Module Handbook

Program:

"Plant Machinery Maintenance"

(Lima and Arequipa)

July, 2014
Lima-Arequipa
Perú

Av. Cascanueces 2221
Santa Anita, Lima 43 - Perú
informeslima@tecsup.edu.pe

Tel.: (51-1) 317-3900
Fax: (51-1) 317-3901
www.tecsup.edu.pe

Instituto de Educación Superior Tecnológico Privado Tecsup No1 RM: No 153-84-ED(17/02/1984) RD No 054-2005-ED (24/02/2005)

Table of Contents

Modules and Courses

Nr	Module	Courses	Semester	ECTS Credits	
MM-01	Fundamentals of Chemistry	Chemistry	1	4	4
MM-02	Physics	Physics I	1	5	10
		Physics II	2	5	
MM-03	Mathematics	Mathematics I	1	6	17
		Mathematics II	2	6	
		Applied Mathematics	3	5	
MM-04	Fundamental of electrical Technology	Electricity	1	5	13
		Electronics	2	5	
		Electrical Workshop	1	3	
MM-05	Values and culture	Attitudes and Values	1	2	4
		National and International Reality	2	2	
MM-06	Communications	Communication I	1	4	10
		Communication II	2	4	
		Successful Presentations	3	2	
MM-07	Quality and safety	Continuous improvement	3	2	5
		Safety, Health and environment	4	3	
MM-08	Basic English	English I	5	4	8
		English II	6	4	
MM-09	Management	Project Management	5	3	6
		Business Management	6	3	
MM-10	Human Resources and Labor Market	Decision Making	4	2	7
		Human Resource management	5	3	
		Induction to Labor Market	6	2	
MM-11	Computer Aided Design	Technical Drawing	2	3	7
		Industrial Drawing and Design	3	4	
MM-12	Mechanical Design	Design of Machine Elements	4	6	11
		Design and Aided Manufacturing	5	5	
MM-13	Fluid Power	Pneumatic Systems	4	4	8
		Hydraulic Systems	5	4	
MM-14	Thermal machines	Thermal Machines	5	5	10
		Refrigeration and Air Conditioning	6	5	
MM-15	Fluid Mechanics and Thermodynamics	Fluid Mechanics and Thermodynamics	3	4	4
MM-16	Maintenance Management	Maintenance Management	4	3	9
		Strategic Maintenance Management	6	6	
MM-17	Industrial Maintenance	Industrial Equipment and components	4	2	12
		Industrial Maintenance	5	6	
		Predictive Maintenance	6	4	
MM-18	Materials Engineering	Materials Technology	2	3	12
		Strength of Materials	3	5	
		Advanced Materials Technology	3	4	
MM-19	Manufacturing Process	Mechanical Workshop	2	3	12
		Manufacturing Process	3	5	
		Welding for Maintenance	4	4	
MM-20	Mechatronics	Industrial Electrotechnics	4	5	11
		Industrial Mechatronics Systems	6	6	
			∑	180	180

Fundamentals of Chemistry Module

<table>
<tr><td>Degree Program</td><td colspan="4">Plant Machinery Maintenance</td></tr>
<tr><td>Module designation</td><td colspan="4">Fundamentals of Chemistry</td></tr>
<tr><td>Module level, if applicable</td><td colspan="4"></td></tr>
<tr><td>Code, if applicable</td><td colspan="4">MM-01</td></tr>
<tr><td rowspan="2">Courses and Semester(s) in which the module is taught</td><td>Courses</td><td colspan="2">ID</td><td>Semester</td></tr>
<tr><td>- Chemistry</td><td colspan="2">QG1010</td><td>1</td></tr>
<tr><td>Person responsible for the Module</td><td colspan="2">Lima
- Lawrence Salmon</td><td colspan="2">Arequipa
-Eloina Berroa</td></tr>
<tr><td>Lecturers</td><td colspan="2">Lima
- Laurence Salmon
- Enrique Ames
- Enrique Cáceres</td><td colspan="2">Arequipa
- Heloina Berroa
- Robert Almendariz</td></tr>
<tr><td>Language</td><td colspan="4">Spanish</td></tr>
<tr><td>Relation to curriculum</td><td colspan="4">Compulsory</td></tr>
<tr><td>Type of teaching, contact hours</td><td colspan="4">Contact hours and class size separately for each teaching method: lecture, lesson, practical, project, seminar, etc.
<table>
<tr><th>Nr</th><th>Courses ID</th><th>Contact hours per week</th><th>Teaching Method</th><th>Class Size</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">QG1010</td><td>2.0</td><td>Lecture</td><td>40 students</td></tr>
<tr><td>1.5</td><td>Laboratory</td><td>20 students</td></tr>
</table></td></tr>
<tr><td>Workload</td><td colspan="4">(Estimated) workload, divided into contact hours (lecture, exercise, laboratory session, etc.) and private study, including examination preparation, specified in hours.
<table>
<tr><th>Nr</th><th>Courses</th><th>Contact Hours per week</th><th>Private Study per week</th><th>Semester Workload</th><th>ECTS Credits</th></tr>
<tr><td>1</td><td>QG1010</td><td>3.5</td><td>3.4</td><td>124</td><td>4</td></tr>
</table></td></tr>
<tr><td>Requirements according to the examination regulations</td><td colspan="4">In order to pass each course of the module, student must obtain a minimal final grade of 11 (eleven). To compute the final grade, the fraction 0.5 or more is considered as a unit in favor the student. (Exam. Reg. 2013 Art. 21)</td></tr>
<tr><td>Recommended prerequisites</td><td colspan="4">Formal: None
Content: Materials and Mathematics knowledge, and computing skills</td></tr>
<tr><td>Module objectives/intended learning outcomes</td><td colspan="4">After having finished the module, students are able to:
Knowledge:
- Discover the structure and properties of matter and types of links in nature inorganic and organic substances.
- Interpret the chemical reactions and the stoichiometric fundamental knowledge.
Skills:
- Design chemical equations and apply stoichiometry in organic and inorganic chemical reactions.
- Assess the feasibility of a chemical reaction in organic and inorganic substances
Competences:
- Predicted by different methodologies both inorganic and organic chemical reactions
- Evaluate the properties of natural and synthetic, and combustible materials</td></tr>
<tr><td>Content</td><td colspan="4">The matter. States of the matter's aggregation. The atom. Elements of periodic table. Link chemist - types of chemical bonds and Intermolecular forces. Chemistry Reaction. Stoichiometry. Acidity and basicity Solutions. Electrochemistry and its applications. Industrial Chemical Processes - inorganic and organic compounds.</td></tr>
<tr><td>Study and examination requirements and forms of examination</td><td colspan="4">- Practical / laboratory: preparations with review, functional projects, lab reports
- Lecture: partial quizzes and final written examination.</td></tr>
<tr><td>Media employed</td><td colspan="4">Blackboard, slides, beamer presentations, demonstration of lab examples and experiments, lab development tools and equipment.</td></tr>
<tr><td>Reading list</td><td colspan="4">- Chang, Raymond (2002) Química. México D.F.: McGraw-Hill (540/CH518/2007)
- Ebbing, Darrell (1997) Química General. México D.F.: McGraw-Hill. (540/E11).
- Gillespie, Ronald (1989) Chemistry. Boston: Allyn and Bacon (540/G39).
- Malone, Leo (1992) Introducción a la química. México D.F.: Limusa (540/M19).</td></tr>
</table>

