Module Guide

1.	Name of Course/Module : **Molecular Medicine**
2.	Course Code : **MM301**
3.	Name(s) of academic staff: Prof Dr Leong Chee Onn, Dr Tan Eng Lai, Dr Gan Sook Yee, Dr Ho Ket Li, Dr Hazwanie, Dr Lim Lay Cheng
4.	Rationale for the inclusion of the course/module in the programme: The module is designed to provide modern concepts and detailed training in medicine with emphasis on understanding of the molecular basis of disease and to use therapeutic influence to correct pathological alterations of the whole organism. Medical practitioners, professionals and researchers in the healthcare, pharmaceutical and life sciences need to be able to understand and evaluate advances in molecular medicine in order to keep abreast with developments in their fields.
5.	Semester and Year offered: Semester 1 and Year 1

6.	Total Student Learning Time (SLT)	Face to Face				Total Guided and Independent Learning	
	L = Lecture T = Tutorial P = Practical O= Others (Case Discussion, Forum, Workshop, Project)	L 16	T	P	O 8	Self-study Case report Case discussion Forum preparation	32 h 45 h 10 h 9 h

7.	Credit Value: 3
8.	Prerequisite (if any): N/A
9.	Learning objectives: This module aims to: 1. provide an advanced understanding of the molecular basis of pathogenesis, clinical presentation, diagnosis and treatment of human diseases. 2. facilitate the application of the knowledge generated in order to foster translational research. 3. develop research skills and the ability to become an independent and creative scientist.

10.	Learning outcomes: On completion of this module, students should be able to: 1. understand the human genome at a molecular level. 2. integrate molecular and cellular biology in relation to human diseases. 3. describe technology currently employed in molecular genetics and cell biology. 4. integrate between such technology and current clinical practice. 5. utilise knowledge on the molecular basis of human disease in planning and design of novel therapies.
11.	Transferable Skills: N/A
12.	Teaching-learning and assessment strategy : Lecture, Discussion, Case Report, Case Discussion, Project, Forum
13.	Synopsis : Molecular medicine is a new field that exploits advances in molecular and cellular biology to characterise how normal cellular processes either fail, or are subverted, in disease. Increasingly, medical practitioners, professionals and researchers in the healthcare, pharmaceutical and life sciences need to be able to understand and evaluate advances in molecular medicine in order to keep abreast with developments in their fields. The molecular medicine teaching module combines traditional areas of biomedical study, including Molecular and Cell Biology, Pathology, Pharmacology and Genetics into a unique interdisciplinary research and graduate training module that is ideally suited for developing scientists of the post-genomic era. The module is designed to provide modern concepts and detailed training in medicine with emphasis on understanding of the molecular basis of disease and to use therapeutic influence to correct pathological alterations of the whole organism. Findings in the field of molecular medicine are of high relevance for society especially in the field of cardiovascular diseases, cancer, or metabolic disorders, including diabetes mellitus, as these diseases are still the major causes of death in the world.
14.	Mode of Delivery : Lecture, Case Discussion, Case Report, Forum, Project, Workshop
15.	Assessment Methods and Types : Case report (x3) 90% Forum 10%
16.	Mapping of the course/module to the Programme Aims : Refer to Appendix 1
17.	Mapping of the course/module to the Programme Learning Outcomes : Refer to Appendix 2

18.	Content outline of the course/module and the SLT per topic :

1.   Introduction to Molecular Medicine *(Lecture – 2 hrs)*

Molecular medicine strives to understand normal body functioning and disease pathogenesis at the molecular level which may allow researchers and physician-scientists to use that knowledge in the design of specific molecular tools for disease diagnosis, treatment, prognosis, and prevention. This lecture will provide an overview on the emerging concepts in the interdisciplinary field of molecular medicine.

2.   Report Writing Workshop *(Workshop – 2 hrs)*
Students will be exposed to the style of writing a scientific report with a coherent flow of factual information and the correct way of citing and referencing published materials. All case reports required in this module are to be written following the style of a scientific report.

3.   From genome to gene function *(Lecture – 4 hrs, , Case report – 15 hrs, Project – 2 hrs)*

The elucidation of genetic components of human diseases at the molecular level on a global scale provides crucial information for gene discovery, biomarker determination, disease classification, and drug target identification. This series of lectures will provide an overview of the current and emerging tools involved in genomic studies, including expression arrays, microRNA arrays, array CGH, ChIP-on-chip, methylation arrays, mutation analysis, proteomic analysis, integrated functional genomic analysis and related bioinformatics and biostatistical analyses. Various *in vitro* and *in vivo* models for disease and drug discovery will also be discussed and their ethical issues addressed in this series of lectures. Students will also learn the ethical guidelines which are involved in scientific and clinical research. At the end of the lecture, students will be given a dataset obtained from a gene expression study and perform a critical analysis. They would need to submit an individual case report of 2000 words.

4.   Genome-wide association studies: theoretical and practical concerns
(Lecture – 2 hrs)

To fully understand the allelic variation that underlies common diseases, complete genome sequencing for many individuals with and without disease is required. This is still not technically feasible. However, recently it has become possible to carry out partial surveys of the genome by genotyping large numbers of common SNPs in genome-wide association studies. Here, we discussed the knowledge gained from these studies, emerging consensus, and describes the

challenges that remain to translate the information gathered into improvements in clinical management.

