ANX-PR/CL/001-01

LEARNING GUIDE

SUBJECT

203000029 - Synthetic And Systems Biology

DEGREE PROGRAMME

20BC - Master Universitario En Biologia Computacional

ACADEMIC YEAR & SEMESTER

2021/22 - Semester 1

Index

Learning guide

1. Description

1.1. Subject details

Name of the subject	203000029 - Synthetic And Systems Biology
No of credits	3 ECTS
Type	Optional
Academic year ot the programme	First year
Semester of tuition	Semester 1
Tuition period	September-January
Tuition languages	English
Degree programme	20BC - Master Universitario en Biologia Computacional
Centre	20 - E.T.S. De Ingenieria Agronomica, Alimentaria Y De Biosistemas
Academic year	2021-22

2. Faculty

2.1. Faculty members with subject teaching role

Name and surname	Office/Room	Email	Tutoring hours *
Elena Caro Bernat (Subject coordinator)	CBGP B55	elena.caro@upm.es	Sin horario. Upon e-mail request

* The tutoring schedule is indicative and subject to possible changes. Please check tutoring times with the faculty member in charge.

3. Skills and learning outcomes *

3.1. Skills to be learned

CE02 - Utilizar sistemas operativos, programas y herramientas de uso común en biología computacional, así como, manejar plataformas de cómputo de altas prestaciones, lenguajes de programación y análisis bioinformáticos

CE03 - Analizar e interpretar bioinformáticamente los datos que se derivan de las tecnologías ómicas, y proponer soluciones bioinformáticas en relación a dichos datos.

CE05 - Utilizar herramientas de biología computacional para el análisis genómico, incluida la genómica comparativa y biología evolutiva.

CE10 - Conocimiento de las técnicas de representación del conocimiento reutilizables y modelos de razonamiento en entornos centralizados y distribuidos a utilizar en la resolución de problemas que impliquen conducta inteligente.

CG01 - Poseer los conocimientos que constituyen la base científica y tecnológica de la Biología computacional, lo que permitirá el desarrollo de ideas originales en este campo, en un contexto de investigación o desarrollo.

CG03 - Que los estudiantes sepan aplicar los conocimientos adquiridos y su capacidad de resolución de problemas en entornos nuevos o poco conocidos dentro de contextos más amplios (o multidisciplinares) relacionados con el area de la Biología Computacional.

CG05 - Que los estudiantes sean capaces de integrar conocimientos en el area de la Biología Computacional, de formular conclusiones, hipótesis o líneas de trabajo a partir de la información disponible, y de formarse una opinion fundamentada sobre las responsabilidades sociales y éticas vinculadas a la aplicación de sus conocimientos.

CT08 - Tener capacidad de análisis y síntesis para interpretar datos relevantes y abordar los problemas desde diferentes perspectivas.

3.2. Learning outcomes

RA27 - Familiarizar a los estudiantes con los datos de biología molecular utilizados en biología sintética

RA28 - Conocer las aplicaciones de los principios de ingeniería a la ingeniería de sistemas biológicos

RA29 - Conocer las diferentes etapas del ciclo biológico de la biología sintética

RA30 - Conocer las teorías subyacentes que se aplican a los conceptos y técnicas de la biología sintética.

* The Learning Guides should reflect the Skills and Learning Outcomes in the same way as indicated in the Degree Verification Memory. For this reason, they have not been translated into English and appear in Spanish.

4. Brief description of the subject and syllabus

4.1. Brief description of the subject

Synthetic Biology began as a discipline that pretended to program transcriptional circuits in bacterial cells with diverse dynamic behaviors (switches, oscillators, etc.). This approach complemented Systems Biology by helping to profile some of the hypotheses about the functioning of natural biological systems through the construction of synthetic alternatives. Initial ideas have subsequently developed into other organisms (yeast, mammalian cells, plant cells) with the use of various molecular substrates (along with transcription factors, micro RNAS, protein phosphorylation, etc.). Additional aspects that complement modern Synthetic Biology include genomic editing, accelerated evolution, or the notion of the minimal cell. The final goal of this discipline combines the best understanding of natural systems and the development of a new bioengineering of biological systems still not existing.

