।। 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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E-mail: bos.srtmun@gmail.com

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. Organic Chemistry Core papers (Third Semester)

Sr. No.	Paper No.	Title	Contact hours	Credits
Organic Chemistry Core papers				
1.	OCH-341	Organic Reaction Mechanism	60	4
2.	OCH-342	Organic Synthesis	60	4
Practical Courses				
1.	LOCH-341	Laboratory Course 1	120	4
2.	LOCH-342	Laboratory Course 2	120	4
1.	SOCH-341	Seminar	15	1

M. Sc. S. Y. Organic Chemistry Elective papers (Third Semester)

Sr. No.	Paper No.	Title	Contact hours	Credits
Organic Chemistry Elective papers (any one from the below or courses offered for any other program in school of chemical sciences)				
1.	EOCH-341	Organic Spectroscopy	60	4
2.	EOCH-342	Chemistry of heterocyclic and biologically Active Molecules	60	4
Open elective (any one)				
1.		Open elective from other schools	60	4
2.		MOOCS/SWAYAM/NPTEL courses	60	4
Open electives offered for students from other schools				
1.	OPCH-311	Intellectual property rights	60	4

M. Sc. S. Y. Organic Chemistry Core papers (Fourth Semester)

Sr. No.	Paper No.	Title	Contact hours	Credits
Organic Chemistry Core papers				
1.	OCH-441	Advanced Organic Chemistry	60	4
2.	OCH-442	Bio-organic Chemistry	60	4
Practical Courses				
1	ITCH-401/ RPCH -401	Industrial Training /Research Project	240	8
2	SOCH-441	Seminar	15	1

M. Sc. S. Y. Organic Chemistry Elective papers (Fourth Semester)

Sr. No.	Paper No.	Title	Contact hours	Credits
Organic Chemistry Elective papers (Any one from the below or courses offered for any other program in school of chemical sciences)				
1.	EOCH-441	Chemistry of Natural product	60	4
2.	EOCH-442	Synthetic methods in organic chemistry	60	4
Open elective (any one)				
1.		Open elective from other schools	60	4
2.		MOOCS/SWAYAM/NPTEL courses	60	4
Open electives offered for students from other schools				
1.	OPCH-411	Radiation Chemistry	60	4

OCH-341 : Organic Reaction Mechanism (Lectures 60) Credits - 4

Course Objectives:

1. Provide sound understanding of fundamental organic principles
2. apply to organic reactions and biological systems
3. To know mechanism of carbanion generation and application
4. Provide deeper understanding of kinetic and non –kinetic methods.

Course contents:

1. Carbanions:-Formation, stability and mechanisms of important reactions.
2. Neighboring group participation.
3. Ester Hydrolysis (acid and base catalyzed).
4. Kinetic and non-kinetic methods used for determination of reaction mechanism.
5. Hammet equation, its modification and applications.
6. Mechanisms in Biological Chemistry.

Home assignment: Organic reaction mechanism: Reactive intermediates–carbonium ion, non-classical carbonium ion, carbine, nitrene, radicals, aryne and catalysis.

Books:

1. Mechanism and structure in organic chemistry E.S. Gould, Holt, Rinehart and Winston.
2. Advanced organic chemistry By-J. March.
3. Physical organic chemistry By – J. Hine.
4. Advanced organic chemistry Part A-Carey F. A. and Sundberg R. J. (Plenum Press).
5. Organic Chemistry By – Clayden, Greeves, Warren and Wothers [Oxford Press].
6. R.O.C.Norman, Principles of Organic Sythesis,Chapman and Hall,Londen,2nd 1980.

Course Outcomes: The learner should be able to

1. Predict the reaction mechanism for common organic reactions
2. Apply the concepts in new reactions
3. Understand the biological systems
4. Understand significance of Hammet equation.