Physics Module

<table>
<tr><td>Degree Program</td><td colspan="5">Plant Machinery Maintenance</td></tr>
<tr><td>Module designation</td><td colspan="5">Physics</td></tr>
<tr><td>Module level, if applicable</td><td colspan="5"></td></tr>
<tr><td>Code, if applicable</td><td colspan="5">MM-02</td></tr>
<tr><td rowspan="3">Courses and Semester(s) in which the module is taught</td><td colspan="2">Courses</td><td>ID</td><td colspan="2">Semester</td></tr>
<tr><td colspan="2">- Physics I</td><td>MG1010</td><td colspan="2">1</td></tr>
<tr><td colspan="2">- Physics II</td><td>MG2010</td><td colspan="2">2</td></tr>
<tr><td>Person responsible for the Module</td><td colspan="2">Lima
- Silvia Espinoza</td><td colspan="3">Arequipa
- Juan Carlos Grande</td></tr>
<tr><td>Lecturers</td><td colspan="2">Lima
- Silvia Espinoza
- Anwar Yarin
- Jerson Araos
- Nicolás Herencia
- Carlos Soca
- Penélope Vargas</td><td colspan="3">Arequipa
- Juan Carlos Grande
- Juan Yucra
- Juan Muñoz</td></tr>
<tr><td>Language</td><td colspan="5">Spanish</td></tr>
<tr><td>Relation to curriculum</td><td colspan="5">Compulsory</td></tr>
<tr><td>Type of teaching, contact hours</td><td colspan="5">Contact hours and class size separately for each teaching method: lecture, lesson, practical, project, seminar, etc.
<table>
<tr><th>Nr</th><th>Courses ID</th><th>Contact hours per week</th><th>Teaching Method</th><th>Class Size</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">MG1010</td><td>3.0</td><td>Lecture</td><td>40 students</td></tr>
<tr><td>1.5</td><td>Laboratory</td><td>20 students</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">MG2010</td><td>3.0</td><td>Lecture</td><td>40 students</td></tr>
<tr><td>1.5</td><td>Laboratory</td><td>20 students</td></tr>
</table></td></tr>
<tr><td>Workload</td><td colspan="5">(Estimated) workload, divided into contact hours (lecture, exercise, laboratory session, etc.) and private study, including examination preparation, specified in hours.
<table>
<tr><th>Nr</th><th>Courses</th><th>Contact Hours per week</th><th>Private Study per week</th><th>Semester Workload</th><th>ECTS Credits</th></tr>
<tr><td>1</td><td>MG1010</td><td>4.5</td><td>3.1</td><td>137</td><td>5</td></tr>
<tr><td>2</td><td>MG2010</td><td>4.5</td><td>3.6</td><td>146</td><td>5</td></tr>
</table></td></tr>
<tr><td>Requirements according to the examination regulations</td><td colspan="5">In order to pass each course of the module, student must obtain a minimal final grade of 11 (eleven). To compute the final grade, the fraction 0.5 or more is considered as a unit in favor the student. (Exam. Reg. 2013 Art. 21)</td></tr>
<tr><td>Recommended prerequisites</td><td colspan="5">Formal: None
Content: Elementary Mathematics knowledge, and computing skills</td></tr>
<tr><td>Module objectives/intended learning outcomes</td><td colspan="5">After having finished the module, students are able to:
Knowledge:
- Analyze and evaluate the application of the basic principles governing the phenomena of classical physics.
Skills:
- Apply the basic principles governing the phenomena of classical physics to specific situations and associated with real situations.
Competences:
- Reasoned argument in oral and written form, using scientific language correctly, on situations or problems related to the experimental sciences applied to your professional future.</td></tr>
<tr><td>Content</td><td colspan="5">Physics I: Thermometry. Expansion. Heat. Calorimetry. Phase change. Thermal balance. Heat transfer. Thermodynamics. Thermal expansion of solids. Thermodynamic processes. Zeroth law, first and second laws. Thermodynamic laws. Simple Harmonic Motion (SHM). Energy in SHM. Simple pendulum. Damped and forced movement. Mechanical resonance. Waves on a string. Melde's Experiment. Forced Harmonic Motion. Waves. Stationary waves. Sound. Doppler effect. Optics. Reflection, refraction of light. Geometrical Optics. Mirrors and lenses.

Physics II: Physical Magnitudes. Vectors. Sum of vectors. Components of vectors. Unit</td></tr>
</table>

	Vectors. Statics. Force. Newton's First and Third Laws. Free body diagrams. Representation of the forces existing in a body or system. Concurrent forces. First condition of equilibrium. Applications. Force or torque moment. Second condition of equilibrium. Kinematics. Uniform linear movement. Acceleration. Uniform linear motion with varied velocity. Free Fall. Gravity. Compound movement. Applications of circular movement. Dynamics. Newton's Second Law. Applications of dynamics. Friction. Friction in solids. Mechanical work. Power. Energy Conservation. Efficiency.
Study and examination requirements and forms of examination	- *Practical / laboratory: preparations with review, functional projects, lab reports* - *Lecture: partial quizzes and final written examination.*
Media employed	*Blackboard, slides, beamer presentations, demonstration of lab examples and experiments, lab development tools and equipment.*
Reading list	- Bueche Frederick J. (2007) Física General. México D.F.: McGraw-Hill (530/B88/2007) - Sears, Francis W. (2004). Física universitaria. México D.F.: McGraw-Hill (530/S31/2004) - Serway, Raymond A. (1998). Física. México D.F.: McGraw - Hill. (530/S42F)

