Description of individual educational component (module)	
کنترل خودکار پیشرفته **Advanced Automatic Control**	
کارشناسی ارشد *Master of Science (M.Sc)*	
Organisation	Sari Agricultural Sciences and Natural Resources University (SANRU)
Faculty	Agricultural engineering
Department	Mechanics of Biosystems engineering
Responsible person	Assoc. Prof. Dr. –Ing. Davood Kalantari
Type of course unit	Elective Course
Level of course unit	Second cycle
Year of study (if applicable), semester/trimester when the individual educational component is delivered	3rd semester
Number of ECTS credits allocated	3 Iranian Credits (Theoretical Credits: 2, Practical Credit: 1) (Equal to 11.5 ECTS)
Total hours	--
Contact hours	80 (32+48)
Self-study hours	Not specified
Mode of delivery	Face-to-face
Maximum attendance	20
Name of lecturer(s)	Assoc. Prof. Dr. –Ing. Davood Kalantari, Dr. Sajad Kiani (Ph.D)
Prerequisites and co-requisites	Prerequisites: Differential Equations, Laplace Transform, Basic Physics, Ordinary and Semi-logarithimic graph papers, Linear Algebra, Matrices, and Matlab software
Course contents	1. Introduction to Laplace and Inverse-Laplace Transform 2. Concepts of Basic control systems 3. Block Diagrams and Signal-Flow Graphs 4. Theoretical Foundation and Background Material: Modeling of Dynamic Systems 5. Time-Domain Analysis of Control Systems 6. Root Locus Analysis 7. Frequency-Domain Analysis 8. Optimal Control of Linear Systems 9. State Variable Analysis 10. Motion control; Standard and advanced control techniques
Recommended or required reading and other learning resources/tools	• Golnaraghi, F., C. Kuo, B. 2017. Automatic Control Systems 10th ed., John Wiley & Sons, Inc. • Nise, N. S., 2004. Control System Engineering, 4th Edition, Wiley Int. Edition. • Ogata, K., 2002. Modern Control Engineering, 4th Edition, Prentice Hall.
Language of instruction	• Persian/English

Learning outcomes of the course unit
Modeling, characteristics, and performance of feedback control systems. Stability, root locus, frequency response methods. Nyquist/Bode diagrams. Lead-lag, PID compensators. Digital implementation, hardware considerations.

Planned learning activities and teaching methods
Lectures, tutorials, and problem solving

Assessment methods and criteria
The final grade is based on a three-point system. It may consist of the results of a final written assignment for the final exam (70%), Literature review (20%), and Report quality (10%) according the «Assessment criteria table».

Mapping Programme Key Learning Outcomes to Module Learning Outcomes	
Programme Key Learning Outcomes	**Module Learning Outcomes**
1. Define basic concepts in automatic control. 2. Determine relations between models of linear dynamic systems in form of differential equations, state space models, transient responses, transfer functions and frequency responses. 3. Analyze linear systems with respect to stability, steady state properties, controllability and observability, and fastness and damping. 4. Evaluate closed loop systems with respect to stability, as well as robustness against and sensitivity for model errors and disturbances. 5. Interpret and apply graphical methods and tools like block diagrams, root locus, Bode and Nyquist diagrams. 6. Understand the function of simple controllers (PID controllers, lead-lag filters, state feedback) and controller structures (feedforward and cascade control)	**On successful competition of this module students should be able to:** 1. Become familiar with the methodologies available for applying control in single loop. 2. Become familiar with the structures of modern computer control systems. 3. use the analysis and design tools of classical linear control in homework problems. 4. use modern computer tools such as MATLAB in solving and handling practical problems. 5. Design simple controllers from given specifications. 6. Understand advanced control techniques, such as Kalman Filter and Model Predictive Control.

	Assessment criteria table				
Attribute	**Grade A (18-20 out of 20) (Excellent)**	**Grade B (16-18 out of 20) (Very good)**	**Grade C (14-16 out of 20) (Good)**	**Grade D/E (12-16 out of 20) (Satisfactory)**	**Grade F/FX (<12 out of 20) Failed / Insufficient**
Final Exam-written part (50%)	The complete solution of the task without serious flaws is given. The correct answer is provided.	The roughly complete solution of the task is provided. The correct answer with some minor mistakes in interim steps is received.	The content of the solution is good. The answer with some weaknesses in interim steps is received.	The content of the task is satisfactory but with several weaknesses regarding evidence and/or some lack of clarity.	The task of the work fell short of that required to pass due to lack of evidence base/or very poor clarity.
Literature review (20%)	The literature library assembled by the student was outstanding with no serious missing articles.	The literature library assembled by the student was very good with only a few missing key articles.	The literature library assembled had a number of missing key articles and lacked breadth.	The literature library lacked breadth to a great degree and was missing many key articles.	The literature library was lacking in breadth and key articles to an extent that fell short of a passing grade.
Report quality (10%)	The style and clarity of the report was excellent.	The style and/or clarity of the report were very good.	The style and/or clarity of the report were good.	The style and/or clarity of the report were adequate.	The style and/or clarity of the report fell short of a passing grade.