ERASMUS COURSE CATALOGUE OF DEPARTMENT OF MARINE STUDIES

Academic Year 2025./2026.

Code	Course (ENG)	Course (HR)	Hours (Lecture+Seminar+ Exercise+Fieldwork)	ECTS	Semester	Study programme	Teacher
SMR208	Seamanship theory and navigation	Poznavanje broda i plovidbe	30+0+30+0	4	Spring	Marine Biology and Technology	Zvonimir Lušić
SMB402	Biological oceanography	Biološka oceanografija	15+0+15+0	3	Spring	Marine Biology and Technology	Maja Krželj
SMB307	Virology	Virologija	20+10+0+0	3	Winter	Marine Biology and Technology	Marin Ordulj
SMB411	Marine pollution	Zagađenje mora	30+15+0+0	4	Spring	Ecology and Protection of the Sea	Maja Krželj
SMB505	Microbiology of polluted waters	Mikrobiologija zagađenih voda	20+10+0+0	3	Spring	Ecology and Protection of the Sea	Marin Ordulj
SMB510	Climatic changes and marine ecosystems	Klimatske promjene i morski ekosustavi	15+15+0+0	3	Winter	Ecology and Protection of the Sea	Maja Krželj
SMR519	Adaptation physiology of marine organisms	Fiziologija prilagodbe morskih organizama	15+15+0+0	3	Spring	Marine Fishery	Josipa Ferri

NAME OF THE COURSE	SEAMANSHIP THEORY AND NAVIGATION						
Code	**SMR208**	Year of study	1				
Course teacher (contact)	Zvonimir Lušić, PhD (zlusic@pfst.hr)	Credits (ECTS)	4				
Associate teachers (contact)	Mirko Farić, mag.ing. (mirko.faric@gmail.com)	Type of instruction (number of hours)	L	S	E	F	
			30		30		
Status of the course	Mandatory	Percentage of application of e-learning	10%				

COURSE DESCRIPTION	
Course objectives	Define basic terms in shipping and maritime navigation.To get familiar with the basic division and characteristics of different types of ships. Master basic concepts in ship construction and ship stability. Get acquainted with relevant international and national regulations, as well as maritime organizations. Be able to respond in distress on board and know how to use personal life-saving appliances and basic fire fighting equipment. Master the basic concepts in navigation, meteorology, maneuvering, planning and realization of ship voyage. To get familiar with the basic principles of keeping a navigational watch, and the rules for collision avoidance.
Course enrolment requirements and entry competences required for the course	/
Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	Distinguish and interpret basic terms in shipping and maritime navigation. Identify the characteristics of different types of ships, and distinguish basic concepts concerning ship construction and ship stability. Properly use personal life-saving appliances, and apply fire protection measures. Commenting on international and national maritime law. Practically draw courses, bearings (azimuths), distances and positions on the navigation chart. Identify hazards on navigation charts and interpret meteorological reports. Interpret important navigation instruments and devices. Make a simple passage plan, and explain the basic techniques of ship maneuvering. Explain and interpret rules for avoiding collisions at sea.
Course content broken down in detail by weekly class schedule (syllabus)	Lectures 1. Basic terms (ship, boat, yacht, shipping, maritime, waterway, sailing lane, navigation route, maritime voyage, passage planning). Ship types - division and basic characteristics of different types of ships. 2. Geometric representation of the ship and its main dimensions, indicating the carrying capacity of the ship and the volume of ship spaces; ship structure, ship stresses, cargo handling equipment, anchor equipment. General concepts of stability; transverse and longitudinal stability, static and dynamic stability. 3. The concept of ship safety and security. Life-saving appliances (LSA). Lifeboats and liferafts. Use of LSA. On-board alert system and safety markings. Handling fire fighting equipment. 4. International Maritime Safety Organizations (IMO, WMO, INMARSAT, ITU, IALA, ILO, WHO, ...). International and national regulations (SOLAS, STCW, MARPOL, UNCLS, Maritime Code, ...). Pollution prevention procedures and associated equipment. 5. Basic terms in navigation: course, bearing/azimuth, bow angle, shape of Earth-the main circles and planes, geographical coordinates, WGS84, departure, magnetic variation and deviation, horizon and orientation. On-board and outboard navigation aids. Instruments and aids: compass, bearing circle sight, depth sounder, speed log, sextant, plotting aids and their use. Reading and plotting coordinates, courses, bearings/azimuths and distances. 6. Division of maritime charts. Projection, Mercator Navigation Chart. Navigation manuals. Reading navigation charts and manuals. Waterway marking. Marine lights, IALA system. Correcting navigation charts and manuals. 7. Positioning in navigation, line/circle of position, types of position (fix, dead reckoning and running fix). Set and drift. Position errors. Auxiliary methods for safe navigation and general recommendations.