Mathematics Module

<table>
<tr><td>Degree Program</td><td colspan="4">Plant Machinery Maintenance</td></tr>
<tr><td>Module designation</td><td colspan="4">Mathematics</td></tr>
<tr><td>Module level, if applicable</td><td colspan="4"></td></tr>
<tr><td>Code, if applicable</td><td colspan="4">MM-03</td></tr>
<tr><td rowspan="4">Courses and Semester(s) in which the module is taught</td><td colspan="2">Courses</td><td>ID</td><td>Semester</td></tr>
<tr><td colspan="2">- Mathematics I</td><td>GG1010</td><td>1</td></tr>
<tr><td colspan="2">- Mathematics II</td><td>GG2810</td><td>2</td></tr>
<tr><td colspan="2">- Applied Mathematics</td><td>MM3090</td><td>3</td></tr>
<tr><td>Person responsible for the Module</td><td colspan="2">Lima
- Gerald Cuzcano
- Nilton Anchayhua</td><td colspan="2">Arequipa
- Elmer Sierra</td></tr>
<tr><td>Lecturers</td><td colspan="2">Lima
- Gerald Cuzcano
- Xyoby Chávez
- Rafael Enciso
- José Fernández
- Alexander Peña
- Ernesto Zeña</td><td colspan="2">Arequipa
- Elmer Sierra
- Marco Cuentas
- Henry Torres
- Roberto Choquehuayta
- César Vera
- Jose Antonio Contreras</td></tr>
<tr><td>Language</td><td colspan="4">Spanish</td></tr>
<tr><td>Relation to curriculum</td><td colspan="4">Compulsory</td></tr>
<tr><td>Type of teaching, contact hours</td><td colspan="4">Contact hours and class size separately for each teaching method: lecture, lesson, practical, project, seminar, etc.
<table>
<tr><th>Nr</th><th>Courses ID</th><th>Contact hours per week</th><th>Teaching Method</th><th>Class Size</th></tr>
<tr><td>1</td><td>GG1010</td><td>6.0</td><td>Lecture</td><td>40 students</td></tr>
<tr><td>2</td><td>GG2810</td><td>6.0</td><td>Lecture</td><td>40 students</td></tr>
<tr><td>3</td><td>MM3090</td><td>3.0</td><td>Lecture</td><td>40 students</td></tr>
</table></td></tr>
<tr><td>Workload</td><td colspan="4">(Estimated) workload, divided into contact hours (lecture, exercise, laboratory session, etc.) and private study, including examination preparation, specified in hours.
<table>
<tr><th>Nr</th><th>Courses</th><th>Contact Hours per week</th><th>Private Study per week</th><th>Semester Workload</th><th>ECTS Credits</th></tr>
<tr><td>1</td><td>GG1010</td><td>6.0</td><td>3.3</td><td>167</td><td>6</td></tr>
<tr><td>2</td><td>GG2810</td><td>6.0</td><td>4.3</td><td>185</td><td>6</td></tr>
<tr><td>3</td><td>MM3090</td><td>3.0</td><td>5.0</td><td>136</td><td>5</td></tr>
</table></td></tr>
<tr><td>Requirements according to the examination regulations</td><td colspan="4">In order to pass each course of the module, student must obtain a minimal final grade of 11 (eleven). To compute the final grade, the fraction 0.5 or more is considered as a unit in favor the student. (Exam. Reg. 2013 Art. 21)</td></tr>
<tr><td>Recommended prerequisites</td><td colspan="4">Formal: None
Content: Elementary Mathematics skills</td></tr>
<tr><td>Module objectives/intended learning outcomes</td><td colspan="4">After having finished the module, students are able to:
Knowledge:
- Analyze situations using science and technology knowledge of analytic geometry, differential and integral calculus.
- Develop and use differential equations to solve problems of strength of materials, thermodynamics and fluid mechanics.
- Using discrete and continuous probability models, used mainly in solving maintenance problems.
Skills:
- Select and apply properties of differential and integral calculus to solve problems in science and technology.
Competences:
- Formulate possible solutions to problems of science and technology by analyzing and interpreting data results from the mathematical point of view.</td></tr>
<tr><td>Content</td><td colspan="4">Mathematics I: Equations and systems of equations. Cartesian plane. The equation of the straight line. Equation of the circumference. Equation of the parabola.</td></tr>
</table>

	Equation of the ellipse. Equation of the ellipse. Inequalities. Functions. Introduction to the calculus and to the limit concept. Indeterminate limits. Continuity of a function. Trigonometric functions. Trigonometric limits. Application of functions in Physics. Definition of the derivative of a function. Application of the derivative of a function. Derivatives of a function. Derivatives of some special functions and the chain rule. Implicit derivative. The antiderivative and the indefinite integral. Methods of integration: by parts and by algebraic substitution. Integration by trigonometric substitution. Methods of integration: By trigonometric substitution. Definite integral. Calculus of areas. ***Mathematics II**: Limits and continuity. Asymptotes and graphs of functions. Derivative and motion. Differentials. Maximum and minimum. Flat region area. Length of a curve. Surface of revolution. Center of mass. Application problems. Volume of solids. Descriptive statistics. Fundamentals. Data presentation. Distribution of frequencies. Graphs. Application problems. Data Description. Measures of central tendency. Application problems. Bivariate tables. Combinatory analysis. Probability of an event. Calculation of probabilities. Normal distribution of probabilities. Selection of a sample. Rubric: Case analysis on the application of statistical techniques.* ***Applied Mathematics**: Derivative: Applications as reason of change. Derivative: Application to determine maxima and minima in a function. Integrals: Applications to calculate gravity centers, inertia moments and areas. Integrals: Mechanical applications. Differential equations. Applications to thermodynamic laws. Differential equations. Applications to fluid mechanics. Differential equations: simple and damped harmonic motion. Fundamentals of statistics. Binomial and Poisson. Discrete probability distribution: Hypergeometric distribution. Continuous probability distribution: Weibull distribution. Analysis of the process capacity using a statistical control.*
Study and examination requirements and forms of examination	*Partial quizzes and final written examination.*
Media employed	*Blackboard, slides, beamer presentations, demonstration of lab examples and experiments, lab development tools and equipment.*
Reading list	- *Berman, Simon L. (1974). Calculus for the nonphysical science. New York: Richart and Winston. (515/B47)* - *Haeussler, Ernest F. (2008). Matemáticas para la administración y economía. México D.F.: Iberoamericana (510/H25/2008).* - *Larson, Ron (2006). Cálculo. México D.F: McGraw-Hill (515/L25).* - *Neuhauser, Claudia (2004). Matemáticas para ciencias. Madrid: Prentice Hall (510/N47M).* - *Pinzón, Álvaro (1973). Cálculo I - diferenrencial. México D.F.:Harla (515/P59).* - *Waner, Stefan (2002). Cálculo aplicado. Madrid: Paraninfo (515/W23).* - *Davis, Linda (1990). Technical mathematics with calculus. Ohio: Merrill (510/D32)* - *Johnson, Richard (1997) Probabilidad y estadística para ingenieros. México D.F.: Prentice Hall (519.2/J67)* - *Pareto, Luis (1985) Formulario de mecánica. Barcelona: CEAC S.A (620.1/P26F)*