OCH-342 : Organic Synthesis (Lectures 60) Credits - 4

Course objectives: To learn about

1. various organic reactionsrequired for synthetic transformations
2. photochemical reaction concepts
3. reaction rearrangements
4. application of the reactions in synthesis

Course contents:

1. Rearranments**:** Rearrangement to electron deficient carbon: Pinacol-pinacolone, Wagner-Meerwein, Benzillic acid, Wolf (Arndt-Eisterts Synthesis), Rearrangement to electron deficient nitrogen: Hoffman, Curtis, Schmidt, Lossen and Beckmann rearrangement, Rearrangement to electron deficient oxygen: Baeyer Villiger rearrangement, Rearrangements to electron rich carbon: Fovorskii, Neber.

2. Oxidation**:** Oxidation of alcohols: chromic acid, chromium (VI) oxide-pyridine complexes, manganese (IV) oxide and silver carbonate. Oxidation to carbon-carbon double bonds: Potassium permanganate, Osmium tetroxide peroxy-acids, Sharples epoxidation. Oxidation of ketones: Conversion of ketones into α,-β-unsaturated ketones, α-Ketols and 1,2-diketones, oxidation with ruthenium tetroxide, oxidation with thallium(III) nitrate, oppenauer oxidation.

3. Reduction**:** Catalytic hydrogenation, stereochemistry and mechanism, homogeneous hydrogenation, Reduction by dissolving metals: reduction with metal and acid, Reduction with metal in liquid ammonia (Birch reduction), reductive fission of alcohols and halides, reduction by hydride transfer reagents: MPV, lithium aluminum hydride and sodium borohydride, Mixed lithium aluminum hydride-aluminum chloride reagents, Di-isobutylaluminium hydride, sodium cyanoborohydride, Trialkylborohydrides, Reduction with borane and dialkylboranes, di-imide.

4. Photochemistry**:** Photochemistry of (π, π*) transitions: Excited states of alkenes, cis-trans isomerisation, photo stationary state, electrocyclisation and sigma tropic rearrangements, di-π methane rearrangement. Intermolecular reactions, photocycloadditions, photodimerisation of simple and conjugated olefins, addition of olefins to α, β-unsaturated carbonyl compounds. Excited states of aromatic compounds, Photoisimerisation of benzene Photochemistry of (n-π*) transitions: Excited states of

carbonyl compounds, homolytic cleavage of α- bond, Norrish type I reactions in acyclic and cyclic ketones and strained cycloalkanediones.Intermolecular abstraction of hydrogen: photoreduction - influence of temperature, solvent, nature of hydrogen donor and structure of the substrate Intramolecular abstraction of hydrogen: Norrish type II reactions in ketones, Esters and 1, 2- diketones, Addition to carbon-carbon multiple bonds, Paterno-Buchi reaction, Photochemistry of nitrites-Barton reaction.principles and applications

Home assignment: Green Chemistry

Chapter 1.

Introduction. Principles, atom economy and scope. Introduction to alternative approaches. Solvent free reactions-principle, scope, utility of solvent free condition reactions. Organic Synthesis in solid state (without using any solvent): Michael addition, Beckmann rearrangement, Synthesis of aziridines; solid supported organic synthesis: Synthesis of aziridines, pyridines, chromenes and flavones.

Chapter 2.

Aqueous Phase Reactions: Diels-Alder Reaction, Heck reaction, epoxidation, Dihydroxylation (Syn- & Anti-)

Chapter 3.

Microwave Technology: Microwave equipment, activation-benefits, limitations, microwave effects.a) Microwave Solvent free reactions (Solid state Reactions) - Deactivation, deprotection, saponification of esters, alkylation of reactive methylene compounds, synthesis of nit riles from aldehydes, reductions.b) Microwave assisted reactions in water — Hoffmann elimination, hydrolysis, oxidation, saponification reactions.c) Microwave assisted reactions in organic solvents — Esterification reactions, Fries rearrangement, Ortho ester Claisen rearrangement, Diels- Alder reaction, decarboxylation.d) Microwave assisted reactions under PTC conditions:

Chapter 4.

Ultrasound assisted reactions: introduction, substitution reactions, addition, oxidation, reduction reactions.