	8. Passage planning. Course/route plotting. Rhumb Line (RL) and Great Circle (GC) sailing. Creating a passage plan, ETD and ETA. 9. Basics of Celestial Navigation. Celestial sphere and coordinate systems. Orientation by use of celestial bodies. Nautical Almanach, sextant, chronometer. Determining the time of the rising and setting of celestial bodies. Principle of positioning and control of compass deviation. 10. Electronic navigation aids: speed log, depth sounder, gyro-compass, radar, ARPA radar, ECDIS, hyperbolic and satellite navigation systems, GPS, DGPS. Use of radar (ARPA radar) to avoid collisions at sea. Use of electronic navigation charts and ECDIS. 11. Basics of meteorology, meteorological instruments, sea and wind state. Synoptic charts. Receiving weather forecast and its interpretation. 12. Offshore rescue and emergency procedures; messages of distress, urgency and safety; WWNWS; GMDSS. Procedures in the event of a security risk to the ship. 13. Basic ship handling techniques; mooring, anchoring; Emergency maneuvering and rescue operations at sea. 14. Rules for avoiding collisions at sea. Organization of work on board, watchkeeping and administration. 15. Ship cargo handling systems, modern transport technologies: containerization, ro-ro technology, integrated transport systems, multimodal transport. Excerises 1. Identification of different types of ships, structural elements of the ship, layout of cargo spaces, navigation bridge, crew accommodation, engine room. 2. Reading the ship's data: reading the ship's drafts, the markings of the freeboard, other dimensions of the ship. Units in Navigation and their conversion. 3. Basics of ship stability, reading the stability curve, determining the elements of ship's static stability. 4. Use of life-saving appliances; handling fire fighting equipment. Boating knots. 5. Identification of ship's systems and equipment. 6. Navigation chart - reading and plotting geographic coordinates, courses, azimuths and distances, dead reckoning position. 7. Navigation chart – position plotting; fix and running fix. 8. Navigation chart - determining elements of drifting (set and drift), route plotting. 9. Navigation chart-route plotting and navigation, ETA. 10. Determination of elements of Rhumb line and Great Circle navigation. Route planning. 11. Navigation with ECDIS/GPS and radar systems. Use of ARPA radar and AIS. 12. Steering the ship. Rules for avoiding collisions at sea and navigation in different conditions. 13. Berthing and anchoring. Rules for avoiding collisions at sea. 14. Navigation in different conditions and application of rules for avoiding collisions. GMDSS and communication in distress. 15. Watchkeeping and administration.

Format of instruction	☒ lectures ☐ seminars and workshops ☒ exercises ☐ *on line* in entirety ☐ partial e-learning ☐ field work	☐ independent assignments ☒ multimedia ☐ laboratory ☐ work with mentor ☐ seminar

Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)*						
	Class attendance	1,5	Research		Practical training	
	Experimental work		Report		(Other)	
	Essay		Seminar essay		(Other)	
	Tests		**Oral exam**	1	(Other)	
	Written exam	1,5	Project		(Other)	
Grading and evaluating	Continuous evaluation of students					

<table>
<tr><td>student work in class and at the final exam</td><td>
<table>
<tr><th>Elements of assessment</th><th>Success (min.%)</th><th>Percentage (%)</th></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>Lectures</td><td>50</td><td>20</td></tr>
<tr><td>Midtermtest I – exercises</td><td>50</td><td>30</td></tr>
<tr><td>Midtermtest II – exercises</td><td>50</td><td>30</td></tr>
<tr><td>Midtermtest III – theory</td><td>50</td><td>20</td></tr>
</table>
Students who do not pass the colloquiums take the final exam (written, regarding exercises), and then the oral exam (theory), the condition is the right to signature.

Final evaluation
<table>
<tr><th>Elements of assessment</th><th>Success (min.%)</th><th>Percentage (%)</th></tr>
<tr><td>Previous activities (including elements of continuous evaluation)</td><td>50</td><td>30</td></tr>
<tr><td>Written part-re exercises</td><td>50</td><td>40</td></tr>
<tr><td>Theoretical exam (written and/or oral)</td><td>50</td><td>30</td></tr>
</table>
Evaluation and final rating:
91% - 100%: grade 5 (excellent);
80% - 90%: grade 4 (very good);
66% - 79%: grade 3 (good);
50% - 65%: grade 2 (sufficient);
<50%: grade 1 (inadequate).
Attendance to lectures and exercises is mandatory and records of class attendance are kept. To be eligible for signature, a student has to attend a minimum of 80% of exercises and 50% of lectures. If a student does not achieve a minimum percentage of attendance on lectures and exercises, he/she is not eligible for signature and is not permitted to take the exam.
</td></tr>
<tr><td>Required literature (available in the library and via other media)</td><td>
<table>
<tr><th>Title</th><th>Number of copies in the library</th><th>Availability via other media</th></tr>
<tr><td>Seamanship Techniques-Shipboard and Marine Operations, DJ House, 2004. (https://anzaliport.pmo.ir/pso_content/media/digitallibrary/2013/1/book13/13.pdf)</td><td></td><td>Yes</td></tr>
<tr><td>Willemsenm; D.: Navigation Course, SailingIssues, 2022. (https://www.sailingissues.com/navcourse0.html)</td><td></td><td>Yes</td></tr>
<tr><td>Lušić, Z.: Teaching materials, 2022.</td><td></td><td>Yes</td></tr>
<tr><td></td><td></td><td></td></tr>
</table>
</td></tr>
<tr><td>Optional literature (at the time of submission of study programme proposal)</td><td>Bowditch, N.: The American Practical Navigator, National Imagery And Mapping Agency, Maryland, 2002.
Wallin, B.: Ship Navigation, Dokmar, 2016.</td></tr>
<tr><td>Quality assurance methods that ensure the acquisition of exit competences</td><td>University Student Survey, Class Attendance Sheets, University Teaching Process Monitoring, Analysis of exam success.</td></tr>
<tr><td>Other (as the proposer wishes to add)</td><td>Consultation times, literature, notices and other relevant informations will be advertised on the official Microsoft Teams joint website. Insight of the exam documentation is foreseen in the consultation period. Students can contact me by email at zlusic@pfst.hr.</td></tr>
</table>