Fundamentals of Electrical Technology Module

<table>
<tr><td>Degree Program</td><td colspan="5">Plant Machinery Maintenance</td></tr>
<tr><td>Module designation</td><td colspan="5">Fundamentals of Electrical Technology</td></tr>
<tr><td>Module level, if applicable</td><td colspan="5"></td></tr>
<tr><td>Code, if applicable</td><td colspan="5">MM-04</td></tr>
<tr><td rowspan="4">Courses and Semester(s) in which the module is taught</td><td colspan="2">Courses</td><td>ID</td><td colspan="2">Semester</td></tr>
<tr><td colspan="2">- Electricity</td><td>EG1010</td><td colspan="2">1</td></tr>
<tr><td colspan="2">- Electronics</td><td>AG2010</td><td colspan="2">2</td></tr>
<tr><td colspan="2">- Electrical workshop</td><td>EG1030</td><td colspan="2">1</td></tr>
<tr><td>Person responsible for the Module</td><td colspan="2">Lima
- Carlos Ortiz</td><td colspan="3">Arequipa
- Hernando Prada</td></tr>
<tr><td>Lecturers</td><td colspan="2">Lima
- Carlos Ortiz
- Dennis Chávarry
- Carlos Cuba
- César Santos</td><td colspan="3">Arequipa
- Danny Meza
- Midward Charaja
- Carlos Quilla
- Alonso Cornejo</td></tr>
<tr><td>Language</td><td colspan="5">Spanish</td></tr>
<tr><td>Relation to curriculum</td><td colspan="5">Compulsory</td></tr>
<tr><td>Type of teaching, contact hours</td><td colspan="5">Contact hours and class size separately for each teaching method: lecture, lesson, practical, project, seminar etc.
<table>
<tr><th>Nr</th><th>Courses ID</th><th>Contact hours per week</th><th>Teaching Method</th><th>Class Size</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">EG1010</td><td>2.0</td><td>Lecture</td><td>40 students</td></tr>
<tr><td>3.0</td><td>Laboratory</td><td>20 students</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">AG2010</td><td>2.0</td><td>Lecture</td><td>30 students</td></tr>
<tr><td>1.5</td><td>Practical</td><td>20 students</td></tr>
<tr><td rowspan="2">3</td><td rowspan="2">EG1030</td><td>0</td><td>Lecture</td><td>40 students</td></tr>
<tr><td>3</td><td>Workshop</td><td>20 students</td></tr>
</table></td></tr>
<tr><td>Workload</td><td colspan="5">(Estimated) workload, divided into contact hours (lecture, exercise, laboratory session, etc.) and private study, including examination preparation, specified in hours.
<table>
<tr><th>Nr</th><th>Courses</th><th>Contact Hours per week</th><th>Private Study per week</th><th>Semester Workload</th><th>ECTS Credits</th></tr>
<tr><td>1</td><td>EG1010</td><td>5.0</td><td>3.1</td><td>146</td><td>5</td></tr>
<tr><td>2</td><td>AG2010</td><td>3.5</td><td>3.0</td><td>117</td><td>5</td></tr>
<tr><td>3</td><td>EG1030</td><td>3</td><td>1.98</td><td>85</td><td>3</td></tr>
</table></td></tr>
<tr><td>Requirements according to the examination regulations</td><td colspan="5">In order to pass each course of the module, student must obtain a minimal final grade of 11 (eleven). To compute the final grade, the fraction 0.5 or more is considered as a unit in favor the student. (Exam. Reg. 2013 Art. 21)</td></tr>
<tr><td>Recommended prerequisites</td><td colspan="5">Formal: None
Content: Elementary Mathematics knowledge</td></tr>
<tr><td>Module objectives/intended learning outcomes</td><td colspan="5">After having finished the module, students are able to:
Knowledge:
- Recognize constituent parts in dc and ac electrical circuits and electrical machines.
- Recognize parameters and operation principles of single-phase and three-phase electrical systems.
- Select appropriate electrical conductors, in low voltage installations.
Skills:
- Evaluate electrical parameters and analyze their behavior using equivalent circuit, phasorial calculation and computer applications.
- Select and install the control components of commercial and industrial use.
Competences:
- Install basic electrical circuits and analyze the behavior of electrical parameters in operational or fault conditions, using measuring instruments and performing security procedures.</td></tr>
</table>

	- *Install control components of commercial and industrial use, using procedures and electrical norms.*
Content	***Electricity**: Fundamental parameters of Electricity. Matter, atom, electrical charge, voltage generation. Electrical circuits. Voltage. Resistance. Electrical current. Fundamental Laws. Ohm's Law. Second and first Kirchoff's law. Power, energy and efficiency. Electrical Power. Efficiency. Electrical energy. Charge diagram. Magnetic field and electric field. Electromagnetism. Alternating current. Sinusoidal wave. Ohm's law in AC. Series AC circuit. Parallel AC circuit. Power in AC. Active power. Reactive power. Apparent power. Three-phase circuits. Star connection. Triangle connection. Three-phase power. Electrical protection. Fuses. Thermomagnetic. Differentials.* ***Electronics**: Introduction to Electronics. Semiconductor diodes. Application of semiconductor diodes. DC voltage sources. Basic calculations in a DC voltage source The bipolar transistor. Basic calculations in the BJT transistor. Thyristors. Optoelectronics. Integrated circuits. Digital Logics and Circuits. Industrial Digital Systems.* ***Electrical Workshop**: Basic operations with electrical conductors. Electrical conductors. Basic Tools Splices with solid conductors. Pig-tail splices. Tap splices. Splices with connectors. Splices with terminals. Application of welding in electrical splices. Connections and insulation of conductors. Taping of splices. Visible electrical installation. Installation of raceways. Installation of a distribution board. Installation of thermomagnetic switches and differential relays. Installation and wiring of switches with ground fault protection. Semi-visible electrical installations with PVC pipes. Embedded electrical installation. Installation of relays in control circuits. Installation of a control circuit with photoelectric detector. Installation of the direct starting mechanism, with contactor. Installation of a communication system.*
Study and examination requirements and forms of examination	- *Practical / laboratory: preparations with review, functional projects, lab reports* - *Lecture: partial quizzes and final written examination.*
Media employed	*Blackboard, slides, beamer presentations, demonstration of lab examples and experiments, lab development tools and equipment.*
Reading list	- *Alcalde San Miguel, Pablo.(1998) Electrotecnia. Equipos e instalaciones electrotécnicas. Madrid: Paraninfo. (621.3 /A35).* - *Dorf, Richard C. (2006) Circuitos eléctricos. México D.F.: Alfaomega. (621.3C / D92C).* - *García Trasancos, José (1998) Electrotecnia. Barcelona: Reverté. (621.3/G25E).* - *Mileaf, Harry (1989) Curso práctico de electricidad. Vol. 1. México D.F.: Ciencia y Técnica. (621.3/M57/v.1)* - *Mileaf, Harry (1989) Curso práctico de electricidad. Vol. 2. México D.F.: Ciencia y Técnica. (621.3/M57/v.2)* - *Boylestad, Robert L. (2003). Electrónica: Teoría de circuitos. México D.F.: Prentice Hall (621.381/B78/2003.)* - *Floyd, Thomas (2006) Dispositivos electrónicos. Mexico D.F..Limusa (621.381/F59D).* - *Floyd, Thomas (2006) Fundamentos de sistemas digitales. New Jersey.Pearson Prentice Hall (621.381/F59).* - *Malvino, Albert Paul (2000) Principios de electrónica. Madrid: McGraw-Hill. (621.381/M19/2000).* - *Savant, C.J. (1992) Diseño electrónico.Circuitos y sistemas. Wilmington: Addison Wesley (621.381C/S25).* - *Camarena, Pedro. (1988). Manual práctico para instaladores y montadores electricistas. México D.F.: Continental (621.3I/C22M)* - *Cultural (1995). Guía práctica de electricidad y electrónica. Madrid: Cultural (621.3EE/C/t.1), (621.3EE/C/t.2), (621.3EE/C/t.3)* - *Foley, Joseph. (1983) Fundamentos de instalaciones eléctricas. México D.F. : McGraw - Hill. (621.3I/F72)* - *Irwin, David J. (2008). Análisis básico de circuitos en ingeniería. México D.F.: Prentice Hall (621.3C/I76/2008)*

	- *Lagunas Marquez, Angel. (1999). Instalaciones eléctricas de baja tensión comerciales e industriales. Madrid: Paraninfo (621.3I/L17I)* - *Martínez Domínguez, Fernando. (1999). Instalaciones eléctricas de alumbrado e industriales. Madrid: Paraninfo (621.3I/M26)* - *PROCOBRE (1996). Uso del cobre. Instalaciones eléctricas. Santiago de Chile: s.n. (621.3I / P/U-C)* - *Richter, H.P. (1989) Manual práctico de instalaciones eléctricas: domésticas, granjas e industrias. México D.F.: Continental. (621.3I/R54)*

