University of Tehran

College of Science

School of Biology

Description of program and course syllabi

Cellular and molecular biology

Master's of Science

Table 1- Required courses

Major: Cellular and molecular biology Program: Master of Science

No.	Course name	Units			Hours			Prerequisite
		Theoretical	Practical	Total	Theoretical	Practical	Total	
1	Advance Molecular Biology	2	0	2	32	0	32	None
2	Advanced Cell Biology	2	0	2	32	0	32	None
3	Regulatory Processes and Signal Transduction	2	0	2	32	0	32	None
4	Principles of Cellular and Molecular Methods	2	0	2	32	0	32	None
5	Structure of Biological Macromolecules	2	0	2	32	0	32	None
6	Cellular Biophysics	2	0	2	32	0	32	None
Total		12	0	12	192	0	192	-

Students must take all 12 units in this table.

Table 2- Elective courses

Major: Cellular and molecular biology Program: Master of Science

No.	Course name	Units			Hours			Prerequisite
		Theoretical	Practical	Total	Theoretical	Practical	Total	
1	Cell Junctions	2	0	2	32	0	32	None
2	Advanced Genetic Engineering	2	0	2	32	0	32	None
3	Molecular Radiobiology	2	0	2	32	0	32	None
4	Molecular Immunology	2	0	2	32	0	32	None
5	Chromatin Biochemistry	2	0	2	32	0	32	None
6	Cellular and Molecular Mechanism of Cancer	2	0	2	32	0	32	None
7	Enzymology	2	0	2	32	0	32	None
8	Bioinformatics	2	0	2	32	0	32	None
9	Human Molecular Genetic	2	0	2	32	0	32	None
Total		20	0	20	288	0	288	-

Students must take 10 units of this table, chosen with approval of the department.

Prerequisites for Master of Science degree in Genetics

The student's supervisor require the student to take up to 12 units of lower level courses.

Topics of required courses

Major: Cellular and molecular biology

Program: Master of Science

Course title: Advanced molecular biology
No. of units: 2
No. of hours: 32
Unit type: theoretical
Course type: required
Prerequisites: none
Additional training: yes
Scientific expedition: no **Workshop:** no **Lab:** no **Seminar:** yes
The overall objectives of the course:
Understanding molecular subjects in eukaryotes
Topics of the course:

1- Repetitive sequences of genome, such as retroviral elements, SINEs and LINEs
2- Transposon elements in eukaryotes - maize transposons and TY elements in yeast
3- P and COPIE elements in Drosophila
4- Proteins and enzymes involved in replication process of eukaryotes
5- Replication of viral genomes: adenoviruses, adeno-associated viruses, baculoviruses, SV40 from papovavirus family
6- Replication of poxviruses, herpes viruses, picornaviruses and small viruses
7- Various transcription factors and chromatin structurs
8- Alternative splicing and specic modifications in RNAs
9- Role of small RNAs (siRNAs, miRNAs, ...)
10- Initiation, elongation and termination steps of translation in eukaryotes
11- Various mechanisms of folding and modification in proteins/chaperons
12- Various modifications of proteins, such as ubiquitylation, isoprenylation and ADP-ribosylation
13- Seminars

Table of assessment

Continuous evaluation	Midterm	Final exam	Project
10%	**-**	**70%- written**	**20%**

References:

- Wolfe, S.L. Molecular Cellolar Biology of Eukaryotes,. Mc. Graw Hill.
- Brown, T. A. Genomes Bios. Science Publishers.
- Turner et al. Molecular Biology Bioss Science Publishers.
- Weaver R.F. Molecular Biology, Mc Graw Hill.

Course title: Advanced cell biology
No. of units: 2
No. of hours: 32
Unit type: theoretical
Course type: required
Prerequisites: none
Additional training: yes
Scientific expedition: no **Workshop:** no **Lab:** no **Seminar:** yes
The overall objectives of the course:
Student's familiarization with advanced subjects of cellular biology field, utilization of recent findings related with cellular and molecular sciences in development and applications of these sciences
Topics of the course:

1- Cell culture and observation methods
2- Cellular skeleton, cellular organization and motility
3- Intracellular compartments and proteins grouping
4- Cell cycle
5- Cell junction and extracellular matrix
6- Cell death
7- Stem cells
8- Cancer
9- Cellular immunology

Table of assessment

Continuous evaluation	Midterm	Final exam	Project
10%	**-**	**70%- written**	**20%**

References:
- B. Alberts, Molecular Biology of the Cell (2015), Garland Science.
- Lodish, Molecular Cell Biology, (2013), W. H. Freeman and Company.

