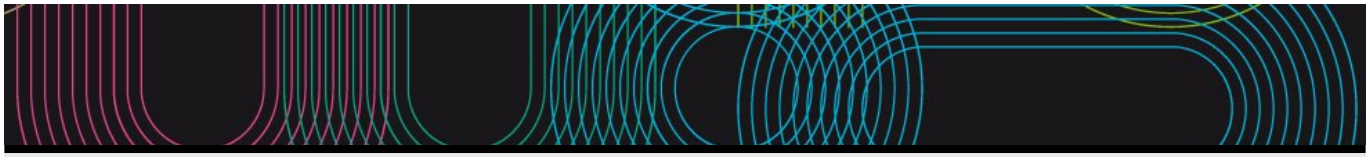

IDENTIFYING DATA				
Graphic engineering				
Subject	Graphic engineering			
Code	V12G380V01602			
Study programme	Degree in Mechanical Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	3rd	2nd
Teaching language	English			
Department				
Coordinator	Pérez Vázquez, Manuel			
Lecturers	Adán Gómez, Manuel Alegre Fidalgo, Paulino Cerqueiro Pequeño, Jorge López Pérez, Luis Pérez Vázquez, Manuel Roa Corral, Ernesto			
E-mail	maperez@uvigo.es			
Web	http://faitic.uvigo.es			
General description	The aim of this course is to provide the student with methods and tools to solve engineering problems graphically. After taking it the student will: Be aware of the criteria used for the selection and use of standard parts. Know about the CAD technologies used in geometrical modelling, and how to use them to produce engineering drawings. Be able to perform analysis on the operation of mechanisms from the specifications in the engineering drawings. Know how to apply geometrical tools to solve problems involving mechanisms, constructions, industrial facilities and installations. Possess skills to create and manage graphical information associated to mechanical engineering problems.			

Competencies	
Code	
B1	CG1 Skills for writing, signing and developing projects in the field of industrial engineering, whose purpose, specializing in Mechanics, construction, alteration, repair, maintenance, demolition, manufacturing, installation, assembly or operation of: structures, mechanical equipments, energy facilities, electrical systems and electronic installations and industrial plants, and manufacturing processes and automation.
C19	CE19 Knowledge and skills to apply the techniques of engineering graphics.
D2	CT2 Problems resolution.
D6	CT6 Application of computer science in the field of study.
D9	CT9 Apply knowledge.
D10	CT10 Self learning and work.
D14	CT14 Creativity.
D16	CT16 Critical thinking.
D17	CT17 Working as a team.

Learning outcomes			
Expected results from this subject	Training and Learning Results		
Know and have of criteria based for the election and application of components normalised.	B1	C19	D2
Know the CAD technologies for the geometrical modelling and the generation of planes from east.		C19	D6
Capacity to realise analysis of the operation of the mechanisms from the specifications of the planes.	B1	C19	D16

Know apply the geometry in the resolution of problems of constructions and industrial installations.	C19	D2 D9 D14
Purchase skills to create and manage relative graphic information to problems of mechanical engineering.	C19	D10 D14 D16 D17

Contents	
Topic	
THEORICAL CONTENTS	
1. Introduction to the charts of engineering	1.1. Types of charts in engineering. Fields of application. Charts for the design, the visualisation and the communication. The graphic language. 1.2. Graphic systems. Types and structure of the graphic files. I handle of the information. Hierarchies. Layers. 1.3. Models. Geometrical model. *Asociatividad Of the information.
2. Representation of pieces and mechanical components normalised.	2.1. Normalisation of values. Designations normalised. 2.2. Representation, *acotación and designations normalised stops: *Resortes, rollings and his accessories, *poleas. Graphic information in planes of toothed wheels. Curves for the profile of the teeth. 2.3. Other forms of transmission of movement. 2.4. Attachments 2.5. Symbolic representation of mechanisms. 2.6. Materials. Designations normalised 2.7. Criteria for selection and employment of components normalised.
3. Management of the variability; functional repercussion of the tolerances. Analysis and synthesis of tolerances.	3.1. The variability associated to the problems of Mechanical Engineering. 3.2. Variability *macro and *micro geometrical. 3.3. Dimensional tolerances and adjust. Specification. 3.4. Geometrical tolerances. Specification. 3.5. References and systems of reference. 3.6. Tolerances of *rugosidad superficial. Specification. 3.7. Statistical tolerances. Functions of cost of the tolerances. 3.8. Analysis of tolerances and synthesis of tolerances. 3.9. Combination of tolerances; repercussion of the accumulation of tolerances on the operation and setting of mechanisms.
4. Concepción and representation of elementary mechanical forms. *Acotación Oriented to the function, the manufacture and the control of the product.	4.1. Constructive forms for the design of pieces *moldeadas, forged, conformed and stuffed. 4.2. Elementary mechanical functions. 4.3. Analysis of the conditions of operation in the mechanisms. 4.4. *Acotación Functional. Chains of heights. 4.5. *Acotación Oriented to the process of manufacture. 4.6. *Acotación Oriented to the control of compliance.
5. Geometrical specification of products.	5.1. Concept of geometrical specification according to ISO. 5.2. Chains of Norms. 5.3. Norms fundamental and global GPS 5.4. Matrices of Norms General GPS 5.5. Matrices of Norms Complementary GPS. 5.6. Operations of specification. 5.7. Interpretation of geometrical specifications in base to the operations to build them.
6. Diagrams, Nomograms and empirical equations.	6.1. Graphic constructions employees in engineering. 6.2. Scales for the graphic constructions. 6.3. Diagrams and Nomograms. Graphic volumetric. 6.4. Graphic representation of empirical equations. 6.5. Functions of analysis of data.
7. Foundations of the charts by computer.	7.1. Basic geometrical transformations. 7.2. *Graficación Of lines: basic algorithms. 7.3. Curves *aproximadoras and *interpoladoras: types and applications. 7.4. *Modelado Geometrical. Structure of the information in the files *CAD 2D and 3D. Entities and models of solid/surfaces/wire mesh/points. 7.5. Graphic bookshops. 7.6. Systems *CAD for mechanical design oriented to the product.