NAME OF THE COURSE	BIOLOGICAL OCEANOGRAPHY					
Code	**SMB402**	Year of study	1			
Course teacher (contact)	Maja Krželj, PhD (mkrzelj@unist.hr)	Credits (ECTS)	3			
Associate teachers	-	Type of instruction (number of hours)	L	S	E	F
			15	0	15	-
Status of the course	Mandatory	Percentage of application of e-learning	-			

COURSE DESCRIPTION

Course objectives	The objective of the course is to introduce students to biological oceanography, various sampling techniques and to gain practical knowledge and experience in the use of modern methods in marine research.
Course enrolment requirements and entry competences required for the course	-
Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	- distinguish sampling techniques in marine environment, - describe different sampling techniques, - analyze the importance of experimental work in biological and fisheries science, - explain the basic biological and ecological characteristics of marine organisms, - present the results of practical work.
Course content broken down in detail by weekly class schedule (syllabus)	Lecture 1: Introduction and definitions. (* 1) Lecture 2: Marine habitats and ecosystems. (* 1) Lecture 3: Marine organisms. (* 1) Lecture 4: Ecological factors in marine habitats. (* 1) Lecture 5: Adaptations of marine organisms. (* 1) Lecture 6: Scientific research, sampling methods and techniques, analysis and presentation of results. (* 2) Lecture 7: Benthos research (* 2) Lecture 8: Plankton research (* 2) Lecture 9: Fisheries research (* 2) Lecture 10: Biodiversity and conservation ecology (* 2) Exercise 1: Field work and sampling. (* 4) Exercise 2: Identification of marine organisms. (* 4) Exercise 3: Laboratory analysis. (* 4) Exercise 4: Data processing and presentation of results. (* 3)
Format of instruction	☒ lectures ☐ seminars and workshops ☒ exercises ☐ *on line* in entirety ☐ partial e-learning ☒ field work ☐ independent assignments ☐ multimedia ☐ laboratory ☐ work with mentor ☐ seminars
Student responsibilities	-

Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)*						
	Class attendance	1	Research		Practical training	1
	Experimental work		Report		(Other)	
	Essay		Seminar essay		(Other)	
	Tests		Oral exam		(Other)	
	Written exam	1	Project		(Other)	
Grading and	Students will be evaluated and graded during the course as well as at the final exam.					

evaluating student work in class and at the final exam	During the course, attendance at classes, seminars and visits, seminar work, seminar activity and acquired knowledge are evaluated. It is necessary to meet all teacher's requirements (class attendance and individual presentation of seminar work) in order to pass the exam. To pass the exam, the questions must be answered with an accuracy of at least 60%. The grade on the exam is formed on the basis of the achievement achieved by the following scoring: 60 - 70 sufficient (2), 71 - 80 good (3), 81 - 90 very good (4), 91 - 100 excellent (5).		
Required literature (available in the library and via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	Cadima E.L., Caramelo A.M., 2005. Sampling methods applied to fisheries science: a manual. FAO 87 p.	-	-
	Krebs C.J. 1989. Ecological Methodology. Harper and Row Publisher, New York, 498 p.	-	-
	Pérès J.M., Gamulin Brida H., Biološka Oceanografija, Školska knjiga, Zagreb 1973, 149-155.	-	-
Optional literature (at the time of submission of study programme proposal)	E. Magurran, Ecological diversity and its measurement, Croom Helm, London. Štirn, J., Manual of methods in aquative environment research, FAO, Rim, 1981.,70 pp. Biswas, S.P.1993, Manual of Methods in Fish Biology. Published by South Asian Publishers, 157 p Harris, R., P., P. H. Wiebe, J. Lenz, H. R. Skjodal and M. Huntley (Eds.) 2000. Zooplankton methodology manual. Academic Press, 683 pp. Kršinić, F. 1990. A new type of zooplankton sampler. Journal of Plankton Research, 12: 337-343. Riedl R. 1983. Fauna und flora des Mittelmeeres. (P. Parey) Sournia, A., Phytoplankton manual UNESCO, Paris 1978. 337 pp. Spare, P., Venema S.C, 1998. Intropduction to tropical fish stock assessment. FAO Fish.Tech.Pap. 306/1 407 Wiebe, P and M. C. Benield, 2003. From the Hensen net toward four-dimensional biological oceanography. Progress in Oceanography, 56 (1): 7-136. Williams, P. J. le B., Thomas, D. N., Reynolds, C. S. 2002. Phytoplankton Productivity: Carbon Assimilation in Marine and Freshwater Ecosystems, Blackwell Publishing, Oxford, 386 p. Groom, M., Meffe, G.K., & Carroll, C.R. (2006). Principles of Conservation Biology, Third Edition. Sinauer Associates, Inc. USA.		
Quality assurance methods that ensure the acquisition of exit competences	The lectures and exercises are designed to be interactive and encourage active student participation in the classroom through questions and comments, thus enabling continuous monitoring of students' work.		
Other (as the proposer wishes to add)	Consultation times and exam dates will be published on the website of the University Department of Marine Studies. Inspection of the exam documentation/and or consultations can be made in office hours. Students can contact Course teacher by email.		

