YEAR: 4TH
SUBJECT: : Bioinformatics
THEORITICAL HOURS: 2
PRACTICAL HOURS: 2
UNITS: 3

Bioinformatics ……. (Theory Syllabus)

Course module description:

This course will prepare students to enter the field of bioinformatics working either in research or in industry. Assuming no prior coursework in Biology, this course will bring you up to speed in genomics and proteomics so you can do research involving proteins, DNA, and RNA.

Course module academic calendar

week	Basic material to be covered	Hours
1	Introduction to Bioinformatics, Molecular biology and computer programming	2
2	visualization of DNA, RNA and proteins / Bacteria and viruses	2
3	Sequence alignment: dynamic programming, Needleman-Wunsch, Smith-Waterman algorithms	2
4	Multiple sequence alignment: ClustalW /MUSCLE	2
5	Protein secondary structure prediction	2
6	Exam	2
7	Energy of protein structures / Protein tertiary structure prediction	2
8	Protein design	2
9	gene finding: motifs	2
10	Phylogenetic trees and string matching	2
11	• Database design and implementation in Bioinformatics	2
12	Molecular Dynamics	2
13	Exam	2
14	statistics & hypothesis testing	2
15	molecular clocks	2

Bioinformatics ……. (Practical Syllabus)

. **Course module academic calendar**

week	Basic material to be covered	Hours
1	Introduction of bioinformatics	2
2	bioinformatics databases	2
3	sequence alignment	2
4	parsimony-based phylogenetics	2
5	basic phylogenetics	2
6	Exam	2
7	evolutionary models	2
8	Estimating evolutionary history using ML	2
9	Estimating evolutionary history using MrBayes	2
10	Class Projects working day	2
11	molecular clocks	2
12	detecting phylogeographic patterns	2
13	Exam	2
14	Linking genes and disease	2
15	Molecular phylogeny.	2

Text Books : Bioinformatics: sequence and genome analysis. *Second edition* by David W Mount. Cold Spring Harbor Laboratory
Press (2004) ISBN: 978-087969712-9

References :

The Phylogenetic Handbook: A Practical Approach to Phylogenetic Analysis and Hypothesis Testing. *Second edition.* Edited by Philippe Lemey, Marco Salemi and Anne-Mieke Vandamme. Cambridge University Press (2009) ISBN:
978-0521730716

YEAR: 4th
SUBJECT: : Biomarkers
THEORITICAL HOURS: 2
PRACTICAL HOURS: 2
UNITS: 3

Biomarkers ……. (Theory Syllabus)

Course module description:

Biomarkers are invaluable tools in identifying and preventing human disease. Due to significant concerns over the risk of human exposure to airborne pollutants, persistent organic pollutants, heavy metals, and other environmental agents, the potential of molecular markers is especially high in identifying susceptible individuals and preventing environmentally-nduced disease. This course will introduce current status of molecular biomarker research, including biomarkers of chemical exposures, genetic toxicity markers,genomics-based biomarkers of susceptibility, and organ and systems biomarkers.

Course module academic calendar

week	Basic material to be covered	Hours
1	Introduction to biomarker classification	2
2	biomarker characteristics, development and validation approaches,	2
3	Biomarkers of chemical exposures/ Air pollutants	2
4	Biomarkers of chemical exposures/ Occupational exposures	2
5	Biomarkers of chemical exposures/organic chemicals	2
6	Biomarkers of chemical exposures/ Metals	2
7	Biomarkers of chemical exposures/ Food contaminants	2
8	Biomarkers of chemical exposures/ Tobacco smoke/Environmental Tobacco Smoke	2
9	Biomarkers of genetic susceptibility	2
10	Exam	2
11	Organ and systems biomarkers	2
12	Markers of organ toxicity	2
13	Oxidative damage and inflammation	2
14	Immunotoxicity markers	2
15	Exam	2

Biomarkers ……. (Practical Syllabus)

. **Course module academic calendar**

week	Basic material to be covered	Hours
1	Definitions, classifications, and characteristics of biomarkers.	2

