents – application – Affinity chromatography – principle and application.

Assignment: Separation of mixture of compounds using paper and thin layer chromatography.

UNIT III: EXCLUSION CHROMATOGRAPHY

Principle – types – Gel chromatography – advantages – instrumentation – factors affecting GPC – applications. Ion-exchange chromatography: Properties of Ion-exchangers – types – factors affecting ion-exchange equilibria – technique and applications.

UNIT IV: GAS CHROMATOGRAPHY

Principle – theory – instrumentation – types of detectors – retention time – hyphenated techniques – applications – Pyrolysis Gas Chromatography and Vapour Phase Chromatography – PGC systems – instrumentation technique – advantages – applications – Vapour phase chromatography – theory – instrumentation –technique – applications.

UNIT V: HIGH PERFORMANCE LIQUID CHROMATOGRAPHY

Characteristics – comparison between HPLC & GLC – instrumentation – effect of temperature on HPLC – applications – Supercritical fluid Chromatography – applications.

TEXTBOOK(S):

Kaur, H., (2001). *An Introduction to Chromatography*, (1st ed.), Meerut: Pragati Prakashan Print.

REFERENCE BOOK(S):

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CHE0405CD CHROMATOGRAPHIC TECHNIQUES	
Class: I / II / III B.Sc.	**Semester: II / III/ IV / V / VI**
Cognitive Level	**K-1** Remember
	K-2 Understand
	K-3 Apply

CHE0406CD CHEMICAL EXPLORATION OF CONSUMER PRODUCTS

(THEORY)

COURSE OUTCOMES:

On successful completion of the course, the student will be able to

CO1: classify the chemical additives in consumer products

CO2: name the chemicals used in cosmetics

CO3: choose healthy food products

CO4: select eco-friendly household products

CO5: identify the role of chemicals in farm products

COURSE CONTENT:

UNIT I: CHEMICAL ADDITIVES

Chemicals additives – definition and classification – types – colourants – flavours and fragrances – sweeteners – preservatives – stabilisers – antioxidants – emulsifiers – anticaking agents – lubricants.

UNIT II: CHEMICALS IN COSMETICS

Ancient cosmetics vs. modern cosmetics – chemicals: skin care – hair care products – personal care and beauty products – baby care products – alternatives for chemicals – herbal cosmetics.

UNIT III: CHEMICALS IN PROCESSED FOODS

Chemical additives: ultra-processed – canned – packaged – frozen – baked – ready-to-eat foods – fast foods – instant mixes – health risks – mindful eating.

UNIT IV: CHEMICALS IN HOUSEHOLD PRODUCTS

Chemical additives – cleansing agents: detergents and bleaching agents – disinfectants – room fresheners – furnishing items: modern furnitures – cushions – bedding and mattresses – kitchenware: plastics and coated appliances – eco-friendly home products.

UNIT V: CHEMICALS IN FARM PRODUCTS

Farm chemicals: fertilisers – pesticides – insecticides – herbicides – fungicides – chemical residues in fruits and vegetables – poultry products – meat – sea foods – organic farming.

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Nema R.K., Rathore K.S. and Dube B.K., (2017). *Textbook of Cosmetics*, India: CBS Publishers & Distributors. Print.

Chopra H.K. and Panesar P.S., (2010). *Food Chemistry*, India: Narosa Publishing House. Print.

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CHE0406CD CHEMICAL EXPLORATION OF CONSUMER PRODUCTS		
Class: ALLM		**Semester: IV**
Cognitive Level	**CO1**	**K-2** Understand
	CO2	**K-1** Remember
	CO3	**K-3** Apply
	CO4	**K-1** Remember
	CO5	**K-2** Understand