Values and Culture Module

<table>
<tr><td>Degree Program</td><td colspan="5">Plant Machinery Maintenance</td></tr>
<tr><td>Module designation</td><td colspan="5">Values and Culture</td></tr>
<tr><td>Module level, if applicable</td><td colspan="5"></td></tr>
<tr><td>Code, if applicable</td><td colspan="5">MM-05</td></tr>
<tr><td rowspan="3">Courses and Semester(s) in which the module is taught</td><td colspan="3">Courses</td><td>ID</td><td>Semester</td></tr>
<tr><td colspan="3">- Attitudes and Values</td><td>GG1030</td><td>1</td></tr>
<tr><td colspan="3">- National and International Reality</td><td>GG2030</td><td>2</td></tr>
<tr><td>Person responsible for the Module</td><td colspan="3">Lima
- Enit Vivanco</td><td colspan="2">Arequipa
-Karina Salas</td></tr>
<tr><td>Lecturers</td><td colspan="3">Lima
- Enit Vivanco
- Luisa Palomino
- Pedro Flores</td><td colspan="2">Arequipa
- José Lima
- Karina Salas</td></tr>
<tr><td>Language</td><td colspan="5">Spanish</td></tr>
<tr><td>Relation to curriculum</td><td colspan="5">Compulsory</td></tr>
<tr><td>Type of teaching, contact hours</td><td colspan="5">Contact hours and class size separately for each teaching method: lecture, lesson, practical, project, seminar, etc.
<table>
<tr><th>Nr</th><th>Courses ID</th><th>Contact hours per week</th><th>Teaching Method</th><th>Class Size</th></tr>
<tr><td>1</td><td>GG1030</td><td>2.0</td><td>Lecture</td><td>40 students</td></tr>
<tr><td>2</td><td>GG2030</td><td>2.0</td><td>Lecture</td><td>40 students</td></tr>
</table></td></tr>
<tr><td>Workload</td><td colspan="5">(Estimated) workload, divided into contact hours (lecture, exercise, laboratory session, etc.) and private study, including examination preparation, specified in hours.
<table>
<tr><th>Nr</th><th>Courses</th><th>Contact Hours per week</th><th>Private Study per week</th><th>Semester Workload</th><th>ECTS Credits</th></tr>
<tr><td>1</td><td>GG1030</td><td>2.0</td><td>1.4</td><td>61</td><td>2</td></tr>
<tr><td>2</td><td>GG2030</td><td>2.0</td><td>1.3</td><td>59</td><td>2</td></tr>
</table></td></tr>
<tr><td>Requirements according to the examination regulations</td><td colspan="5">In order to pass each course of the module, student must obtain a minimal final grade of 11 (eleven). To compute the final grade, the fraction 0.5 or more is considered as a unit in favor the student. (Exam. Reg. 2013 Art. 21)</td></tr>
<tr><td>Recommended prerequisites</td><td colspan="5">Formal: None
Content: None</td></tr>
<tr><td>Module objectives/intended learning outcomes</td><td colspan="5">After having finished the module, students are able to:
Knowledge:
- Recognize the importance of the practice of values, cultural diversity and develop a personal life plan.
- Analyze the components of national and international reality and proposes alternative solutions to the cyclical problem, based on ethical and moral principles that contribute to the development of society.
Skills:
- Value himself, recognize their emotions and feelings, and making decisions assuming a positive attitude, and an active and responsible behavior.
- Interpret and analyze problems of socio-cultural, economic and political reality at national and international levels, identifying potential opportunities in Peru and its insertion in the world market.
Competences:
- Display a positive attitude towards values, recognize and accept its culture, respect the diversity of its environment.
- Analyze the current situations in the components: political, economic, social and cultural, assuming a critical and reflective attitude on the national and international reality.</td></tr>
<tr><td>Content</td><td colspan="5">Attitudes and Values: Academic regulations and rules guiding the institution. Study methods and habits. Values, positive attitudes, anti-values and consequences. Self-esteem. Personal Image. Decision-making. Cultural diversity, interculturality. Rubric – Analysis of presentations proposed in order that students can recognize and accept their culture and respect the diversity. Anxiety, tension, stress and self-control techniques. Intelligent behaviour, emotional intelligence. Thought, cognitive skills</td></tr>
</table>

	Memory and learning. Life Plan. Courtesy rules. Leadership. ***National and International Reality**: National and international reality. Spatial reality. Ecology and environment. Organization of group assignments. Spatial reality. Peruvian territory. Spatial reality. National and international geo-strategy and geo-politics. Social reality. National cultural diversity. Transnational migratory process. Rubric – Analysis of the migratory process. Social reality. National identity. Social reality. Worldwide perception of Peru. Political reality. Peruvian State: Political and administrative organization. Evaluation of research progress. Political reality. Peruvian decentralization process. Democracy and political parties. Economic reality. Peruvian economic model. International economic blocks. Business Outlook in Peru. Social responsibility. Economic reality: Peru as a possibility. Productive clusters and holding. Development of micro, small and medium business in Peru.*
Study and examination requirements and forms of examination	*Lecture: partial quizzes and final written examination.*
Media employed	*Blackboard, slides, beamer presentations, demonstration of lab examples and experiments, lab development tools and equipment.*
Reading list	- *Berumen de los Santos, Nora María (2001). Ética del ejercicio profesional. México D.F.: Continental (179.9/B45)* - *Gomez, María Teresa (1997). Cómo educar en valores. Madrid: s.n. (179.9/G62)* - *Olcese Salvatecci, Alfieri (2002). Cómo estudiar con éxito: Técnicas y hábitos para aprender mejor. México D.F.: Alfaomega (371.302/O21)* - *Rodriguez Estrada, Mauro (2006). Aprendizaje creativo continuo. Cuando aprender es emprender. México D.F.: Trillas (370.157/R75)* - *Towers, Marc (2006). Venza a su peor enemigo: Autoestima. Madrid: Fundación Confemetal (155.2/T77)* - *Agenda Perú, Caretas y PUCP (2001) Los 50 y tantos libros que todo peruano culto debe leer. Lima: Caretas: PUCP.* - *Contreras, Carlos (2000). Historia del Perú Contemporáneo. Lima: Instituto de Estudios Peruano. (985/C81)* - *Matos Mar, José (2005). Desborde popular y crisis del estado, veinte años después. Lima: s.n. (306.2/M28)* - *Raich, Mario (2008). Más allá. Empresa y sociedad en transformación. Lima: Tecsup. (658.3A/R18)* - *Soto, Hernando de (2000). El ministerio del capital. Porqué el capitalismo triunfa en occidente y fracasa en el resto del mundo. (330.122/S71)*

