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<th>Module Code and Title</th>
<th>BL5214 Advanced Protein NMR</th>
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<tr>
<td>2</td>
<td>Modular Credits (MC)</td>
<td>4</td>
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<td>3</td>
<td>Rationale for introducing this module</td>
<td>To confer good theoretical background for the increasing number of graduate students performing biological NMR and structural biology research.</td>
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<td>4</td>
<td>Brief Module Description  (of Publishable Quality for Handbook / Prospectus / Bulletin / Websites)</td>
<td>The objective of this module is to enable students to understand the principles behind various protein NMR experiments and allow them to apply those experiments to study protein structural and dynamical properties. The major topics covered includes NMR phenomenon and parameters; multidimensional multinuclear NMR experiments; relaxation and dynamics; NMR protein sample preparation; backbone and side chain assignment; and restraints for NMR protein structure calculation. Graduate students who are or will use NMR for biological research are strongly encouraged to take this module. This module will also be useful for students in structural biology and protein engineering.</td>
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<td>5</td>
<td>Aims and objectives  (Elaboration of teaching and learning objectives)</td>
<td>The module focuses on the basics of NMR principles and its application to protein structural/functional studies. Various experiments used for studying peptide and protein will be discussed in details. The first objective of the course is to understand how and why various NMR experiments work in various ways. The second one is to know how to interpret NMR data in terms of resonance assignment, structure, and dynamics.</td>
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| 6 | Syllabus  (Elaboration of major topics covered) | **Part I: Principles of NMR Spectroscopy**  
(1) The phenomenon of NMR including nuclear spin, magnetic moment and Boltzman distribution.  
(2) Experimental NMR parameters such as chemical shifts, coupling constants, quantum mechanics, pulse sequences and effect of RF.  
(3) Setup of multidimensional multinuclear NMR experiments, e.g. 3D HNCACB.  
(4) NMR relaxation and dynamic processes, e.g. T₁ and T₂ measurement.  
**Part II: Applications of Biomolecular NMR Spectroscopy**  
(5) Protein and peptide NMR sample preparation including stable isotope labeling and optimization of buffer conditions.  
(6) Backbone and side-chain sequential assignment using triple resonance experiments.  
(7) Distance and dihedral angle restraints from NMR experiments for protein structure calculation.  
(8) NMR data processing and protein structure calculation using computational software.  
(9) Protein dynamics and protein complex structure determination. |
| 7. | **Assessment**  
(Please indicate % breakdown of each CA component and % for Final Examination) | **C.A.:** quizzes (15%) and student presentation (25%)  
**Final Examination:** short questions (closed book) | 40%  
60%  
100% |
|------|---------------------------------|-------------------------------------------------|-----|
| 8. | **To be offered with effect from**  
(State academic year and semester) | 2004/2005, Semester 1 |
| 9. | **Cross Listing (if applicable)** | N.A. |
| 10. | **Prerequisites (if applicable)** | Basic understanding of protein chemistry is essential. Pre-university level physics and mathematics are desired. Students with strong physics or computer background who want to know more on protein NMR are also encouraged. |
| 11. | **Preclusions (if applicable)** | Nil |
| 12. | **Module Lecturer(s)**  
Name(s)/Department(s):  
*Coordinator*  
Yang Daiwen*, Department of Biological Sciences;  
Mok Yu Keung, Henry, Song Jianxing  
Email: dbsydw@nus.edu.sg; dbsmokh@nus.edu.sg  
Tel.No.:  65161014; 68742967 | Yang Daiwen*, Department of Biological Sciences;  
Mok Yu Keung, Henry, Song Jianxing  
Email: dbsydw@nus.edu.sg; dbsmokh@nus.edu.sg  
Tel.No.:  65161014; 68742967 |
| 13. | **Modes of Teaching and Learning**  
(Lectures, regular tests, Q & A, IVLE, problem-based learning) | The students are expected to participate actively in lectures by asking questions. The tutorial session is a complete question and answer session, it gives the students chances to solve anything that they don't understand during lectures. Every student is required to do a presentation on a topic related to protein NMR, extensive question and answer session by students will follow each presentation. |
| 14. | **Basic Reading List**  
Compulsory reading | Nil |
| 15. | **Maximum Class Size** | 24 |
| 16. | **Workload Per Week**  
(The workload for a 4-MC module must add up to 10 hours per week. E.g. 2 hours lecture; 1 hour tutorial; 7 hours preparatory work) | Lecture hours per week: 2  
Tutorial hours per week: 0.5  
Laboratory hours per week: 0  
No. of hours per week for projects, fieldwork, assignments, etc.: 0.5  
No. of hours per week for preparatory work: 7  
**Total hours per week:** 10 |