।। सा विद्या या विमुक्तये ।।
स्वामी रामानंद तीर्थ मराठवाडा विद्यापीठ, नांदेड
"ज्ञानतीर्थ" परिसर, विष्णुपूरी, नांदेड - ४३१६०६ (महाराष्ट्र)
SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY NANDED
"Dnyanteerth", Vishnupuri, Nanded - 431606 Maharashtra State (INDIA)
Established on 17th September 1994 – Recognized by the UGC U/s 2(f) and 12(B), NAAC Re-accredited with 'A' Grade
ACADEMIC (1-BOARD OF STUDIES) SECTION
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प्रस्तुत विद्यापीठीय संकुलातील विज्ञान व तंत्रज्ञान विद्याशाखेतील पदव्युत्तर स्तरावरील द्वितीय वर्षाचे CBCS Pattern नुसारचे अभ्यासक्रम शैक्षणिक वर्ष २०२०—२१ पासून लागू करण्याबाबत.

प रि प त्र क

या परिपत्रकान्वये सर्व संबंधितांना कळविण्यात येते की, **दिनांक २० जून २०२० रोजी संपन्न झालेल्या ४७व्या मा. विद्या परिषद बैठकीतील विषय क्र.११/४७—२०२०** च्या ठरावानुसार **प्रस्तुत विद्यापीठीय संकुलातील विज्ञान व तंत्रज्ञान विद्याशाखेतील पदव्युत्तर स्तरावरील द्वितीय वर्षाचे** खालील विषयांचे **C.B.C.S. (Choice Based Credit System) Pattern** नुसारचे अभ्यासक्रम शैक्षणिक वर्ष २०२०—२१ पासून लागू करण्यात येत आहेत.

01. M.Sc.-II Year-Botany
02. M.Sc.-II Year-Analytical Chemistry
03. M.Sc.-II Year-Industrial Chemistry
04. M.Sc.-II Year-Medicinal Chemistry
05. M.Sc.-II Year-Organic Chemistry
06. M.Sc.-II Year-Physical Chemistry
07. M.Sc.-II Year-Polymer Chemistry
08. M.Sc.-II Year-Computer Application
09. M.Sc.-II Year-Computer Network
10. M.Sc.-II Year-Computer Science
11. M.C.A.-II Year (Master of Computer Applications)
12. M.Sc.-II Year-Environmental Science
13. M.A./M.Sc.-II Year-Geography
14. M.Sc.-II Year-Geophysics
15. M.Sc.-II Year-Geology
16. M.A./M.Sc.-II Year-Mathematics
17. M.Sc.-II Year-Microbiology
18. M.Sc.-II Year-Physics
19. M.Sc.-II Year-Zoology
20. M.Sc.-II Year-Biotechnology
21. M.A./M.Sc.-II Year-Statistics

सदरील परिपत्रक व अभ्यासक्रम प्रस्तुत विद्यापीठाच्या **www.srtmun.ac.in** या संकेतस्थळावर उपलब्ध आहेत. तरी सदरील बाब ही सर्व संबंधितांच्या निदर्शनास आणून द्यावी.

'ज्ञानतीर्थ' परिसर,
विष्णुपुरी, नांदेड – ४३१ ६०६.
जा.क्र.: शैक्षणिक—१/परिपत्रक/पदव्युत्तर(संकुल)—सीबीसीएस अभ्यासक्रम/२०२०—२१/**५१३**

स्वाक्षरित/—
उपकुलसचिव
शैक्षणिक (१—अभ्यासमंडळ) विभाग

दिनांक : ०८.०८.२०२०.

प्रत माहिती व पुढील कार्यवाहीस्तव :
१) मा. कुलसचिव यांचे कार्यालय, प्रस्तुत विद्यापीठ.
२) मा. संचालक, परीक्षा व मूल्यमापन मंडळ यांचे कार्यालय, प्रस्तुत विद्यापीठ.
३) मा. संचालक, सर्व संबंधित संकुले, प्रस्तुत विद्यापीठ.
४) साहाय्यक कुलसचिव, पदव्युत्तर विभाग, प्रस्तुत विद्यापीठ.
५) उपकुलसचिव, पात्रता विभाग, प्रस्तुत विद्यापीठ.
६) सिस्टम एक्सपर्ट, शैक्षणिक विभाग, प्रस्तुत विद्यापीठ.

M. Sc. S. Y. Physical Chemistry Core Courses (Third Semester):

Sr. No.	Course No.	Title	Contact hours	Credits
Physical Chemistry Core Courses:				
1.	PHCH-371	Solid State Chemistry	60	**4**
2.	PHCH-372	Advanced Quantum Chemistry	60	**4**
		Laboratory Courses:		
1.	LPHCH-371	Laboratory Course 1	120	**4**
2.	LPHCH-372	Laboratory Course 2	120	**4**
1.	SPHCH-371	Seminar	15	**1**

M. Sc. S. Y. Physical Chemistry Elective Courses (Third Semester):

Sr. No.	Paper No.	Title	Contact hours	Credits
Physical Chemistry Elective Courses (any one from the below or courses offered for any other program in school of chemical sciences);				
1.	EPHCH-371	Organic Spectroscopy	60	**4**
2.	EPHCH-372	Statistical Thermodynamics	60	**4**
Open Elective Courses (any one):				
1.		Open Elective Course from schools	60	**4**
2.		MOOCS/SWAYAM/NPTEL Courses	60	**4**
Open Elective Course offered for students from other schools				
1.	OPCH-311	Intellectual Property Rights	60	**4**

M. Sc. S. Y. Physical Chemistry Core Courses (Fourth Semester):

Sr. No.	Paper No.	Title	Contact hours	Credits
Physical Chemistry Core Courses:				
1.	PHCH-471	Electrochemistry	60	**4**
2.	PHCH-472	Photochemistry	60	**4**
Industrial Training/Research Project:				
1.	ITCH-401/ RPCH -401	Industrial Training /Research Project	240	**8**
1.	SPHCH-471	Seminar	15	**1**

M. Sc. S. Y. Physical Chemistry Elective Courses (Fourth Semester):

Sr. No.	Paper No.	Title	Contact hours	Credits
Physical Chemistry Elective Courses (any one from the below or courses offered for any other program in school of chemical sciences):				
1.	EPHCH-451	Biophysical Chemistry	60	**4**
2.	EPHCH-452	Synthetic Methods in Organic Chemistry	60	**4**
Open Elective Courses (any one):				
1.		Open Elective Course (from other schools)	60	**4**
2.		/ MOOC/ SWAYAM/ NPTEL Courses	60	**4**
Open elective offered for students from other schools:				
1.	OPCH-411	Radiation Chemistry	60	**4**

M.Sc. S. Y. (PHYSICAL CHEMISTRY) Semester Third

(Solid State Chemistry)

PHCH-371 **Contact Hours– 60** **Credits – 4**

Course Objectives:

1. To deepen student's understanding of solid state reaction mechanism, synthesis and preparation of solid state reagents
2. To introduce students concept of perfect and imperfect crystals,
3. To analyze conducting, non- conducting and semiconducting materials.
4. To understand concept, principle, types of superconductors.
5. To develop skill of calculations, data interpretation and problem characteristics.
6. To evaluate theoretical and practical concept of crystal structure determination method.

