A) COURSE

Course Id:	Course
5800	Computer Aided Engineering

Class Hours per Week	Lab hours per week	Complementary practices	Credits	Total hour course
3	2	3	8	48 hrs. theory 32 hrs. lab 80 hrs. total

B) GENERAL COURSE INFORMATION:

	EE (IEA)	ME (IM)	MME (IMA)	EME (IME)	MTE (IMT)
Level:	N.A.	IX	IX	IX	IX
Course Type (Required/Elective)		Elective	Elective	Elective	Elective
Prerequisite Course:		360 credits	360 credits	360 credits	Finite element method (5613)
CACEI Classification:		IA	IA	IA	IA

C) COURSE OBJECTIVE

At the end of the course, the student will be capable of:
Know the elements , technologies and trends in systems Computer Aided Engineering (CAE , its acronym in English) . Relate Systems Design and Engineering (CAD -CAE) . Finally at the end of the course, students will have the ability to perform analysis in the area of Mechanical , Manufacturing and thermofluids for design validation ; with the support of this discipline.

D) TOPICS (CONTENTS AND METHODOLOGY)

1.- Introduction to Computer Aided Engineering		**6 hours**
Specific Objective:	That students understand the purpose of tools computer-aided engineering and areas included within the CAE systems and computer systems available .	

1.1 General 1.2 Areas included in the computer-aided engineering 1.2.1 The finite element method 1.2.2 The computational fluid dynamics 1.2.3 Kinematics and dynamics of bodies and mechanisms 1.2.4 Optimization oriented design 1.2.5 Computational Electromagnetics 1.2.6 Virtual Prototyping 1.2.7 Systems computer-aided manufacturing 1.3 CAM and CAE systems existing	
Readings and other resources	library resources [1] B.O. Saracoglu , "Identification of technology performance criteria for CAD / CAM / CAE / CIM / CAL in shipbuilding industry" , IEEE Xplore . [2] B. Raphael and I.F.C. Smith , " Fundamentals of computer aided engineering" , John Wiley .
Teaching methods	• The student must perform tasks in which conduct analyzes and simulations of mechanical systems where implement each of the topics reviewed in class. • The student must build a project in which the analysis and simulation of a mechanical system involved.
Learning activities	Professor will design activities that allow the evaluation of StudentOutcomes involved in the course .

2.- Cinematic analsis mechanical systems		**10 hours**
Specific Objective::	**Objective 2:** The student has the ability to simulate and analyze kinematic systems using technical computing software such as Matlab and analysis modules midlevel integrated mechanical design software platforms .	
2.1 General 2.2 mechanisms using computer simulation design platforms 2.2.1 General 2.2.2 Defining Constraints 2.2.3 Representation motion generating elements 2.2.4 Generation and analysis of position- speed graphics - acceleration 2.3 Simulation of mechanisms using the language of technical computing (SimMechanics Matlab) 2.3.1 Representation mechanisms 2.3.2 Representation together 2.3.3 Elements of Strength 2.3.4 Output Data Generation or.		
Readings and other resources	Library resources [1] Ahmed A. Shabana , "Dynamic of multibody systems" , Cambridge University. [2] Homer Rahnejat , " Multy -body dynamics : vehicles , machines and mechanisms" , Professional Engineering. [3] Huei - Huang Lee, " With SolidWorks Engineering labs dynamics Motion 2014," SDC Publications. [4] Kuang -Hua Chang, "Motion simulation and mechanism design with SolidWorks Motion 2011," SDC Publications. [5] Paul M. Kurowski , " With SolidWorks Simulation analysis Engineering 2012" , SDC Publications. computer resources (software): Matlab, Ansys LS- DYNA , SolidWorks . Electronic resources : MatLab SimMechanics User Guide: https://mecanismos2mm7.files.wordpress.com/2011/09/tutorial-sim-mechanics.pdf	

Teaching methods	• The student must perform tasks in which conduct analyzes and simulations of mechanical systems where implement each of the topics reviewed in class. • The student must build a project in which the analysis and simulation of a mechanical system involved. •
Learning activities	Professor will design activities that allow the evaluation of StudentOutcomes involved in the course .

3.- Finite element Analsis by mechanical design software		**16 hours**
Specific Objective:	**Objective 3:** The student has the ability to simulate and analyze mechanical systems using tools Finite Element Analysis which are included in mechanical design software .	
3.1 General 3.2 Software that uses the finite element method 3.3 Modeling and simulation of mechanical components 3.3.1 Modeling of the geometry 3.3.2 Definition of mechanical properties of the 3D model 3.3.3 Discretization of the domain 3.3.4 Application of boundary conditions 3.3.5 Simulation 3.3.6 Post-processing , analysis of results and convergence 3.4 Modeling of mechanical assemblies 3.4.1 Definition of joints and mechanical properties of 3D models 3.4.2 Discretization domain 3.4.3 Application of boundary conditions 3.4.4 Simulation 3.4.5 Post-processing , analysis of results and convergence 3.5 Modeling of dynamic systems using ANSYS LS -DYNA 3.6 Solving differential equations using the PDE Toolbox Matlab tool		
Readings and other resources	Library resources [1] Reiner Anderl , Peter Binde , " Simulations With NX : Kinematics , FEM , CFD ," Hanser Fachbuchverlag . [2] Sergio Gomez, " Solidworks simulation " AlfaOmega . computer resources (software): NX , Matlab, Ansys LS- DYNA . Electronic resources : Matlab PDE Tutorial: http://www.math.mtu.edu/~msgocken/pdebook2/tutorial.pdf ANSYS LS- DYNA User Guide: http://orange.engr.ucdavis.edu/Documentation12.1/121/ans_lsd.p	
Teaching methods	• The student must perform tasks in which conduct analyzes and simulations of mechanical systems where implement each of the topics reviewed in class. • The student must build a project in which the analysis and simulation of a mechanical system involved.	
Learning activities	Professor will design activities that allow the evaluation of StudentOutcomes involved in the course.	