Communications Module

<table>
<tr><td>Degree Program</td><td colspan="4">Plant Machinery Maintenance</td></tr>
<tr><td>Module designation</td><td colspan="4">Communications</td></tr>
<tr><td>Module level, if applicable</td><td colspan="4"></td></tr>
<tr><td>Code, if applicable</td><td colspan="4">MM-06</td></tr>
<tr><td rowspan="4">Courses and Semester(s) in which the module is taught</td><td colspan="2">Courses</td><td>ID</td><td>Semester</td></tr>
<tr><td colspan="2">- Communications I</td><td>GG1020</td><td>1</td></tr>
<tr><td colspan="2">- Communications II</td><td>GG2820</td><td>2</td></tr>
<tr><td colspan="2">- Successful Presentations</td><td>GG2910</td><td>3</td></tr>
<tr><td>Person responsible for the Module</td><td colspan="2">Lima
- Elisa Montoya</td><td colspan="2">Arequipa
- Deysi Flores</td></tr>
<tr><td>Lecturers</td><td colspan="2">Lima
- Elisa Montoya
- Susan Cuentas
- Mónica Jiménez
- Miguel Ortiz
- Julia Torres</td><td colspan="2">Arequipa
- Deysi Flores
- Manuel Linares
- David Rondon
- Sandra Romaní.</td></tr>
<tr><td>Language</td><td colspan="4">Spanish</td></tr>
<tr><td>Relation to curriculum</td><td colspan="4">Compulsory</td></tr>
<tr><td>Type of teaching, contact hours</td><td colspan="4">Contact hours and class size separately for each teaching method: lecture, lesson, practical, project, seminar, etc.
<table>
<tr><th>Nr</th><th>Courses ID</th><th>Contact hours per week</th><th>Teaching Method</th><th>Class Size</th></tr>
<tr><td>1</td><td>GG1020</td><td>6.0</td><td>Lecture</td><td>40 students</td></tr>
<tr><td>2</td><td>GG2820</td><td>5.0</td><td>Lecture</td><td>40 students</td></tr>
<tr><td>3</td><td>GG2910</td><td>2.0</td><td>Lecture</td><td>40 students</td></tr>
</table></td></tr>
<tr><td>Workload</td><td colspan="4">(Estimated) workload, divided into contact hours (lecture, exercise, laboratory session, etc.) and private study, including examination preparation, specified in hours.
<table>
<tr><th>Nr</th><th>Courses</th><th>Contact Hours per week</th><th>Private Study per week</th><th>Semester Workload</th><th>ECTS Credits</th></tr>
<tr><td>1</td><td>GG1020</td><td>6.0</td><td>1.6</td><td>137</td><td>4</td></tr>
<tr><td>2</td><td>GG2820</td><td>5.0</td><td>1.8</td><td>122</td><td>4</td></tr>
<tr><td>3</td><td>GG2910</td><td>2.0</td><td>1.4</td><td>61</td><td>2</td></tr>
</table></td></tr>
<tr><td>Requirements according to the examination regulations</td><td colspan="4">In order to pass each course of the module, student must obtain a minimal final grade of 11 (eleven). To compute the final grade, the fraction 0.5 or more is considered as a unit in favor the student. (Exam. Reg. 2013 Art. 21)</td></tr>
<tr><td>Recommended prerequisites</td><td colspan="4">Formal: None
Content: Entry-level skills in communication and computing skills</td></tr>
<tr><td>Module objectives/intended learning outcomes</td><td colspan="4">After having finished the module, students are able to:
Knowledge:
- Categorize and interpret ideas, data and explicit and implicit concepts in a text given the context in which it was generated and in which it was received.
- Base his opinion with clarity, fluency and coherence using verbal and non-verbal resources.
- Produce texts according to the specific purpose of each communication.
Skills:
- Build different types of texts.
- Select the appropriate type of argument to support their position.
- Discriminate the relevant from the complement of any text.
Competences:
- Communicate in oral or written form the themes of his profession with informative and argumentative base, applying appropriate resources to facilitate the expression of speech in specialized and non-specialized audiences.</td></tr>
<tr><td>Content</td><td colspan="4">Communication I: Human communication and information in contemporary</td></tr>
</table>

	society. Reading as a tool for communication. Text analysis: organization and integration of the text. Annotations and concept maps Bibliographical citations. APA format. Writing technical reports. Spelling rules. Capitalization. General accentuation. Special cases of accentuation. Diacritical marks. Sentence. Punctuation marks. Connectors. Paragraph. Condensed description. E-mail. Commercial writing. Communicating orally through the speech. Oral communication. ***Communication II**: Communication in organizations. Assertive communication and characteristics. Techno scientific language. Technical description of the workshop. Reading comprehension. Writing. Reading comprehension. Text production. Oral comprehension and expression. Types of discussion. Argumentation as a foundation for controversy and discussion. Argumentative presentation. Administrative writing.* ***Successful presentations**: Competences in-demand today. The first contact. Individual and shared presentations. The psychological preparation. Stage fright. Presentation design. Preparation of training designs. How to improve your behaviour when you give a presentation. Emphasis and motivation in presentations. Self-confidence. Use of techniques. Presentation of techniques. Audiovisual aids. Institutional presentation. Institutional presentation. Communication styles. Formal aspects of conferences. Criteria to evaluate presentations before an audience. Presentation of topics assigned using appropriate techniques.*
Study and examination requirements and forms of examination	- *Practical: oral presentations* - *Lecture: partial quizzes and final written examination.*
Media employed	*Blackboard, slides, beamer presentations, demonstration of lab examples and experiments, lab development tools and equipment.*
Reading list	- *AGUIRRE, Mauricio y ESTRADA, Christian. (2007). Redactar en la universidad. Conceptos y técnicas fundamentales. Lima: UPC.BUSTOS, Juan. (2005). A escribir se aprende escribiendo. Madrid: Comunidad de Madrid Consejería de Educación.CHOMSKY, Noam. (2006). Nuestro conocimiento del lenguaje humano. Santiago de Chile: Edición Bilingüe.CLAVIJO Olarte, Amparo. (2006). Prácticas innovadoras de lectura y escritura. Bogotá: Universidad Distrital Francisco José de Caldas.REAL ACADEMIA ESPAÑOLA. (2010) Ortografía de la lengua española. Madrid: Espasa.* - *AGUIRRE, Mauricio y ESTRADA, Christian. (2007). Redactar en la universidad. Conceptos y técnicas fundamentales. Lima: UPC.* - *BUSTOS, Juan. (2005). A escribir se aprende escribiendo. Madrid: Comunidad de Madrid Consejería de Educación.* - *CHOMSKY, Noam. (2006). Nuestro conocimiento del lenguaje humano. Santiago de Chile: Edición Bilingüe.* - *CLAVIJO Olarte, Amparo. (2006). Prácticas innovadoras de lectura y escritura. Bogotá: Universidad Distrital Francisco José de Caldas* - *REAL ACADEMIA ESPAÑOLA. (2010) Ortografía de la lengua española. Madrid: Espasa.* - *Del Pozo Delgado, Pilar. (2007) Formación de formadores. Madrid: Pirámide (658.3124/D49)* - *Robbins, Stephen P. (2004) Comportamiento organizacional. Mexico D.F.: Pearson Education. (658.3A/R71).* - *Schermerhorn, John R. (2006). Administración. Mexico D.F.: Limusa. (658.3A/S29)*