Course Content:

1. Solid State Reactions:

Introduction, classification solids, Wagner reaction mechanism of solids, general principles, experimental procedures, co-precipitation as precursor to solid state reactions, kinetics of solid state reactions, thermal decomposition reaction. free energy of nucleation, growth of nuclei of solid.

2. Synthetic Methods for Solid State reactions:

Nucleation and growth, free energy of nucleation, growth of nuclei of solid. epitaxy and topotaxi, examples of solid state reactions 1) $LiSiO_4$ and 2) $Y\text{-}Ba_2Cu_3O_7$, sol-gel method for $MgAl_2O_4$ and silica glass, preparation of YBCO super conductor, electrochemical and chemical vapour deposition method for thin film preparations.

3. Electronic Properties and Band Theory:

Semiconductors, insulator and semiconductors, electronic structure of solids, band theory, energy bands in solids, formation of bands in solids, energy bands in conductors, insulators and semiconductors, intrinsic semiconductors, extrinsic semiconductors, types of impurities (dopping), types of extrinsic semiconductors, p-n junction, formation of p-n junction diode, energy band diagram of p-n junction, forward and reversed bias.

4. Crystal Defects:

Perfect and imperfect crystals, types of defects, stoichiometric defects, non stoichiometric defects, point defects, Schottky defects, thermodynamics of point defects, Schottky defect and Frenkel defects, metal excess defects, metal deficiency defects, line defects or dislocations, edge dislocations, screw dislocations, plane defects,

5. Superconductors:

Superconductivity, basic facts about superconductivity, type I and type II superconductors, isotope effect, low temperature superconductivity (LTSC), high temperature superconductivity (HTSC), occurrence of superconductivity, conventional super conduction, organic superconductors, fullerenes, applications of superconductor.

6. Organic Solid State Chemistry:

Intramolecular reactions, intermolecular reactions, electrically conducting organic solids, conjugated systems, organic charge transfer complexes, new superconductors

7. Crystal Structure Determination Methods:

Diffraction methods, space lattice, unit cell, x-ray crystallography, Bragg's x-rays spectrometric method, determination of crystal structure by Bragg's method, powdered crystal method, applications, structure of rock salts (NaCl), Bragg structure of NaCl, structure of skyline (KCl), expected similarities between NaCl and KCl, (numerical).

Home Assignment:

Optical properties, optical reflectance, photoconduction photoelectric effects, magnetic properties , classification of materials quantum theory of paramagnetic co operative phenomenon, magnetic domains hysteresius, MRI. Lattice energy, lattice heat capacities, Debye theory of heat capacities.

Books:

1. Solid State Chemistry and its Applications, A.R.West Plenum.
2. Principles of the Solid State, H. V. Kier, Wiley Eastern publication.
3. Solid State Chemistry, D.K. Chakarabaty, New Age International publication.
4. Physical Chemistry of Solids Berg, R.J. and G. J. Dines, Academic Press 1992.
5. West A. R., Basic Solid state chemistry, 2nd edition., John Wiley and Sons. 1999.
6. Solid State Chemistry, C.N.R. Rao , Dekker, N. Y.
7. Basic Solid State Chemistry, A. R. West, John Wiley & Sons Ltd. 1999.
8. Introduction to Solid, Leonid V. Azaroff, Tata McGraw Hill, New Delhi.

Course Outcomes:

At the end of this course students will be able to:

1. Define and explain basic concept and principles of solid state reactions.
2. Apply the knowledge to develop innovative ideas in the research and develop of solid state reactions.
3. Discriminate among different solid state materials as conductors, non conductors, semiconductors, super conductors and various types of solid defects.

(Advanced Quantum Chemistry)

PHCH-372 **Contact Hours– 60** **Credits – 4**

Pre-requisite:

Completion of elective course Quantum chemistry & Spectroscopy.

Course Objectives:

- The aim of the course is to provide an in-depth knowledge of theory and hands-on practical experience in advanced quantum chemistry.
- The course has specific objectives right from understanding the Born-Oppenheimer approximation and approximation methods while dealing with simpler multi-electron systems like H_2^+ ion and H_2 molecules through molecular orbital theory and valence bond theories.
- The introduction to Hartree product and Hartree-Fock SCF methods with restricted and unrestricted systems for open as well as closed shell electronic configurations through spin projected operators will be thoroughly discussed. The necessity for going to multi-determinant approaches to cover the correlation energy part will be emphasized
- A review of semi-empirical methods also will be dealt like AM1, PM3 and CNDO approaches. The hands-on practical sessions through Gaussian 16 software will be conducted regularly.

Course Content:

1. Theoretical and Computational Treatment of Atoms and Molecules, Hartree-Fock Theory:

Review of the principles of quantum mechanics, Born-Oppenheimer approximation, Slator-Condon rule, Hartree-Fock equation, Koopmans and Brillouin theories, Roothan equation, Gaussian basis sets.

2. Configuration Interaction and MC-SCF:

Introduction to CI, full and truncated CI theories, size consistency, introductory treatment of coupled cluster and MC-SCF methods.

3. Semi-empirical Theories:

A review of the Huckel, EHT and PPP treatments, ZDO approximation, detailed treatment of CNDO and INDO theories.

4. Co-ordinate Systems:

Introduction to Molecular Modeling, Single molecule calculations, assemblies of molecules and reactions of molecules - Co-ordinate systems, Cartisian and internal Co ordinates, Z-matrix, Potential energy surface - Conformational search - Global minimum, Local minima, Conformational analysis of ethane. Hands on experience on PC with Gaussian 09 software.

5. Density Functional Theory:

Derivation of Hohenberg-Kohn theorem, Kohn-Sham formulation, N and V representabilities review of the performance of the existing local (e.g. slater and other methods) and non-local functionals, treatment of chemical concepts with the density functional methods.

Home Assignment:

Semi-empirical methods and XC functional.

Books:

1. Modern quantum chemistry, N. A. Ostuland and A. Szabo, MCgraw Hill.
2. Methods of molecular quantum mechanics R. Mcweeny and B. E. Suteliffe, Academic press.
3. Density functional theory of Atoms and Molecules R. G. Parr and W. Yang Oxford
4. Exploring chemistry with electron structure methods J. B. Foresman and E. Frish, Gaussian Inc.
5. Computational Chemistry, Guy H. Grant & W. Graham Richards, Oxford University press.
6. Computational Chemistry: Introduction to the theory and Applications of Molecular and Quantum Mechanics, Errol Lewars, Springer Publications.
7. Molecular modelling – Basic Principles and Applications by Hans Dieter Holtje and GerdFolkers, VCH, 1996.
8. Introduction to Computational Chemistry by Jensen, Wiley Publishers.