<table>
<tr><td>NAME OF THE COURSE</td><td colspan="5">VIROLOGY</td></tr>
<tr><td>Code</td><td>SMR307</td><td>Year of study</td><td colspan="3">3.</td></tr>
<tr><td>Course teacher (contact)</td><td>Marin Ordulj, Asst. Prof. (mordulj@unist.hr)</td><td>Credits (ECTS)</td><td colspan="3">3</td></tr>
<tr><td rowspan="2">Associate teachers</td><td rowspan="2">-</td><td rowspan="2">Type of instruction (number of hours)</td><td>L</td><td>S</td><td>E</td><td>F</td></tr>
<tr><td>20</td><td>10</td><td>0</td><td>0</td></tr>
<tr><td>Status of the course</td><td>Elective</td><td>Percentage of e-learning application</td><td colspan="3">-</td></tr>
<tr><td colspan="6">COURSE DESCRIPTION</td></tr>
<tr><td>Course objectives</td><td colspan="5">This course introduces students to basic concepts that describe viruses, viroids, and prions. As a result, students can differentiate these biological entities from other organisms. The course also aims to distinguish between the replication cycles of viruses. After completing this course, students will be able to distinguish between eukaryotic and prokaryotic viruses and understand and explain the significance and role of viruses in biological ecosystems and their impact on human life.</td></tr>
<tr><td>Course enrolment requirements and entry competences required for the course</td><td colspan="5">Completed courses of Cell Biology, General Microbiology and Genetics.</td></tr>
<tr><td>Learning outcomes expected at the level of the course (4 to 10 learning outcomes)</td><td colspan="5">Understand basic concepts of virology, viruses, and viral ecology.
Distinguish viruses from other organisms based on their structure and genome type.
Identify the cycle of virus replication.
Be able to identify the basic groups of viruses, to understand and interpret the activity of certain viral groups.
Understand and explain the role viruses in biological ecosystems and human life.</td></tr>
<tr><td>Course content broken down in detail by weekly class schedule (syllabus)</td><td colspan="5">Lecture 1. Introduction to virology (2 hours)
Lecture 2. What is a virus? (2 hours)
Lecture 3. Chemical structure, shape, and size of the virus (2 hours)
Lecture 4. Viral genetics and virus replication (2 hours)
Lecture 5. Methods in virology (2 hours)
Lecture 6. Virus classification (2 hours)
Lecture 7. Viroids and viral satellites (2 hours)
Lecture 8. Antivirus agents (2 hours)
Lecture 10. Overview of the most important groups of RNA viruses (2 hours)
Lecture 11. Overview of the most important groups of DNA viruses (2 hours)
Lecture 12. Tumor viruses (2 hours)
Lecture 13. Plant viruses (1 hour)
Lecture 14. Viral Ecology (2 hours)

SEMINAR PAPERS
In 10 hours of seminar papers, selected groups of viruses will be presented in such a way that the most relevant characteristics of the group are presented in the introductory part of the lecture, and then the students will present papers in which they cover the most prominent genera from selected groups. Since it is not possible to process all groups of viruses in detail during lectures, in agreement with students, 8-10 groups are selected depending on their occurrence and significance.

Each of the students is required to produce a seminar paper on a given topic and present it to other students.</td></tr>
<tr><td>Format of instruction</td><td colspan="2">☒ lectures
☒ seminars and workshops
☐ exercises</td><td colspan="3">☐ standalone tasks
☐ multimedia
☐ laboratory</td></tr>
</table>

	☐ on line in entirely ☐ partial e-learning ☐ field classes	☐ mentoring work ☐ (other type)
Student obligations	Students are required to attend classes.	

Screening student work (name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)	Attendance	1	Research		Practical work	
	Experimental work		Report		(Other type)	
	Assay		Seminar paper	1	(Other type)	
	Colloquiums		Viva voce		(Other type)	
	Pisani exam	1	Project		(Other type)	

Grading and evaluating student work in class and at the final exam	During class, attendance, teaching activity, adopted knowledge are evaluated. The seminar paper is graded from a minimum of 1 to a maximum of 5 points. The written exam is evaluated by the percentage of correctly answered questions as follows: 5 points for 90%, 4 points - 80%, 3 points - 70%, 2 points - 60% for the correctly solved exam. The final grade is obtained by summing up the points from the seminar paper and the written exam as follows: excellent (5) - 9 and above points very good (4) - 8 points and above good (3) - 7 and above points sufficient (2) - 6 and above points insufficient (1) - less than 6 points.

	Title	Number of copies in the library	Availability through other media
Required literature (available in the library and via other media)	Flint, S.J., Enquist, L.W., Krug, R.M., Racaniello, V.R. and A.M. Skalka. 2015. Principles of virology: molecular biology, pathogenesis and control, 4th edition. ASM press.		
	Carter, J. and V. Saunders. 2013. Virology: Principles and Applications. Wiley and Sons, England, 358p.		
	Duraković, S. and S. Ređepović, 2002. Chapter 17: Viruses, 435-480, U: Introduction to General Microbiology, Zagreb-Kugler, (Textbooks of the University of Zagreb), 665 p.		

