REQUIREMENTS

Semmelweis University, Faculty of Dentistry

Name of the course: Molecular cell biology I

Credit value: 3

Lessons *(in hours)*: 42 **lectures:** 14 **practicals:** 28 **seminars: –**

Type of the course: **compulsory** **obligatory elective** **elective**

Frequency of announcement *(per semester or year)*: per year

Academic year: 2022/23/1

Subject code[1]: FOKOMBT306_1A

Lecturer of the course: Miklós Csala MD, PhD
Contact: csala.miklos@med.semmelweis-univ.hu

The goals of the course in point of view of the education:
This subject focuses on the main procedures in molecular biology and cell biology. It serves as a base for several fields in medicine, such as molecular pathology, molecular diagnostics, pharmacology, gene therapy and medical biotechnology.

Location of the course *(address of lecture hall, seminar room etc.)*:
EOK, 1094 Budapest, Tűzoltó utca 37-47.

Competences acquired by completion of the course:
Students having completed the subject will be familiar with the principles, main pathways and mechanisms of molecular biology and cell biology, which will help them to orient themselves and to apply scientific achievement in various fields of molecular medicine, which is essential in the 21st century.

Pre-study requirements and prerequisites of course registration and completion:
Medical chemistry
Dental biochemistry I.

Number of students required for announcement of course *(min., max.)*: Max.: 110 students

Method of course registration: Neptun

Detailed course/lecture description[2]: *(to facilitate credit recognition in other institutions)*

1. Introduction to molecular cell biology (Miklós Csala)
2. Structure and function of nucleotides and nucleic acids. Packaging of DNA into chromatin (Miklós Csala)
3. DNA packaging in pro- and eukaryotic cells; the role of topoisomerases (Miklós Csala)
4. Structure of the human genome 1 (Viola Tamási)
5. Structure of the human genome 2 (Viola Tamási)
6. Principles of DNA replication. Replication in prokaryotes (Zsolt Rónai)
7. Replication in eukaryotes (Zsolt Rónai)
8. DNA repair (Zsolt Rónai)
9. Transcription in prokaryotes (Miklós Csala)
10. Transcription in eukaryotes, mRNA processing (Miklós Csala)
11. Regulation of transcription (Miklós Csala)
12. Nuclear receptors. Transcriptional factors, DNA-binding domains (Szabolcs Sipeki)
13. MicroRNAs (Tamás Arányi)
14. Epigenetics (Tamás Arányi)
15. The genetic code, translation 1 (Tamás Mészáros)
16. The genetic code, translation 2 (Tamás Mészáros)
17. The genetic code, translation 3 (Tamás Mészáros)
18. Posttranslational modification of proteins (Tamás Mészáros)
19. Protein folding (Tamás Mészáros)
20. Quality control (Tamás Mészáros)
21. Protein targeting into metabolic compartments 1 (Tamás Mészáros)
22. Protein targeting into metabolic compartments 2 (Tamás Mészáros)
23. Proteostasis, the ubiquitin–proteasome system (Sőti Csaba)

24. Mechanisms of autophagy (Csaba Sőti)
25. Molecular biology of viruses (Miklós Csala)

*Practicals **(4x45 min every other week)**:*

1. Introduction, Biuret test, Ellmann's reaction, consultation
2. Cell fractions I
3. Cell fractions II
4. Consultation
5. Regulation of beta-galactosidase expression
6. Purification of a bacterially expressed protein by affinity chromatography
7. SDS-PAGE and western blot

Courses *(obligatory and elective)* which in part or entirely overlap the topics of above course:
There is no overlap with other subject.

Special academic work required for completion of the course[3]: –

Attendance on practices and lectures, replacement in case of missed sessions:
Attendance of at least 75% of the practical lessons is obligatory.

Consequences of absence from sessions and exams:
Attendance of at least 75% of the practical lessons is required for getting the signature.