8. Systems *CAD/FALL/CAM. Systems for acquisition of data of the real geometries. *Prototipado Fast.	8.1. Systems *CAx. 8.2. Tools *CAD/CAM. 8.3. Tools FALLS in the context of the engineering of design. 8.4. Virtual reality: characteristics and devices. Applications in the field of the engineering. 8.5. Digitalisation of forms. Projects of reverse engineering. 8.6. Systems of *prototipado fast. 8.7. Formats for the exchange of information.
9. Representation of constructions and industrial installations.	9.1. Symbolic representation of structures. 9.2. Planes of detail for metallic structures. 9.3. Representation and *acotación of the unions soldered. 9.4. Drawings for coppersmithing. 9.5. Symbols and diagrams for circuits *oleohidráulicos and tyres. 9.6. Symbols and diagrams for drivings of fluids.
10. Introduction to the industrial design.	10.1. Design. Types. The industrial design: product, communication and corporate image. 10.2. Methodologies for the design. 10.3. Stages of the process of design. 10.4. The creativity in the process of design. 10.5. Assessment of alternatives of design. 10.6. *DfX.
PRACTICAL CONTENTS	.
1. *Croquizado Of a mechanical group	It will propose the individual realisation of the *croquizado of a mechanical group, that will include elements of transmission and a high number of components normalised. The previous process to the realisation of the *croquizado, consistent in his study, research of information and analysis, will realise by groups of three or four students/ace.
2. Modelling of the previous group	Once corrected and given back by the professor the previous practice, will realise the modelling of the pieces and the assembled of the group by means of the program *CAD available in the Laboratory. It will be an individual work, although they will form groups for the put in common and learning *colaborativo.
3. Realisation of planes in 2D	Splitting of the previous modellings, will elaborate the planes of detail and of group of the assembled, by means of the program *CAD available, containing the list of pieces and all the necessary specifications (heights, tolerances *macro and *microgeométricas, special indications), that are necessary to guarantee an optimum operation of the mechanism to the that belong each piece.
4, Representations of coppersmithing	Realise the modelling solid and represent the developments for an element of coppersmithing, with all the necessary dimensional specifications, employing the program *CAD available.
5. Realisation of a memory for analysis of functionality and *intercambiabilidad	It will realise a critical analysis of the design of the exercises 1-4, that contain a forecast of the conditions of operation expected, based in the tolerances applied and the effect combined between all they, and a study that reflect how can reduce the costs of the tolerances from the effect combined of all those that take part. It will realise an analysis FALLS of a notable piece of the design. All the parts of this work will be documented with what graphic information, of the worked in the course, was possible to apply for a better understanding of the memory.
6. Representation of an industrial construction. Diagrams for drivings of fluids and other installations.	Represent by means of the program *CAD available a small building of the type industrial ship to house a workshop or small mechanical industry, with bounded planes of the metallic structure and his corresponding constructive details. Realise the symbolic representation of diverse notable installations of the ship: energy, flowed, etc.

Planning

	Class hours	Hours outside the classroom	Total hours
Master Session	26	39	65
Troubleshooting and / or exercises	24	36	60
Integrated methodologies	5	5	10
Group tutoring	5	5	10
Others	5	0	5

*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

Methodologies

	Description
Master Session	Active master session. Each topic will be presented by the lecturer using audiovisual resources, this being complemented with the comments that students make, based either on the recommended references or on any others that are relevant for this part of the suject.
Troubleshooting and / or exercises	Exercises and/or problems will be proposed to be solved along the masterclasses, either partially or fully in class, either individually or in groups, and always with the active orientation of the lecturer. These activities will be oriented to make easier a better understanding of the application and practical utility of the contents of each topic. The purpose of these exercises will also be to provide an orientation on the contents and aims of the laboratory classes.
Integrated methodologies	Realisation of activities that require the active participation of students and the collaboration among them.
Group tutoring	Realisation of activities to reinforce the learning by means of the tutored resolution in groups of practical cases related with the theory contents of the subject, evaluating along them how the students associate these contents to each one of the different stages developed in the analysis and solution processes of each problem.
Others	PERSONALISED ATTENTION: Proposition of learning support activities and review of its results, either individually or in small groups of students.

