DURABILITY OF CONCRETE

1	Course Title:	DURABILITY OF CONCRETE	
2	Course Code:	INS5046	
3	Type of Course:	Optional	
4	Level of Course:	Third Cycle	
5	Year of Study:	1	
6	Semester:	2	
7	ECTS Credits Allocated:	6.00	
8	Theoretical (hour/week):	3.00	
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:	Prof. Dr. ALİ MARDANİ	
15	Course Lecturers:		
16	Contact information of the Course Coordinator:		
17	Website:		
18	Objective of the Course:	The aim of this course is to introduce the physical and chemical corrosive effects on concrete, to explain the mechanisms of these effects and the precautions that can be taken. One of the biggest problems frequently encountered in concrete is lack of durability and therefore reinforced concrete structures appear to be damaged before their service life. The penetration of water into concrete is generally the main cause of all types of damage and the permeability of the material determines the severity of this deterioration. Therefore, the behavior of concrete, the structure of water and its harmful effects on concrete will be discussed first.	
19	Contribution of the Course to Professional Development:	1 To determine the possible effects of the gaps in the concrete in terms of durability according to the size and shape. 2 Classification of effects causing damage to concrete / reinforced concrete due to physical and chemical reasons. 3 To be able to identify possible causes of cracks in concrete / reinforced concrete structures due to durability problems. 4 To be able to explain the mechanisms of chemical effects that cause durability problems in concrete. 5 To recommend concrete production methods and measures that can be taken that are resistant to physical abrasive effects such as abrasion, fire and frost. 6 To classify the measures that can be taken to increase the durability of concrete / reinforced concrete structures according to the level of external impact.	
20	Learning Outcomes:		
		1	To determine the possible effects of the gaps in the concrete in terms of durability according to the size and shape.
		2	Classification of effects causing damage to concrete / reinforced concrete due to physical and chemical reasons.
		3	To be able to identify possible causes of cracks in concrete / reinforced concrete structures due to durability problems.

	4	To be able to explain the mechanisms of chemical effects that cause durability problems in concrete.
	5	To recommend concrete production methods and measures that can be taken that are resistant to physical abrasive effects such as abrasion, fire and frost.
	6	To classify the measures that can be taken to increase the durability of concrete / reinforced concrete structures according to the level of external impact.
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21	Course Content:

Course Content:

Week	Theoretical	Practice
1	Structure of Concrete 1.1. Structure of the Aggregate Phase 1.2. Structure of Hydrated Cement Paste 1.2.1. Calcium Silicate Hydrate 1.2.2. Calcium Hydroxide 1.2.3. Calcium Sulfo Aluminates 1.2.4. Non-Hydrated Cement 1.2.5. Gaps in Hydrated Cement Paste 1.2.6. Water Presence in Hydrated Cement Paste	
2	Interface Zone in Concrete 2.1. Structure of the Interface Zone 2.2. Interface Area	
3	Structure of Water 3.2. Damage Mechanism	
4	Permeability 4.1. Performance of Cement Permeability of Concrete	
5	Classification of the Impacts Causing	
	and Deterioration 5.2. Cracks In The Cavities As A Result Of Salt Crystallization	
	Hardened Concrete 6.2. Freezing Effect on	
	Concrete	
	Temperature on Cement Paste 7.2. The Effect of High Temperature on Aggregate 7.3.	
8	Midterm	
9	Deterioration by Chemical Reactions 9.1. Hydrolysis of Cement Paste Components 9.2. Cation Exchange Reactors	
10	Reactions That Create Expanding Product 10.1. Sulphate Attack 10.1.1. Chemical Reactions 10.1.2. Control of Sulfate Attack	
11	Reactions Forming Expanding Product (continued) 11.1. Alkali-Silica Reaction 11.1.1. Reacting Aggregate and Cement Types 11.1.2. Expansion Mechanism 11.1.3. Control of Expansion	

Activites	Number	Duration (hour)	Total Work Load (hour)
Theoretical	14	3.00	42.00
Practicals/Labs	0	0.00	0.00
Self study and preparation	14	8.00	112.00
Homeworks	1	20.00	20.00
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			180.00
Total work load/ 30 hr			5.93
ECTS Credit of the Course			6.00

12	Reactions Forming Expanding Product (continued) 12.1. Hydration of MgO and CaO Salts 12.2. Alkali-Carbonate Reaction 12.1.1. Reacting Aggregate and Cement Types 12.1.2. Expansion Mechanism 12.1.3. Control of Expansion	
13	13. Reinforcement Corrosion in Concrete 13.1. Concrete Degradation as a Result of Reinforcement Corrosion 13.2. Corrosion Control	
14	Concrete in Sea Water	

22	Textbooks, References and/or Other Materials:	Neville, A., M., Properties of Concrete Pitman Publishing, London 1995. Woods, H., Durability of Concrete Construction, ACI Monograph No.4, 1968. -Mindess, S., and Young J.F., Concrete, Prentice-Hall Inc., Englewood Cliffs, 1981.
23	Assesment	

TERM LEARNING ACTIVITIES	**NUMBER**	**WEIGHT**
Midterm Exam	1	20.00
Quiz	0	0.00
Home work-project	1	20.00
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		Measurement and evaluation are performed according to the Rules & Regulations of Bursa Uludağ University on Undergraduate Education.

24 ECTS / WORK LOAD TABLE

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	5	0	4	0	0	4	0	0	0	0	0	0	0	0	0	0
ÖK2	5	0	0	3	0	4	0	0	0	0	0	0	0	0	0	0
ÖK3	5	0	4	0	3	0	0	0	0	0	0	0	0	0	0	0
ÖK4	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ÖK5	0	0	0	0	0	0	5	5	0	4	0	0	0	0	0	0
ÖK6	0	0	0	0	0	0	4	5	0	4	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**