Course Outcomes:

1. By the end of this course, students will have a conceptual understanding of the laws of quantum mechanics necessary for the description of electronic structure of atoms and molecules.

2. Also, they will be able to choose the appropriate method (in terms of applicability, accuracy, and economy) for the calculation of a given chemical problem.

3. The hands-on sessions will help students to perform, understand, and interpret the results of the calculations and bring them in a publication ready form.

(Laboratory Course-1)

LPHCH-371 **Contact Hours–120** **Credits – 4**

Course Objectives:

1.To prepare, standardize and use of the solutions.

2. To create safety handling of glasswares and chemicals.

3. To aware the hand on experience for physical chemistry equipments

4. To learn to find the error and problem solving ability.

5. To analysis of data, interpreate in the form of results and conclusions.

Course Content:

(Any twelve experiments from the following list to be performed.)

1. Spectroscopy:

1.To determine the indicator constant pK_{in} of and indicator by using half height method (bromo cresol purple).

2. To determine the stability constant of metal complex between 5-SSA and Fe^{+3} with the help of Job's curve and Bent and French method (for weak complex).

3. To determine the concentration of Fe (II) and Cu (II) by spectrophotometric titration with EDTA.

4.To investigate the effect of ionic strength on pK_a of bromo cresol green and thus determine pK_{in}.

5.To investigate the reaction kinetics between $K_2S_2O_8$ and KI by spectrophotometry.

6.To determine simultaneously the dichromate and permanganate ions in the given solution.

Polarimetry:

7. Determine the percentage of two optically active substances in a mixture

8. To investigate the complex ion formation between Fe (II) and thiocyanate ion

9. To study Kinetics of hydrolysis of sucrose by Hammett-Zuckerman approach

10. Investigate the effect of substitution of chloride ions on rate constan of inversion of cane sugar by using mono, di, and trichloro acetic acid as catalyst.

Refractometry:

11. Determine the refractive indices of series of solution of a salt and determine the concentration of the salt in the given unknown solution .

12. Determine the molar refraction of ethyl, propyl and butyl acetate and show the constancy of contribution to the molar refraction amide by CH_2 group.

13. Determine the molar refraction of methyl acetate, ethyl acetate, n-hexane and carbon tetrachloride and calculate the atomic refraction of C, H and Cl atoms.

14. Study the variation of refractive index with composition of mixtures of carbon tetrachloride and ethyl aetate and determine the molar refraction of the given unknown mixture.

Viscosity:

15. Study the variation of viscosity with composition of I) ethanol – water II) methanol ethelidene chloride III) the formation of compound 5)

16. Determine the molecular weight of macromolecules

17. Determine the iso-electric point of gelation and examine the effect of aging by viscometric methods.

Flame photometry:

18. Estimation of Na, K, Li and Ca by flame photometry.

Books:

1. Practical Physical Chemistry, A. M. James and P. E. Prichands, Longman Group Ltd.

2. Findlay's Practical Chemistry, S. P.Levitt (Editor), Longman Group Ltd.

3. Experimental Physical Chemistry, Das and Bhera, Tata McGraw Hill,

4. Advanced Practical Physical Chemistry, J. B. Yadav, Goel Publication, Meerut.

5. Advanced Experiments in Physical Chemistry, J. Rose.

6. Systematic Experimental Physical Chemistry, S. W. Rajbhoj, T. K. Chondhekar.

Course Outcome: At the end of this course students will be able to:

1. Strengthen the knowledge regarding writing skill, for principle of practical, theory, procedure presentation in the form of observations, table, graphical presentations, to conclude the result and verify with theoretical concept.

2. Enhance calculations ability,

3. Handling of equipment, glassware, calibration and preparation of solutions

(Laboratory Course-2)

LPHCH-372 **Contact Hours–120** **Credits – 4**

Course Objectives:

- The basic objective of this course has three fold dimensions like to strengthen the knowledge of fundamental physical chemistry principles while dealing with dissociation of electrolytes into ions.
- Dealing with surface tension and applying thermodynamic principles to the chemical systems.

Course Contents;

Potentiometer:

1. Titrate ferrous ammonium sulphate with cerricsulphate and find out formal redox potential of Fe^{2+}/Fe^{3+} and Ce^{3+}/Ce^{4+} system

2. Titrate potentiometrically phosphoric acid solution against NaOH and calculate pK^1, pK^2 and pK^3 of the acid

3. Titrate potentiometricallyNaCl solution against $AgNO_3$ and find out the concentration of NaCl and hence determine the solubility product of AgCl

4. To determine the standard free energy change G^0 and equilibrium constant for the reaction $Cu + 2Ag^+ \rightarrow Cu^{++} + Ag$

5. Determine the activity coefficient of silver ions using a concentration cell without transference

pHmetry;

6. To determine the ligand stability constant of an organic acid and the metal ligand stability constant of its complex by pH measurements(Bjerrum-Calvin titration)

7. Determine the Hammett constant of a given substituted benzoic acid by pH measurements

8. Determine the pH value of various mixtures of sodium acetate and acetic acid in aqueous solution and hence find out the dissociation constant of the acid

9. To determine the hydrolysis constant of aniline hydrochloride by pH measurements

Conductometry:

10. To determine the thermodynamic dissociation constant of weak acid conductometrically.

11. Investigate the kinetics of basic hydrolysis of ethyl acetate conductometrically

12. To determine the degree of hydrolysis and hydrolysis constant of sodiumacetate conductometrically.

Surface Tension:

13. Study the effect of surfactant (n-propyl alcohol) at various concentrations on the surface tension of water and hence determine the limiting cross sectional area of alcohol molecule by stalagnometer

14. Determine the parachor of a solid by stalgnometer

Thermodynamics:

15. Determine the partial molar volume of ethanol and water in a given composition by density measurements

16. To determine the heat of dissociation of benzoic acid in water

Books:

1. Practical Physical Chemistry, A. M. James and P. E. Prichands, Longman Group Ltd.
2. Findlay's Practical Chemistry, S. P.Levitt (Editor), Longman Group Ltd.
3. Experimental Physical Chemistry, Das and Bhera, Tata McGraw Hill,
4. Advanced Practical Physical Chemistry, J. B. Yadav, Goel Publication, Meerut.
5. Advanced Experiments in Physical Chemistry, J. Rose.
6. Systematic Experimental Physical Chemistry, S. W. Rajbhoj, T. K. Chondhekar.

Course Outcomes:

1. At the end of the course, the student will have enough knowledge about measuring the strength of ions by applying traditional techniques like potentiometer, pH meter and conductivity meter.
2. Students will make use of simple physical chemistry principles like redox potentials, dissociation constant, equilibrium constant, activity coefficient, Hammett constant and ligand stability constants while performing the experiments.

(Seminar)

SPHCH-371 **Contact Hours–15** **Credits – 1**

Seminar Objective:

1.To enhance the presentation skill and stage courage.
2.To provide the platform to the students to express them.
3.To be able to prepare the report component and structure.
4.To increase knowledge of students in the specific subject.