Chapter 5.

Organocatalysis: Aldol reactions, Acyl transfer reactions, nucleophilic N-heterocycliccarbenes in asymmetric oregano catalysis, setter reaction and Baker’s Yeast.

Chapter 6. Ionic liquids: Introduction and applications in organic synthesis (illustrate with two examples).

Books:

1. Organic Chemistry, J. Clayden.
2. Some modern methods of organic synthesis, W. Carrathers, Cambridge Univ. Press
3. Modern synthetic reaction, H.O. House, W. A. Benjamin.
4. Advanced organic reactions, reactions, mechanisms and structure, J. March, Wiley.
5. Principles of organic synthesis, R.O.C. Norman and J. M. Coxon, Blackie Academic and Professional.
6. Advanced organic chemistry part-B, F, A. Carrey and R. J. Sundberg, Plenum
7. Organic reaction and their mechanisms, P. S. Kalsi, New Age International Publishers.
8. Protective groups in organic synthesis, T. W. Greene and P. G. M. Wuts, IInd Edition, John Wiley and Sons 1991.
9. Organic synthesis: the disconnection approach, sturant warren, John Wiley and sons.

Course Outcomes:

The learner should be able to

1. Apply different reactions in organic synthesis.
2. Know photochemical outcome of reported reactions and apply them in synthesis.
3. Develop mechanism based new reactions.
4. Apply protection and deprotection strategies.

LOCH-341 : Laboratory Course–1 Credits - 4

Course Objectives:

1. Develop expertise in various separation techniques.
2. Functional group identification
3. Exposure microscale synthesis
4. Exposure to different characterization techniques

Separation of at least ten mixtures containing three components.: The mixtures should also involve separation of nitro phenols, amino acids, low boiling substances, water soluble substance. Amines, phenols and acids used should also contain other elements and functional groups. Preparation should be carried out on micro scale using 10 mmols or 1.0 gm of starting material and reactions should be monitored by TLC

Course Outcomes :

Skill development of Students in

1. Various techniques of separation
2. Analysis of organic substances
3. Drying and crystallization
4. TLC analysis
5. Microscale technique.
6.

LOCH-342 : Laboratory Course– 2 (Credits - 4)

Course Objectives: The learner Should be able to

1. Interpret spectra
2. Solve combined problems
3. Carry out multistep synthesis
4. Handle microscale experiments

A. Identification of organic compounds by spectral analysis. Minimum 10 problems based on joint applications of UV, IR, PMR, CMR and mass should be carried out

B. Two stage preparations of heterocyclic and biologically active molecules: Atleast 10 preparatives should be carried out on microscale using 10 mmol of starting material.

1 Benzaldehyde → Benzalacetophenone → Epoxide
2 Acetophenonephenylhydrazone → 2-Phenyl indole → Bis-indolyl methane
3 Acetophenone → Chalcone → Pyrazoline
4 Glycine → Hippuric acid → Azlactone
5 2-Chlorobenzoicacid → n-Phenylanthranilic → 9-Acridone
6 2-Aminobiphenyl → o-Formamidobiphenyl → Phenanthridine
7 Fluorenone → Fluorenone oxime → 6-Phenanthridone
8 p-Toluidine → 4-(p-tolylamino)pent-3-en-2-one → 2,4,6-Trimethylquinoline
9 Salicylaldehyde → o-Formylphenoxyacetic acid → Benzofuran
10 Diethylmalonate → Barbituric acid → Nitrobarbituric acid →
11 o-Phenylenedimine → Diphenyl quinoxaline → 5,6-diphenylpyrazine-2,3-dicarboxylic acid
12 o-Nitrobenzaldehyde → □□□-Diformamido-o-nitrotoluene → Quinazoline

13 o-Hydroxyacetophenone → Chalcone → Flavonone and Flavonol

14 Benzene → Benzil → benzilic acid.

15 Benzene → 2-benzoyl benzoic acid → Anthraquinone

16 Cyclohexanone → Phenylhydrazone → 1, 2, 3, 4-tetrahydrocarbazole

17 Phenol → Salicyladehyde → Coumarin

Course Outcomes : Students

1. Exposure to multistep organic synthesis
2. Develop expertise in various techniques involved in preparation
3. Develop expertise in analysis of organic compounds
4. Deduce structure of compounds based on spectral analysis .

