Course Syllabus

1. **Course title:** Environmental Systems Optimization
2. **Course code:** ENSO 237410
3. **Credit units: 2** (2/0/6) (2 units of theory/ 0 unit of practice/ 4 units of self-study)

   Duration: 15 weeks (2 hours of theory+0 hours of practice, and 4 hours of self-study per week)
4. **Course instructors:**

   1/ Dr. Nguyen Thai Anh

   2/ Dr. Tran Thi Kim Anh
5. **Course requirements:**

   Prerequisite courses : None

   Previous courses : None

   Parallel courses : None
6. **Course description:**

   This course covers some knowledge of optimization in engineering and environmental systems; apply modern tools to solve the environmental problems with the optimized methods. The course will introduce the different optimization techniques such as linear programming, geometric programming, dynamic programming to solve a variety of environmental problems.
7. **Course goals**

Goals	Goal description	Programme Expected learning outcome (ELOs)
G1	Having the knowledge of mathematics, sciences and society in the optimization of environmental systems.	ELO1, ELO2
G2	Identify the environmental issues, the exploitation and the use of resource approaches.	ELO4
G3	Be highly aware of the need and responsibility in life-long learning.	ELO7
G4	Strengthen the awareness and ideas on the application of optimization methods in technical and environmental issues.	ELO13

8. Course learning outcomes (CLOs)

CLOs		CLOs description (After accomplishing this course, students are able to:)	Programme ELOs
G1	CLO1	Apply the concepts of optimization in the environment, components and functions of an optimization solution;	ELO1
	CLO2	Use tools to solve the optimization problems in environmental systems . Identify, analyze, and determine the best possible resolution strategy for environmental solutions.	ELO2
G2	CLO3	Solve the specific optimization problems.	ELO4
G3	CLO4	Apply tools to solve the optimization problems in EET.	ELO4, 7
G4	CLO5	Conceive ideas, optimization model systems, implement and manage environmental projects.	ELO13

9. Learning resources

- Text books:

1. Nguyễn Đình Soa, Nguyễn Cảnh, Tối ưu hóa thực nghiệm trong hóa học và kỹ thuật hóa học, Trường Đại học kỹ thuật TP.HCM, 1994.

- References:

1. PGS. TS. Nguyễn Nhật Lệ (2009), Các bài toán cơ bản của tối ưu hóa và điều khiển tối ưu, NXB Khoa học và Kỹ thuật.
2. PGS. TS. Nguyễn Nhật Lệ (2001), Tối ưu hóa ứng dụng, NXB Khoa học và Kỹ thuật.
3. PGS. TS. Phan Vĩnh Cẩn (2013), Tối ưu hóa hệ thống cấp thoát nước và môi trường, NXB Xây Dựng, 2013.
4. Beidou Xi, Yonghai Jiang (2016), Optimization of Solid Waste Conversion Process and Risk Control of Groundwater Pollution, Springer.
5. Singeresu S. Rao, Enineering Optimization – Theory and Practice, 4th Edition, Wiley, 2009.
6. Douglas A. H., Environmental System Optimization, John Wiley and Sons, New York, 1981.

10. Student assessment:

- Grading scale: **10**

- Assessment plan:

Type	Content	Timeline	Assessment method	CLOs	Rate (%)
Subtest					**20**
Design technical and environmental systems by using the design tools and concepts of technical optimization		Tuần 1-10			

learned.					
Exercise #1	Linear programming problem.	Tuần 3	Subtest	CLO1	5
Exercise #2	Nonlinear programming problem.	Tuần 5	Subtest	CLO1	5
Exercise #3	Transport problem of the position.	Tuần 7	Subtest	CLO2	5
Exercise #4	The experimental optimization problem (orthogonal matrices).	Tuần 9	Subtest	CLO4	5
Essay					**30**
	Students are asked to read and learn about the application of computer software (Excel solver and minitab software) to solving optimization problems in engineering, environment and empirical analysis.	Tuần 2-14	Group discussion Presentation	CLO2, CLO5	
Final exam					**50**
	- The content covers all the major learning outcomes of the course. - Test duration is 60 minutes.	Tuần 16	Writing test	CLO1, CLO2, CLO3, CLO4	

11. Course Content:

Week	Content	CLOs
1-2	**Chapter 1: General knowledge of optimization (4/0/8)**	
	A/ Content and pedagogical methods in class (4) **Content:** 1.1 Introduction to the course 1.2 History of optimization 1.3 Application of optimization in the field of environment **Pedagogical methods:** + Presentation of lecture + Group discussion	CLO1, CLO2, CLO3, CLO4, CLO5
	B/ Self-study content (8) 1.4 The use of optimization in the environmental engineers 1.5 Learn the tools as well as software to solve the optimization problem	
3-4	**Chapter 2: Optimization theory (4/0/8)**	

	A/ Content and pedagogical methods in class (4) **Content:** 2.1 The input establishment of optimized problems 2.2 Classification of optimized problems 2.3 Methods of solving optimized problems 2.4 The use of software to solve optimized problems **Pedagogical methods**: + Presentation of lecture + Group discussion	CLO1, CLO2, CLO3, CLO4, CLO5
	B/ Self-study contents (8) 2.5 More study in solving methods of optimized problems 2.6 Learn to use Excel, Minitab software to solve the optimized problems	
5-14	**Chapter 3: Environmental solutions - system optimization (20/0/40)**	
	A/ Content and pedagogical methods in class (20) **Content:** 3.1 Maximum profits based on the efficiency of resource management 3.2 Determine optimal parameters for environmental treatment technology. 3.3 Optimal-cost solid waste transportation options 3.4 Design of experiment, building of regression equation 3.5 Optimization of drainage system **Pedagogical methods**: + Presentation of lecture + Group discussion	CLO1, CLO2, CLO3, CLO4, CLO5
	B/ Self-study contents (40) More research on the environmental systems optimization in the world	

12. Learning ethics:

- If the exercises and translations from the internet are detected to be copied, the course score will be deducted 100%. If it is so serious, both the author and the copier are banned at the final exam.
- Students who do not complete the task (section 10), will be banned from the final exam and be offered the disciplinary which is showed in front of the campus.
- Student and the other who is hired for the taking the test, will be suspended or expelled.

13. Date of first approval:

14. Approval by: August 1st, 2012

Dean	Head of Department	Compiler
Prof. Nguyen Van Suc	**MSc. Nguyen Thi Minh Nguyet**	**Dr. Nguyen Thai Anh**

15. Date and Up-to-date content

1st time: Date: August 25th, 2015 - Update content and structure of the programme adjusted in: Course title, teaching content and assessment method	Instructor: Head of Department: Dr. Tran Thi Kim Anh