Seminar Content:

The student has to select topic of his her having utility or applications in the science or concern subject. Get approved the topic from in charge teacher. He or she will submit report in two copies to the institute. The student will make the presentation as a seminar. The assessment will be Carried out by an examiner at the end of Semester as per the Scheduled program.

Seminar Outcome:

1. The presentation skill and stage courage of the students will be strengthen.
2. This activity will provide the platform to the students to express their knowledge
3. Students will be able to prepare report component and structure.

4.The knowledge of students in the specific subject will be enriched.

M.Sc. S. Y. (PHYSICAL CHEMISTRY) Semester Third

Elective Courses

(Organic Spectroscopy)

EPHCH-371 **Contact Hours– 60** **Credits – 4**

Course Objectives:

The students should learn

1. Different spectroscopic principles
2. Their applications like UV,IR and PMR, CMR and Mass.
3. Different 2D techniques
4. Emerging trends in spectroscopy

Course contents:

1. UV, IR and PMR: Elementary ideas (recapitulation)
2. PMR (Advanced ideas)
3. Spin couplings, different spin systems, factors affecting coupling constants, rate processes, different types of couplings, methods used for simplification of PMR spectra. NOE, Two dimensional (2D) NMR techniques (COSY < HETCOR etc.)
4. CMR- elementary ideas, instrumental problems, advanced idea, chemical shift features of hydrocarbons, effect of substituent on chemical shifts, different types of carbons.
5. Mass spectrometry-theory, instrumentation, rules of fragmentation, fragmentations of different functional groups, factors controlling fragmentation.
6. Problems based on joint applications of UV, IR, PMR, CMR and Mass.
   Home assignment: Applications of PMR in biological systems, structural assignments of complex molecules based on given structure and joint applications of UV, IR, PMR, CMR and Mass.

Books:

1. Introduction to spectroscopy by Donald L. Pavia Gary M. Lampman, George S. Kriz (Harcourt college publications) 3rd Edition.
2. Spectrometric Identification of organic compounds by – R. M. Silverstein, T. C. Morril, G. C. Basseler.
3. 13 C-NMR spectroscopy by – G. C. Levy, R. L. Lichter, G. L. Nelson (Wiley).
4. Spectroscopic methods in organic chemistry by –D. H. Williams and Ian flemming.
5. Absorption spectroscopy of organic molecules by-V. M. Parikh.

Course Outcomes:

The learner should be able to

1. Understand the different spectroscopic principles.
2. Interpret different spectra .
3. Elucidate the structure of organic compounds.
4. Apply the knowledge in characterisation of compounds.

(Statistical Thermodynamics)

EPHCH-372 **Contact Hours– 60** **Credits – 4**

Course Objectives:

- The main goal of this course is to acquire fundamental knowledge of classical and quantum statistical mechanics, construct a bridge between macroscopic thermodynamics and microscopic statistical mechanics by using mathematical methods.
- To be specific, the objective of statistical thermodynamics is to give a molecular basis for thermodynamics.
- Thus, it is necessary to define the concepts and evaluation of thermodynamic properties at the molecular level in order to understand the properties of system under study at bulk level.

Course Content:

1. Background Concepts:

Combinatorial problems, number ways in which particles can be arranged in order or placed in container, the situations of this distribution in Boltzman, Fermi-Dirac and Bose- Einstein statistics, illustrations stirling approximation, Lagrange method of undetermined multipliers, distribution and most probable distribution, problems

2. Statistical Mechanics of a System of Independent Particles:

Introduction: distribution laws, partition functions and its significance, limit of applicability of various distribution laws, relation between partition function and thermodynamics function, illustrative examples and problems.

3. Application of Statistical Mechanics:

a. Ideal gases: Partition function of a monoatomic gas, thermodynamics function of a molecule, heat capacity and the residual entropies of polyatomic molecules
b. Solids: Introduction, thermal characteristics of crystalline solids, Einstein model, Debye modifications, limitations and modifications of Debye theory and comparision between Debye theory and Einstein model.
c. Solutions: Introduction, lattice models, ideal solution, non-ideal solutions, polymer solutions.

4. NuclearSspin Statistics:

Introduction, the mean symmetry and the nuclear-spin, ortho and para nuclear states, ortho and para hydrogen, nuclear spin statistics of deuterium

5. Fluctuations:

Introduction, the mean distribution and mean square deviation, fluctuation in energy in a canonical esemble, fluctuations in density and radioactive disintegrations, the Brownian movement, Problems.

Home Assignment:

Numerical problems from syllabus.

Books:

1. Statistical Thermodynamics, Donald A Mc Quarrie, Happer and Row, Newyork, 1973
2. Statistical Thermodynamics, M. C. Gupta, Wiley Eastern Ltd, New Delhi
3. Elements of Statistical Thermodynamics, L. K. Nash, Addison Wesley, Menlo park
4. Text book of Physical Chemistry, Samuel M. Glasstone
5. Physical Chemistry, P. W. Atkins (ELBS).
6. Theoretical Physical Chemistry, S. M. Glasstone

Course Outcome:

- Upon completion of the course, the students will understand basic principles, and be able to use principles and ideas to calculate properties of simple statistical systems.
- It includes, learning different statistical ensembles, their distribution functions, ranges of applicability and the corresponding thermodynamic potentials.
- Application of quantum and statistical distributions in circumstances varying from standard examples such as gases, solutions, polymer solutions, solids and electrolytic charge carriers to statistics will be greatly acknowledged.
- Also, students become aware of the richness and complexity of statistical behavior exhibited by interacting systems and various approaches (phenomenological and microscopic) developed to comprehend such systems.

(INTELLECTUAL PROPERTY RIGHTS)

OPCH 311 **Contact Hours– 60** **Credits – 4**

Course Objectives :

Greatest teacher, philosopher of India *Chanakya* has once quoted "*create wealth from knowledge and Knowledge is Power*". Intellectual Property Rights has got importance in the economic development of India. A renewed awakening of the role of intellectual property in the countries of the various regions of the world has led more recently to the adoption of national legislation on Intellectual Property Rights (IPR) as well as to the establishment or modernization of Government structures that administer such legislation. The present module has been designed keeping in view the above opportunities and challenges to give in-depth knowledge of IPR to the postgraduate students. The course is designed to introduce fundamental aspects of Intellectual Property Rights to teachers, students who are going to play a major role in development of modern economy of India.

- University Grants Commission Bahadur Shah Zafar Marg New Delhi. 110 002. letter to Universities about inclusion of intellectual Property rights curriculum in universities.
- Intellectual Property rights (http://www.ipindia.nic.in/#content) Office of the controller general of patents, designs & Trade marks.
- *"What are intellectual property rights?". World Trade Organization. World Trade Organization. Retrieved* 2016-05-23.
- Law Relating to Patents, Trademarks, Copyright, Designs and Geographical Indications. B L Wadehra
- MANUAL OF PATENT OFFICE PRACTICE AND PROCEDURE THE OFFICE OF CONTROLLER GENERAL OF PATENTS, DESIGNS & TRADEMARKS Controller General of Patents, Designs and Trademarks Mumbai.