Skill development technique Synthesis using : Micro wave, Sono chemistry, mechano chemistry. Development of highly efficient nano structured catalysts . Exposure to state of art instrumentation facility

SOCH-341: Seminar **Credit - 1**

Course Objective: To enhance the student's

1. presentation skill
2. stage exposure
3. Self studyand preparation
4. Exposure to power point presentation

Course Outcomes: Develop mastery in

1. Data collection, compilation, internet use
2. Organic concepts
3. Presentation techniques
4. Verbal communication

EOCH-341: Organic Spectroscopy (60 Lectures) 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.

EOCH-342: Chemistry of Heterocycles and Biologically Active Molecules

(60 Lectures) Credits-4

Course Objectives: The students should learn about

Types of heterocycles.

1. Nomenclature.
2. Synthetic routes.
3. Applications of heterocycles in different areas.
4. Heterocycles in natural products.

Course Contents:

1. Nomenclature and classification of heterocycles
2. Five-membered rings: Synthesis and reactions of Furan, Pyrrole, and thiophene.
3. Five membered rings: Synthesis and reactions of Benzofuran, indole, benzothiophene
4. Six membered and fused six membered rings: Synthesis and reactions of Pyridine, Quinoline, Isoquinoline.
5. Rings with more than one hetero atom: Synthesis and reactions of imidazoles, oxazoles, thiazoles, pyrimidines, purines, oxadiazoles, thiadiazoles.
6. Non aromatic heterocycles: structure, synthesis and preparation of azeridine, oxirane, thiairane, oxaziridine, azetidine, azetidinone, oxetane, oxetanone, thietane
6. Seven membered rings: Synthesis and reactions of azepines, oxepines, thiepines.
7. Heterocycles in natural products, medicine and materials

Home assignment: Chiral drugs

- Introduction to chiral drugs. Three-point contact model, Eutomer, Distomer and eudesmic ratio.
- Pfeiffer's rule. Role of chirality on biological activity: Distomers – a) with no side effects b)with undesirable side effects c) both isomers having independent therapeutic value d)combination products having therapeutic advantages e) metabolic chirality inversion. Synthesis and pharmacological activity of S-Ibuprofen, S- Metaprolol, Ininavirsulfate, Levocetrazine, 2S-Verapamil, S,S-Ethambutol , (+)Lomefloxacin, Fluvastatin, Dextropropoxyphen, (+)Ephedrine, (+)Griseofulvin, Dexormaplatin, R-Indacrinone, Nateglinide, Oxybutynin hydrochloride, S,S- Captopril and S,S,S-Enalaprilate

Books:

1. Heterocyclic chemistry by Joule and Mills.
2. Modern Heterocyclic chemistry by L. A. Paquette, Benjamin.
3. Advanced organic chemistry by – Carry and Sundberg
4. Mechanism and structure in organic chemistry by – E. S. Gould, Holt, Rinehart and Winston.
5. The Chemistry of Heterocycles by Theophil Eicher, Siegfried hauptmann.
6. Heterocyclic chemistry by R. K. Bansal.
7. Heterocyclic Chemistry by T. L. Gilchrist.
8. Contemporary Heterocyclic Chemistry by G. R. Newkome and W. W. Poudler, Wiley.

Course outcomes: The learner should know

1. Characteristic features of different heterocycles
2. The importance of heterocycles in different fields
3. Synthetic methods for different heterocyclic moieties
4. Therapeutic application of heterocycles

OPCH 311: INTELLECTUAL PROPERY MANAGEMENT (60 HR) CREDIT-04

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.

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.

