

## MHRD Scheme on Global Initiative on Academic Network (GIAN)

### Title

#### Diverse Application of Modern Stereoselective Synthesis - Where Now ?

#### 1.0 Overview

The need of enantiomerically pure bioactive molecules has guided the chemist to discover an asymmetric variation of the known reaction, as well as to search for novel asymmetric transformations. Therefore, during the past few decades the stereoselective synthesis has emerged immense importance due to its huge application in the synthesis of complex drug molecules and natural products. A basic understanding of the stereoselective synthesis provides an efficient backbone to design novel complex molecules and catalysts that can be utilized to install multiple stereogenic centres in medicinally active agents. To meet the requirements for the synthesis of medicines to treat several lives threatening disease like cancer, the increasing demands of chemical technology must be taken care in order to create complex chiral centers. The current topic will focus on introduction of a new, simplified classification for stereoselective reactions.

In recognition of this research field enormous amount of work has been invested in order to synthesize complex target molecules. One of such example is the enantioselective multistep synthesis of (-)-desethylburnamonine, (-)-vindeburnol and (-)-3-epitacamonine using (-)-acetoxyglutarimide as starting material.

#### 2.0 Objectives

The key objective of this course is to educate the participants on the fundamental concepts of stereoselective synthesis and its applications to resolve the challenges to install multiple stereogenic centers in the "*molecules that save life*". Giving importance to the explicit narrow exposure of students from remote north-eastern region on recent trends of Indian academic, such a course will help to broaden their platform and also open up several channels for collaborative research with the international, and faculties. The key lectures will be delivered by Professor Ilan Marek, who is one of the most experts in this horizons and presently he is affiliated to the Department of Chemistry of Technion-Israel Institute of Technology, Israel. The course coordinator will coordinate the tutorials each day in the afternoon. We plan to have ten lectures, three tutorials and two assignments within the time frame mentioned above. The tentative title of the course would be: "Diverse Application of Modern Stereoselective Synthesis - Where Now ?".

#### 3.0 Teaching Faculty with allotment of Lectures and Tutorials

- (1) Prof. Dr. Ilan Marek, Department of Chemistry of Technion-Israel Institute of Technology, Israel
  - 7 hours lecture and 3 hours tutorial
- (2) Dr. Chandi Charan Malakar, Department of Chemistry, National Institute of Technology, Manipur
  - 3 hours lecture and 3 hours tutorial

#### 4.0 Course details

The course will open up huge opportunities to the participants to interact with external faculty during the course period. Every day there will be two-hour lecture on the topics outlined above. This will be followed by tutorial, discussions and assignments that will be restricted on the concepts delivered in the lectures. The course coordinator, together with other faculties, will conduct the tutorials. The tentative course content is given below.

#### 4.1 Tentative Duration:

If proposal is accepted the above mentioned course is proposed to be held at the seminar hall, NIT Manipur, Langol campus during 10 - 14 December 2020 (5 days) : 10 hrs lecture, 6 hrs tutorial and 2 hrs assignment.

#### 4.2 Proposed Lecture Schedule

##### Day 01: December 10, 2020 (Thursday)

|                   |  |
|-------------------|--|
| <b>Lecture 01</b> | <b>10:00 am -11:00 am</b>  |
|                   | <i>Title: Overview of the stereoselective synthesis (by Prof. Dr. Ilan Marek)</i>                          |
| Lecture Overview  | The lecture will focus on the basic concept of stereoselective synthesis.                                  |
| <b>Lecture 02</b> | <b>11:00 am - 12:00 noon</b>   |
|                   | <i>Title: Concept of stereoselective synthesis using chiral auxiliaries (by Dr. Chandi Charan Malakar)</i> |
| Lecture Overview  | During the lecture the importance of chiral auxiliaries in synthesis will be discussed.                    |
| <b>Lecture 03</b> | <b>2:00 pm - 3:00 pm</b>   |
|                   | <i>Title: Chiral auxiliary in synthesis of bioactive molecules (by Prof. Dr. Ilan Marek)</i>               |
| Lecture Overview  | This lecture will highlight the application of chiral auxiliaries in the synthesis of bioactive molecules. |

##### Day 02: December 11, 2020 (Friday)

|                    |  |
|--------------------|--|
| <b>Lecture 04</b>  | <b>10:00 am -11:00 am</b>  |
|                    | <i>Title: Stereoselective synthesis using chiral reagents (by Prof. Dr. Ilan Marek)</i>  |
| Lecture Overview   | The mentioned course will offer the overview of the potential approaches on the various methods for the preparation of chiral reagents and their application on stereoselective synthesis. |
| <b>Tutorial 01</b> | <b>11:00 am - 12:00 noon</b>   |

The tutorial session will focus on the discussion and problem solving  
(by Dr. Chandi Charan Malakar)

**Lecture 05****2:00 pm - 3:00 pm***Title: Chiral reagents in total synthesis (by Prof. Dr. Ilan Marek)*

Lecture Overview

The above mentioned lecture will highlight a broad overview on the application of chiral reagents on total synthesis of natural products and drug molecules.