Course Content:

1) Introduction to Intellectual Property:

- What is Intellectual Property (IP)? Types of IP meaning of the concept of Copyright, Trademark, Patent, Industrial Designs, Geographical Indications, traditional Knowledge etc.
- Significance and importance of IP in the business.
- Significance and importance of IP in Teaching Field.
- Patents Overview - What is a patent? – Importance of Patents in the knowledge economy
- Historical evolution of patents, Why protect inventions by patents? Searching a patent, Drafting of a patent specification, Filing of a patent, Types of patents Divisional, and Provisional applications.

2) Legal Aspects of Intellectual Property:

- Indian Patent laws, International convention relating to Intellectual Property, Establishment of WIPO – Mission and Activities – History – General Agreement on Trade and Tariff (GATT) – TRIPS Agreement.
- Indian Position Vs WTO and Strategies – Indian IPR legislations – commitments to WTO-Patent
- Ordinance and the Bill – Draft of a national Intellectual Property Policy – Present against unfair competition.
- What is infringement? – Direct and Indirect infringement.
- What is PCT? PCT provisional or full specification, where to file? PCT application and detailed procedure.

3) Intellectual Property Management:

- Patenting in Academics – Why should academics patent?
- What should academics patent? - Do patents affect research quality?
- History of academic patenting and exploitation.
- Land mark patents form academics and exploitation – Are universities abusing patent system?
- Encouraging patenting culture in Indian Academia, particularly in State Universities.

4) Transfer of Technology:

- Basic concepts of technology transfer, meaning of know-how and technical expertise technological knowledge for installation, operation and functioning managerial expertise.
- Role of universities (University Teachers and Researchers), research institutions (Scientists) and industries (Industrialist) in international technology transfers.
- Types of technology transfer agreements, difference between license and transfer, types of licenses and transfer agreements, technology transfer agreements and competition Law

Home Assignment:

Research and practical based Home Assignment (Beyond Class Room Activity)

Compilation of report on various case studies related to IPR involving techno-scientific and legal issues therein for patent, trade mark and geographical indicators etc (Referring various case studies and compilation to be done by students) and Open discussion of the report (among the students).

Recommended Study Material (Books);

1) WIPO Publication on Intellectual property (refer Chapters 1to 6).
2) Cornish W & Llewellyn D, intellectual Property: patents, Copyright, trademarks & Allied Rights, Sweet & Maxwell, 2007.

3) Susan Sell et.al, *Who Governs the Globe?*, Cambridge University Press, (2010).
4) Odagiri et.al, *Intellectual Property Rights, Development, and Catch Up*, Oxford University Press, (2010).
5) Christopher May & Susan K. Sell, *Intellectual Property Rights: A Critical History*, Lynne Rienner Publications, (2005).
6) John Odell (ed.), *Negotiating Trade: Developing Countries in the WTO and NAFTA*, Cambridge University Press, (2006).
7) Gustavo Ghidini, Intellectual Property and competition Law: The Innovation Nexus, Edward Elgar, (2006).
8) David J. Teece, *The Transfer and Licensing of Know-how and Intellectual Property*, World Scientific (2008).
9) Susan K. Sell, *Private power, public law : The globalisation of IPR*, Cambridge University Press, (2006).
10) Kenneth L. Port, Licensing Intellectual Property in the digital age, Carolina Academic Press, (1999).
11) Merges, Lemley, et.al, (4th Ed.) Intellectual Property in the new technological age Aspen Publishers, (2007).
12) Thomas Pogge, Mathew Rimmer, Kim Rubenstein (ed), Incentives for global public health: Patent law and access to essential medicines, Cambridge University Press (2010).
13) DebiragE.Bouchoux: "Intellectual Property". Cengage learning , New Delhi .
14) M..Ashok Kumar and Mohd.Iqbal Ali: "Intellectual Property Right" Serials Pub.
15) Prabhuddha Ganguli: ' Intellectual Property Rights" Tata Mc-Graw –Hill, New Delhi.
16) Kerly's Law of Trade Marks and Trade Names, 14th Edition, Thomson, Sweet &Maxweel.
17) A. K. Bansal, Law of Trade Marks in India (2009 Edition) Institution of Constitutional and Parliamentary Studies and Centre for Law, Intellectual Property and Trade, New Delhi. ChristoherWadlow, The Law of Passing Off, 1995.
18) Marsha A. Echols, Geographical Indications for Food Products, International Legal and Regulatory Perspectives (2008), Wolters Kluwer.
19) N.S. Gopalakrishnan & T.G. Agitha, Principles of Intellectual Property (2009), Eastern Book Company, Lucknow.

20) W.R. Cornish, Intellectual Property, Sweet & Maxwell, London (2000).
21) P. Narayana, Patent Law, Wadhwa Publication.
22) Merges, Patent Law and Policy: Cases and Materials, 1996.
23) Brian C. Reid, A Practical Guide to Patent Law, 2nd Edition, 1993.
24) Brinkhof (Edited), Patent Cases, Wolters Kluwer .
25) Prof. Willem Hoyng& Frank Eijsvogels, Global Patent Litigation, Strategy and Practice, Wolters Kluwer .
26) Gregory Stobbs, Software Patents Worldwide, Wolters Kluwer .
27) Feroz Ali Khader, The Law of Patents – with a special Focus on Pharmaceuticals in India, LexisNexis Butterworths Wadhwa, Nagpur.
28) AjitParulekar and Sarita D' Souza, Indian Patents Law – Legal & Business Implications; Macmillan India ltd , 2006.
29) B. L. Wadehra; Law Relating to Patents, Trade Marks, Copyright, Designs & Geographical Indications; Universal law Publishing Pvt. Ltd., India 2000.
30) P. Narayanan; Law of Copyright and Industrial Designs; Eastern law House, Delhi, 2010.

Course Outcomes :

Intellectual Property (IP) is one of the most important assets of a leading edge technology company. Whether it be patents, copyrights, trademarks, trade secrets or know-how, it is critically important to identify it, document it, protect it and in some cases, register it. Good IP management also requires the development of a strategy in order to balance the cost involved in registering IP against the protection that will be required in markets you are in or plan to develop.

Another important part of managing IP is keeping tabs on what your competitors are doing. Any time a competitor is awarded a patent, you should be examining it to ensure that you are not infringing on their IP. If you are familiar with your competitors' IP, you can design around it. Reasons for Patenting Your Inventions Patents provide the exclusive rights, **Strong market position** - Through these exclusive rights, **Higher returns on investments, Opportunity to license or sell the invention, Increase in negotiating power, Positive image for your enterprise.**

The Introduction of an institutional/university/college level elective course aims to facilitate the protection and valorization of intellectual properties generated during the research pursuit in the Institute/university/college and offer scope for wealth generation, alleviation of human sufferings and betterment of human life. University urges all faculty, staff and students to document their IP, so that they can be protected and applied to the gain of the country, the institute/university/college and the concerned inventors. This elective course can facilitate faculties and staff of institute/university/college in a proactive manner in the generation, protection and transaction of Intellectual Properties which offer potential and scope for shared benefits to society, institute/university/college and inventors.