OCH-441: Advanced Organic Chemistry (60 Lectures) Credits - 4

Course Objectives: The learner should know

1. The steriochemical principles.
2. Application of organomettalic reagents,
3. Most common reagents used in organic synthesis.
4. Principles of asymmetric synthesis

Course Contents :

1. Principles of asymmetric synthesis :

   Introduction and terminology: Topicity in molecules Homotopic, stereoheterotopic (enantiotopic and diastereotopic) groups and faces- symmetry, substitution and addition criteria.Prochirality Stereoselective reactions: Substrate stereoselectivity, product stereoselectivity, enantioselectivity and diastereoselectivity. Conditions forstereoselectivity: Symmetry and transition state criteria, kinetic and thermodynamic control.

   Methods for inducing enantio and diastereoselectivity. Analytical methods: % Enantiomeric excess, enantiomeric ratio, optical purity, % diastereomeric excess and diastereomeric ratio. Techniques for determination of enantiomeric excess, specific rotation, Chiral NMR; Chiralderivatizing agents, Chiral solvent, Chiral shift reagents and Chiral HPLC.

2. Use of organometallic reagents:
   Synthesis and applications of Li and Mg reagents, nucleophilic addition to aldehyde, ketones, ester, epoxide, CO_2, CS_2, isocyanates, ketenes, imines, amides, lactones, *o*-metallation of arenes using organolithium compounds. Organozinc reagents: Preparation and applications, Reformatsky reaction, Simon-Smith reaction. Organo Cd and Pd reagents in organic synthesis, transition metal complexes in organic synthesis.

3. Reagents in organic synthesis:

Use of following reagents in organic synthesis and functional group transformation: Gilman's reagent (lithium dimethyl cuprate), lithium diisopropylamide (LDA), trimethylsilyl iodide or chloride, phase transfer catalyst, crown ether and Merrifield resin, Peterons's synthesis, Wilkinson's catalyst, Baker's yeast, diazomethane, polyphosphoric acid, dicyclohexylcarbodiimide (DCC), yields, organoboranes.

4. Green chemistry: use of microwave and ultrasonic techniques in organic synthesis.

Home assignment :

Strategies in Asymmetric Synthesis: l. Chiral substrate controlled, 2. Chiral auxiliary controlled, 3. Chiral reagent controlled and 4. Chiral catalyst controlled

1. Chiral Substrate controlled asymmetric synthesis: Nucleophilic additions to chiral carbonyl compounds. 1, 2- asymmetric induction, Cram's rule and Felkin-Anh model.
2. Chiral auxiliary controlled asymmetric synthesis: α-Alkylation of chiral enolates, azaenolates, imines and hydrazones. 1, 4-Asymmetric induction and Prelog's rule. Use of chiralauxiliaries in Diels-Alder reaction.
3. Chiral reagent controlled asymmetric synthesis: Asymmetric reductions using BINAL-H. Asymmetric hydroboration using IPC2 BH and IPCBH2.
4. Chiral catalyst controlled asymmetric synthesis: Sharpless and Jacobsen asymmetric epoxidations. Sharpless asymmetric dihydroxylation. Asymmetric hydrogenations using chiral Wilkinson biphosphine and Noyoricatalys. Enzyme mediated enantioselective synthesis
5. Asymmetric aldol reaction: Diastereoselective aldol reaction (chiral enolate & achiral aldehydes and achiral enolate & chiral aldehydes) its explanation by Zimmerman-Traxel model.

Books:

1. Modern synthetic reactions-(Benjamin) H. O. House.
2. Reagents in organic synthesis-(John Wiley) Fieser and Fieser
3. Principles of Organic synthesis-(Methuen) R. O. C. Norman
4. Hydroboration- S. C. Brown.
5. Advances in Organometallic Chemistry- (A.P.)F. C. A. Stone and R. West.
6. Organic Chemistry (Longman)Vol. I & Vol. II- Finar
7. Oxidation by-(Marcel Dekker) Augustin
8. Advanced Organic Chemistry 2nd Ed. R R. Carey and R. J. Sundburg.
9. Tetrahedron reports in Organic Chemistry- Vol.1, No. 8.

