

Liverpool John Moores University

Title: PROTEIN ENGINEERING AND MOLECULAR MODELLING
Status: Definitive
Code: **7004BTBMOL** (101530)
Version Start Date: 01-08-2011

Owning School/Faculty: Pharmacy & Biomolecular Sciences
Teaching School/Faculty: Pharmacy & Biomolecular Sciences

Team	Leader
Patricia Burke	Y
Amanda Reid	
Colin Reynolds	

Academic Level: FHEQ7 **Credit Value:** 15.00 **Total Delivered Hours:** 32.00
Total Learning Hours: 150 **Private Study:** 118

Delivery Options

Course typically offered: Semester 1

Component	Contact Hours
Lecture	15.000
Practical	7.000
Seminar	3.000
Tutorial	2.000
Workshop	3.000

Grading Basis: 40 %

Assessment Details

Category	Short Description	Description	Weighting (%)	Exam Duration
Exam	AS1	Section A: 2 essay type questions from 5 (2hrs)	60.0	2.00
Practice	AS2	Essay/oral presentation	20.0	
Practice	AS3	Practical	20.0	

Aims

To understand the basic structural principles of protein folding. To outline the

methods used to determine the three dimensional structure of a protein by X-ray crystallography. To show how knowledge of the tertiary structure may be used in the intelligent design of proteins with modified properties. To provide an introduction to molecular modelling.

Learning Outcomes

After completing the module the student should be able to:

- 1 Demonstrate the basic features of protein stereochemistry.
- 2 Evaluate the importance of physical forces in determining the 3d arrangements of proteins.
- 3 Appraise how protein structures are obtained by X-ray crystallographic methods.
- 4 Use effectively an interactive molecular graphics package to display, manipulate and modify a protein structure.
- 5 Critically evaluate how you may alter the structure of a protein to tailor its properties in a predetermined and useful manner.
- 6 Consider the applications of protein engineering to problems with industrial or medical implications.

Learning Outcomes of Assessments

The assessment item list is assessed via the learning outcomes listed:

EXAM	1	2	3	5	6
Essay	3	5	6		
Report	4	5	6		

Outline Syllabus

Structural organisation of proteins. Principles governing protein structure: electrostatic forces, hydrogen bonding and hydrophobic interactions. Regular conformations and common structural motifs found in proteins. Basic principles of protein crystallography: crystallisation of proteins, X-ray diffraction, data collection, phase determination, calculation and interpretation of electron density maps, refinement of protein structures.

Expression systems. Recombinant DNA methods. Site-directed mutagenesis.

Protein ligand interaction. Enzyme kinetics. Energetics of enzyme catalysis.

The role of computer graphics techniques in protein engineering. Use of a molecular modelling package on a microcomputer.

Case studies: Engineered proteins with novel applications in industry, medicine and technology. (1) Antibody engineering, humanised and chimeric antibodies, single chain and bispecific antibodies, (2) engineering faster-acting insulin's, (3) enhancing activity in enzymes, (4) engineering improved stability of proteins, (5) modification of the pH/activity profile of enzymes, (6) altering substrate specificity of enzymes, (7) engineering thermostability in proteins.

Learning Activities

Lectures, workshops, tutorials, seminars and practicals.

References

Course Material	Book
Author	Moody, P.C.E., Wilkinson, A.J.
Publishing Year	1990
Title	Protein Engineering.
Subtitle	
Edition	
Publisher	IRL Press.
ISBN	

Course Material	Book
Author	Creighton, T.E.
Publishing Year	1992
Title	Proteins: Structures and Molecular Properties.
Subtitle	
Edition	
Publisher	W.H. Freeman, New York.
ISBN	

Course Material	Book
Author	Borrebaeck, C.A.K. (ed.)
Publishing Year	1995
Title	Antibody Engineering.
Subtitle	
Edition	2nd ed.
Publisher	W.H. Freeman, New York.
ISBN	

Course Material	Book
Author	Fersht, A.R.
Publishing Year	1999
Title	Structure and Mechanism in Protein Science
Subtitle	
Edition	
Publisher	W.H. Freeman, New York
ISBN	

Course Material	Book
Author	Berry, A., Radford, S.

Publishing Year	2001
Title	From Protein Folding to New Enzymes'
Subtitle	
Edition	
Publisher	Portland Press, Colchester
ISBN	

Course Material	Book
Author	Whitford, D
Publishing Year	2005
Title	Proteins: Structure and Function
Subtitle	
Edition	
Publisher	Wiley, Chichester
ISBN	

Notes

Protein engineering is concerned with the construction, analysis, and uses of modified proteins. This module concentrates on aspects of protein structural organisation, protein structure determination, molecular genetics and modelling which are of direct relevance to protein engineering (P.E.). A number of case studies are considered which show the importance and potential of P.E. both as a tool for exploring how proteins work and as a route to designing proteins for industrial and medical uses.