M.Sc. S. Y. (PHYSICAL CHEMISTRY) Semester Fourth

M. Sc. S. Y. Physical Chemistry Core Courses :

(Electrochemistry)

PHCH-471 **Contact Hours– 60** **Credits – 4**

Course Objectives:

1.To cover main aspects of subject through teaching, learning and evaluation method.

2.To provide an introduction to a electrochemistry in its present state.

3.To explain fundamentals of the subject by introducing the

basic principles theories of electrolysis, electro kinetic phenomena, types of cells.

To explain concept, the inter ionic attraction theory and electrode reactions

processes with simple and clear aspects of electrochemical applications.

5.To apply the recent electrochemistry applications overvoltage, passivity, corrosion theories

in applied chemistry.

Course Contents:

1.Introduction :

Basic introduction to electrolytic conductance, theory of electrolytic dissociation, mechanism of electrolytic conductance and the migration of ions.

2. Free Energy and Activity:

Activity and activity coefficient, equilibrium and free energy changes, Debye-Huckel theory, Debye-Huckel limiting law, Debye-Huckel equation of appreciable concentration, Huckel and Bronsted equation, quantitative verification of appreciable concentration, , tests of Debye Huckel limiting equation, activities in concentration solutions, extension of Debye- Huckel theory, ion association, equilibrium in electrolytes, strong intermediates and weak electrolytes, solubility, solubility product principle, solubility for common ions and complexion, determination of instability constant, activity coefficient form solubility, measurements solubility and Debye-Huckel theory.

3. Reversible Cells:

Reversible and irreversible cells, reversible electrodes, application or e. m. f. measurements, concentration cells with a single electrolyte, amalgam concentration cells, electrode potential, potentials in non aqueous solution, factors affecting electrode potentials, rate of electrode potentials, electrode potentials and equilibrium constants, electrode potentials and solubility products.

Oxidation reduction system, types of oxidations reduction systems, determination of oxidation reduction potentials, (numerical).

4. Dynamic Electrochemistry:

Electrochemical process at electrodes, electrical double layer, rate of charge transfer, polarization, electrochemical process, electrolysis, characteristics of working cells,. power production and corrosion, types of electrochemical corrosions,

5. Fuel Cells:

Fuel Cell and its operation, hydrogen/ oxygen cell ,Lead storage battery, Nickel/ Cadmium cell. power generation in fuel cells, power storage, secondary cells, thermodynamics and kinetics of corrosion and their prevention methods, applications of electrolysis in electro refining, electroplating and electrotyping.

Home Assignment:

Ion-solvent and ion-ion interactions, structure of water, the ion-dipole model, heat of salvation, Born charging process and Bernal-Fowler model for water & aqueous solutions. The failures of Arrhenius theory for strong electrolyte dissociation

Books :

1. An Introduction to Electrochemistry, S. Glasstone, Van Nostrand, East-West 1965.
2. Modern Electrochemistry, Vol. I and II, 2nd Edition, J. O'M Bockris and A. K. N. Reddy, Plenum, 1977.
3. Electrolytic Solutions, R. A. Robinson and R. H. Stokes, Butterworths, London, 1959.
4. Physical Chemistry, P. W. Atkins, ELBS, 1986.
5. Text book of Physical Chemistry, Samuel. M.Glastone, Littern Educational publishing in., New York.

6. Physical Chemistry, P.W. Atkins (ELBS).

Outcomes:

At the end of this course students will be able to:

1. Safty handling of electrodes, identify and construct the cells..

2. Applyt the knowledge in the field of nanotechnology, electronic and chemical industries for developing new electrochemical method for synthesis of various non materials in the sustainable development.

3. Enhance the knowledge based skill which can be applied in industries for manufacturing of batteries, fuel cells to update and electrodes electronic equipments such as laptop, tablet, PC, computers, cell phones etc

(Photochemistry)

PHCH-472 **Contact Hours– 60** **Credits – 4**

Course Objectives:

- The theoretical foundation for photochemistry is outlined and discussed on the basis of the properties of light and the nature of relevant photo physical and photochemical processes involved within
- The response to the application of radiation at uni and bimolecular levels will be reviewed and discussed with particular emphasis on mechanistic aspects.
- Special attention will be paid to the importance of photochemical and photo physical processes with respect to modern applications such as harvesting solar energy and storage.

Course Content:

1. Photochemical Reactions:

Interaction of electromagnetic radiation with matter, types of excitation, rate of excited molecule, quantum yield, transfer of excitation energy, actionomety

2. Determination of Reaction Mechanism:

Classification, rate constant and life times of reactive energy states determination of rate constants of reactions, effects of light intensity on the rate of photochemical reactions, types of photochemical reactions, photodissociation, gas phase photolysis

3. Photophysical Process in Electronically Excited Molecules:

Types of photochemistry, pathways with jabalonski diagram radiation theory, internal conversion and intersystem crossing, fluorescence emission, fluorescence and structure, triplet states and photophosperescnce emission, emission property and the electronic configuration, photophysical kinetics of unimolecular process, state diagrams delayed fluorescence, the effect of temperature on emission process.

4. Photophysical Kinetics of Bimolecular Process:

Kinetic collisions and optical collision, bimolecular collisions in gases and vapors and the mechanism of fluorescence quenching, collisions in solution, kinetics of collisions

quenching, Stern-volmer equation, concentration dependence of quenching and excimer formation, quenching by foreign substances

5. Some Aspects of Organic and Inorganic Photochemistry:

Photoreduction and reactions, photoxidation and photo oxygenation, cycloaddition reactions, woodward-Hoffman rule of electrocyclic reactions, chemiluminiscence, transition metal complexes

6. Some Current Topics in Photochemistry:

Photosynthesis, photoelectrochemistry of excited state redox reactions, solar energy conversion and storage

Home Assignment:

Organic and inorganic photochemistry

Books:

1.Fundamentals of Photochemistry, K. K. Rohtagi- Mukherji, Wiley eastern
2.Essentials of Molecular Photochemistry, A. Giolber and J. baggot, Blackwell Scientific Publication
3.Molecular Photochemistry, NJ Turro, W. A. Benjamin
4.Introductory Photochemistry, A.Cox, T. Camp, McGraw-Hill
5.Photochemsitry, R. P. Kundall and A. Golbert, Thomson Nelson
6.Organic Photochemistry, J. Coxon, B. Halton, Cambridge University Press.