10. Organic Synthesis-(Prentice Hall)R. E. Ireland.
11. Homogeneous Hydrogenation-(J. K.) B. R. James.
12. Comprehensive Organic Chemistry- (Pargamon) Barton and Ollis.
13. Organic reactions- various volumes- R. Adams.
14. Some modern methods of Organic synthesis-(Cambridge)W.Carruthares.
15. Advanced Organic Chemistry – J. March
16. Lehninger's Principles of Biochemistry,(4thEd.) David L. Nelson, Michael M. Cox.

Course Outcomes:

The learner should know

1. common organic reagents,
2. organometallic reagents
3. concepts for asymmetric synthesis
4. application of application of different reagents in total synthesis

OCH-442: Bio-Organic Chemistry (60 Lectures) Credits - 4

Course Objectives: the learner should know

1. Origin of life and basic building blocks
2. The macromolecules in the biological systems
3. Application of biopolymers
4. Synthetic enzymes and applications

Course contents:

1 Cell Structure and Functions:

Structure of prokarytic and eukaryotic cells, intracellular Organelles and their functions, comparison of plant and animal cells, Overview of metabolic processes-catabolism and anabolism. ATP-the biological energy currency. Origin of life-unique properties of carbon, chemical evolution and rise of living systems. Introduction to biomolecules, building blocks of bio-macromolecules.

2 Carbohydrates:

Conformation of monosaccharides, strucute and functions of Important derivatives of minosaccharides like glycosides, deoxy sugars, myoinosito, amino sugars. N-acetylmuramic acid, sialic acid, disaccharides and polysaccharides.

Structural polysaccharides – cellulose and chitin. Storage polysaccharides-starch and glycogen. Structure and biological functions of glucosaminoglycans or mucopolysaccharides. Carbohydrates of glycoproteins and glycolipids. Role of sugars in biological recognition. Blood group substances. Ascorbic acid. Carbohydrate metabolism – Kreb's cycle, applications of carbohydrates.

3 Lipids:

Fatty acids, essential fatty acids, structure and function of triacylglycerols. Glycerophospholipids ,sphiningolipids, cholesterol, bile acides prostaglandins. Lipoproteins composition and function, role in atherosclerosis. Propertieof lipid aggregates-micelles, bilayers, liposomes and their possible biological functions. Biological membrages. Flid mosaic model of membrane structure. Lipid metabolism– B-oxidation of fatty acids.

4 Amino-acids, Peptides and Proteins :

Chemical and enzymatic hydrolysis of proteins to peptides, amino acid sequencing. Secondary strucutre of proteins, forces responsible for holding of secondary structures. A-helix, b-sheets, super secondary structure, triple helix structure of collagen, Tertiary structure of protein-folding and domain structure. Quaternary structure. Amino acid metabolism-degradation and biosynthesis of amino acids, sequencedetermination: Chemical/enzymatic/mass spectral, racemization/ detection. Chemistry of oxyocin and tryptophan releasing hormone 9TRH).,

5 Nucleic Acids:

Purine and pyrimidine bases of nucleic acids, base pairing via H-bonding. Structure of ribonucleic acids (RNA) and deoxyribonucleic acids (DNA), double helix model of DNA and forces responsible for holding it. Chemical and enzymatic hydrolysis of nucleic acids. The chemical basis for heredity, and overview of replication of DNA, transcription, functions of nucleotides. Chemical synthesis DNA

6 Enzymes and Enzyme Models:

(a) Enzymes: Introduction and historical perspective, chemical and bioogical catalysis, remarkable properties of enzymes like caalytic power, specificity and regulation. Nomenclature and classification, extraction and purification. Fischer's lock and key and koshland's induced fit hypothesis, concept and identification of active site by the use of inhibitors, affinity labeling and enzyme modification by site-directed mutagenesis. Enzyme kinetics, Michaelis–Menten and Lineweaver Burk plots,

reversible and irreversible inhibition, mechanism of enzyme action. : Transition state theory, orientation and sterioc effect, acid base catalysis, coalent catalysis, strain or distortion some typical examples, enzyme in organic synthesis. (b) Enzyme Models: Host-guest chemistry, chiral recognition and catalysis, molecular recognition, molecular asymmetry and prochirality. Biomimetic chemistry, crown ethers, Cyclodextirns, cyclodextrin-based enzyme models, micelles, synthetic enzymes or synzymes.