**Tutorial 02****3:00 pm - 4:00 pm**

The tutorial session will focus on the discussion and problem solving  
The tutorial session will focus on the discussion and problem solving  
(by Dr. Chandi Charan Malakar)

**Day 03: December 12, 2020 (Saturday)****Lecture 06****10:00 am - 11:00 am***Title: Stereoselective synthesis using chiral catalyst (by Prof. Dr. Ilan Marek)*

Lecture Overview

This lecture will represent the novel approaches for the synthesis of chiral catalyst.

**Tutorial 03****11:00 am - 12:00 noon**

The tutorial session will focus on the discussion and problem solving  
(by Prof. Dr. Ilan Marek)

**Lecture 07****2:00 pm - 3:00 pm***Title: Organocatalysis in stereoselective synthesis (by Dr. Chandi Charan Malakar)*

Lecture Overview

This lecture will provide an overview of the synthesis of organocatalyst and their application on stereoselective synthesis

**Assignments 01****3:00 pm - 4:00 pm (by Dr. Chandi Charan Malakar)****Day 04: December 13, 2020 (Sunday)****Lecture 08****10:00 am - 11:00 am***Title: Advances on generation of all-carbon quaternary stereogenic centers (by Prof. Dr. Ilan Marek)*

Lecture Overview

This lecture will provide an overview of installation of all-carbon quaternary centers

|                    |   |
|--------------------|---|
| <b>Tutorial 04</b> | <b>11:00 am - 12:00 noon</b><br>The tutorial session will focus on the discussion and problem solving<br>(by Prof. Dr. Ilan Marek)  |
| <b>Lecture 09</b>  | <b>2:00 pm - 3:00 pm</b><br><i>Title: Metal-catalysis in stereoselective synthesis (by Prof. Dr. Ilan Marek)</i>                    |
| Lecture overview   | This lecture will discuss regarding recent development on application of metal catalysis in stereoselective synthesis               |
| <b>Tutorial 05</b> | <b>3:00 pm - 4:00 pm</b><br>The tutorial session will focus on the discussion and problem solving<br>(by Dr. Chandi Charan Malakar) |

**Day 05: December 14, 2020 (Monday)**

|                      |  |
|----------------------|--|
| <b>Lecture 10</b>    | <b>10:00 am -11:00 am</b><br><i>Title: Miscellaneous and conclusion (by Dr. Chandi Charan Malakar)</i>                             |
| Lecture Overview     | The entire lecture will focus on the recent challenges and future scope of the stereoselective synthesis                           |
| <b>Tutorial 06</b>   | <b>11:00 am - 12:00 noon</b><br>The tutorial session will focus on the discussion and problem solving<br>(by Prof. Dr. Ilan Marek) |
| <b>Assignment 02</b> | <b>2:00 pm - 3:00 pm</b> (by Dr. Chandi Charan Malakar)  |

**Date of Examination:** December 14, 2020 (Monday) (3:00 pm - 4:00 pm)

**5.0 Who can attend?**

Undergraduate, Post-graduate, Ph.D Students, Postdoctoral fellow or Research Associate and faculty from both Science and Engineering streams as well as from Industry and Research Organization.

## 6.0 Detailed CV of Experts

### 6.1 CV of Prof. Dr. Ilan Marek (Department of Chemistry of Technion-Israel Institute of Technology, Israel)



Ilan Marek, FRSC was born in Haifa (Israel), educated in France, and received his PhD thesis in 1988 from the University Pierre et Marie Curie, Paris, (France) under the guidance of Professor J. F. Normant. In 1989 he was postdoctoral fellow in Louvain-la-Neuve (Belgium) with Professor L. Ghosez and obtained a research position at the CNRS in France in 1990. After obtaining his Habilitation in organic chemistry, he moved to the Technion-Israel Institute of Technology at the end of 1997 where he currently holds a full Professor position. Since 2005, he holds the Sir Michael and Lady Sobell Academic Chair.

He was awarded the First French Chemical Society-Acros Prize for young Organic Chemist (under 40 years old in 1997); the Japan Society for the Promotion of Science Visiting Professor Award (1997); the Lawrence G. Horowitz Career Development Chair (1998); the Yigal Alon Fellowship (1998); Evelyn and Salman Grand Academic Lectureship-USA (1998); the Yosefa and Leonid Allschwang Award, administered by the Israel Science Foundation (2000); the Michael Bruno Memorial Award 2002, administered by the Rotschild Foundation (2002); the Prize for Excellent Young Chemist, The Israel Chemical Society (2004); the Merck Sharpe and Dohm Lecturer (2005); the Bessel Award of the Humboldt Foundation, Germany (2007), the Taub Award for Academic Excellence (2009), The German-Technion for Academic Excellence and Scientific Collaborations (2010), the Royal Society Chemistry Organometallic Award from the RSC (2011), the Taiwan National Science Council Visiting Scholar (2011), the Janssen Award for Creativity in Organic Synthesis (2012), the Israel Chemical Society Award for Excellence (2012), the Moore Distinguished Scholar Appointment from California Institute of Technology (CalTech) in 2013, the SFB-guest professor Wilhelms-University Muenster (2015), The Weizmann Prize for Exact Sciences (2015), the 17th International Organic Chemistry Foundation Yoshida Lectureship, Japan (2015) and the Yannai Prize for Excellence in Teaching (2015).