Optional literature (at the time of submission of study programme proposal)	-
Quality assurance methods that ensure the acquisition of exit competences	At the end of the semester, the evaluation of subject and teachers will be conducted through the student evaluation of the teaching work. The work of students will be evaluated and evaluated during the performance of classes as well as on the final exam. During class,: a) attendance b) activity in teaching c) knowledge adopted
Other (as the proposer wishes to add)	-

NAME OF THE COURSE	MARINE POLLUTION					
Code	**SMB411**	Year of study	1			
Course teacher	Maja Krželj, PhD (mkrzelj@unist.hr)	Credits (ECTS)	4			
Associate teachers	-	Type of instruction (number of hours)	L	S	E	F
			30	15	0	-
Status of the course	Mandatory	Percentage of application of e-learning	-			

COURSE DESCRIPTION	
Course objectives	The objective of the course is to introduce students to different forms of pollution, marine pollution and impact of pollutants on marine ecosystems.
Course enrolment requirements and entry competences required for the course	-
Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	- define the main forms of contamination and pollution in marine environment, - explain the impacts of pollutants on marine ecosystem, - argue the link between pollutants and changes in the ecosystem, - assess the impact of pollutants on the marine ecosystem, - predict changes in marine ecosystems in response to pollution, - list and describe the most important conventions and action plans to prevent the introduction of pollutants into the marine environment.
Course content broken down in detail by weekly class schedule (syllabus)	Lecture 1: Introduction, definitions, atmosphere, hydrosphere and lithosphere pollution. Marine pollution. (* 3) Lecture 2: Categorization of marine pollution, waste and marine litter. Biodegradable organic matter. (* 3) Lecture 3: Marine oil pollution. (* 3) Lecture 4: Fertilizers. Non-persistent pollutants. (* 3) Lecture 5: Heavy metals and organometallic compounds. Persistent organic pollutants. (* 4) Lecture 6: Radioactivity. Solid waste. (* 4) Lecture 7: Marine Environment Monitoring. Monitoring techniques and pollution indicators. (* 3) Lecture 8: International conventions and action plans to prevent marine pollution. Marine environment protection and management. European directives on water and marine strategy. EU Marine Strategy Framework Directive. Water Framework Directive. (* 4) Lecture 9: Marine environment protection and management in Croatia. Framework for marine environment protection in Croatia. National action plans and legislation in prevention and reduction of pollutant inputs into the marine environment. (* 3) Seminar 1: Determination of pollutant concentrations and quantities in water column and sediment. Examples of wastewater discharge (communal and industrial). Graphical representations of input from various sources. (* 4) Seminar 2: Pollutants from river inflow and discharge of wastewater. Calculation of inflow, ie pollutants input by rivers, applying four different methods. Calculation of pollutants concentration taking into account various factors that affect the concentration. (* 2) Seminar 3: Documentary and discussion (* 2) Seminar 4: Field teaching - visit to wastewater treatment plants and / or CIAN plants. (* 2) Seminar 5: Discussion (* 2) The debate is conducted according to the principle of public debate. Students are divided into four different groups that represent their interests. Four different topics are covered and student groups change depending on the topic. Seminar 6: Students presentations (* 3)
Format of instruction	☒ lectures ☐ independent assignments	

	☐ seminars and workshops ☐ exercises ☐ *on line* in entirety ☐ partial e-learning ☐ field work	☐ multimedia ☐ laboratory ☐ work with mentor ☒ seminars
Student responsibilities	-	

Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)*						
	Class attendance	1	Research		Practical training	
	Experimental work		Report		(Other)	
	Essay		Seminar essay	1	(Other)	
	Tests		Oral exam		(Other)	
	Written exam	2	Project		(Other)	

Grading and evaluating student work in class and at the final exam	Students will be evaluated and graded during the course as well as at the final exam. During the course, attendance at classes, seminars and visits, seminar work, seminar activity and acquired knowledge are evaluated. It is necessary to meet all teacher's requirements (class attendance and individual presentation of seminar work) in order to pass the exam. To pass the exam, the questions must be answered with an accuracy of at least 60%. The grade on the exam is formed on the basis of the achievement achieved by the following scoring: 60 - 70 sufficient (2), 71 - 80 good (3), 81 - 90 very good (4), 91 - 100 excellent (5).

Required literature (available in the library and via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	Frid CLJ., Caswell BA. (2017) Marine Pollution. Oxford: Oxford University Press, 268 str.		

Optional literature (at the time of submission of study programme proposal)	Judith S. Weis (2015) Marine Pollution: What Everyone Needs to Know, Oxford University Press, Oxford, 200 str. Tobias N. Hofer (2008) Marine Pollution: New Research, Nova Publishers, 448 str. Clark, R.B. (2001). Marine Pollution (Fifth Edition), Clarendon Press, Oxford, 248 str Laws, E.A. (2000). Aquatic Pollution, An Introductory Text (Third Edition). Willey Intersci. Publ., New York, 672 str. Hester RE., Harrison RM. 2011. Marine Pollution and Human Health. Royal Society of Chemistry, 168 str. EU direktiva o vodama (60/2000/EC) (www.voda.hr)
Quality assurance methods that ensure the acquisition of exit competences	The lectures and seminars are designed to be interactive and encourage active student participation in the classroom through questions and comments, thus enabling continuous monitoring of students' work.
Other (as the proposer wishes to add)	Consultation times and exam dates will be published on the website of the University Department of Marine Studies. Inspection of the exam documentation/and or consultations can be made in office hours. Students can contact Course teacher by email.

