

**ADIKAVI NANNAYA UNIVERSITY: RAJAMAHENDRAVARAM**  
**SCHOOL OF CHEMICAL SCIENCES**  
**DEPARTMENT OF CHEMISTRY**  
**SYLLABUS FOR Pre-PhD WRITTEN EXAMINATION**

**PAPER-1**

**RECENT ADVANCES IN THE CHEMICAL SCIENCES**

**Unit - I. Named reactions and their mechanisms:**

- 1) Aldol Reaction 2) Birch Reduction 3) Prins Reaction 4) Diels-Alder Reaction.
- 5) Barton Reaction 6) Heck Reaction 7) Michael Reaction 8) Wittig Reaction
- 9) Reimer-Tiemann Reaction 10) Bayer Villager Oxidation.

**Unit - II. Organic reagents and their applications:**

1. Lead tetra Acetate ( $\text{Pb}(\text{OAc})_4$ ) 2. Sodium Borohydride ( $\text{NaBH}_4$ ) 3. Lithium aluminium hydride ( $\text{LiAlH}_4$ ) 4. Di-isobutyl aluminium hydride (DIBAL-H) 5. 9-Borabicyclo[3.3.1]nonane 9-BBN, 6. Selenium dioxide ( $\text{SeO}_2$ ) 7. Osmium tetroxide ( $\text{OsO}_4$ ) 8. Periodide ( $\text{HIO}_4$ ) 9. 2,3-dichloro-5,6-Dicyano-1,4-Benzoquinone (DDQ) 10. Pyridinium chloro chromate (PCC).

**Unit - III. Photochemistry and Retro Synthetic analysis**

**Photochemistry:**

1. Norrish type-I cleavage 2. Norrish type-II cleavage 3. Jablonski diagram 4. Photo Reduction
5. Photochemistry of Nitrite esters

**Retro Synthetic Analysis:**

- a) Disconnection b) Target Molecule c) Synthons d) Synthetic Equivalent
- e) Functional Group Interconversion (FGI) f) Functional Group Addition (FGA)
- g) Convergent synthesis and Linear synthesis

**Unit-IV. Organometallic chemistry**

18 electron rule, Metal carbonyl complexes, Nitrosyl complexes, Metal alkyls, carbenes, carbynes, alkyl complexes, metallocenes

**Reactivity and Catalysis:**

Reactivity: Substitution reactions in carbonyl complexes, Nucleophilic and electrophilic attack of coordinated ligands

Catalysis: Alkene hydrogenation (Wilkinson's Catalyst), Ziegler-Natta Catalysis, Wacker Process

## **Unit-V. Chromatography and Instrumentation**

Chromatography: Principle and instrumentation of HPLC, Ion-Exchange mechanism, Thin layer Chromatography, Column Chromatography, Paper Chromatography

Instrumentation: Principle and instrumentation of Nuclear magnetic spectroscopy(NMR)-Coupling Constant, Chemical shift, spin-spin splitting. Principle and instrumentation of Infrared radiation spectroscopy-Factors influencing Vibrational frequencies. Principles and applications of Scanning electron microscopy (SEM),Transmission electron Microscopy(TEM)

### **Books for References:**

- 1) Advances in Organic chemistry: Jerry March, Wiley Eastern Limited.
- 2) Some modern methodologies in organic synthesis, W. Caruthers, Cambridge.
- 3) Photochemistry by C W J Wells
- 4) Organic Photochemistry by Turro
- 5) Inorganic Chemistry by Pearson
- 6) A textbook of Chromatography-Rajbir Singh

**ADIKAVI NANNAYA UNIVERSITY: RAJAMAHENDRAVARAM**  
**SCHOOL OF CHEMICAL SCIENCES**  
**DEPARTMENT OF CHEMISTRY**  
**SYLLABUS FOR Pre-PhD WRITTEN EXAMINATION**

**Paper-II**

**DESIGN AND NOVEL SYNTHESIS OF OXYGEN CONTAINING NATURAL PRODUCTS THROUGH A PRINS AND RELATED CYCLIZATIONS AND RESEARCH METHODOLOGY.**

**Unit-I Prins Reaction**

General introduction about Prins type cascade cyclizations focusing new methodologies development and application to natural product synthesis as a background. Development in this area for the stereoselective synthesis of wide range of tetrahydropyran and tetrahydrofuran derivatives.

**Unit-II New Synthetic methodologies of Prins Reaction**

Development of new synthetic methodologies for the stereoselective synthesis of 2, 3, 6 tri-substituted tetrahydropyrans and spiropyrrolidine derivatives through Prins/Ene cyclization. Domino Prins/ Ene cyclization and Prins bicyclization for the synthesis of spiropyrrolidine derivatives.