5. **Epigenetics: molecular mechanisms and implications for disease** *(Lecture – 2 hrs, Case Discussion - 6 hrs)*

Epigenetics is rising to prominence in biology as a mechanism by which environmental factors have intermediate-term effects on gene expression without changing the underlying genetic sequence. This can occur through the selective methylation of DNA bases and modification of histones. There are wide-ranging implications for the gene-environment debate and epigenetic mechanisms are causing a reevaluation of many traditional concepts such as heritability. The reversible nature of epigenetics also provides plausible treatment or prevention prospects for diseases previously thought hard-coded into the genome. Here, we will explore how growing knowledge of epigenetics is altering our understanding of biology and medicine, and its implications for future research. At the end of the lecture, student will be given a case discussion, where they are required to perform critical analysis and conduct an open discussion with the class.

6. **Progress in personalised medicine** *(Lecture – 2 hrs, Case Discussion – 6 hrs)*

Advances in human genome research are opening the door to a new paradigm for practising medicine that promises to transform healthcare. Personalized medicine, the use of marker-assisted diagnosis and targeted therapies derived from an individual's molecular profile, will impact the way drugs are developed and medicine is practiced. But how far have we come, and how close is personalized medicine to delivering on its promise? This series of lectures will explore the promises and challenges in personalized medicine, and its implication to the social-economy of the society. The lectures will also discuss the importance of various biomarkers and the emerging technology in diagnostic medicine. At the end of the lecture, student will be given a case discussion, where they are required to perform critical analysis and conduct an open discussion with the class.

	7. Stem cell therapy in regenerative medicine – hype or hope? *(Lecture – 2 hrs, Case report 15 hrs)*
	Stem cells undergo self-renewal and differentiate into multiple lineages of mature cells. The identification of stem cells in diverse adult tissues and the findings that human embryonic stem cells can be proliferated and differentiated has kindled the imagination of both scientists and the public regarding future stem cell technology. These cells could constitute an unlimited supply of diverse cell types that can be used for cell transplantation or drug discovery. The new options raise several fundamental ethical issues. This series of lectures gives an overview of the scientific basis underlying the hope generated by stem cell research and discusses current ethical and regulations stem cell therapy. They would need to submit an individual case report of 2000 words.
	8. Nanotechnology: convergence with modern biology and medicine *(Lecture – 2 hrs, Case report 15 hrs)*
	Recent research on biosystems at the nanoscale has created one of the most dynamic science and technology domains at the confluence of physical sciences, molecular engineering, biology, biotechnology and medicine. Nanotechnology-based tools and techniques are rapidly emerging in the fields of medical imaging and targeted drug delivery. Highlighting clinically available and preclinical applications, these lectures explore the opportunities and issues surrounding nanomedicine. They would need to submit an individual case report of 2000 words.
	9. Therapeutic wisdom in traditional medicine: a perspective from modern science *(Forum – 11 hrs)*
	Drug discovery strategies based on natural products and traditional medicines are re-emerging as attractive options. The reasons why the standards of evaluating Western medicine are not suitable for testing traditional Chinese medicine (TCM) are explicit in the therapeutic objective and principles of TCM. TCM aims to correct maladjustments and restore the self-regulatory ability of the body, and not to antagonize specific pathogenetic targets. Can the principles of TCM harmonize with Western medicine? Can we explain TCM on a molecular basis? Is TCM similar to systems biology and pharmacogenetics? These issues will be discussed and addressed in this open discussion session through participation of students as well as academics in TCM and modern medicine.
19.	Main reference supporting the course : N/A

	Additional references supporting the course : 1. ALLIS, D., JENUWEIN, T., REINBERG, D. & CAPARROS, M.-L. (2007) *Epigenetics*, Cold Spring Harbor Laboratory Press. 2. BROWNSTEIN, M. J. & KHODURSKY, A. (2010) *Functional Genomics: Methods and Protocols* Humana Press 3. CHRISTIANSEN, F. B. (2008) *Theories of Population Variation in Genes and Genomes*, Princeton University Press. 4. GINSBURG, G. S. & WILLARD, H. (2009) *Essentials of Genomic and Personalized Medicine* Academic Press. 5. JAIN, K. K. (2008) *The Handbook of Nanomedicine* Humana Press. 6. LANZA, R., GEARHART, J., HOGAN, B., MELTON, D., PEDERSON, R., THOMAS, E. D., THOMSON, J. & WILMUT, S. I. (2009) *Essentials of Stem Cell Biology*, Academic Press. 7. PEVSNER, J. (2009) *Bioinformatics and Functional Genomics* Wiley-Blackwell. 8. PINTER, B. & MESZAROS, Z. (2010) *Epigenetics: Mechanisms, Functions and Human Effects* Nova Science Pub Inc 9. TIBBALS, H. F. (2010) *Medical Nanotechnology and Nanomedicine* CRC Press.
20.	Other additional information : N/A