Course title: Regulatory processes and signal transduction
No. of units: 2
No. of hours: 32
Unit type: theoretical
Course type: required
Prerequisites: none
Additional training: yes
Scientific expedition: no **Workshop:** no **Lab:** no **Seminar:** yes
The overall objectives of the course:
Familiarity with advanced subjects and utilization of recent findings related with cellular and molecular sciences in development and applications of these sciences
Topics of the course:

1- Structure and dynamic of cell membrane, structure and molecular mechanisms of membrane proteins
2- Ions and small molecules transport from membrane and membrane potential
3- Signal processing by protein networks and biochemistry of signal transduction
4- Signal transduction by G-proteins
5- Signal transduction by kinases
6- Transduction by small G-proteins
7- Regulatory mechanisms in transcription
8- Chromatin and control of gene expression and pre-transcriptional control by different factors
9- Gene expression control at post-transcriptional level
10- Regulatory mechanisms in translation process
11- Seminars

Table of assessment

Continuous evaluation	Midterm	Final exam	Project
10%	**-**	**70%-written**	**20%**

References:

-B. Alberts, Molecular Biology of the Cell, (2015), Garland Science.
-H. Lodish, Molecular Cell Biology, (2013), W. H. Freeman and Company.
-F. Marks ,Cellular Signal Processing, (2009), Garland Science.
-G. Krauss ,Biochemistry of Signal Transduction and Regulation, (2014), WILEY-VCH.
-R. F. Weaver ,Molecular Biology, (2008), Mc Graw Hill.

Course title: Principles of cellular and molecular methods
No. of units: 2
No. of hours: 32
Unit type: theoretical
Course type: required
Prerequisites: none
Additional training: yes
Scientific expedition: no **Workshop:** no **Lab:** no **Seminar:** yes
The overall objectives of the course:
Understanding of principles of cellular and molecular biology methodology and application to research designs.
Topics of the course:

1- Methods of electron microscopy including scanning (SEM) and transmission (TEM)
2- Confocal, fluorescence, magnetic force, and atomic force microscopy
3- Chromatography methods: adsorption chromatography, gas chromatography, gel filtration, ion exchange, affinity, hydrophobic interaction, focusing, normal phase and invert phase chromatography
4- Regular and iso-density centrifugation for molecular separation and determination of molecular weight and sedimentation constants
5- Denaturing and non-denaturing electrophoretic methods for nucleic acids and proteins, including various forms of one or two dimensional protocols used for separation and determination of molecular weights, and gel staining and detecting methods.
6- Blotting methods including southern, northern, western, dot blot, reverse dot blot, and their applications
7- PCR and RT-PCR
8- New nucleic acid sequencing methods including Sanger sequencing, pyrosequencing, sequencing-based on mass spectrometry, second generation and third generation sequencing protocols
9- Microarrays
10- Absorption, emission, and differential spectroscopy methods including visible, ultraviolet, infrared, fluorescence, and circular dichroism spectroscopy
11- Immunologic methods
12- Equilibrium dialysis and filtration
13- Genome study methods

Table of assessment

Continuous evaluation	Midterm	Final exam	Project
10%	**-**	**70%-written**	**20%**

References:

- K. Wilson Principles and Techniques of Biochemistry and Molecular Biology (2010), Cambridge University Press.

Course title: Structure of biological macromolecules
No. of units: 2
No. of hours: 32
Unit type: theoretical
Course type: required
Prerequisites: none
Additional training: yes
Scientific expedition: no **Workshop:** no **Lab:** no **Seminar:** yes
The overall objectives of the course:
Familiarization with structural subjects and use of new findings in cellular and molecular sciences for developing and expanding these sciences
Topics of the course:

1- Intermolecular forces, different interactions including electrostatic, Van der Waals, hydrogen bonding and hydrophobic
2- Glycans, study of structural and stereo chemical isomers, structural effects of proteins glycosylation,
3- Lipids: structural, dynamic and phase studies
4- Structure of nucleic acids (DNA): physicochemical studies of constituents, the study of geometric and structural properties in different levels including structural, super-structural and bending properties
5- Structure of nucleic acids (RNA): physicochemical studies of constituents, the study of geometric and structural properties in different levels
6- Structure of proteins including physicochemical studies of constituents (amino acids), the study of geometric and structural properties of polypeptide chain in different levels of structure (secondary, super secondary, tertiary and quaternary) and classification of proteins based on secondary structure
7- The structural studies of alpha, alpha/beta and beta domains
8- Membrane and filamentous proteins
9- Enzymes: kinetics and catalysis
10- The study of proteins folding and accuracy of DNA and proteins biosynthesis
11- Methods for studying macromolecules structure, cell membrane structure

Table of assessment

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References:

- B. Alberts, Molecular Biology of the Cell, (2015), Garland Science.
- H. Lodish, Molecular Cell Biology, (2013), W. H. Freeman and Company.
- F. Marks ,Cellular Signal Processing, (2009), Garland Science.
- G. Krauss ,Biochemistry of Signal Transduction and Regulation, (2014), WILEY-VCH.
- R. F. Weaver ,Molecular Biology, (2008), Mc Graw Hill.

Course title: Cellular biophysics
No. of units: 2
No. of hours: 32
Unit type: theoretical
Course type: required
Prerequisites: none
Additional training: yes
Scientific expedition: no **Workshop:** no **Lab:** no **Seminar:** yes
The overall objectives of the course:
Familiarization with applications of biophysics in cellular sciences and use of biophysical research findings in cellular and molecular sciences
Topics of the course:

1- Biophysics: perspective, fields of study and tools
2- water's mathematics and physics
3- Statistic sight in biology dynamics
4- Life in crowded and irregular environments
5- Cellular dynamic and speed equations
6- Dynamics of molecular motors
7- Bioelectricity and Hodgkin-Huxley model
8- Light and life
9- Organization of biology networks
10- Biology patterns (spatiotemporal order)
11- Seminars

Table of assessment

Continuous evaluation	Midterm	Final exam	Project
10%	**-**	**70%-written**	**20%**

References:
- R. Phillips, Physical Biology of the Cell (2012), Garland Science.
- P. Nelson ,Biological Physics, (2008), W. H. Freeman.
- T. F. Weiss, Cellular Biophysics, Vol I and II, (1996), A Bradford Book.

Topics of elective courses

Major: Cellular and molecular biology

Program: Master's of Science

Course title: Cell junctions
No. of units: 2
No. of hours: 32
Unit type: theoretical
Course type: elective
Prerequisites: none
Additional training: yes
Scientific expedition: no **Workshop:** no **Lab:** no **Seminar:** yes
The overall objectives of the course:
An introduction to cell adhesion molecules and study of their role in establishment of cell junctions and in cellular processes
Familiarity with the molecules and mechanisms involved in establishment of permanent or transient junctions between cells is effective in understanding the cause of some diseases and prediction of new treatment strategies
Topics of the course:
1-An introduction to various cell junctions
2- Communicating junctions, gap junctions and plasmodesmata
3- Tight junctions
4- Mechanisms involved in cell polarity
5- Anchoring junctions
6- Cadherins and their types
7- The role of cadherins in signal transfer and control of cellular processes
8- Integrins and their role in the cell
9- Immunoglobolin protein superfamily (IgSF)
10- Extracellular matrix (ECM)
11- The role of ECM in control of essential functions of the cell
12- Stable and unstable appendices of the cell membrane
13- Seminars

Table of assessment

Continuous evaluation	Midterm	Final exam	Project
10%	**-**	**70%- written**	**20%**

References:

-Bruce Alberts, Molecular Biology of the Cell, Fifth ed., 2008, Garland Science, UK.
-Harvey Lodish, Molecular Cell Biology, 2012, W. H. Freeman and Company, New York, NY.

Course title: Advanced genetic engineering
No. of units: 2
No. of hours: 32
Unit type: theoretical
Course type: elective
Prerequisites: none
Additional training: yes
Scientific expedition: no **Workshop:** no **Lab:** no **Seminar:** yes
The overall objectives of the course:
Understanding of applications of gene cloning in research and biotechnology
Topics of the course:

1- A review on basic topics of genetic engineering
2- Study of gene expression and function, and detection and sequencing of transcripts, analysis of transcripts by primer extension, analysis of transcripts by PCR
3- Study of gene expression regulation, identification of protein binding regions on DNA, gel retardations assay, foot-printing by DNaseI, identification of regulatory sequences by analysis of deletions
4- Identification and study of the cloned gene products, HRT and HART, protein analysis by *in vitro* mutagenesis
5- Genome, transcriptome and proteome studies
6- Protein production from cloned genes, various vectors use for foreign gene expression in *E.coli*, problems related to recombinant proteins production in *E.coli* and recombinant proteins production in eukaryotic cells
7- Gene cloning and DNA analysis in medicine, recombinant drug production, identification of genes responsible for disease in human, gene therapy.
8- Gene cloning and DNA analysis in agriculture, genetic engineering in plants, gene destruction, and issues related to modified plants.
9- Gene cloning and DNA analysis in legality issues and archeology, DNA analysis in forensics, the study of kinship, sex determinations, archeology genetics.
10- Advanced novel methods and their application in genetic engineering
11- Designing and analysis of data extracted from mentioned methods

Table of assessment

Continuous evaluation	Midterm	Final exam	Project
10%	**-**	**70%- written**	**20%**

References:

- Brown T. A. 2010. Gene cloning. 6th edition. Wiley-Blackwell.
- Primrose S. B and Twuman R. 2016. Principle of gene manipulation and genomics. 8th edition. Wiley-Blackwell.
- Nichol D. S. T. 2008. An introduction to genetic engineering. 3rd edition. Cambridge university press.

Course title: Molecular radiobiology
No. of units: 2
No. of hours: 32
Unit type: theoretical
Course type: elective
Prerequisites: none
Additional training: yes
Scientific expedition: no **Workshop:** no **Lab:** no **Seminar:** yes

The overall objectives of the course:

Understanding the molecular mechanisms of radiation exposure effects on different biological environments

Topics of the course:

1- An overview to radiations, the manner of production, classification, transmission in environment, identification and measurement
2- Investigating the mechanisms of radiations reaction with water molecules which constitutes the highest volume of live systems
3- Investigating the mechanisms of radiations effects on different compounds such as biological membranes, plasma, organelles and nucleus membrane
4- Investigating the molecular mechanisms of radiations effects on different types of simple and compound carbohydrates
5- Investigating the molecular mechanisms of radiations effects on different types of lipids
6- Investigating the molecular mechanisms of radiations effects on amino acids with different physicochemical properties
7- Investigating the molecular mechanisms of radiations effects on different proteins
8- Investigating the molecular mechanisms of radiations effects on ribonucleic acids: sugar, base, phosphate group
9- Investigating the molecular mechanisms of radiations effects on deoxyribonucleic acids: sugar, base, phosphate group
10- Investigating the molecular mechanisms of radiations effects on double strand nucleic acids
11- Investigating the mechanisms of specific radiation reactions with organic bases: purines and pyrimidines
12- Investigating the molecular mechanisms of radiations in creating breaks in nucleic acids
13- Investigating the role of specific structure of macromolecules on their responses to radiation exposure
14- Investigating the role of environment condition on macromolecule's response to radiation exposure
15- Introducing new subjects related with molecular radiobiology
16- Seminars

Table of assessment

Continuous evaluation	Midterm	Final exam	Project
10%	**-**	**70%- written**	**20%**

References:

- K. P. Mishra,"Radiobiology and Bio-medical Research", , 2004.
- M. Tubiana, J. Dutreix, A. Wambersie,"Introduction to Radiobiology, 1990.
- J. Selman, "Elements of Radiobiology", Charles C. Thomas Inc. 1983.
- D. Wigg,,"Applied Radiobiology and Bioeffect Planning", 2001.

Course title: Molecular immunology
No. of units: 2
No. of hours: 32
Unit type: theoretical
Course type: elective
Prerequisites: none
Additional training: yes
Scientific expedition: no **Workshop:** no **Lab:** no **Seminar:** yes
The overall objectives of the course:
Familiarization with molecular subjects of immunology methods
Topics of the course:

1- An overview to basic subjects in immunology, innate immune systems
2- Antibody structure, antigen recognition by T-cell receptors (TCR), major histocompatibility complex (MHC) structure
3- Genes and making diversity in TCR
4- TCR and MHC genes
5- Signaling in immune system receptors
6- Differentiation of B lymphocytes, production of efficient T cells
7- The role of dendritic and macrophage cells
8- Cytotoxic T cells mechanism of action, APC regulation in immune response
9- Humoral immune response - adaptive immunity against infection
10- Innate system deficiency, acquired immunodeficiency syndrome, recent findings
11- Immunity against infection and deficiency in host defense, allergy and hypersensitivity mechanisms
12- Transplant rejection, response to allo antigens, self/nonself tolerance
13- Pathogenesis of autoimmune diseases
14- Immuno-engineering responses
15- Molecular immunology of tumors
16- Vaccination, whole cell vaccine, subunit vaccine