Method of checking acquired knowledge during the study period[4]:
Students can collect "practical points" during the labs. These points are taken into account at the Molecular cell biology II. final exam at the end of the academic year.

Requirements of an accepted semester *(signature of the lecturer)*:
Attendance of at least 75% of the practical courses

Type of the exam: Oral examination

Requirements of the exam[5]:
Oral exam is based on the topic list announced in the beginning of the semester. For topics, refer to *Detailed course description* section.

I. DNA

1. Chemical structure of nucleotides; primary and secondary structures of nucleic acids (DNA and various RNAs)
2. Condensation levels of DNA in the eukaryotic cells; the role of topoisomerases and chromatin proteins
3. Structure of the human genome: coding and gene regulatory sequences; non-coding genomic sequences: introns, pseudogenes, repetitive sequences
4. Principles of the semiconservative DNA replication; replication fork, leading and lagging strand
5. DNA replication in the pro- and eukaryotic cells; comparison of the enzymes, proteins involved
6. The telomere; function and significance of the telomerase
7. Common types of DNA damage and repair mechanisms; DNA lesions versus mutations
8. Formation of spontaneous point mutations; DNA polymorphism; possible effects of point mutations on the encoded proteins

II. RNA

9. Structure and function of RNA polymerase of *E. coli*; initiation of transcription in prokaryotes; the prokaryotic transcription unit
10. Termination of transcription in prokaryotes; post-transcriptional RNA modifications in prokaryotic cells
11. The eukaryotic transcription unit; initiation and termination of transcription in the eukaryotic cells
12. Regulation of transcription in eukaryotes
13. Maturation of mRNA
14. Formation and regulatory functions of microRNAs in eukaryotic cells
15. Significance of DNA methylation and histone modifications
16. DNA-binding proteins and their characteristic structural motifs with examples
17. Structure and function of nuclear receptors; steroid-thyroid receptors and the aryl hydrocarbon receptor

III. Proteins

18. The genetic code; codon-anticodon interaction; function and role of aminoacyl-tRNA synthetases
19. Structure and function of the ribosome; the ribosome cycle; role of tRNA in translation
20. Initiation of translation in pro- and eukaryotic cells
21. Regulation of eukaryotic translation; the role of eIF2α phosphorylation
22. Elongation and termination of translation in pro- and eukaryotic cells; pharmacological inhibitors of translation
23. Post-translational modifications of proteins, characteristic modifications in the endoplasmic reticulum

24. Maturation and quality control of proteins; ERAD
25. Protein targeting within the secretory pathway; targeting to peroxisome or mitochondrion; entry of lysosomal proteins and substrates to be degraded into the lysosome
26. The concept of proteostasis; possible modes of intracellular protein degradation
27. Different types of autophagy; role of the lysosomes
28. The lytic replication cycle of bacteriophages; strategies of bacteria and phages to distinguish foreign DNA from their own

Grading of courses[6]:
The exam is taken before a committee of two (examiner and co-examiner). Students pick 3 random questions (DNA, RNA, Proteins) of the topic list. The exam can be passed if all these topics are sufficiently answered.

Exam registration: Neptun

Rules of repeating exams: According to general regulation

List of textbooks, lecture notes and recommended textbooks:
Lodish: Molecular Cell Biology (8th edition)
E-learning system (Moodle) https://itc.semmelweis.hu/moodle

Signature of course lecturer:

Signature of head of department:

Date of submission: 9/5/2022

Opinion of OKB:

Notes from the Dean's Office:

Signature of Dean:

[1] Filled out by the Dean's Office following approval
[2] Detailed and numbered for each week of theoretical and practical lessons one by one, indicating the names of lecturers and instructors
[3] Eg. field practice, medical chart analysis, survey conducting, etc.
[4] Eg. homework, report, midterm exam etc. Topics, dates, method of retake and replacement.
[5] List of topics in case of theoretical exam, thematic and method in case of practical exam.
[6] Method of inclusion of theoretical and practical exams. Method of inclusion of midterm assessments.