<table>
<tr><td colspan="2">NAME OF THE COURSE</td><td colspan="5">MICROBIOLOGY OF POLLUTED WATERS</td></tr>
<tr><td>Code</td><td>SMB505</td><td>Year of study</td><td colspan="4">1</td></tr>
<tr><td>Course teacher (contact)</td><td>Asst. Prof. Marin Ordulj, Ph.D. (mordulj@unist.hr)</td><td>Credits (ECTS)</td><td colspan="4">3</td></tr>
<tr><td rowspan="2">Associate teachers</td><td rowspan="2">-</td><td rowspan="2">Type of instruction (number of hours)</td><td>L</td><td>S</td><td>E</td><td>F</td></tr>
<tr><td>20</td><td>10</td><td></td><td></td></tr>
<tr><td>Status of the course</td><td>Mandatory</td><td>Percentage of application of e-learning</td><td colspan="4">-</td></tr>
<tr><td colspan="6">COURSE DESCRIPTION</td></tr>
<tr><td>Course objectives</td><td colspan="5">The microbiology of polluted waters focuses on the study of microorganisms that are allochthonous in water. The waters they are isolated in do not represent their natural environment. The presence of such microorganisms in water represents microbiological pollution, and the aim of the course is for students to be able to define the microbiological or sanitary quality of waters based on the pollution level.</td></tr>
<tr><td>Course enrolment requirements and entry competences required for the course</td><td colspan="5">General Microbiology, Marine Microbiology</td></tr>
<tr><td>Learning outcomes expected at the level of the course (4 to 10 learning outcomes)</td><td colspan="5">Know the sources of allochthonous microorganisms and their overview, also traits of pathogenic microorganisms that are most commonly found in polluted waters. Know the microorganism indicator groups, the criteria, and standards for water quality assessment. Understand the fate of allochthonous microorganisms upon entry into the aquatic environment and the factors that affect their survival. To assess the impact of microbiologically polluted waters on the water-based economic activities.</td></tr>
<tr><td>Course content broken down in detail by weekly class schedule (syllabus)</td><td colspan="5">Lecture 1. Know the sources of allochthonous microorganisms: municipal wastewater, atmosphere, soil, animal and fish farms, ballast water. Be able to define different groups of pathogenic microorganisms that enter the aquatic environment from various sources. Provide an overview of pathogenic bacteria, viruses, fungi, protists and other parasites commonly found in polluted waters. (2 hours)

Lecture 2. Give an overview and properties of allochthonous pathogenic groups of microorganisms found in eutrophicated waters. To know the changes the blooms of microorganisms are causing in the water environment, understand how microorganisms are creating hypoxic and anoxic conditions. To know the effects of such conditions in the water environment. (2 hours)

Lecture 3. Know the different species of cyanobacteria that may be present in bathing waters. Know the threats of cyanobacteria found in bathing waters. Know the causes of cyanobacterial blooms in the waters. Know the different species of cyanobacteria that may be present in bathing waters. Know the negative impact of cyanobacteria in bathing waters. Know the legislation that defines the quality of bathing waters. (2 hours)

Lecture 4. Know the concept and definition of criteria and standards for water quality and review the standards for different types of water (drinking water, rivers, sea, etc.). Define the term and definition of the indicator and give an overview of the faecal pollution indicators: coliform bacteria, fecal coliforms (Escherichia coli), fecal streptococci, intestinal enterococci, and anaerobic bacteria. What is the purpose of determining the degree of pollution of different types of water? Know the fate of what happens to microorganisms upon their arrival in the aquatic environment. Adopt the survival of allochthonous microorganisms in the freshwater and marine environment; understand the mechanisms of adaptation and survival. Give an overview of the factors that have a significant impact on</td></tr>
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	the survival of microorganisms: solar radiation (light), temperature, osmotic pressure, pH, nutrients, heavy metals, antagonistic activity of other organisms, and the combined effect of several factors. (2 hours) Lecture 5. To know what information is used to create a beach profile, define the. Be capable of creating to profile the public beach. (2 hours) Lecture 6. Know the methods of elimination of potentially pathogenic microorganisms from drinking waters. Know the response of microorganisms to the methods of disinfection used for drinking waters. (2 hours) Lecture 7. Analyse which pathogenic microorganisms from pre-treated sources most often enter the aquatic environment and why? Provide an overview of pathogenic bacteria, viruses, fungi, protists and other parasites commonly found in polluted waters. Understand the effect of water treatment procedures on pathogenic microorganisms. Know the regulations for urban wastewater treatments. Know the fate of microorganisms upon their arrival in the aquatic environment. (2 hours) Lecture 8. Learn the processes of bioremediation; know which types of microorganisms can be used in the process of bioremediation to remove the negative effect of microbiologically polluted waters. (2 hours) Lecture 19. Know how the microorganisms are transferred in different waters by the ballast water; Know the differences in survival among the specified groups of microorganisms. (2 hours) Lecture 10. Know how biosensors can be used to monitor microbiologically polluted waters. To get acquainted with the usage of biosensors for measuring the impact of allochthonous and pathogenic microorganisms in the water (2 hours) SEMINARS Each student independently creates a seminar paper on the most important topics related to individual lectures. The presentations of the seminars are followed by a discussion on the topic covered.
Format of instruction	☐ lectures ☐ seminars and workshops ☐ exercises ☐ *on line* in entirety ☐ partial e-learning ☐ field work ☐ independent assignments ☐ multimedia ☐ laboratory ☐ work with mentor ☐ (other)

Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)*						
	Class attendance	1	Research		Practical training	
	Experimental work		Report		(Other)	
	Essay		Seminar essay	1	(Other)	
	Tests		Oral exam		(Other)	
	Written exam	1	Project		(Other)	

