GENERAL PHYSICS

Course Objective (4)

Learn and understand the fundamental concepts of physics in order to level out the knowledge acquired by students from related professional careers. The students also develop the ability to recognize basic physics phenomena

Course content (5)

A. MECHANICS

	TOPIC	Theory (hrs)	Practice (hrs)	Weeks
1	Vectors	4	2	1
1.1	Vector and Scalar Quantities			
1.2	Properties of Vectors			
1.3	Properties of Vectors			

	TOPIC	Theory (hrs)	Practice (hrs)	Weeks
2	Kinematics and Dynamics	8	4	2
2.1	Motion along straight line			
2.2	Motion along straight line with constant acceleration			
2.3	Newton's Laws			
2.4	Applications of Newton's Laws			
2.5	Circular motion			

	TOPIC	Theory (hrs)	Practice (hrs)	Weeks
3	Energy and Work	8	4	2/2=1
3.1	Physic definitions of Energy and Work			
3.2	Work- Energy theorem			
3.3	Potential energy and conservation of energy			
3.4	Conservative and Nonconservative Forces.			

	TOPIC	Theory (hrs)	Practice (hrs)	Weeks
4	Linear Momentum and Collisions	4	2	1
4.1	Linear momentum and Newton's second law			
4.2	Conservation of linear momentum			
4.3	Collisions and impulse			
4.4	Center of mass			
4.5	Systems of Many Particles			

	TOPIC	Theory (hrs)	Practice (hrs)	Weeks
5	Rotation and Angular momentum	4	2	1
5.1	Rotation with constant angular acceleration			
5.2	Moments of Inertia (Rotational Inertia)			
5.3	Torque			
5.4	Rotational Kinetic Energy			
5.5	Definition of Angular Momentum			
5.6	Conservation of Angular Momentum			

	TOPIC	Theory (hrs)	Practice (hrs)	Weeks
6	Static Equilibrium	4	2	1X2=2
6.1	The requirements of equilibrium			
6.2	Some examples of Static Equilibrium			

	TOPIC	Theory (hrs)	Practice (hrs)	Weeks
7	Oscillation motion	4	2	1
7.1	Harmonic movement of mass-spring system: differential equation			
7.2	Pendulums			
7.3	Damped Oscillations			
7.4	Forced Oscillations			

B. **ELECTROMAGNETISM**

	TOPIC	Theory (hrs)	Practice (hrs)	Weeks
8	Electrostatic	8	4	2
8.1	Electric charge and Coulomb's Law			
8.2	Electric Field and Electric Potential			
8.3	Capacitance and Dielectrics			
8.4	Gauss's Law			

	TOPIC	Theory (hrs)	Practice (hrs)	Weeks
9	Electric Current	4	2	1
9.1	Physics concept of electric current			
9.2	Resistance and Ohm's law			
9.3	Direct-current circuits			

	TOPIC	Theory (hrs)	Practice (hrs)	Weeks
10	Magnetic fields	8	4	2
10.1	Magnetic Force acting on electric charges			
10.2	Magnetic Force due to currents			
10.3	Ampere's Law and Ampere-Maxwell's law			

	TOPIC	Theory (hrs)	Practice (hrs)	Weeks
11	Magnetic Induction.	4	2	1
11.1	Magnetic flux			
11.2	Faraday's Law and Lenz's Law			
11.3	Faraday's Law applications			

	TOPIC	Theory (hrs)	Practice (hrs)	Weeks
12	Maxwell's Equations			
12.1	Maxwell's Equations: integral and differential forms			
12.2	Equation of electromagnetic waves and solution			
	TOTAL 96 HRS	**60**	**30**	**15+1=16**

Bibliografía

1. Serway R., Jewett J.W. Physics for Scientists and Engineers. 9th. Edition. Cengage Learning (2014)
2. Tipler, P., Mosca, G. Physics for Scientists and Engineers. 6ª. Edition. W. H. Freeman (2010).
3. Resnick R., Halliday D., Krane K. Physics. 5th. Edition. Wiley (2001)

LEARNING ACTIVITIES (6)

In theoretical sessions will be discussed of fundamental concepts for each issue. Selected problems will also be resolved during these sessions.

It is recommended to use multimedia resources: videos, animations or software.

The practical sessions will be to resolve advanced problems.

CRITERIOS Y PROCEDIMIENTOS DE EVALUACION Y ACREDITACION

A minimum of three exams will be applied.

Grading: 100 % Exams

General Chemistry

Dr. Mou Pal

GENERAL PURPOSE (4)

The overall objective of this induction course in Chemistry is to provide students the theoretical foundations that help them understand the chemical phenomena as well as the main processes involved in the formation of compounds.