Course Outcomes:

- At the end of this course, the fundamental concepts behind interaction of matter with radiation and its fine tuning in order to control the photophysical as well as photochemical processes will be thoroughly understood.
- The significance of reactive energy states generated while interaction of matter with radiation and their kinetics and lifetime will be established.
- The knowledge of quenching mechanism by added substances or self-quenching will be generated.
- Application of these concepts to some organic and inorganic systems will be done. Also, the extension of the syllabus to explore recent advancement in this field to find applications in solar energy conversion and storage will enrich the knowledge in this subject area.

(Industrial Training/Research Project)

ITCH-471/RPCH-471 **Contact Hours– 60** **Credits –08**

* The projects will be initiated in the beginning of **Semester III** and the examination will be conducted at the end of **Semester IV.**

* Educational Tour: Organizing Educational Tour aiming at giving practical exposure to second year students is expected. (at their own cost).

Course Objectives:

1. To aware various techniques. (TLC, Column Chromatography, Distillation, Purification of solvents and reagents.)
2. To provide the training to use the various laboratory equipments.
3. To create awareness of green and sustainable reactions.
4. To develop the practical skill to study reaction mechanisms, use of physicochemical parameters,

Course Outcomes:

At the end of this course students will be able to:

1. Apply the knowledge in using various techniques. (TLC, Column Chromatography, Distillation, Purification and measurements of physic chemical parameters.
2. Enhance the capacity to use the various laboratory equipments in different research methodology..
3. Develop green and sustainable reaction's alternatives to present methods.
4. Apply the practical skill to develop innovative methods using reaction mechanisms,.

(Seminar)

SPHCH 471 **Contact Hours–15** **Credits –01**

Seminar Objective:

- To enhance the presentation skill and stage courage.
- To provide the platform to the students to express them.
- To be able to prepare the report component and structure.
- To increase knowledge of students in the specific subject.

Seminar Content:

- The student has to select topic of his / her having utility or applications in the science or concern subject.
- Get approved the topic fro in charge teacher. He or she will submit report in two copies to the institute.
- The student will make the presentation as a seminar. The assessment will be
- Carried out by an examiner at the end of Semester as per the scheduled program.

Seminar Outcomes:

- The presentation skill and stage courage of the student be strengthen.
- This activity will provide the platform to the students to express their knowledge
- Students will be able to prepare report component and structure.
- The knowledge of students in the specific subject will be enrich.
- Develop explanations power.

M. Sc. S. Y. Physical Chemistry Elective Courses (Fourth Semester):

(Biophysical Chemistry)

EPHCH-471 **Contact Hours– 60** **Credits – 4**

Course Objectives:

1.To determine macromolecular structures.

2. To develop the applications of quantitative methods to analyze biological systems.

3. To know the basic structure of the biological cell and its compounds.

4. To know the physical and chemical properties of bio macromolecules

5. To understand the importance of cell constituents, its functions and forms of various transport processes.

Course Contents:

1. Biological Cell and its Constituents:

Biological cell structure, constituents **o**f the cell, difference between prokaryotic and eukaryotic cell, structure and functions of compounds of living cell. basic design of the cell.

2. Bio Macromolecules in Living System:

Proteins: General chemical composition of amino acids, classification of amino acids, structure of proteins, classification of proteins, functions of proteins, polypeptide and protein structures, introduction to protein folding problem.

Enzymes: Structure and functions, nomenclature of the enzymes, classification of enzymes, chemical nature of enzymes, factors affecting enzyme activity, function of enzymes.

Nucleic Acids: Deoxyribose Nucleic Acid (DNA), double helix structure of DNA Ribonucleic Acid (RNA), types of RNA , structure and functions of RNA.

3. Bioenergetics:

Bioenergetics, Gibb's free energy change and feasibility of biochemical reaction, An exergonic reaction and endergonic reaction, standard free energy changes and additive

values, role of high energy phosphates in energy capture and transfer, hydrolysis of ATP, bioenergetics significance of ATP, Calculations of free energy change from standard reduction potentials.

4. Statistical Mechanics in Biopolymers:

Chain configuration and conformation of macromolecules, statistical distribution end to end dimensions, Thermodynamic probability of polymer chain.

5. Thermodynamics of Biopolymer Solution:

Thermodynamics of biopolymer solutions, entropy and heat of mixing of biopolymer solutions, osmotic pressure, membrane equilibrium, muscular contraction and energy production and biochemical activities in muscle contraction, functional and structural basis classification of muscles.

6 . Cell Membrane and Transport of Ions:

Structure and functions of cell membrane, ion transport through cell membrane, irreversible thermodynamics treatment of membrane transport, nerve conduction.

7. Forces Involved in Biopolymer Interactions:

Electrostatic charges and molecular expansion, hydrophobic forces, dispersion force interactions, multiple equilibria and various types of binding processes in biological systems, hydrogen ion titration curves. synthesis of ATP from ADP.

Home Assignment:

Electrostatic charges and molecular expansion, hydrophobic forces, dispersion force interactions, multiple equilibria and various types of binding processes in biological systems, hydrogen ion titration curves. Synthesis of ATP from ADP. Calculation of average dimension of various chain structures Biopolymers and their molecular weight Evaluation of size, shape, molecular weight and expect of hydration of biopolymer by various experimental technique, sedimentation equilibrium, hydrodynamic methods, diffusion, sedimentation velocity, viscosity, electrophoresis and rational motions.

Books:

1. Principles of Biochemistry – by A. L.O. Lehniger, Worth Publisher
2.Text Book of Biophysical Chemistry - by U. N. Desai, MacmillanIndia.Ltd.Publication.
3. Bioinorganic Chemistry : A Chemical Approach to Enzyme Action – by H. Dugas, Penny Springer Verlag Publication.
4. Macromolecules structure and functions – by F. Would, Prentice Hall, Publication.
5.Biochemistry –by Veot John Wiley & Sons
6.Quoins of Biochemistry – by E. E. Conn, P. K. Stump, John Wiley & Sons 2000.

Course Outcomes :

At the end of this course students will be able to:

1.Determine macromolecular structures.

2. Develop the applications of quantitative methods to analyze biological systems.

3.Kknow the basic structure of the biological cell and its compounds.

4. Apply the physical and chemical properties of bio macromolecules.

5. Aware the functions and construction as well as importance of cell constituents. .

(Synthetic Methods in Organic Chemistry)

EPHCH-472 **Contact Hours– 60** **Credits – 4**

Course Objectives:

The students should

1. Understand synthetic strategies and retro synthesis
2. Apply them for synthesis of new molecules
3. Use different protection and deprotection techniques
4. Know enamines and their applications

Course Contents:

1.Umpolung in organic synthesis.

2. Synthetic Strategies I

Synthetic Strategies; Introduction, Terminology: target, synthon, synthetic equivalent, functional group interconversion (FGI), functional group addition, functional group elimination.Criteria for selection of target. Linear and convergent synthesis. Retrosynthetic analysis and synthesis involving chemoselectivity, regioselectivity, reversal of polarity and cyclizations. .Order of events in synthesis by retrosynthetic approach, explanation with examples Ssalbutamol, Propoxycaine and Dinocap. Introduction to one group C-C and C-X disconnections. One group C-C disconnections, Alcohols and carbonyl compounds. One group C-X disconnections, Carbonyl compounds, alcohols, ethers and sulphides.