6 Biotechnological Applications of Enzymes:

Large-scale production and purification of enzymes, techniques and methods of immobilization of enzymes, effect of immobilization on enzyme activity application of immobilized enzymes, use of enzymes in food and drink industry-brewing and cheesemaking, syrups from corn starch, enzymes as targets for drug design. Clinical uses of enzymes, enzyme therapy, enymes and recombinant DNA technology.

Home assignment: Chemical biology

Books:

1. Principles of Biochemistry, A. A. Lehninger, Worth publishers.
2. Biochemistry, L. Stryer, W. H. Freeman.
3. Biochemistry, J. David Rawn. Neil Patterson.
4. Principles of Biochemistry, A. A. Lehninger, Worth publishers.
5. Biochemistry, L. Stryer, W. H. Freeman.
6. Biochemistry, J. David Rawn. Neil Patterson.
7. Biochemistry, oet and Voet, John Wiley.
8. Outlines of Biochemistry, E.E. Conn and P. K. Stumpf, John Wiley.
9 Bioorganic Chemistry A Chemical Approach to Enzyme Action, Hermann Dugas & C. Penny, Springer –Verla Understanding Enzymes, Trevor palmer, Prentice Hall.
9. Enzyme Chemistry Impact and Applications, Ed. Collin J. Suckling, Chapman and Hall
10. Enzyme Mechanisms Ed. M. I. Page and A. Williams, Royal Society of Chemistry.
11. Fundamentals of Enzymology, N. C. Price ad L. Stevens, Oxford University Press.
12. Immobilized Enzymes: An Introduction and Applications in Biotechnology, Michael D. Trevan, John Wiley.

13. Enzymatic Reaction Mechanisms, C. Walsh, W. H. Freemain.

14. Enzyme Structure and Mechanism, A. Fresht, W. H. Freeman..

15. Biochemistry: The Chemical Reactions of Living Cells, D.E. Metzler, Academic Press.

Course outcomes: The learner will understand

1.The basic principles governing the metabolic reactions.

2.Energy pathways.

3. Functioning of catalytic systems .

4.Evolution of life and fundamental process governing it.

ITCH-401/RPCH-401 Industrial training/research project Credit - 8

Course Objectives:

The student is given exposure to different aspects of research such as

1. Literature survey,
2. Design the problem of research,
3. Develop methodology and
4. Execute the project

Course Contents: The student should carry out an independent research project with proper choice of the problem, design, and execution of the same within the stipulated time period.

Course Outcomes:

The student would excel in different aspects of research such as

1. Literature survey.
2. Selection of research topic.
3. Analysis of the problem.
4. Independent execution of the project selected with final dissertation .

SOCH-421 SEMINAR Credit – 01

Course Objectives: The learner should

1.Get Exposure to emerging trends in the field of choice

2.Understand the topic

3. use different toosl for presentation

3.Develop verbal mastery in presentation

Course Contents: The seminar topic may be related course content of the semester and should cover some of the emerging topics in the field. The topic should shed light on different aspects related to the field such as literature, mechansism and application.

Course outcome: The course provides the student a platform for

1. Self study
2. Learning emerging topics
3. Verbal presentation
4. Interaction

EOCH-441: Chemistry of Natural Products (60 Lectures) Credits - 4

Course Objectives:

Exposure to different natural products, and their

1.Nomenclature

2. Biogenesis,

3. Stereochemistry and structure elucidationS

4. Synthetic routes and biological role played by them

Course contents:

1. Introduction:

   Natural products of plant, animal, marine origin. Some examples of novel natural products of therapeutic application.