Table of assessment

Continuous evaluation	Midterm	Final exam	Project
10%	**-**	**70%- written**	**20%**

References:
-Abbas, A. K. Lichtman, A. H. Pober, J. S,Cellular and Molecular Immunology, 5th edition, W. B. Saunders Company.
-Jeneway, C.A, Travers, P., Hunt, S. ,Immunobiology, The Immune System in Health and Disease", 6th edition, Curr Biol Ltd.

Course title: Chromatin biochemistry
No. of units: 2
No. of hours: 32
Unit type: theoretical
Course type: elective
Prerequisites: none
Additional training: yes
Scientific expedition: no **Workshop:** no **Lab:** no **Seminar:** yes
The overall objectives of the course:
Learning chromatin structure and function from biochemical point of view.
Topics of the course:

1- Chromatin, chromosome, light chromatin, dense chromatin, chromatin constituents.
2- Histones: general features, classification, specific features, primary, secondary and tertiary level of structures.
3- Five main histone proteins: H1, H2A, H2B, H3, H4 conservation and Bradbury model.
4- Interactions with and influences of environmental factors on histone and chromatin structure, histone coding genes.
5- Histone modifications and citrullination.
6- Impacts of one histone modification on other histone modifications and on chromatin structure and function.
7- Non-histone proteins: Low mobility groups (LMGs).
8- Non-histone proteins: High mobility groups (HMGs).
9- Nucleosome structure, nucleosome remodeling and its effective factors.
10- Heterochromatin, euchromatin, chromatin structure and cell cycle.
11- Factors that affect Chromatin condensation and decondensation.
12- Role and importance of chromatin structure in gene regulation.
13- Changes in chromatin structure during cellular aging / telomers.
14- Histone like proteins and protamines.
15- Current topics about the biochemistry of chromatin.
16- Seminars.

Table of assessment

Continuous evaluation	Midterm	Final exam	Project
10%	**-**	**70%- written**	**20%**

References:

- Li H. J and Eckhardt R. 2012. Chromatin and chromosome structure. Academic Press.
- Turner B. M. 2001. Chromatin and gene regulatory mechanisms in epigenetics. Blackwell.
- Ballard T. D, Wolff J, Griffin J. B, Stanley J. S, Calcar S. V, Zempleni J. 2002. Biotidinasecatalysesdebiotinylation of histones. Eur. J. Nutr., 41:78-84.
- Healy S. H, Heightman L, Schriemer d, Gravel R. A. 2009. Nonenzymaticbiotinylation of histone H2A. Protein Sci., 18(2): 314-328.
- Orgy B and Ebet E. 2006. Citrullination: A post-translational modification in health and disease.

Course title: Cellular and molecular mechanisms of cancer
No. of units: 2
No. of hours: 32
Unit type: theoretical
Course type: elective
Prerequisites: none
Additional training: yes
Scientific expedition: no **Workshop:** no **Lab:** no **Seminar:** yes
Understanding the cellular and molecular mechanisms of cancer
Topics of the course:

1- Introduction: Steps of transformation of a normal cell into a cancerous cell; molecular characteristics of cancerous colorectal tissue
2- Molecular mechanisms of epithelial- mesenchymal transition (EMT)
3- Intercellular junctions and their relevance to cancer
4- Deregulation of the G1/S phase transition in cancer
5- Deregulation of the G2/M phase transition in cancer
6- Senescence and cancer
7- Apoptosis and cancer
8- Oncogenes and mechanisms of oncogene activation in human cancers
9- Tumor suppressor genes and mechanisms of tumor suppressor gene inactivation in human cancers
10- Major signal transduction pathways and mechanisms of their deregulation in human cancers
11- Genetic instability in cancer
12- Cellular and molecular mechanisms of angiogenesis in tumors
13- Cellular and molecular mechanisms of metastasis
14- New approaches in human cancer therapy
15- Seminars

Table of assessment

Continuous evaluation	Midterm	Final exam	Project
10%	**-**	**70%- written**	**20%**

References:
-Volgelstein B and Kinzler K.W. 2002. The genetic basis of human cancer. McGraw Hill. 2nd edition.
- Research and review articles. (Nature reviews).