Quality and Safety Module

<table>
<tr><td>Degree Program</td><td colspan="5">Plant Machinery Maintenance</td></tr>
<tr><td>Module designation</td><td colspan="5">Quality and Safety</td></tr>
<tr><td>Module level, if applicable</td><td colspan="5"></td></tr>
<tr><td>Code, if applicable</td><td colspan="5">MM-07</td></tr>
<tr><td rowspan="3">Courses and Semester(s) in which the module is taught</td><td colspan="3">Courses</td><td>ID</td><td>Semester</td></tr>
<tr><td colspan="3">- Continuous Improvement</td><td>GG3020</td><td>3</td></tr>
<tr><td colspan="3">- Safety, Health and Environment</td><td>GG4010</td><td>4</td></tr>
<tr><td>Person responsible for the Module</td><td colspan="3">Lima
- Luis Peña</td><td colspan="2">Arequipa
- Alberto Ochoa</td></tr>
<tr><td>Lecturers</td><td colspan="3">Lima
- Luis Peña
- Segundo Jiménez</td><td colspan="2">Arequipa
- Alberto Ochoa
- José Pauca</td></tr>
<tr><td>Language</td><td colspan="5">Spanish</td></tr>
<tr><td>Relation to curriculum</td><td colspan="5">Compulsory</td></tr>
<tr><td>Type of teaching, contact hours</td><td colspan="5">Contact hours and class size separately for each teaching method: lecture, lesson, practical, project, seminar, etc.
<table>
<tr><th>Nr</th><th>Courses ID</th><th>Contact hours per week</th><th>Teaching Method</th><th>Class Size</th></tr>
<tr><td>1</td><td>GG3020</td><td>2.0</td><td>Lecture</td><td>40 students</td></tr>
<tr><td>2</td><td>GG4010</td><td>4.0</td><td>Lecture</td><td>40 students</td></tr>
</table></td></tr>
<tr><td>Workload</td><td colspan="5">(Estimated) workload, divided into contact hours (lecture, exercise, laboratory session, etc.) and private study, including examination preparation, specified in hours.
<table>
<tr><th>Nr</th><th>Courses</th><th>Contact Hours per week</th><th>Private Study per week</th><th>Semester Workload</th><th>ECTS Credits</th></tr>
<tr><td>1</td><td>GG3020</td><td>2.0</td><td>1.3</td><td>59</td><td>2</td></tr>
<tr><td>2</td><td>GG4010</td><td>4.0</td><td>2.1</td><td>110</td><td>3</td></tr>
</table></td></tr>
<tr><td>Requirements according to the examination regulations</td><td colspan="5">In order to pass each course of the module, student must obtain a minimal final grade of 11 (eleven). To compute the final grade, the fraction 0.5 or more is considered as a unit in favor the student. (Exam. Reg. 2013 Art. 21)</td></tr>
<tr><td>Recommended prerequisites</td><td colspan="5">Formal: None
Content: Basic Statistics knowledge and computing skills</td></tr>
<tr><td>Module objectives/intended learning outcomes</td><td colspan="5">After having finished the module, students are able to:
Knowledge:
- Design basic model of continuous improvement and quality´s system
- Design basic structure of security, healthy and environment´s system
Skills:
- Use tools for continuous improvement of quality
- Use tools for evaluate personal and environment of risk
Competences:
- Propose, implement and evaluate the improvement actions in the quality´s system
- Evaluate the risks present in the workplace and suggests control measures</td></tr>
<tr><td>Content</td><td colspan="5">Continuous Improvement: Principles and foundations of quality. Foundations for continuous improvement. Methodology of operational excellence. Building understanding. Measurement and analysis. Generating solutions. Improving and controlling. Creating institutions. Continuous Improvement – Kaizen. Problem resolution methodology. Projects of improvement. ISO 9000: 2000 Standards Series. Integrated management systems. Rubric – Case analysis: Application of continuous improvement at a corporation. Implementation of a quality management model.

Safety, Health and Environment: Prevention of labor risks. Industrial safety. Prevention of labor risks. Industrial hygiene. Environment and Industrial Social Responsibility. Systems of health, safety and environment management and social responsibility. Regulations on health, safety and environment. Electrical hazards and risks of hydrocarbons. Identification of hazards, evaluation and risk control. Control of risks to health and safety. Personal protection equipment. Environmental risks control. Preparation for emergencies. Prevention and control of spillages and fire. Preparation for emergencies. First aids.</td></tr>
</table>

Study and examination requirements and forms of examination	*Lecture: partial quizzes, assignments and final written examination.*
Media employed	*Blackboard, slides, beamer presentations, demonstration of lab examples and experiments, lab development tools and equipment.*
Reading list	- *Crosby, Philip B (2001) La calidad no cuesta: El arte de cerciorarse de la calidad. México D.F.: Continental (658.562/C91C)* - *Gutierrez Pulido, Humberto (2005). Calidad total y productividad. México D.F.: McGraw-Hill (658.562/G96P)* - *Imai, Masaki (1992). Kaizen, México D.F.: Continental (658.562/I41)* - *Imai, Masaki (1998) Cómo interpretar el Kaizan en el sitio de trabajo. Bogotá. Mc Graw-Hill (658.562/I4)* - *Polya, G. (2004). How to solve it. A new aspect of mathematical method. New Jersey / Princeton University Press (511/P75)* - *Grimaldi, John V. (1991) Manual de seguridad industrial. Bogotá: Alfaomega. (620.86/G82M)* - *Letayf, Jorge (1998). Seguridad, higiene y control ambiental. México D.F.: Mc Graw-Hill. (658.2/L52)* - *Ramírez Cavassa, César (2007). Seguridad industrial. Un enfoque integral. México D.F: Limusa. (620.86/R22)*

Basic English Module

<table>
<tr><td>Degree Program</td><td colspan="5">Plant Machinery Maintenance</td></tr>
<tr><td>Module designation</td><td colspan="5">Basic English</td></tr>
<tr><td>Module level, if applicable</td><td colspan="5"></td></tr>
<tr><td>Code, if applicable</td><td colspan="5">MM-08</td></tr>
<tr><td rowspan="3">Courses and Semester(s) in which the module is taught</td><td colspan="2">Courses</td><td>ID</td><td colspan="2">Semester</td></tr>
<tr><td colspan="2">- English I</td><td>GG5010</td><td colspan="2">5</td></tr>
<tr><td colspan="2">- English II</td><td>GG6010</td><td colspan="2">6</td></tr>
<tr><td>Person responsible for the Module</td><td colspan="2">Lima
- Milton Chuquiruna</td><td colspan="3">Arequipa
- Julio Monjaras</td></tr>
<tr><td>Lecturer</td><td colspan="2">Lima
- Milton Chuquiruna</td><td colspan="3">Arequipa
- Julio Monjaras</td></tr>
<tr><td>Language</td><td colspan="5">English</td></tr>
<tr><td>Relation to curriculum</td><td colspan="5">Compulsory</td></tr>
<tr><td>Type of teaching, contact hours</td><td colspan="5">Contact hours and class size separately for each teaching method: lecture, lesson, practical, project, seminar, etc.
<table>
<tr><th>Nr</th><th>Courses ID</th><th>Contact hours per week</th><th>Teaching Method</th><th>Class Size</th></tr>
<tr><td>1</td><td>GG5010</td><td>6.0</td><td>Lecture</td><td>40 students</td></tr>
<tr><td>2</td><td>GG6010</td><td>6.0</td><td>Lecture</td><td>40 students</td></tr>
</table></td></tr>
<tr><td>Workload</td><td colspan="5">(Estimated) workload, divided into contact hours (lecture, exercise, laboratory session, etc.) and private study, including examination preparation, specified in hours.
<table>
<tr><th>Nr</th><th>Courses</th><th>Contact Hours per week</th><th>Private Study per week</th><th>Semester Workload</th><th>ECTS Credits</th></tr>
<tr><td>1</td><td>GG5010</td><td>6.0</td><td>1.6</td><td>137</td><td>4</td></tr>
<tr><td>2</td><td>GG6010</td><td>6.0</td><td>1.7</td><td>139</td><td>4</td></tr>
</table></td></tr>
<tr><td>Requirements according to the examination regulations</td><td colspan="5">In order to pass each course of the module, student must obtain a minimal final grade of 11 (eleven). To compute the final grade, the fraction 0.5 or more is considered as a unit in favor the student. (Exam. Reg. 2013 Art. 21)</td></tr>
<tr><td>Recommended prerequisites</td><td colspan="5">Formal: None
Content: Entry-level skills in communication</td></tr>
<tr><td>Module objectives/intended learning outcomes</td><td colspan="5">After having finished the module, students are able to:
Knowledge:
- Identify and effectively use basic English structures in order to read, interpret and translate texts on general topics of increasing complexity.
Skills:
- Establish basic communication in English in oral and written form.
- Understanding and interpreting basic general English texts.
Competences:
- Read, translate and interpret English texts on basic general topics.
- Speaking in basic form using simple grammatical structures of English.</td></tr>
<tr><td>Content</td><td colspan="5">English I: People and places. You and yours. Everyday life. Loves and hates. Getting from A to B. Eating and drinking. Extraordinary lives. Fact or fiction. Buying and selling. Keeping in touch. Going places. Street life.