He is a member of the International Scientific Committee of European Symposium on Organic Chemistry (ESOC), including the position of Chairman (2007-2009), Chairman of the Organic Division of the European Association of Chemical and Molecular Science (EuChemS), member of Advisory Board of Chemical Communications (RSC), Organic and Biomolecular Chemistry (RSC), European Journal of Organic Chemistry (Wiley), *Angewandte Chemie International Edition* (Wiley), *Chemistry – A European Journal* (Wiley), *Synlett* (Thieme); *Synthesis* (Thieme), *The Chemical Record* (Wiley), *Helvetica Chimica Acta* (Wiley). He is associate editor of *Beilstein Journal of Organic Chemistry* and of the *Israel Journal of Chemistry* and serves as senior editor of the Patai's series. He is also volume editor of *Comprehensive Organic Synthesis* (Elsevier) and *Science of Synthesis* (Thieme).

He is concerned with the design and development of new and efficient stereo and enantioselective strategies for the synthesis of important complex molecular structures. He is particularly interested in developing carbon-carbon bond forming as well as carbon-carbon bond activation processes, which efficiently create multiple stereocenters in a single pot operation. Understanding of reaction mechanisms gives insight into the origins of chemo and stereoselectivity, and governs optimization towards the most efficient and general protocols for his methodologies. His vision is that we should provide an answer to challenging synthetic problems but it has to be coupled with unique efficiency and elegance. In recognition of his excellent scientific career, apart from his endless number of publications Prof. Marek has several publications in top ranking journals like *Science* and *Nature*. Please follow the link of his research webpage @ <http://chemistry.technion.ac.il/members/ilan-marek/>

## 6.2 CV of Dr. Chandi Charan Malakar, Assistant Professor Department of Chemistry, National Institute of Technology (NIT) Manipur



Dr. Chandi Charan Malakar currently an Assistant Professor at the department of chemistry, National Institute of Technology (NIT) Manipur. After Completing M.Sc from IIT Kanpur and working as a research fellow at Ludwig-Maximilians University Munich (LMU Munich), Germany, Dr. Malakar awarded his doctorate degree in 2011 from University of Hohenheim, Stuttgart, Germany with Prof. Uwe Beifuss. Followed by three successive Postdoctoral Research stay (during 2011-2014) at University of Antwerp, Belgium and University of Heidelberg, Germany, in 2014 Dr. Malakar has joined a Canadian Pharmaceutical Company called SignalChem LifeSciences Pvt. Ltd. as Senior Principal Scientist. Afterwards, in 2015 he worked as research associate at Indian Institute of Science (IISc) Bangalore and as Assistant Professor (on contract) at NIT Jalandhar. He has awarded several fellowships such as MCM scholarship for M.Sc study, Pegasus Marie Curie postdoctoral fellowship, PBC postdoctoral fellowship and BOF - IWO postdoctoral fellowship etc. Apart from a number of abstract high-lights in scientific magazine, chemical catalogues and conference papers, he has published more than 50 research articles in high impact factor international peer-reviewed journals. His current research targets on developing novel methodologies on transition-metal catalysis, C-H activation, organocatalysis, frustrated Lewis Pairs, cooperative dual catalysis, *asymmetric catalysis*, chemistry of heterocycles and green chemistry.

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## 7.0 Course Registration

Fees Structure for attending the course is as follows:

Participants from abroad: US \$200

Participants from Industry/ Research Organizations: Rs. 5000/-

Participants from Academic Institutions:

UG Students: Rs. 1000/-

PG Students: Rs. 1500/-

Ph.D Students: Rs. 2000/-

Postdoctoral fellow/Research Associate: Rs. 2500/-

Faculty Members: Rs. 3000/-

If available, the participants will be provided with accommodation in hostel.

## 8.0 Proposed Budget

| Sl. No              | Description of Budgetary Head for the Course                                  | Amount (Rs.)       |
|---------------------|---|--------------------|
| 1                   | International Expert Air Fare   | 1,50,000.00        |
| 2                   | Honorarium to Expert<br>(\$300x7 + \$250x3 = \$2850) x 67 [\$1.00 = Rs. 67/-] | 1,90,950.00        |
| 3                   | Lecture Notes/video-learning material preparation                             | 80,000.00          |
| 4                   | Video recording expenses  | 50,000.00          |
| 5                   | Contingency & Miscellaneous   | 80,000.00          |
| <b>Grand Total:</b> |   | <b>5,50,950.00</b> |

## 9.0 Coordinators

**Course Coordinator: Dr. Chandi Charan Malakar, Department of Chemistry, NIT Manipur**

**Local Coordinator: Dr. Th. David Singh, Department of Chemistry, NIT Manipur**

**Course Coordinator**

A handwritten signature in cursive script that reads "Chandi Charan Malakar". The signature is written in black ink on a white background.

**Signature**

**Dr. Chandi Charan Malakar**

**Department of Chemistry**

**National Institute of Technology Manipur**

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