2. Terpenoids and Carotenoids:

   Classification, nomenclature, occurrence, isolation, general methods of structure determinat on, isoprene rule, structure determination, stereochemistry, biosynthesis and synthesis of the following representative molecules (only two) : B-Carotene a-Terpeneol, Home assignment:

stereochemistry, biosynthesis and synthesis of citral, Geraniol, Menthol, Farnesol, Zingiberene, Santonin, phytol, and abietic acid.

3. Alkaloids:

   Definition, nomenclature and physiological action, occurrence, isolation, general methods of strucutre elucidation, degradation, classification based on nitrogen heterocyclic ring, role of alkaloids in plants, Structure, stereochemistry, synthesis and biosynthesis of the following : Atropine, ajmaline Home assignment stereochemisry, synthesis & biosynthesis of Ephedrine, (+)- coniine, Nicotine, Quinine, Morphine, reserpine, Vinea alkaloids.

4. Steroids:

   Occurrence, nomenclature, basic skeleton, Diel's hydrocarbon and stereochemistry. Isolation, structure determination and synthesis of Cholesterol and Testosterone, Biosynthesis of steroids, Synthesis of Bile acids, Androsterone, Estrone, Progestrone, Aldosterone, estradiol,

5. Plant Pigments:

   Occurrence, nomenclature and general methods of structure detrmination. Isolation and synthesis of Apigenin and Myrcetin, biosynthesis of Flavonoids: Acetate pathway and shikimic acid pathway Home assignment: structure determination. Isolation and synthesis of Luteolin, Quercetin, Quercetin-3-glucoside, Vitexin, Diadzein, Butein, Aureusin, Cyanidin-7-arabinoside, Cyanidin, Hirsutidin

6. Prostaglandins:

   Occurrence, nomenclature, classification, biogenesis and physiological effects, synthesis of PGE2, PGE2a and other derivatives.

7. Pyrethroids, Rotenones and pheromones:

   Synthesis and reactions of pyrethroids, Rotenones and pheromons (For structure elucidation, emphasis is to be placed on the use of spectral parameters wherever possible).

8. Recent advances in the synthesis of therapeutically important natural products.

Home Assignment: Biogenesis: Building blocks and construction mechanism of terpenoids, steroids and alkaloids

Books:

1. Natural Products : Chemistry and Biological Significance, J. Mann, R.S. Davidson, J. B. Hobbs, D. V. Banthrope and J. B Harborne, Longman, Essex.
2. Organic Chemistry, Vo. 2. I. L. Finar, ELBS.
3. Stereoselective synthesis: A Practical Approach, M. Nogradi, VCH.
4. Rodd's Chemistry of Carbon Compounds, Ed. S. Coffey, Elsevier.

5. Chemistry, Biological and Pharmacological Properties of Medicinal plants from the Americas, Ed. Kurt Hostettmann, M. P. Gupta and A. marston, Harwood Academic publishers.
6. Introduction to Flavonoids, B. A. Bohm, harwood Academic Publishers.
7. New Trends in Natural Product chemistry, Atta-ur-Rahman and M. I. Choudhary, Harwood Academic Publishers.
8. Insectcides of Natural Origin, Sukh Dev. Harwood AdemicPblishers.
9. Chiral auxilliaries and ligands in asymmetric synthesis-seyden-penne (Wiley Interscience).
10. Biotechnological innovations in chemical synthesis-Butterworth-Heinemenn, Biolot.

Course Outcomes:

The learner will be familiar with different natural products with respect to

1. Extraction methods, structure elucidation, degradation, stereochemistry.
2. Synthetic strategies for total synthesis of natural products.
3. Therapeutic application of different natural products and prostaglandins.
4. Rotenones and their applications.
5. Resents advances in natural products.

EOCH-442: Synthetic Methods in Organic Chemistry (60 Lectures) 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.
4. Apply enamines in organic synthesis.

OPCH-411**: Radiation Chemistry** (60 contact hours) Credit-4

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.