Personalized attention

Methodologies	Description
Group tutoring	For the election, follow-up and control of the works

Assessment

	Description	Qualification	Training and Learning Results
Master Session	They will realise the number of proofs of control that consider the professor (like minimum two), in distinguished dates, in which it will be possible to surpass all or any of the parts. In this modality of CONTINUOUS EVALUATION the maximum qualification will be of 10 points.	60	C19 D10 D16
Troubleshooting and / or exercises	The practical activities to realise will correspond with the indicated in the section of Practical Contents, and will pose for his development, resolution and back delivery to the professor in the date that in each concrete case indicate . Each activity presented will evaluate in accordance with the criteria that previously have indicated , and will be given back with promptness so that the learning that contribute each correction can be incorporated to the following practical activities. The calendar for execution and presentation of the practical activities will be known to the start of the course.	ata 40	B1 C19 D2 D6 D9 D14 D16 D17
Others	Works to realise during the course	ata 40	B1 D2 D9 D10 D17

Other comments on the Evaluation

The continuous evaluation will include all the work developed of face-to-face form or no face-to-face, of those individual activities and group work programmed. The subject approves by means of the continuous evaluation when reaching 5,00 points in each one of the parts, without need to realise the examination of the official announcement established by the centre.

When in the process of continuous evaluation remain pending parts, the student will examine of these parts in the final examination, so much of theory as of practices, save in those cases that the professor consider the possibility to recover them with an additional or complementary work of the previous. The parts surpassed will conserve for the second announcement.
In the final examination will examine of the total of the contents of the subject those who have renounced to the modality of continuous evaluation, and those that wish to change the note having studied the modality of continuous evaluation. The maximum qualification will be of 10 points. The theoretical part of said examination will realise in the date fixed by the centre, being able to realise the practical part in hour and different day.
Expects that the present student a suitable ethical behaviour. In the case to detect a no ethical behaviour (copy, plagiarism, utilisation of unauthorised electronic devices, and others) will consider that the student does not gather the necessary requirements to surpass the matter. In this case the global qualification in the present academic course will be of suspense

(0.0). It will not allow the utilisation of any electronic device during the proofs of evaluation except permission expresses.

Sources of information

Basic Bibliography

AENOR, **Normas UNE/EN/ISO diversas actualizadas**, AENOR,

Cordero, J.M.; Cortés, P., **Curvas y Superficies para Modelado Geométrico**, Ra-ma, 2002

Félez, J.; Martínez, M.L., **Ingeniería Gráfica y Diseño**, Síntesis, D.L., 2008

Foley, J. D.; Van Dam, A.; Feiner, S. K.; Hughes, J. F.; Philips, R. L., **Introducción a la Graficación por Computadora**, Addison-Wesley Ib., 1996

Complementary Bibliography

Aguayo, F.; Soltero, V., **Metodología del Diseño Industrial. Un Enfoque desde la Ingeniería Concurrente.**, Ra-ma, 2003

Company, P.; Vergara, M.; Mondragón, S., **Dibujo Industrial**, Publicacions de la Universitat Jaume I, 2007

Farin, G., **Curves and surfaces for computer aided geometric design**, Academic Press, 1997

Fischer, B. R., **Mechanical Tolerance Stackup and Analysis**, Marcel Dekker, Inc., 2004

García, M.; Alcaide, J.; Gómez, T.; Collado-Ruiz, D., **Fundamentos del diseño en la ingeniería**, UPV, 2009

Giesecke F.E.; et al., **Technical Drawing with Engineering Graphics**, Prentice Hall (Pearson Education, 2012

Gómez, S., **El Gran Libro de SolidWorks Office Professional**, Ed. Marcombo, 2010

Hearn, D.; Baker, P., **Gráficos por computador**, Prentice Hall Hispanoamericana, 1995

Jensen, C.; Helsel, J. D.; Short, D. R., **Dibujo y diseño en Ingeniería**, Mc Graw-Hill, 2002

Molero, J., **Autocad 2010: Curso Avanzado**, Anaya Multimedia, 2009

Recommendations

Subjects that continue the syllabus

Product design and communication, and automation of plant elements/V12G380V01931
Systems for product design and development/V12G380V01934
Final Year Dissertation/V12G380V01991

Subjects that are recommended to be taken simultaneously

Machine design 1/V12G380V01304

Subjects that it is recommended to have taken before

Graphic expression: Fundamentals of engineering graphics/V12G380V01101
Fundamentals of manufacturing systems and technologies/V12G380V01305

Other comments

It is required in order to register in this subject to either have passed all subjects in the former courses, or to be registered in all of them.
It is specifically recommended to have passed the 'Graphic Expression' subject from first year.