Topics and subtopics (5)

	TOPIC	Theory (hrs)	Practice (hrs)	Weeks
1	**CHEMICAL CALCULATIONS** -Stoichiometry: atomic mass; isotopes; mole and Avogadro's number; percentage composition; determination of empirical formulas; determination of molecular formulas; balancing chemical equations. - Solutions: definition; types of solutions; concentration calculation	10	5	2.5
2	**ATOMIC STRUCTURE and PERIODIC TABLE** - Nature of matter, atomic structure, atomic models, atomic orbitals and quantum mechanics; quantum numbers. - The periodic table and the electronic configuration; penetration and shielding; baseline configurations. - Atomic parameters: atomic radii; ionization energy; electron affinity; electronegativity; periodic relations between the elements.	9	6	2.5
3	**MOLECULAR STRUCTURE** - Lewis Structures - Molecular geometry and valence shell electron pair repulsion theory (VSEPR). - Molecular orbital theory: bonding and antibonding orbitals; types of bonding according to their symmetry (sigma bond and pi bond); building of molecular orbital diagram for homo- and heteronuclear diatomic molecules; Bonding order; HOMO and LUMO.	10	5	2.5
4	**CHEMICAL BONDING** - Octet rule; ionic bond; Covalent bond; Coordinate covalent bond, polarity, hydrogen bonding.	6	3	1.5
5	**CLASSIFICATION OF CHEMICALS** - Nomenclature of ionic compounds; Stock method; nomenclature - oso and/ ico; Nomenclature of non-metal-nonmetal compounds; Nomenclature of acid; Nomenclature of oxyanions.	4	2	1
6	**ACIDS AND BASES** **-** Arrhenius theory; Bronsted Lowry theory; acidity and basicity; Strong and week acids and bases. pH/pOH scale; Lewis acids and bases; buffer solutions; effects of common ions; Henderson-Hasselbalch equation.	8	4	2
7	**OXIDATION AND REDUCTION** - Electron transfer reactions; Oxidation number; Oxidising and reducing agentes; Balanceing redox equations; Redox reactions in acid and basic solutions.	8	4	2
	TOTAL	55	29	14

BIBLIOGRAPHY

1. Thomas J. Greenbowe, Jeffrey Pribyl, K. A. Burke, CHEMISTRY, AN EXPERIMENTAL SCIENCE, Publishers: Wiley.
2. T. R. Dickson, Introducción a la Quimica,Publicaciones CULTURALES
3. Raymond Chang, Quimica, Sexta Edicion, (McGraw-Hill Education, 2009)

4. Shriver & Atkins, inorganic Chemistrty, Oxford Press, 5th Edition

LEARNING ACTIVITIES (6)

1. Conceptual presentation/analysis.
2. Problem solving.

CRITERIA OF EVALUATION AND GRADING (7)

1. Participation and problem solving in clases.
2. Problem solving exercises in class.
3. Homework.
4. Partial examinations.

THERMAL PHYSICS

AIM OF THE COURSE

This introductory course on Thermal Physics aims the students learn or consolidate the basic concepts and methods of Classical Thermodynamics, Kinetic Theory of Gases and Statistical Mechanics, required to successfully go through the courses of a graduate program on Material Sciences.

CONTENT

	A. Introduction to Classical Thermodynamics	Theory (hrs)	Examples (hrs)	Weeks
1	Elementary concepts and definitions	2	2	2/3
2	Thermodynamics Zeroth law, temperature and thermal equilibrium	4	2	3/3
3	Work, heat and first law of thermodynamics	3	5	4/3
4	Cycles and thermal engines	4	4	4/3
5	Second law of Thermodynamics	2	2	2/3
6	Entropy	2	2	2/3
7	Thermodynamic potentials and Maxwell relations	4	4	4/3
8	Heats of reaction and formation, paramagnetic gas	2	4	3/3
		23	25	8

	B. Basics of Kinetic Theory and Statistical Mechanics	Theory (hrs)	Examples (hrs)	Weeks
9	Energy and pressure of a dilute gas	2	2	2/3
10	Mean free path and mean free time	2	2	2/3
11	Maxwell-Boltzmann, Planck, Bose-Einstein and Fermi-Dirac distributions	6	8	7/3
12	Applications: classical dilute gases, ideal quantum gases, black body radiation, electrons in metals, magnetic materials, specific heats	6	8	7/3
		16	20	6

Bibliography

1) Introducción a la Termodinámica Clásica, L. García-Colín, Ed. Trillas, 1998.

