BASIC PHYSICS OF STRUCTURES (2016-17)

GENERAL INFORMATION

Code 16006

ECTS Credits 6

Departments and areas

Department	Area	Area	Report R.
PHYSICS, ENGINEERING SYSTEMS AND SIGNAL THEORY	APPLIED PHYSICS	YES	YES

Studies

DEGREE IN TECHNICAL ARCHITECTURE

Context of subject

Basic Physics of Structures is a basic subject in the degree in Technical Architecture. This course aims firstly to revisit areas of mechanics which may have been covered in pre-university Physics, and to build on this common base the principles of mechanics of solids on which many subsequent modules depend. This includes basic equilibrium, work and energy and the analysis of statically determinate frameworks, leading into a major section on the analysis of stress and strain in two and three dimensions, which includes material failure criteria. The architecture graduate should be able to use the relevant laws of kinematics and dynamics to solve problems of equilibrium of rigid bodies, trusses, and beams. What we do is show problematic situations (open problems relevant to the technical architecture student, both theoretical and practical situations) where we have to think about possible solutions doing research, and not necessarily requiring a numerical answer. This methodology facilitates the autonomy and responsability of the students, the interactivity teacher-student and student-student, and shows the connection between physics and other areas of knowledge.

OBJECTIVES

Subject objectives/competences (2016-17)

Scientific-technical capacities necessary for professional practice in technical architecture as well as a number of other fields, such as calculation techniques, measurements, appraisals and studies of economic viability, inspection and defects analysis, reports and technical documents, design plan on plots and buildings.

SUBJECT OBJECTIVES

To acquire and apply physics and mathematical knowledge to solve technical architecture situations.

To achieve the basic knowledge of the Physic laws which are needed to understand other subjects study during the degree.

To give a simple description and as complete as possible for statics, and apply it to solve simple structures; establishing the basic relationships that exist between this subject and other subjects in the curriculum.

To calculate centre of mass and moment of inertia of plane surfaces.

To increase the capacity of planning and conducting experiments, as well as analysis and interpretation of experimental data.

To develop autonomy in the learning processes forming capacities and attitudes to facilitate life-long learning and capacities to communicate making use of the scientific language.

To acquire skills in information technologies.

CONTENTS

Theoretical and practical contents (2016-17)

The fundamental concepts and principles of Mechanics and force systems. Centroids, centre of gravity, and second moments of area and moments of inertia. Equilibrium of rigid bodies. Elastic behaviour of solids. Internal forces in structural menbers: trusses and beams.

THEORETICAL AND PRACTICAL CONTENTS

Chapter I: THE FUNDAMENTALS CONCEPTS AND PRINCIPLES OF MECHANICS. I.1. Introduction to physical magnitudes. I.2. Definition of force. Dynamics: Newton's laws. I.3. Scalar and vectorial magnitudes I.4. Basic vectorial algebra and analytical geometry. I.5. Dot product and cross product. Double cross product.

Students must to know this chapter for applying in the subject contents. It will facilitate documents of theory and exercises to practice. Doubts will be answer during tutorial hours.

Chapter II: SLIDING VECTORS. II.1. Definition. II.2. Moment of a sliding vector. II.3. Systems of sliding vectors. II.4. Invariants of a given system of sliding vectors. II.5. Equation of the central axis. II.6. Classification of systems of sliding vectors. II.7. Varignon's theorem.

Chapter III: CENTRE OF GRAVITY OF PLANE SURFACES. III.1. Centre of gravity of plane surfaces. III.2. Systematic calculation of centres of gravity. III.3. Theorems of Pappus and Guldinus. III.4. Static moments and centre of gravity of a surface.

Chapter IV: MOMENTS OF INERTIA OF AREAS. IV.1. Moments of inertia of plane surfaces. IV.2. Radius of gyration of an area. IV.3. Change of the reference system. Steiner's theorem. IV.4. Product of inertia. IV.5. Geometric and mass moments of inertia.

Chapter V: PRINCIPALS MOMENTS AND DIRECTIONS OF INERTIA OF PLANE SURFACES. V.1. Principal moments of inertia of a section. V.2. Principal axes and principal directions of inertia. V.3. Properties of the principal axis of inertia. V.4. Calculation of de principal directions of inertia.

Chapter VI: EQUILIBRIUM OF RIGID BODIES. VI.1. Basic principles of static equilibrium. VI.2. Support and connection types. VI.3. Friction. VI.4. Free-body diagrams.

Chapter VII: ANALYTICAL TECHNIQUES TO SOLVE COPLANAR FORCE SYSTEMS. VII.1. Graphical solution for coplanar force systems. VII.2. General case. VII.3. Concurrent force systems. VII.4. Parallel force systems. VII.5. Distributed forces. VII.6. Stability and overturn.