4.- Analysis and simulation of fluid		**8 hours**
Specific Objective:	**Objective 4:** The student should know and have the ability to simulate and analyze the behavior of fluids using computer tools	

4.1 General 4.2 Constitutive equations 4.3 Fluid pipes 4.4 Drag 4.5 Vorticidades	
Readings and other resources	Library resources [1] Pieter Wesseling, *"Principles of computational fluid dynamics",* Springer series. [2] Oleg Zikanov, *"Essential computational fluid dynamics",* John Wiley & Sons. [3] P. Niyogi, S.K. Chakrabartty, M.K. Laha, *"Computational fluid dynamics",* Pearson Education. computer resources (software): Kratos Multiphysics : http://www.cimne.com/kratos/galeriaCFD.asp Electronic resources: Tutorials of Kratos Multiphysics: http://kratos-wiki.cimne.upc.edu/index.php/Kratos_Tutorials
Teaching methods	• The student must perform tasks in which conduct analyzes and simulations of mechanical systems where implement each of the topics reviewed in class. • The student must build a project in which the analysis and simulation of a mechanical system involved.
Learning activities	Professor will design activities that allow the evaluation of StudentOutcomes involved in the course .

5.- Tools computer-aided manufacturing		**8 hours**
Specific Objective:	**Objective 5: :** The student should know and have the ability to simulate and analyze the various manufacturing processes and process parameters involved.	
5.1 General and CAM 5.2 Simulation for different manufacturing processes 5.3 Simulation of casting processes and injection 5.4 Simulation of additive manufacturing processes 5.5 Simulation systems for computer integrated manufacturing		
Readings and other resources	Library resources [1] C. Elanchezhian, T. Sunder Selwyn, G. Shanmuga Sundar, *"Computer Aided Manufacturing"*, Laxmi Publications. computer resources (software): DelCAM, SolidWorks Injection Simulation, Matlab, Delmia. Electronic resources: http://nsmwww.eng.ohio-state.edu/542.pdf http://www.journalamme.org/papers_vol24_1/24156.pdf http://www.ewp.rpi.edu/hartford/~ernesto/SPR/Shen-FinalReport.pdf	
Teaching methods	• The student must perform tasks in which conduct analyzes and simulations of mechanical systems where implement each of the topics reviewed in class. • The student must build a project in which the analysis and simulation of a mechanical system involved.	
Learning activities	Professor will design activities that allow the evaluation of StudentOutcomes involved in the course .	

E) TEACHING AND LEARNING METHODOLOGIES

F) EVALUATION CRITERIA:

Evaluation:	Schedule	Suggested Form of Evaluation and weighing	Topics
1st . Partial evaluation	session 16	**33 % Total evaluation** Partial Evaluation: Exam 60% Project advance 40%	Unit 1 to 2
2nd Partial Evaluation	session 32	**33 % Total evaluation** Partial Evaluation: Exam 60% Project advance 40%	Unit 3
3rd . Partial evaluation	Session 48	**33 % Total evaluation** Partial Evaluation: Exam 60% Project advance 40%	Unit 4 to 5
Final Ordinary evaluation		100 % (Average Partial Ratings)	
Other activity:	Laboratory with activities specified in the corresponding Manual .		
Extraordinary exam	Week 17 of the semester	100% Exam	100% agenda
According to exam	According to schedule school secretary	100% Exam	100% agenda
Regularization exam	According to schedule school secretary	100% Exam	100% agenda

G) BIBLIOGRAPHY AND ELECTRONIC RESOURCES

Basic texts

DEDWORTH, David; HENDERSON, Mark; WOLFW, Philip m.
Computer Integrated Desing and Manufacturing
Skirius U.S.A.
Mc. Graw-Hill, 1991

ZEID
CAD-CAM, Theory and Practice. U.S.A.
Mc Graw Hill, 1991

DING.Qiulin.
Surface Engineering Geometry for CAD AND CAM
U.S.A. John-Wiley, 1985

COMPLEMENTARY TEXTS

Internet sites
MatLab SimMechanics User Guide: https://mecanismos2mm7.files.wordpress.com/2011/09/tutorial-sim-mechanics.pdf
PDE Matlab Tutorial: http://www.math.mtu.edu/~msgocken/pdebook2/tutorial.pdf
ANSYS LS-DYNA User Guide: http://orange.engr.ucdavis.edu/Documentation12.1/121/ans_lsd.pdf
Tutoriales de Kratos Multiphysics: http://kratos-wiki.cimne.upc.edu/index.php/Kratos_Tutorials
http://nsmwww.eng.ohio-state.edu/542.pdf
http://www.journalamme.org/papers_vol24_1/24156.pdf
http://www.ewp.rpi.edu/hartford/~ernesto/SPR/Shen-FinalReport.pdf

Computer resources
NX, Matlab, Ansys LS-DYNA.
Kratos Multiphysics (Libre de licencia): http://www.cimne.com/kratos/galeriaCFD.asp
DelCAM, SolidWorks Injection Simulation, Matlab, Delmia.