4.2. Syllabus

1. Basic concepts in Systems and Synthetic Biology

2. Genomic engineering: from minimal cells to synthetic communities

3. Genetic circuits, biological "plug-and-play"

4. Applications of Synthetic Biology

5. Socio-economic impact of Synthetic Biology

5. Schedule

5.1. Subject schedule*

Week	Face-to-face classroom activities	Face-to-face laboratory activities	Distant / On-line	Assessment activities
1			**Basic concepts in Systems and Synthetic Biology (I)** Duration: 02:00	
2			**Basic concepts in Systems and Synthetic Biology (II)** Duration: 02:00	
3			**Basic concepts in Systems and Synthetic Biology (III)** Duration: 02:00	**Individual assignment: "Basic concepts in Systems and Synthetic Biology"** Continuous assessment Not Presential Duration: 02:00
4			**Genomic engineering: from minimal cells to synthetic communities (I)** Duration: 02:00	
5			**Genomic engineering: from minimal cells to synthetic communities (II)** Duration: 02:00	
6			**Genomic engineering: from minimal cells to synthetic communities (III)** Duration: 02:00	**Individual assignment: "Genomic engineering: from minimal cells to synthetic communities"** Continuous assessment Not Presential Duration: 02:00
7			**Genetic circuits, biological "plug-and-play" (i)** Duration: 02:00	
8			**Genetic circuits, biological "plug-and-play" (il)** Duration: 02:00	
9			**Genetic circuits, biological "plug-and-play" (il)** Duration: 02:00	**Individual assignment: In silico design and implementation of synthetic circuits** Continuous assessment Not Presential Duration: 02:00

10			**Applications of Synthetic Biology (i)** Duration: 02:00	
11			**Applications of Synthetic Biology (il)** Duration: 02:00	
12			**Applications of Synthetic Biology (il)** Duration: 02:00	**Individual assignment: Propose new applications of synthetic biology and their implementation** Continuous assessment Not Presential Duration: 02:00
13			**Socio-economic impact of Synthetic Biology (i)** Duration: 02:00	
14			**Socio-economic impact of Synthetic Biology (il)** Duration: 02:00	
15				**Exercises: Socio-economic impact of Synthetic Biology** Continuous assessment Not Presential Duration: 02:00
16				
17				**Final Exam** Final examination Presential Duration: 02:00

Depending on the programme study plan, total values will be calculated according to the ECTS credit unit as 26/27 hours of student face-to-face contact and independent study time.

* The schedule is based on an a priori planning of the subject; it might be modified during the academic year, especially considering the COVID19 evolution.

6. Activities and assessment criteria

6.1. Assessment activities

6.1.1. Continuous assessment

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
3	Individual assignment: "Basic concepts in Systems and Synthetic Biology"		No Presential	02:00	20%	5 / 10	CG03 CE05 CG01 CE02 CE03 CE10 CG05 CT08
6	Individual assignment: "Genomic engineering: from minimal cells to synthetic communities"		No Presential	02:00	20%	5 / 10	CG03 CE05 CG01 CE02 CE03 CE10 CG05 CT08
9	Individual assignment: In silico design and implementation of synthetic circuits		No Presential	02:00	20%	5 / 10	CG03 CE05 CG01 CE02 CE03 CE10 CG05 CT08
12	Individual assignment: Propose new applications of synthetic biology and their implementation		No Presential	02:00	20%	5 / 10	CG03 CE05 CG01 CE02 CE03 CE10 CG05 CT08
15	Exercises: Socio-economic impact of Synthetic Biology		No Presential	02:00	20%	5 / 10	CG03 CG01 CE02 CE03 CE10 CG05 CT08

							CE05

6.1.2. Final examination

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
17	Final Exam		Face-to-face	02:00	100%	5 / 10	CG03 CE05 CG01 CE02 CE03 CE10 CG05 CT08

6.1.3. Referred (re-sit) examination

Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
Writing of a short document about one of the subjects discussed in the course.		Face-to-face	02:00	100%	5 / 10	CG03 CE05 CG01 CE02 CE03 CE10 CG05 CT08

6.2. Assessment criteria

Continuous evaluation: Discussions in class and individual assignments.

7. Teaching resources

7.1. Teaching resources for the subject

Name	Type	Notes
S. Strogatz, Nonlinear Dynamics And Chaos: With Applications To Physics, Biology, Chemistry, And Engineering, 2nd Ed., Westview Press, 2014.	Bibliography	
Purnick, P. E. M., & Weiss, R. (2009). The second wave of synthetic biology: from modules to systems. Nature Reviews Molecular Cell Biology, 10(6), 410?422. https://doi.org/10.1038/nrm2698	Bibliography	
Cheng, A. A., & Lu, T. K. (2012). Synthetic Biology: An Emerging Engineering Discipline. Annual Review of Biomedical Engineering, 14(1), 155?178. https://doi.org/10.1146/annurev-bioeng-071811-150118	Bibliography	
E. Voit. A First Course in Systems Biology, 2nd Edition. Garland Science, 2018. ISBN-10: 0815345682	Bibliography	
S. Camazine et al. Self-Organization in Biological Systems. Princeton University Press, 2003	Bibliography	

8. Other information

8.1. Other information about the subject