2	. Development and validation of biomarkers	2
3	Overview of biomarker applications in environmental health	2
4	Biomarkers of chemical	2
5	Genetic toxicity markers	2
6	Exam	2
7	Biomarkers of genetic susceptibility.	2
8	Organ and systems biomarkers	2
9	Technologies for biomarker measurements	2
10	Application of biomarkers in public health policies and interventions	2
11	- describe the process and methods of biomarker discovery and validation	2
12	describe different types of biomarkers and methods of applications	2
13	account for known biomarkers for important human diseases	2
14	theoretically formulate and process scientific questions and laboratory techniques	2
15	Exam	2

Text Books :

References :

YEAR: 4th ss
SUBJECT: : Biosensors
THEORITICAL HOURS: 2
PRACTICAL HOURS: 2
UNITS: 3

Biosensers ……. (Theory Syllabus)

Course module description:

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This course provides a broad perspective about description of biosensor and its general principles, immobilization of biological materials, support materials, their types and properties, the properties and characteristic of biosensors, performance factors in biosensors, enzymatic biosensors, immunobiosensors, DNA biosensors, Cell basis biosensors, electrochemical biosensors, optical biosensors

Course module academic calendar

week	Basic material to be covered	Hours
1	Description of biosensors	2
2	Biomolecules used in biosensors and immobilization methods	2

3	Support materials, types and properties	2
4	The properties and characteristic of biosensors and performance factors	2
5	Enzymatic biosensors	2
6	Exam	2
7	Immunobiosensors	2
8	DNA biosensors	2
9	Cell based biosensors	2
10	Electrochemical biosensor	2
11	Biosensors in food analysis	2
12	Biosensors in environmental analysis	2
13	Optical biosensor	2
14	Other measurements methods	2
15	Exam	2

Biosensors ……. (Practical Syllabus)

. **Course module academic calendar**

week	**Basic material to be covered**	**Hours**
1	Introduction	2
2	Electrochemical Biosensing	2
3	Miniaturized Biosensors/ Photomask Fabrication	2
4	Miniaturized Biosensors/ Soft Lithography, Part 1	2
5	Miniaturized Biosensors/ Soft Lithography, Part 2	2
6	Miniaturized Biosensors/ Microfluidic testing and microvalve testing	2
7	Exam	2
8	Laser micromachined fluidic structures	2
9	Mini Design Project/ Team based mini design project	2
10	*Biosensor applications*	2

11	Enzyme-based recognition	2
12	Mathematical modeling of Enzymatic Sensors	2
13	Potentiometric biosensors	2
14	Field-effect transistor for biosensors	2
15	Exam	2

Text Books : Chemical Sensors and Biosensors, Eggins, B. R., John Wiley & Sons, 2002.

References : Biochemistry (3rd ed), Mathews, C. K., K. E.van Holde, and K. G. Ahern, Addison Wesley Longman, Inc., 2000.
A. J. Cunningham, Introduction to Bioanalytical Sensors, Wiley, 1998 -

YEAR: 4th
SUBJECT: : Gene therapy
THEORITICAL HOURS: 2
PRACTICAL HOURS: 2
UNITS: 3

Gene therapy ……. (Theory Syllabus)

Course module description:

The molecular basis of gene therapy and the use of viral gene delivery systems for the treatment of human disease are examined. Gene therapy strategies are contrasted with various diseases, including cancer and AIDS

.**Course module academic calendar**

week	Basic material to be covered	Hours
1	Course Introduction Student Introductions •	2
2	An Introduction to Viral Vectors, Part I History of Gene Transfer • Nonviral Gene Transfer • Gene Therapy Strategies	2
3	An Introduction to Viral Vectors, Part II Molecular Biology and Virology Basics • Retroviruses	2
4	An Introduction to Viral Vectors, Part III Adenoviruses • Other Viral Systems • Safety and Compliance	2
5	Retroviruses as Vectors 1 Midterm Topic Due • Discussion of Assigned Journal Articles	2
6	Exam	2
7	Retroviruses as Vectors 2 Discussion of Assigned Journal Articles	2

8	Retroviruses as Vectors 3 Discussion of Assigned Journal Articles	2
9	Adenoviruses as Vectors Discussion of Assigned Journal Articles	2
10	Pox Viruses as Vectors Discussion of Assigned Journal Articles	2
11	Rabies Viruses as Vectors Discussion of Assigned Journal Articles	2
12	Gene Therapy for Cancer 1/Viral Vaccines	2
13	Viral Vaccines: T-Lymphocyte Protocols	2
14	Gene Therapy Gone Wrong	2
15	Exam	2

