WASTEWATER TREATMENT BIOPROCESS

1	Course Title:	WASTEWATER TREATMENT BIOPROCESS
2	Course Code:	CEV3078
3	Type of Course:	Optional
4	Level of Course:	First Cycle
5	Year of Study:	3
6	Semester:	6
7	ECTS Credits Allocated:	3.00
8	Theoretical (hour/week):	2.00
9	Practice (hour/week):	0.00
10	Laboratory (hour/week):	0
11	Prerequisites:	
12	Language:	Turkish
13	Mode of Delivery:	Face to face
14	Course Coordinator:	Doç.Dr. AHMET UYGUR
15	Course Lecturers:	
16	Contact information of the Course Coordinator:	(ahmetuygur@uludag.edu.tr, 0 224 294 21 12, Bursa Uludağ Üniversitesi, Mühendislik Fakültesi, Çevre Mühendisliği Bölümü, 16 059 Görükle/Bursa)
17	Website:	https://sites.google.com/site/docdrahmetuygur/home/dersler/lisans-dersleri/cev-3078
18	Objective of the Course:	The objective of this course is to provide fundamentals background information on the microorganisms used to treat wastewater and to consider the application of biological process fundamentals for the biological treatment of wastewater. Growth kinetics of microbial, aerobic/anaerobic oxidation, nitrification/denitrification and biological phosphorus removal on suspended/attached growth treatment processes are the major topics of this course
19	Contribution of the Course to Professional Development:	By teaching students a broad knowledge of biological treatment, they gain many gains in the design, operation and control of suspended and attached growth systems.
20	Learning Outcomes:	
	1	To provide fundamental background information on microorganism used to treat wastewater.
	2	To consider the application of biological process fundamentals for the biological treatment of wastewater.
	3	To contribute the objectives of biological treatment, some useful definitions, the role of microorganisms in the biological treatment of wastewater
	4	To introduce biological processes used for wastewater treatment
	5	To learn the performance of biological processes used for wastewater treatment depends on the dynamics of substrate utilization and microbial growth
	6	Have the ability to model suspended/attached growth treatment process
	7	Understand the process description, microbiology, stoichiometry, growth kinetics and environmental factors for aerobic/anaerobic biological oxidation
	8	Have the ability to solve growth kinetics and stoichiometry for nitrification mechanism.
	9	Have the ability to solve growth kinetics and stoichiometry for denitrification mechanism.

	10	Have the ability to solve growth kinetics and stoichiometry for biological phosphorus removal. Know the description of aerobic/anaerobic biodegradation on biological removal of toxic, recalcitrant organic compounds and heavy metals.

21	Course Content:	
	Course Content:	
Week	Theoretical	Practice
1	Overview of Biological Wastewater Treatment: Objectives of biological treatment, some useful definitions, role of microorganisms in wastewater treatment, types of biological processes for wastewater treatment	
2	Composition and Classification of Microorganisms: Cell components, cell composition, environmental factors, microorganism identification and classification, use of molecular tools	
3	Introduction to Microbial Metabolisms: Carbon and energy sources for microbial growth, nutrient and growth factors requirements	
4	Bacterial Growth and Energetics: Bacterial re production, bacterial growth patterns in a batch reactor, bacterial growth and biomass yield, measuring biomass growth, estimating biomass yield and oxygen requirements from stoichiometry, estimating biomass yield from bioenergetics, stoichiometry of biological reactions, biomass synthesis yields for different growth conditions, observed versus synthesis yield	
5	Microbial Growth Kinetics: Microbial growth kinetics terminology, rate of utilization of soluble substrates, other rate expressions for the utilization of soluble substrate, rate of soluble substrate production from biodegradable particulate organic matter, rate of biomass growth with soluble substrates, kinetic coefficients for substrate utilization and biomass growth, rate of oxygen uptake, effects of temperature, total volatile suspended solids and active biomass, net biomass yield and observed yield	
6	Modeling Suspended Growth Treatment Processes: Description of suspended growth treatment processes, biomass mass balance, substrate mass balance, mixed liquor solids concentration and solids production, the observed yield, oxygen requirements, design and operating parameters, process performance and stability, modeling plug-flow reactors	
7	Substrate Removal in Attached Growth Treatment Processes: Substrate flux in biofilms, substrate mass balance for biofilm, substrate flux limitations, quiz	
8	Aerobic Biological Oxidation: Process description, microbiology, stoichiometry of aerobic biological oxidation, growth kinetics, environmental factors	
9	Biological Nitrification: Process description, microbiology, stoichiometry of biological nitrification, growth kinetics, environmental factors	
10	Midterm Exam	