2) Heat and thermodynamics, M.W. Zemansky, R. H. Dittman, Ed. McGraw-Hill, 1981.

3) Chemical Thermodynamics of Materials, C.H.P. Lupis, Ed. Elsevier, 1983.

4) Thermodynamics and Kinetics in Materials Science, B.S. Bokstein, M.I. Mendelev, Oxford University Press, 2005

5) Fundamentals of statistical and thermal physics., F. Reif, Ed. McGraw-Hill, 2008.

6) Thermal Physics, C. Kittel, H. Kroemer, Ed. Dover, 1980.

7) Thermodynamics and Kinetics in Materials Science, B.S. Bokstein, M.I. Mendelev, D.J. Srolovitz, Oxford University Press, 2005.

LEARNING ACTIVITIES

- Presentation and discussion of concepts
- Problem solving sessions
- Investigation on specific topics
- Recitation

CRITERIA AND PROCEDURES FOR EVALUATION AND GRADE

- Initial examination for diagnosis
- Assignments and set problems
- Solution of partial exams

- Investigation on specific topics

Mathematical Methods

Ph.D. Arriaga Rodríguez, J. Jesús
Ph.D. González Ronquillo, Ana Lilia
Ph.D. Mendez Bermúdez, José Antonio
Ph.D. Meza Montes, Lilia
Ph. D. Meza, Octavio

GOAL OF THE COURSE (4)

Provide fundamental concepts and applications of mathematical tools for the Master's Degree in Materials Science

TOPICS AND SUBTOPICS (5)

	TOPIC	Theory (hrs)	Problems (hrs)	Weeks
1	Fundamentals 1.1. Real numbers and functions 1.2. Limits and continuity 1.3. Derivatives, minima, maxima and critical points 1.4. Integration 1.5. Functions of two or more variables 1.6. Sequences and series 1.6.1. Taylor series 1.6.2. Fourier series 1.7. Fourier transforms	12	6	3
2	Vector Analysis 21. Vector algebra 2.1.1. Dot product or inner product 2.1.2. Cross product or vector product 2.1.3. Triple products 2.2. Vector functions 2. 3. Limits, continuity and derivative of vector functions 2.3.1. Gradient, divergence and curl 2.4. Orthogonal curvilinear coordinates 2.4.1. Gradient, divergence and rotational orthogonal coordinate 2.4.2. Cylindrical and spherical coordinates 2.5. Double and triple integrals 2.6. Line integrals 2.6.1. Green theorem 2.7. Surface integrals 2.7.1. Divergence theorem 2.7.2. Stokes theorem	12	6	3

	TOPIC	Theory (hrs)	Problems (hrs)	Weeks
3	Linear Algebra 3.1. Definitions 3.2. Matrix operations 3.3. Determinants 3. 4. Inverse of a matrix 3.5. Orthogonal and unitary matrices 3.6. Systems of linear equations 3.6.1. Cramer's rule 3.7. Eigenvalues and eigenvectors 3.8. Tensors	12	6	3
4	Complex Variable 4.1. Complex functions 4.2. Limits and continuity 4.2.1. Derivatives 4.2.2. Cauchy-Riemann equations 4.3. Integrals 4.3.1. Cauchy theorem 4.3.2. Cauchy's integral formula 4.4. Singular points 4.4.1. Poles 4. 5. Residues 4.5.1. Residue theorem	12	6	3
5	Differential equations 5.1. Ordinary differential equations 5.1.1. Definition 5.1.2. Linear equations 5.1.3. Separation of variables 5.1.4. Exact equations 5.1.5. Integrating factor 5.2. Partial differential equations 5.2.1. Definition 5.2.2. Linear equations 5.2.3. General solutions 5.2.4. Separation of variables	8	4	2
	Total	**56**	**28**	**14**

Bibliography

1. James Stewart, Calculus: Early Transcendentals (Cengage Learning, 7 Ed. 2007).
2. M. R. Spiegel, Advanced Mathematics for Engineers and Scientists (McGraw-Hill, 2001).
3. Ruel V. Churchill, Variable Compleja y Aplicaciones (McGraw-Hill, 1992).
4. J. E. Marsden y A. J. Tromba, Vector Calculus (W. H. Freeman, 2003).
5. L. Leithold, The Calculus (Oxford, 1998).
6. G. Arfken, Mathematical Methods for Physicists (Academic Press, 1995).

LEARNING ACTIVITIES

- Discussion of key concepts
- Resolving and discussing problems in class of key concepts
- Homeworks

CRITERIA AND PROCEDURES FOR ASSESSMENT AND ACCREDITATION

- A partial exam for each topic
- Final note equal to the average score of partial exams