Gene therapy ……. (Practical Syllabus)

. **Course module academic calendar**

week	Basic material to be covered	Hours
1	Introduction	2
2	Genetic modification in Agriculture terminology, methods of genetic modification, genetic modification of bacteria, plant & animal, controversies over genetic modification, policy around the world (USA, European Union, EU regulation, Japan, China & other developing countries).	2
3	Genetically modified foods transgenic plants, genetically modified foods, application, future applications, ecological impact of transgenic plants	2
4	Genetically modified foods – organic foods, types of organic foods, identifying organic foods, organic food & preservatives.	2
5	Genetic modification in Food industry – background, history, controversies over risks, application, future applications.	2
6	Genetic modification in Medicine - gene therapy, types of gene therapy, vectors in gene therapy, molecular engineering, human genetic engineering, problems & ethics	2
7	Exam	2
8	Genetic mapping of Mendelian characters	2
9	Identifying Human disease genes	2
10	Mapping and identifying genes conferring susceptibility to complex diseases	2
11	Molecular Pathology	2
12	Explain the types of viral gene delivery systems.	2
13	· Explain the physical methods of gene transfer	2
14	· Describe methods of regulating gene expression	2
15	Exam	2

Text Books

Molecular Biotechnology, Principles and Applications of Recombinant DNA, 2nd ed., (1998), American Society for Microbiology Press, Washington, D.C.

YEAR: 4th

SUBJECT: Genetic engineering

THEORITICAL HOURS: 2
PRACTICAL HOURS: 2
UNITS: 3

Genetic engineering ……. (Theory Syllabus)

Course module description:

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This course provides a broad perspective about description of biosensor and its general principles, immobilization of biological materials, support materials, their types and properties, the properties and characteristic of biosensors, performance factors in biosensors, enzymatic biosensors, immunobiosensors, DNA biosensors, Cell basis biosensors, electrochemical biosensors, optical biosensors

Course module academic calendar

week	Basic material to be covered	Hours
1	**Genetic Engineering and Tools of Genetic Engineering:**	2
2	**Restriction endonucleases**	2
3	**Gene Cloning, gene libraries and transformation techniques:**	2
4	**Transformation Techniques**	2
5	**Plating, screening and selection:** Preparation of nutrient media with selection, marker antibiotics and additives for visual screening of recombinant clones, selection of clones, amplification and preservation	2
6	Exam	2
7	**Labeling of DNA, RNA and proteins :** Use of radioactive isotopes, Non – radioactive labeling	2
8	**In-vitro translation and Hybridization techniques :**	2
9	selection of clones, amplification and preservation	2
10	characterization of protein products on gel electrophoresis	2
11	agarose gel,	2

	polyacrylamide gel and 2D gel electrophoresis	
12	DNA microarrays (DNA chips) to study gene expression.	2
13	Prokaryotic expression systems	2
14	Eukaryotic expression systems Transgenic animals and plants	2
15	Exam	2

Genetic engineering ……. (Practical Syllabus)

. **Course module academic calendar**

week	Basic material to be covered	Hours
1	Introduction	2
2	Isolation of nucleic acids from different sources. 5.. 6. Western and Southern Blotting.	2
3	Restriction enzyme digestion of DNA and calculation of molecular weight of the digested DNA	2
4	DNA amplification by PCR method	2
5	Preparation of competent cells in *E. coli*	2
6	Transformation through $CaCl_2$, PEG methods	2
7	Exam	2
8	Western and Southern Blotting.	2
9	Functional Genomics: Analysis of Gene Expression	2
10	Modifying Gene Expression and Cellular Function	2
11	Genetic engineering in animals III: examples	2
12	Genetic engineering in animals IV: xeno transplantation part a	2
13	Genetic engineering in animals IV: xeno transplantation part b	2
14	Genetic engineering in animals	2
15	Exam	2

Text Books : An Introduction to Genetic Engineering D. Nicholl, 2002
Kingsman , S.M and A.J. Kingsman (1998) Genetic Engineering : An introduction to Gene analysis and exploitation in Eukaryotes, Blackwell Scientific publications, Oxford

References :

Old R.W. and S.B. Primrose (1994) Principles of gene manipulation, Boston Blackwell Scientific Publications