Grading and evaluating student work in class and at the final exam	The exam consists of an oral and a written part. The student is required to orally present a seminar. The final grade is the average of the grades achieved from the oral and written exams.		
Required literature (available in the library and via other	**Title**	**Number of copies in the library**	**Availability via other media**

media)	Tortora, G.J., Funke, B.R., Case, C.L., Johnson, T.R. 2016. Microbiology: an introduction (Vol. 9). San Francisco, CA: Benjamin Cummings. 810 p.		
	Mayer, R.M., Pepper, I.L. and Gerba, C.P. 2000. Environmental Microbiology, Academic Press, 585 p.		
	C. B. Munn - Marine Microbiology: Ecology & Applications, 2nd Edition. 2011 CRC Press		
Optional literature (at the time of submission of study programme proposal)	Ordulj. 2020. Instructional materials (internal script, ppt presentations…).		
Quality assurance methods that ensure the acquisition of exit competences	Students' performance will be evaluated and graded during the course as well as at the final exam. During the course, the following are evaluated: a) Attendance b) Teaching activity c) Knowledge acquired		
Other (as the proposer wishes to add)			

NAME OF THE COURSE	CLIMATE CHANGE AND MARINE ECOSYSTEMS					
Code	**SMB510**	Year of study	2			
Course teacher	Maja Krželj, PhD (mkrzelj@unist.hr)	Credits (ECTS)	3			
Associate teachers	-	Type of instruction (number of hours)	L	S	E	F
			15	15	0	-
Status of the course	Elective	Percentage of application of e-learning	-			

COURSE DESCRIPTION

Course objectives	The objective of the course is to introduce students to global and regional climate change and impact these changes have on marine ecosystems.
Course enrolment requirements and entry competences required for the course	-
Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	- to know the causes of climate change on a global and regional scale - to analyse the impacts of climate change on a global and regional level - to link climate change to changes occurring in marine ecosystems - to predict the effects of climate change on populations and composition of marine organisms' communities - to assess the potential and actual effects of climate change on living marine resources - to analyse problems and solutions related to the impact of climate change on marine ecosystems
Course content broken down in detail by weekly class schedule (syllabus)	**Lecture 1:** Introduction. The concept of climate system, climate and mechanisms of climate change. **Lecture 2:** The causes of climate change: natural and anthropogenic. The role of CO_2 and other greenhouse gases in the atmosphere and in oceans. **Lecture 3:** Recorded changes in climate system at various spatial and temporal scales and their effects on ecosystems. Trends and oscillations of the atmosphere and the sea. **Lecture 4:** Global warming. Glacier melting and sea level rise. Possible trends in sea warming and ecosystem impact. Negative effects on the marine ecosystem. **Lecture 5:** Marine organisms as indicators of changes in the ecosystem. Population fluctuations, migration, changes in habitats and areas. **Lecture 6:** Climate change in the northern hemisphere, the Mediterranean and the Adriatic Sea. **Lecture 7:** Potential effects of climate change on marine fisheries (socio-economic element). Conferences, resolutions, strategies, plans and programmes for climate change mitigation and adaptation. **Seminar 1:** Calculation of carbon footprint and greenhouse gas emissions; Renewable energy sources (2 hours) **Seminar 2:** Documentary movie (2 hours) **Seminar 3:** Education, media, economics, climate financing and sustainable development (2 hours) **Seminar 4:** Climate change impact assessments, vulnerability and climate change assessment (2 hours) **Seminar 5:** Discussion (2 hours) **Seminar 6:** PAP / RAC Visit (3 hours) **Seminar 7:** Student presentations (3 hours)

Format of instruction	☒ lectures ☐ seminars and workshops ☐ exercises ☐ *on line* in entirety ☐ partial e-learning ☐ field work	☐ independent assignments ☐ multimedia ☐ laboratory ☐ work with mentor ☒ seminars

Screening student work *(name the proportion of ECTS*	Class attendance	1	Research		Practical training	
	Experimental		Report		(Other)	

credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)	work					
	Essay		Seminar essay	1	(Other)	
	Tests		Oral exam		(Other)	
	Written exam	1	Project		(Other)	

Grading and evaluating student work in class and at the final exam	Students will be evaluated and graded during the course as well as at the final exam. During the course, attendance at classes, seminars and visits, seminar work, seminar activity and acquired knowledge are evaluated. It is necessary to meet all teacher's requirements (class attendance and individual presentation of seminar work) in order to pass the exam. To pass the exam, the questions must be answered with an accuracy of at least 60%. The grade on the exam is formed on the basis of the achievement achieved by the following scoring: 60 - 70 sufficient (2), 71 - 80 good (3), 81 - 90 very good (4), 91 - 100 excellent (5).

Required literature (available in the library and via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	Marine Ecosystems and Global Change (2010) M Barange, JG Field, RP Harris, EE Hofmann, RI Perry, FE Werner. Oxford University Press, 440 p.		
	Aquatic Ecosystems in a Changing Climate (2018) DP Hader, K Gao. CRC Press, 318 p.		
	Climate Change Impacts on Marine Ecosystems (2012) SC Doney, M Ruckelshaus, JE Duffy, JP Barry, F Chan, CA English, HM Galindo, JM Grebmeier, AB Hollowed, N Knowlton, J Polovina, NN Rabalais, WJ Sydeman, LD Talley. Annual Review of Marine Science 4819:11-37.		
	Impacts of Climate Change on Marine Organisms and Ecosystems (2009) AS Brierley, MJ Kingsford. Current Biology 19 (14): R602-R614.		
	Climate Change and Costal Ecosystems: Long-Term Effects of Climate and Nutrient Loading on Trophic Organization (2014) RJ Livingston. CRC Press, 572 p.		