Chapter VIII: GRAPHICAL TECHNIQUES TO SOLVE COPLANAR FORCE SYSTEMS. VIII.1. Analytical solution for coplanar force systems. VIII.2. Polygon of forces. VIII.3. Funicular polygon. VIII.4. Graphics conditions of equilibrium. VIII.5. Properties of the funicular polygon. VIII.6. Applications of graphical techniques.

Chapter IX: MECHANICAL PROPERTIES OF SOLIDS. IX.1. Elastic behaviour of solids. IX.2. Method of sections. IX.3. Normal stress and shear stress. IX.4. Axial deformation: Young's modulus.

Chapter X: INTERNAL FORCES IN STRUCTURAL MEMBERS: PLANE TRUSSES. X.1. Plane trusses. Introduction. X.2. Assumptions made in truss analysis. X.3. Isostatic and hyperstatic systems. X.4. Method of joints. X.5. Method of Maxwell-Cremona. X.6. Method of Ritter or method of sections.

Chapter XI: INTERNAL FORCES IN STRUCTURAL MEMBERS: ISOSTATIC PLANE BEAMS. XI.1. Isostatic beams. Introduction. XI.2. Reactions at supports. XI.3. Types of loads on beams. XI.4. Internal forces in beams. Sign convention. XI.5. Loads, shear and axial forces. XI.6. Bending moments. XI.7. Graphical analysis of a beam. XI.8. Elastic curve of a beam.

EVALUATION

Instruments and criteria of Evaluation 2016-17

All work (assignments and exams) that you submit must be strictly your own work. Obtaining solutions from any external source or another student's homework or sharing your homework with another student is absolutely not allowed and will imply a mark of "0" in the work. Both the head of the department and the Polytechnic School will be informed of this action. Giving and receiving help on concepts is allowed and encouraged. Punishments will be according to the Reglamento de disciplina académica de los Centros oficiales de Enseñanza Superior y de Enseñanza Técnica dependientes del Ministerio de Educación Nacional BOE 12/10/1954.

General evaluation system:

- Written tests (controls, solving problem reports or exercises, and so on) which will be done individually or in group, throughout the semester for the continuous evaluation of the technical competences of the subject. Students must do at least the 80% of the evaluation activities and earn at least 5 points to 10 to pass this part.
- It could be evaluated the attendance of classes.
- Laboratory reports.
- It could be assessed, if it proceeds, the skills and attitudes showed by the student in the individual or group activities.
- Final examination, if it proceeds, comprising the whole subject and which contribution to the final mark will not be greater than 50% of the final total mark. Students must earn at least 4 points to 10 to receive an overall grade point average in this course.

Type	Criterion	Description	Ponderation
FINAL TEST	The final mark for this subject will be contributed by: **FINAL MARK = 50% long term evaluation + 50% final exam** The final exam will consist of resolution of exercises corresponding to the different themes of the course. Students must earn at least 4 points to 10 to receive an overall grade point average in this course. You will have three options to pass the long term evaluation in July and/or December: 1. Earn **at least** a **70%** in the **final exam**. **FINAL MARK** = **maximum** (**5.0; 50% long term evaluation + 50% final exam**) 2. **Do a group of activities** to demonstrate that they have learned all the contents evaluated during the long term evaluation, if the student has talked to the professor **before the end of the semester classes** to plan and organize the assessments properly. 3. If a student has a **justified reason** for missing long term evaluation, then the student will be given the opportunity to do an **specific final exam with a 100%** of the final mark which will have **three parts mandatory**: theory, problems and do a laboratory experience. **Professors** of the subject, **or** the **coordinator**, will **analyse** if the **submitted reasons are justified or not**.	Final examination	50

ACTIVITIES OF EVALUATION DURING THE SEMESTER	The long term evaluation for June, July and/or December, there will be as follows: **LONG TERM EVALUATION = 20% theory + 15% problems + 15% laboratory** **Criteria for problem sessions:** There will be two controls with problems covering the themes I, II, III, IV, and V (week 8), and VI, VII, VIII, IX, X, and XI (week 15). Professor in the classroom hours could request the delivery of exercises at the end of the session. The weight in the final evaluation will be 15%. **Criteria for theoretical sessions:** There will be two tests with multiple items covering the themes I, II, III, IV, and V (week 8) and themes VI, VII, VIII, IX, X, and XI (week 14 or 15). Professor in the classroom hours could request the delivery of conceptual questions at the end of the session. The weight in the final evaluation will be 20%. **Criteria for laboratory:** It will be assess: the attitude and participation in the laboratory sessions, and the laboratory reports. The weight in the final evaluation will be 15%.	Long term evaluation	50