11	Biological Denitrification: Process description, microbiology, stoichiometry of biological denitrification, growth kinetics, environmental factors	
12	Biological Phosphorus Removal: Process description, microbiology, stoichiometry of biological phosphorus removal, growth kinetics, environmental factors	
13	Anaerobic Fermentation and Oxidation: Process description, microbiology, stoichiometry of anaerobic fermentation and oxidation, growth kinetics, environmental factors	
14	Biological Removal of Toxic, Recalcitrant and Heavy Metals: Development of biological treatment methods, anaerobic degradation, aerobic degradation, aerobic degradation, abiotic losses, modeling biotic and abiotic losses, biological removal of heavy metals	

22	Textbooks, References and/or Other Materials:	Wastewater Engineering Treatment and Reuse, George Tchobanoglous, Franklin L. Burton, H. David Stensel, California, 2003
23	Assesment	

TERM LEARNING ACTIVITIES	**NUMBER**	**WEIGHT**
Midterm Exam	1	30.00
Quiz	1	10.00
Home work-project	0	0.00
Final Exam	1	60.00
Total	3	100.00
Contribution of Term (Year) Learning Activities to Success Grade		40.00
Contribution of Final Exam to Success Grade		60.00
Total		100.00
Measurement and Evaluation Techniques Used in the Course		MIDTERM, SHORT EXAM, FINAL EXAM

24 **ECTS / WORK LOAD TABLE**

Activites	Number	Duration (hour)	Total Work Load (hour)
Theoretical	14	2.00	28.00
Practicals/Labs	0	0.00	0.00
Self study and preperation	14	4.00	56.00
Homeworks	0	0.00	0.00
Projects	0	0.00	0.00
Field Studies	0	0.00	0.00
Midterm exams	1	2.00	2.00
Others	0	0.00	0.00
Final Exams	1	2.00	2.00
Total Work Load			88.00
Total work load/ 30 hr			2.93
ECTS Credit of the Course			3.00

25	CONTRIBUTION OF LEARNING OUTCOMES TO PROGRAMME QUALIFICATIONS															
	PQ1	**PQ2**	**PQ3**	**PQ4**	**PQ5**	**PQ6**	**PQ7**	**PQ8**	**PQ9**	**PQ10**	**PQ11**	**PQ12**	**PQ13**	**PQ14**	**PQ15**	**PQ16**
ÖK1	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ÖK2	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0
ÖK3	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ÖK4	0	4	5	0	5	0	0	0	0	0	0	0	0	0	0	0
ÖK5	0	4	5	0	5	0	0	0	0	0	0	0	0	0	0	0
ÖK6	0	5	4	0	0	0	0	0	0	0	0	0	0	0	0	0
ÖK7	5	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0
ÖK8	0	5	0	0	4	0	0	0	0	0	0	0	0	0	0	0
ÖK9	5	0	5	0	4	0	0	0	0	0	0	0	0	0	0	0
ÖK10	0	5	4	0	0	0	0	0	0	0	0	0	0	0	0	0
LO: Learning Objectives PQ: Program Qualifications																
Contribution Level:	**1 very low**		**2 low**			**3 Medium**			**4 High**			**5 Very High**				