Optional literature (at the time of submission of study programme proposal)	-
Quality assurance methods that ensure the acquisition of exit competences	The lectures and seminars are designed to be interactive and encourage active student participation in the classroom through questions and comments, thus enabling continuous monitoring of students' work.
Other (as the proposer wishes to add)	Consultation times and exam dates will be published on the website of the University Department of Marine Studies. Inspection of the exam documentation/and or consultations can be made in office hours. Students can contact Course teacher by email.

NAME OF THE COURSE	ADAPTATION PHYSIOLOGY OF MARINE ORGANISMS					
Code	**SMR519**	Year of study	1			
Course teacher (contact)	Josipa Ferri (josipa.ferri@unist.hr)	Credits (ECTS)	3			
Associate teachers (contact)	-	Type of instruction (number of hours)	L	S	E	F
			15	15	0	-
Status of the course	Elective	Percentage of application of e-learning	-			

COURSE DESCRIPTION	
Course objectives	The purpose of the course is to acquaint students with the responses of marine organisms to changed living conditions, since physiological adaptive mechanisms are crucial for the survival of organisms when altering abiotic and biotic factors.
Course enrolment requirements and entry competences required for the course	-
Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	Adopt osmoregulatory mechanisms in crustaceans and fish. Distinguish osmoregulatory mechanisms between freshwater and marine fishes. Adopt the mechanisms of anoxia survival. Describe the impact of temperature changes on crustaceans, molluscs and fish. Know the role of antifreeze protein and the reasons for the disappearance of respiratory pigment (haemoglobin) in polar fish. Explain the link between stress and individual hormones and clarify the impact of stress on crustaceans and fish. Adopt the physiological mechanisms of fish in reproduction systems - the importance of bioenergy, environmental temperature, oxygen demand, salinity tolerance.
Course content broken down in detail by weekly class schedule (syllabus)	**Lecture 1.** Osmoregulation of crustaceans and fish. (3 hours) Learning outcomes: Adopt osmoregulatory mechanisms in crustaceans and fish. Differentiate adaptations of organisms in brackish and freshwater environment. Know the role of excretory organs in the osmoregulation of crustaceans. Distinguish osmoregulatory mechanisms between freshwater and marine fishes. **Lecture 2.** Respiratory adjustments. (3 hours) Learning outcomes: Adopt mechanisms in respiratory adjustment processes. Know the basic principles of respiration for crustaceans, molluscs and fish. Adopt the mechanisms of anoxia survival. **Lecture 3.** Temperature and adjustments. (3 hours) Learning outcomes: Describe the impact of temperature changes on crustaceans, molluscs and fish. Distinguish between ectoderm and endoderm fish. Clarify adaptations of organisms to low and elevated temperatures. Know the role of antifreeze protein and the reasons for the disappearance of respiratory pigment (haemoglobin) in polar fish. **Lecture 4.** Stress of aquatic organisms. (3 hours) Learning outcomes: Adopt concepts such as homeostasis, allostasis, and what are compensatory and chronic stress responses. Explain the link between stress and individual hormones and clarify the impact of stress on crustaceans and fish. **Lecture 5.** Fish physiology in breeding systems. (3 hours) Learning outcomes: Adopting the physiological mechanisms of fish in breeding systems - the importance of bioenergy, environmental temperature, oxygen demand, salinity tolerance. The topics of the seminar depend on the interests of the students, and besides the topics suggested by the teacher, students can choose other topics that are content related to the subject of the course. The seminars demand the active participation of all students by answering the questions at the end of the seminar, where the teacher has the role of moderator, while the student who prepared the seminar should be ready to answer any

	questions that may arise from the discussion. The aim of the seminar papers is to analyse in detail some specific physiological adaptation and to link theoretical knowledge with practical problems (e.g., in reproduction systems).

Format of instruction	☒ lectures ☒ seminars and workshops ☐ exercises ☐ *on line* in entirety ☐ partial e-learning ☐ field work	☐ independent assignments ☐ multimedia ☐ laboratory ☐ work with mentor ☐ (other)

Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)*						
	Class attendance	1	Research		Practical training	
	Experimental work		Report		(Other)	
	Essay		Seminar essay	1	(Other)	
	Tests		Oral exam		(Other)	
	Written exam	1	Project		(Other)	

Grading and evaluating student work in class and at the final exam	The examination is taken in writing and consists of the material from the lectures. The exam consists of rounding, supplementing questions, then those to which a descriptive answer should be given, and those to which it is necessary to decide whether a given statement is true or false. The student is required to achieve a minimum score of 61% on the exam. The final grade will be determined by the criterion: <61% - grade 1 (insufficient), 61% - 70% - grade 2 (sufficient), 71% - 80% - grade 3 (good), 81% - 90% - grade 4 (very good), 91% - 100% - grade 5 (excellent). To enter the final grade in the index, the student is required to do a seminar paper.

Required literature (available in the library and via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	Farrell A. 2011. Encyclopedia of Fish Physiology (First Edition). Academic Press, 2272 pages.	-	-

Optional literature (at the time of submission of study programme proposal)	Eddy FB, Handy RD. 2012. Ecological and Environmental Physiology of Fish. Oxford University Press, 264 pages.
Quality assurance methods that ensure the acquisition of exit competences	Students' performance will be evaluated and graded during the course as well as at the final exam. During the course, the following are evaluated: a) attendance b) teaching activity / seminar presentation c) knowledge acquired
Other (as the proposer wishes to add)	-