Course title: Enzymology
No. of units: 2
No. of hours: 32
Unit type: theoretical
Course type: elective
Prerequisites: none
Additional training: yes
Scientific expedition: no **Workshop:** no **Lab:** no **Seminar:** yes
The overall objectives of the course:
Learning the structure and function of enzymes
Topics of the course:
1- Seminars

Table of assessment

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10%	**-**	**70%- written**	**20%**

References:
- B. Alberts, Molecular Biology of the Cell, (2015), Garland Science.
- H. Lodish, Molecular Cell Biology, (2013), W. H. Freeman and Company.
- R. F. Weaver, Molecular Biology, (2008), Mc Graw Hill.

Course title: Bioinformatics
No. of units: 2
No. of hours: 32
Unit type: theoretical
Course type: elective
Prerequisites: none
Additional training: yes
Scientific expedition: no **Workshop:** no **Lab:** no **Seminar:** yes
The overall objectives of the course:
The aim of this course is to familiarize students with informatics studies in biology and using of the related findings and application of them in cellular and molecular biology sciences
Topics of the course:

1- Introduction to history and importance of bioinformatics
2- Information databases such as bibliographic databases, primary databases of proteins and nucleic acids, secondary databases like Prosite and Blocks
3- Pairwise sequence alignment and scoring matrices
4- Whole and partial alignment
5- Multiple sequence alignment, scoring method, gradual and reversible methods
6- Phylogenetic trees, distance methods and maximum likelihood
7- Prediction of RNA secondary structure
8- Genome analysis including gene prediction in prokaryotes and eukaryotes
9- Promoter prediction
10- Classification of proteins and prediction of protein's spatial structure

Table of assessment

Continuous evaluation	Midterm	Final exam	Project
10%	**-**	**70%- written**	**20%**

References:
-D. W. Mount, Bioinformatics, (2004), Cold Springer Harbor Laboratory Press.
-R. Durbin, Biological Sequence Analysis, (1999), Cambridge University Press.
-T. K. Attwood, Introduction to Bioinformatics, (1999), Longman.
-J. Gu, Structural Bioinformatics, (2009), Wiley-Blackwell.
-S. Ignacimuthu, Basic Bioinformatics, (2013), Alpha Science International Limited.
-A. M. Lesk, Introduction to Bioinformatics, (2014), Cambridge University Press

Course title: Human molecular genetics
No. of units: 2
No. of hours: 32
Unit type: theoretical
Course type: elective
Prerequisites: none
Additional training: yes
Scientific expedition: no **Workshop:** no **Lab:** no **Seminar:** yes

The overall objectives of the course:

To teach students the molecular biology of human genetics in a manner that will facilitate the application of powerful novel methodologies developed in the past two decades to design and performance of research projects.

Topics of the course:

1- Overview of human genome projects: achievements and prospects for application
2- Categorizing human diseases based on their genetic criteria
3- Molecular structure of the human nuclear and mitochondrial genomes
4- Monogenic human diseases: grouping and study methods
5- Cytogenetics: study of human chromosomes and chromosomal anomalies
6- Hemoglobin damages and molecular basis of hereditary diseases caused by abnormal hemoglobin
7- Principles of human gene expression – genetics and epigenetics
8- Biochemical genetics –congenital metabolic diseases and molecular basis of human monogenic diseases
9- Physical and genetic mapping of the human genome; use of various types of polymorphisms in the genome
10- Identification of disease genes and factors that cause hereditary predisposition to disease
11- Laboratory methods used in genetic studies: amplification and manipulation of DNA, transgenic organisms, gene targeting, gene silencing
12- Pharmacogenetics and personalized medicine
13- Genetic approaches for treatment of diseases: drugs, recombinant proteins, vaccines, cell therapy, RNA and oligonucleotide therapy

Table of assessment

Continuous evaluation	Midterm	Final exam	Project
10%	**-**	**70%- written**	**20%**

References:

- Strachan T and Read A. 2013. Human molecular genetics, 4th edition. Garland science
- Lewis R. 2009. Human genetics: concepts and applications. 9th edition. McGraw Hill higher education.
- Nussbaum R. L. McInnes R.R, Willard H. F. 2015. Thompson & Thompson genetics in medicine. 8th edition. Elsevier.