3. Synthetic Strategies II

Introduction to two group C-C and C-X disconnections, Two group C-X disconnections; 1,1-difunctionalised, 1,2-difunctionalised and 1,3-difunctionalised compounds. Two group C-C disconnections; Diels-Alder reaction, 1,3-difunctionalised compounds, 1,5- difunctionalised compounds, Michael addition and Robinson annulation. Control in carbonyl condensations, explanation with examples oxanamide and mevalonic acid. Strategic bond: definition, choosing

disconnection/ guidelines for disconnection; disconnection of C-X bonds, disconnect to greatest simplification, using symmetry in disconnection, disconnection corresponding to known reliable reaction, high yielding steps and recognizable starting materials. Other approaches to retro.

4. .Protecting and deprotecting groups for hydroxyl, amino carboxyl and aldehyde functions as illustrated in the synthesis of polypeptide and polynucleotide.peptide synthesis: actiation coupling, reversible blocking of amino and carboxylic groups, solid phase peptide synthesis.

5.Enamines in organic synthesis.

Home assignment:

New Synthetic reactions

1. Metal mediated C-C and C-X coupling reactions: Suzuki, Heck, Stille, Sonogishira cross coupling, Buchwald-Hartwig and Negishi-Kumada coupling reactions.

2. C=C Formation Reactions: Shapiro, Bamford-Stevens, McMurrey reactions, Julia-Lythgoe olefination and Peterson's stereoselective olefination.

3. Multicomponent Reactions: Ugi, Passerini, Biginelli, Hantzsch and Mannich reactions.

4. Ring Formation Reactions: Pausan-Khand reaction, Bergman cyclisation, Nazerov cyclisation.

5. Click Chemistry: Criteria for Click reaction, Sharpless azides cycloadditions.

6.Metathesis: Grubb's 1st and 2nd generation catalyst, Olefin cross coupling metathesis(OCM), ring closing metathesis(RCM), ring opening metathesis(ROM), applications.

7. Other important synthetic reactions: Baylis-Hilman reaction, Eschenmoser-Tanabe fragmentation, Mitsunobu reaction, .

Books:

1. Modern synthetic reactions By – H. O. House and Benjamin.

2. Organic Chemistry By – Clayden, Greeves, Warren and Wothers (Oxford press).

3. Designing organic synthesis by S. Warren (Wiley).

4. Some Modern methods of organic synthesis by – W. Carruthers (Cambridge)

5. Organic synthesis by – M. B. Smith

6. Organometallics in organic synthesis by – J. M. Swan and D. C. Black (Chapman and Hall).

Course Outcomes :

The learner would be able to

1. Perform Retrosynthesis of a given molecule.
2. Design synthesis using suitable building blocks.
3. Confirm the product structure.

   Apply enamines in organic synthesis.

(Radiation Chemistry)

OPCH-411 Contact Hours– 60 Credits – 4

Credits 4 (60 contact hours)

Course Objectives:

1. To understand the concepts of radiation chemistry
2. To study and understand the nuclear reactions and reactors
3. To understand the elements of radiation chemistry
4. To understand effects of radiation on matter
5. To understand the applications of radioisotopes in different fields

Course Contents:

1. Radioactivity and Radioactive Decay:

Introduction, neutron-proton ratio and nuclear stability, nuclear stability and binding energy, various modes of decay, natural radioactivity, successive radioactivity decay, growth kinetics, radioactive equilibrium, half life, half life of mixed radioisotopes, decay scheme, its determination by experimental methods decay kinetics, units of radioactivity, parent daughter growth relationship.

2. Nuclear Reactions and Reactors:

Nuclear Reactions: Definition and Bethes notation, threshold energy of nuclear reaction, energetic of nuclear reactions, conservation in nuclear reactions, conservation of protons and neutrons, conservation of momentum and conservation of energy, various types nuclear reactions, special nuclear reactions, photonuclear, thermonuclear reaction.

Nuclear Reactors: Three stage nuclear program of India, mass and charge distribution, release of energy and neutrons, spontaneous fission, nuclear reactors and their use for power production, Thermal and fast breeder nuclear reactors, nuclear fusion.

3. Interaction of Radiations With Matter and Detectors:

Interaction of gamma radiation with matter by photoelectric, Crompton and pair production, Interaction of beta particles, neutrons and heavy charged particles with matter. Units of measuring radiation absorption.

Gas filled counter, Ionization chamber, Proportional and G. M. Counter, Scintillation counter, and solid state detector Ge(Li), Si(Li) and HPGe.

4. Effects of Radiation on Matter:

Measurement of dose, units of dose, chemical dosimeter (Fricke dosimeter and Ceric sulphate dosimeter), experimental determination of dose, radiolysis of water and aqueous solution, redox

reactions due to irradiated crystals, radiation induced colour centers in crystal, radiation effect on organic compound, polymer and nitrate, Thermoluminence.

5. Application of Radioactivity:

Typical reactions involved in the preparation of radioisotopes: Scillard Chalmers reactions. Typical application of radioisotopes as tracers in: Chemical investigation, physio-chemical research, analytical applications, medical applications, agricultural applications, industrial applications, radioisotopes as a source of electricity and carbon dating.

Home assignment:

a) Discovery of radioactivity, properties of nucleons and nuclei, nuclear models, shell model, liquid drop model, Fermi gas model, collective model and optical model b) Nuclear fusion and nuclear fission c) Nuclear reactors, classification of nuclear reactors and waste management d) detection and measurement of radioactivity, ionization chamber, GM counter.

Books:

1. Source of atomic energy, S. Glasstone, D. Van Nestrated Co. Inc.
2. Essentials of Nuclear Chemistry, H. J. Arnikar, New Age International P. Ltd
3. Introduction to Nuclear Physics and Chemistry, B. G. Harvey.
4. Nuclear Chemistry, M. G. Arora & M. Singh Anmol Publications.
5. Elements of Nuclear Chemistry, A. K. Srivastav, P. C. Jain, S. Chand & Co.
6. A Text book of nuclear chemistry, C. V. Shekar, Eminent publications & Distributions, New Delhi.
7. Radiochemistry & Nuclear Chemistry, G. R. Chpppin, J. Liljenzin, J. Rydberg, Butterwerth-Heinemann.
8. Nuclear chemistry, M. N. Shastri.
9. Modern Nuclear Chemistry, W. Loveland, DJ Morrissey, GT Seaborg, John Wiley and Sons.

Course Outcomes:

1. The student will be able to understand the different concepts of radiation chemistry.
2. The student can distinguish different nuclear reactions and explain construction and working of the nuclear reactor.
3. The student will be able to describe the elements of radiation chemistry.
4. The students will understand the details of the effects of radiation on matter
5. The students will be able to discuss application of radioisotopes in different fields
6. The students can apply their knowledge in the nuclear reactions if selected in such institutions..