INTERNATIONAL MEDICAL UNIVERSITY
MALAYSIA

Master of Science in Analytical and Pharmaceutical Chemistry Programme

MAPC304

Computational Drug Discovery Techniques

(4 Credits)

Semester 2

Module Guide

TITLE: Computational Drug Discovery Techniques
COURSE CODE: MAPC304

SEMESTER: 1/ 2

PROGRAMME: MSc in Analytical and Pharmaceutical Chemistry

CONTENT SYNOPSIS:

In this module, students are provided extensive training on various computational tools present in Schrödinger Discovery Suite, which is a leading drug discovery software and widely used in pharmaceutical and biotechnology industries all over the world. Based on industry case studies, the students in collaboration with peers and faculty, will practise various computational techniques such as Ligand-based pharmacophore modeling, Structure-based protein-ligand docking, e-Pharmacophore modeling etc. This module will enhance student technical skills in the drug discovery process which will complement their knowledge in the field and could be immediately transferred and practiced in work-place.

AIM:

The aim of this module is to equip students with latest computational drug discovery techniques.

OBJECTIVES:

The objectives of this module is to provide the students

1) essential technical skills necessary for effective use of various tools in Schrodinger Discovery Suite
2) essential knowledge in reviewing and interpretation of computational analysis results

LEARNING OUTCOMES:

At the completion of this course, the students should be able to:

1) evaluate, compare and interpret the merits, demerits and synergy of various computational techniques in drug discovery
2) judge and predict the most suitable workflow for discovering a new drug to treat a disease in question.
3) create and select novel drug-like molecules with improved efficacy and safety.
4) evaluate, criticise and defend industry case studies and information on drugs.
5) Summarise, justify and prepare a report outlining the selection of top 10 new leads for the treatment of a disease, which could be further developed as drugs.

LEARNING HOURS:

NOTIONAL LEARNING HOURS

Lectures:	8 hours
CAL:	65 hours
Student Independent Learning:	91 hours

TOTAL LEARNING HOURS: **164 HOURS**

TEACHING AND LEARNING METHODS

Lectures:	8 hours
CAL:	65 hours

TOTAL CONTACT HOURS: **73 HOURS**

ASSESSMENTS:

Coursework

CAL quiz	10%
CAL reports (4 × 10%)	40%
Project report	50%

MODULE LEADER: Dr Vasudevarao Avupati
ASSOCIATED LECTURERS: Prof Mallikarjuna Rao Pichika

SYLLABUS:

1. **Introduction to Maestro** *(CAL– 5 hrs)*
   a. *Starting Maestro and viewing molecules*
   b. *Building molecules using Maestro*
   c. *Changing the appearance of structures*
   d. *Measuring, analysing and superimposing structures*
   e. *Advanced Maestro features*

   (In the CAL session, the students are guided how to use maestro for visualisation, drawing the structures and capturing the images. The students are given 10 one best answer questions (OBAs) to evaluate their application of knowledge and contributes to 10% of marks. The OBAs will be of higher order and students are expected to spend 30 minutes to answer all OBAs)

2. **Structure based drug design** *(Lecture – 2 hr, CAL – 15 hrs)*
   a. Theory and principles involved in structure based drug design
   b. Preparation of receptor for molecular docking studies
   c. Identification of binding sites
   d. Rigid and induced fit docking
   e. Interpretation and analysis of docking results

f. Industry case studies

(In the CAL session, the students are guided how to use tools in modules related to structure based drug design in Schrodinger suite. The students are asked to suggest compounds with improved efficacy and safety against a given target and contributes to 10% of marks)

3. Ligand based drug design *(Lecture – 2 hr, CAL – 15 hrs)*

a. Theory and Principles involved in ligand based drug design
b. Prepare ligands for pharmacophore modelling
c. Creating pharmacophore sites
d. Finding common pharmacophores
e. Generation, scoring and validation of hypotheses
f. Industry case studies

(In the CAL session, the students are guided how to use tools in modules related to ligand based drug design in Schrodinger suite. The students are asked to suggest compounds with improved efficacy and safety for the treatment of a disease and contributes to 10% of marks)

4. Quantitative Structure–activity relationships *(Lecture -2 hr, CAL – 15 hrs)*

a. Theory and Principles involved in QSAR
b. Calculation of 3D molecular descriptors
c. Field-based QSAR
d. AutoQSAR
e. Building QSAR models
f. Analysis and validation of QSAR models
g. Industry case studies

(In the CAL session, the students are guided how to use tools in modules related to structure activity relationship studies in Schrodinger suite. The students are asked to suggest compounds with improved efficacy and safety for the treatment of disease and contributes to 10% of marks)

5. Virtual screening in drug discovery *(Lecture - 2 h, CAL – 15 hrs)*

a. Theory and Principles involved in virtual screening
b. Virtual screening workflows
c. e-Pharmacophore
d. Lead hoping and optimisation
e. Building compound databases
f. Industry case studies

(In the CAL session, the students are guided how to use tools in modules related to virtual screening in Schrodinger suite. The students are asked to prepare a library

of 100 top hits with improved efficacy and safety for the treatment of disease or against a target and contributes to 10% of marks)

6. **Project Report** *(10 hrs independent learning time)*

   Based on all the lectures, industry case studies, and experience gained in CAL sessions, the students submit a report, of not more than 500 words (excluding tables, figures, graphs, references), proposing top 100 leads against a target or for the treatment of disease which could be further studied to develop as drugs.

READING LIST:

1) Rankovic Z, Morphy R. Lead generation approaches in drug discovery. John Wiley & Sons; 2010 Apr 7.
2) Mannhold R, Kubinyi H, Folkers G. Sotriffer C, editor. Virtual screening: principles, challenges, and practical guidelines. John Wiley & Sons; 2011 Mar 31.
3) Joel Barrish, Percy Carter. Accounts in Drug Discovery: Case Studies in Medicinal Chemistry. Christopher Barber – 2010
4) Rydzewski RM. Real world drug discovery: A chemist's guide to biotech and pharmaceutical research. Elsevier; 2010 Jul 7.
5) Merz Jr KM, Ringe D, Reynolds CH, editors. Drug design: structure-and ligand-based approaches. Cambridge University Press; 2010 May 31.
6) Groner B, editor. Peptides as drugs: Discovery and development. John Wiley & Sons; 2009 Nov 18.