**Unit-III Definition of Research:**

Nature and importance of Research, Aims and Objectives of Research, Selection of area of research, Design of experimental program, Applications of research and types

**Unit-IV Searching the chemical literature:**

Search for existing literature, Review the literature selected, Develop a theoretical and conceptual framework, writing up the review, Selection of literature, collection of literature, Manual collection from Library, usage of E-library, collection of literature from web, collection of literature from Scopus, Science direct, Scifinder etc.,

**Unit-V Thesis and report writing:**

General format, Tables and figures, experimental details, spacing and alignment, abbreviations and special symbols.

## Books and References:

1. Alexander Deiters ; Stephen F. Martin. *Chem. Rev.* **2004**,104, 2199.
2. (a) Nicolaou, K. C.;Chen, J.S. *Chem. Soc. Rev.* **2009**, 38, 2993. (b) Parsons, P. J.; Penkett, C.S.; Shell, A.J. *Chem. Rev.* **1996**, 96, 195 (c) Nicolaou, K. C.; Edmonds, D. J.; Bulger, P.G. *Angew. Chem. Int. Ed.* **2006**, 45, 7134 (d) Domling, A. *Chem. Rev.* **2006**, 106, 17. (e) Ramon, D. J.; Yus, M. *Angew. Chem., Int. Ed.* **2005**, 44, 1602. (f) Domling, A.; Ugi, I. *Angew. Chem. Int. Ed.* **2000**, 39, 3168.
3. a) Zhu, J. P.; Bienayme, H. *Multicomponent Reactions*; Wiley-VCH, **2004**. (b) Tietze, L. F.; Brasche, G.; Gericke, K. *Domino Reactions in Organic Synthesis*; Wiley-VCH: Weinheim, **2006**. (c) Tietze, L. F. *Chem. Rev.* **1996**, 96, 115.
4. (a) Fujioka, H.; Murai, K.; Kubo, O.; Ohba, Y.; Kita, Y. *Org. Lett.* **2007**, 9, 1687. (b) Yan, C. G.; Song, X. K.; Wang, Q. F.; Siemeling, U.; Bruhn, C. *Chem. Commun.* **2008**, 1440.
5. (a) Xue, D.; Chen, Y. C.; Wang, Q. W.; Cun, L. F.; Zhu, J.; Deng, J. G. *Org. Lett.* **2005**, 7,5293. (b) Xue, D.; Li, J.; Zhang, Z. T.; Deng, J. G. *J. Org. Chem.* **2007**, 72, 5443.
6. (a) Marchalin, S.; Baumlova, B.; Baran, P.; Oulyadi, H.; Daich, A. *J. Org. Chem.* **2006**, 71, 9114. (b) Inokuma, T.; Hoashi, Y.; Takemoto, Y. *J. Am. Chem. Soc.* **2006**, 128, 9413.
7. Prins, H. J. *Chem. Weekbl.* **1919**, 16, 1072 and **1919**, 16, 1510.
8. (a) Adams, D. R.; Bhatnagar, S. R. *Synthesis***1977**, 661. (b) Arundale, E.; Mikeska, L. A. *Chem. Rev.* **1952**, 51, 505.
9. For reviews on Prins cyclizations see: (a) Olier, C.; Kaafarani, M.; Gastaldi, S. S.; Bertrand, M. P. *Tetrahedron.***2010**, 66, 413. (b) Crane, E. A.; Scheidt, K. A. *Angew. Chem., Int. Ed.* **2010**, 49, 8316. (c) Pastor, M.;Yus,I. M. *Curr. Org. Chem.* **2012**, 16, 1277. (d) Han, X.; Peh, G. R.; Floreancig, P. E. *Eur. J. Org. Chem.* **2013**, 1193.
10. Hanschke,E.*Chem. Ber.* **1955**, 88, 1053.
11. Alder, R. W.; Harvey, J. N.; Oakley, M. T. *J. Am. Chem. Soc.* **2002**, 124, 4960.
12. (a) Martinet, P.; Mousset, G.; Michel, M. C. R. *Acad. Sci. Paris. Ser.C.* **1969**, 268, 1303. (b) Martinet, P.; Mousset, G. *Bull. Soc. Chim. Fr.* **1970**, 1071.
13. (a) Overman, L. E. *Acc. Chem. Res.* **1992**, 25, 352. (b) Overman, L. E. *Aldrichim. Acta.***1995**, 28, 107. (c) Selectivities in Lewis Acid-Promoted Reactions; NATO ASI Series C; Schinzer, D., Ed.; Kluwer Academic: Dordrecht, The Netherlands, **1989**,289, 1.
14. Jerry March: Advanced Organic chemistry : 6<sup>th</sup> edition ,wiley, madras
15. Research Methodology- A Step-By-Step Guide for Beginners by Ranjit Kumar.
16. Research Methods by Trochim,William M.K.