NATIONAL UNIVERSITY OF ENGINEERING
COLLEGE OF INDUSTRIAL AND SYSTEMS ENGINEERING
SYSTEMS ENGINEERING PROGRAM

SYLLABUS - ST123 OPERATIONS RESEARCH II

I. GENERAL INFORMATION

CODE	:	ST123
SEMESTER	:	6
CREDITS	:	3
HOURS PER WEEK	:	4 (Theory – Practice)
PREREQUISITES	:	113 STOperations Research I
CONDITION	:	Compulsory
INSTRUCTOR	:	Cesar Canelo
INSTRUCTOR E-MAIL	:	ccanelo@uni.edu.pe

II. COURSE DESCRIPTION

This course trains students in the application of concepts, methods and techniques of the queuing and simulation theory, in order to recognize and describe situations involving waiting phenomena, and to develop and implement solutions. The concepts of probability and random variable are introduced and applied to generate probability and mathematical models in order to quantitatively predict the system behavior. The concepts of queuing theory are applied to build models simulating the behavior of entities within a system. Engineering application problems are solved and specialized software is used.

III. COURSE OUTCOMES

1. Recognize situations of waiting phenomena, identifying the elements involved in a waiting phenomenon.
2. Classify systems in finite and infinite ones, generate mathematical models, make calculations and solve problems applying probabilities in the queuing theory.
3. Understand and apply continuous and discrete probability distribution; interpret the system state and assess results.
4. Estimate average arrival and service values, and apply statistical tests to check the density function. Interpret the random variable behavior.
5. Generate random numbers and use them to simulate random, discrete and continuous variable values.
6. Build simulation models to generate stages, calculate results, interpret and exercise fair value judgments.

IV. LEARNING UNITS

1. QUEUING THEORY / 12 HOURS

Basic concepts / Waiting phenomena / Queuing theory / Structure of a queuing system / Kendal Notation / Birth-death process / Building of a generalized queuing model.

2. QUEUING MODELS OF FINITE AND INFINITE POPULATION / 16 HOURS

Development of finite queuing model / Development of infinite queuing model / Structures of queuing models with service priority / Structures of queuing models in series / Costs of queuing models.

3. SIMULATION / 28 HOURS

Definitions and concepts of simulation / Stages for implementing a simulation study / Random numbers generation / Congruential methods: mix, multiplicative, additive, central square / Statistical tests for ran don numbers: averages, frequencies, Kolmogorov-Smirnov / Generation of non-uniform random variables / Inverse transform method / Montercarlo Method / Reject Method / Composition Method / Special procedures method / Simulation applications: Queuing system, game theory, decision theory, inventories system, investment projects / Analysis of simulation results: Estimation methods, simulations intervals, regenerative simulation / Programming language and simulation language applied to real cases / Simulation stages.

V. LABORATORIES AND PRACTICAL EXPERIENCES

Lab 1: Probability distribution, Poisson and Exponential.
Lab 2: Infinite queuing model.
Lab 3: Estimation of Lambda and Mu parameters.
Lab 4: Finite queuing model.
Lab 5: Random numbers generation.
Lab 6: Non-uniform variables generation: Inverse transform method.
Lab 7: Non-uniform variables generation: Montecarlo method.

VI. METHODOLOGY

This course is carried out in theory, practical and lab sessions. In theory sessions, the instructor introduces concepts, theorems and applications. In practical sessions, different problems are solved and their solutions are analyzed. In lab sessions, Tora, Excel, WinQsb and Promodel software programs are used to solve problems and analyze their solutions. At the end of the course, students must hand over and expose an integrating paper or project. In all sessions, students' active participation is encouraged.

VII. EVALUATION FORMULA

The average grade PF is calculated as follows:

PF = (EP + EF + PP + LC)/4

EP: Mid-Term Exam
F: Final Exam
PP: Quizzes average (4 and 1 is eliminated)
LC: Labs

VIII. BIBLIOGRAPHY

1. **TAHA, HAMDY**
   Introduction to Operations Research (Spanish)
   McGraw Hill Editorial, (2005)

2. **HILLIER, FREDERICK AND LIERBERMAN, GERALD**
   Introduction to Operations Research (Spanish)
   McGraw Hill Editorial (2003)

3. **BRONSON, R.**
   Operations Research (Spanish)
   Schaum Collection
   McGraw Hill Editorial (1995)