NATIONAL UNIVERSITY OF ENGINEERING
COLLEGE OF MECHANICAL ENGINEERING
MECHATRONICS ENGINEERING PROGRAM

MT723 – DESIGN OF AUTOMATIC MACHINES

I. GENERAL INFORMATION

CODE	: MT723 Design of Automatic Machines
GRADE	: 9
CREDITS	: 4
HOURS PER WEEK	: 5 (Theory - Practice)
PREREQUISITES	: MC-338, MT-517)
CONDITION	: Compulsory

II. COURSE SUMMARY

The main objective of the course development is the design of an automatic machine from the recognition of a need to automate a process. The design of this automatic machine involves the specification of the solution to the problem by means of the detail and assembly drawings based on engineering calculations. Students will obtain the design of this automatic machine following some methodological design procedure (Eg VDI Standards 2221). An automatic machine is the integration of subsystems: mechanical, electronic and program. The design of the automatic machine involves finding an optimal solution using the computer support of CAD-CAE processes, that is to say, using software: fluidsim, Labview, Pspice, matlab, Ansys, abaqus and Solidworks, etc.

III. COMPETENCES

At the end of the course, the student should be able to:

1. Apply a procedure of methodological design for design in engineering, from the recognition of a need and the establishment of an optimal solution through an automatic machine
2. Work as a team. In the development of a project, these future professionals will be developed in different activities and functions but with common goals. Which implies that they establish strategies of planned and coordinated work, so they also share responsibilities.
3. Apply CAD-CAE processes in the design of an automatic machine
4. Design the system of automation and control of an automatic machine.
5. Design the actuators and sensors of the automatic machine

IV. LEARNING UNITS

1. INTRODUCTION TO THE COURSE OF DESIGN OF AUTOMATIC MACHINES / 05 HOURS

Presentation of the course / Design Definition / Design methodological procedures / Description of the design procedure 2221 / Description of other design procedures / Example of the application of a methodological design procedure in the design of an automatic machine / CAD-CAE processes in The design process.

2. PROBLEM DEFINITION / 10 HOURS

   Definition of the problem.- Recognition of the need to automate a process / Specification of the problem.- description of the process to be automated, machine capacity, desired tolerances, scope, cost restrictions and time limit. / Methods for obtaining the detailed specification of the problem. /

3. SEARCHING FOR SOLUTIONS: BRAINSTORM AND SELECTION OF A SOLUTION / 10 HOURS

   Search for existing solutions, through the brainstorming process / Search for original solutions (if any) / Establishment of the solution alternatives evaluation matrix (eg VDI procedure 2221) / Evaluation of solutions in Function of all the data specified in the problem statement / EXPOSURE OF THE MONOGRAPH 01 /.

4. DESIGN OF THE AUTOMATION AND CONTROL SYSTEM / 10 HOURS

   CIM: integrated and computer controlled production with multiple automation systems / SCADA systems / Use of industrial standards / Process flow diagram / Functional scheme description / List of components of the control system: sensors and instrumentation, equipment and actuators / Interaction systems And system monitoring: data acquisition, data communication and its integration into information networks / Control systems: wired and programmed technologies / Virtualization of the control system, fault tolerance and cybersecurity / Specification of the implementation problem of the control system In the design of an automatic machine / Optimization of the design and implementation of the control system / EXPOSURE OF QUALIFIED PRACTICE NRO. 01 /.

5. DESIGN OF ACTUATORS AND SENSORS / 10 HOURS
   Types of sensors: proximity, linear or angular position, presence, speed, force, torque and pressure, temperature, flow rate, etc. / Types of actuators: electric, hydraulic, pneumatic, thermal / Selection of actuators and sensors in the design of an automatic machine and its integration to the control and automation system / EXPOSURE OF QUALIFIED PRACTICE NRO. 02 /.

6. DESIGN OF THE MECHANICAL SYSTEM / 10 HOURS
   Design of the power transmission axes by the finite element method / Design of the power transmission elements by gears (straight, helical, auger, etc.) / Design

of the power transmission elements by: Design of bearings / bearings / Design of adjustment screws / EXPOSURE OF QUALIFIED PRACTICE NRO. 03. /

7. DESIGN OF MACHINE STRUCTURE / 10 Hours
   Static design of the support structure of the machine using finite element software (eg solidworks, ansys, abaqus) / Design of the joints (usually welded) / Dynamic analysis of the structure and machine using software Of finite elements (eg solidworks, ansys, abaqus). / EXPOSURE OF QUALIFIED PRACTICE NRO. 04 / After one week: EXHIBITION OF THE MONOGRAPH NRO. 02 /.

V. LABORATORIES AND PRACTICAL EXPERIENCES

Theoretical and practical classes will be developed in each chapter.

VI. METHODOLOGY

THEORY: The course development will be theoretical and practical (explanatory-demonstrative). Presentation of the specific theory corresponding to each topic. Presentation of practical examples on each topic. The CAE and CAD processes will be shown in the design examples; That is to say, depending on each particular case, the appropriate computational support will be used, through the use of fluidsim, Labview, Pspice, matlab, Ansys, abaqus and Solidworks.

PRACTICE: The practical part will comprise the development of the design of an automatic machine. This design of an automatic machine will be developed by groups formed by 05 to 06 students. In practical development, computational support should be used through the use of softwares (depending on the particular characteristics of the projects developed): fluidsim, Labview, Pspice, matlab, Ansys, abaqus and Solidworks. At the end of each chapter, the groups will present a report with their respective exposition concerning the advance of the design of the automatic machine.

VII. EVALUATION FORMULA

Evaluation System "D". Calculation of Final Average: PF = (2 M + PC1 + PC2 + PC3) / 8; PC1: Qualified Practice 1, PC2: Qualified Practice 2, PC3: Qualified Practice 3.

VIII. BASIC BIBLIOGRAPHY

1. Derby S.**, Design of Automatic Machinery,** Edit. Dekker, 2009
2. Boothroyd, G., **Assembly Automation and Product Design,** 2005, edit. CRC, 2nd
3. **B. R. Mehta Y. J. Reddy,** Industrial Process, Automation Systems, Design and Implementation, Edit. Elsevier 2015.

IX. ADDITIONAL BIBLIOGRAPHY

1. Pahl G,. and W. Beitz W., **Engineering Design, A Systematic Approach,** Edit Springer, 2008, 3rd edit.