English II: The world around us. A weekend away. Learning for the future. Leisure and lifestyle. Important firsts. At rest, at work. Special occasions. Appearances. Time off. Ambitions and dreams. Countries and cultures. Old and new. Take Care</td></tr>
<tr><td>Study and examination requirements and forms of examination</td><td colspan="5">Lecture: partial quizzes, oral and written assignments and final written examination.</td></tr>
<tr><td>Media employed</td><td colspan="5">Blackboard, slides, beamer presentations, demonstration of lab examples and experiments, lab development tools and equipment.</td></tr>
<tr><td>Reading list</td><td colspan="5">- Cutting Edge - Students´ Book, Workbook, Students´.
- Resource Bank, Mini-Dictionary and Student CD. Sarah.
- Cunningham & Moor Peter with Frances Eales.</td></tr>
</table>

Management Module

<table>
<tr><td>Degree Program</td><td colspan="5">Plant Machinery Maintenance</td></tr>
<tr><td>Module designation</td><td colspan="5">Management</td></tr>
<tr><td>Module level, if applicable</td><td colspan="5"></td></tr>
<tr><td>Code, if applicable</td><td colspan="5">MM-09</td></tr>
<tr><td rowspan="3">Courses and Semester(s) in which the module is taught</td><td colspan="3">Courses</td><td>ID</td><td>Semester</td></tr>
<tr><td colspan="3">- Project Management</td><td>GG5020</td><td>5</td></tr>
<tr><td colspan="3">- Business Management</td><td>GG6020</td><td>6</td></tr>
<tr><td>Person responsible for the Module</td><td colspan="3">Lima
- Edwin Ramos</td><td colspan="2">Arequipa
- José Rojas</td></tr>
<tr><td>Lecturers</td><td colspan="3">Lima
- Edwin Ramos
- Luis Peña</td><td colspan="2">Arequipa
- José Rojas
- José Lima</td></tr>
<tr><td>Language</td><td colspan="5">Spanish</td></tr>
<tr><td>Relation to curriculum</td><td colspan="5">Compulsory</td></tr>
<tr><td>Type of teaching, contact hours</td><td colspan="5">Contact hours and class size separately for each teaching method: lecture, lesson, practical, project, seminar, etc.
<table>
<tr><th>Nr</th><th>Courses ID</th><th>Contact hours per week</th><th>Teaching Method</th><th>Class Size</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">GG5020</td><td>2.0</td><td>Lecture</td><td>40 students</td></tr>
<tr><td>1.0</td><td>Laboratory</td><td>20 students</td></tr>
<tr><td>2</td><td>GG6020</td><td>2.0</td><td>Lecture</td><td>40 students</td></tr>
</table></td></tr>
<tr><td>Workload</td><td colspan="5">(Estimated) workload, divided into contact hours (lecture, exercise, laboratory session, etc.) and private study, including examination preparation, specified in hours.
<table>
<tr><th>Nr</th><th>Courses</th><th>Contact Hours per week</th><th>Private Study per week</th><th>Semester Workload</th><th>ECTS Credits</th></tr>
<tr><td>1</td><td>GG5020</td><td>3.0</td><td>2.3</td><td>95</td><td>3</td></tr>
<tr><td>2</td><td>GG6020</td><td>2.0</td><td>3.2</td><td>94</td><td>3</td></tr>
</table></td></tr>
<tr><td>Requirements according to the examination regulations</td><td colspan="5">In order to pass each course of the module, student must obtain a minimal final grade of 11 (eleven). To compute the final grade, the fraction 0.5 or more is considered as a unit in favor the student. (Exam. Reg. 2013 Art. 21)</td></tr>
<tr><td>Recommended prerequisites</td><td colspan="5">Formal: None
Content: Quality tools, communication and computing skills</td></tr>
<tr><td>Module objectives/intended learning outcomes</td><td colspan="5">After having finished the module, students are able to:
Knowledge:
- Develop, plan, organize and manage human and material resources in a project.
- Plans, organize, direct and control the human and material resources of a business.
Skills:
- Use modern theories and methodologies for managing resources of a business
Competences:
- Apply concepts and methodologies in the management of resources in an industrial and / or services business.</td></tr>
<tr><td>Content</td><td colspan="5">Project Management: Fundamental concepts related to projects. Identification of problems and improvement opportunities. Market research. Sales and incomes budget. Project engineering. Introduction to costs. Calculation of costs using proposed exercises. Sensitivity analysis – Differential costs. Laboratory costs. Budget of costs and investment. Expenses budget. Projected Financial statements. Projected cash flow. Financial assessment. Financial assessment. Planning the implementation. Diagrams. Planning the implementation: RED PERT-CPM. Follow-up and closing. Other project approaches. Real cases of improvement projects.

Business Management: Administrative process. Strategic planning. Organizational structure. Legal and tax aspects of a business. Group case 1. Starting up a business</td></tr>
</table>

	Sales projection. Industrial marketing strategies. Aggregate planning. Production programming. Launching and production control. Rubric – Planning, programming and controlling the production in a business unit. Purchases, stocks and storage. Financial statements analysis. Administrative , operational and financial operators Stocks and financial operations. Rubric. Calculation and definition of cost in a business unit. Cost-volume-profit model. Financial analysis
Study and examination requirements and forms of examination	- *Practical / laboratory: preparations with review, functional projects, lab reports and oral presentations* - *Lecture: partial quizzes and final written examination.*
Media employed	*Blackboard, slides, beamer presentations, demonstration of lab examples and experiments, lab development tools and equipment.*
Reading list	- *Amat, Joan María (2002) Control presupuestario. Barcelona: Gestión 2000. (658.1G/A52C).* - *Colmenar Santos, Antonio (2007). Gestión de proyectos con Microsoft Project 2007. México D.F.: Alfaomega (005.368PR/C75)* - *Domingo Ajenjo, Alberto (2005). Dirección y gestión de proyectos. Un enfoque práctico. México D.F.: Alfaomega - Rama (658.404/A33)* - *Gido, Jack (1999) Administración exitosa de proyectos. México D.F.: s.n. (658.404/G44)* - *Project Management Institute (2008). A guide to the project management body of knowledge: (PMBOK Guide). Atlanta: Project Management Institute (658.404/P87/2008)* - *Chase, Richard (2000) Administración de producción y operaciones. Manufactura y servicios. Bogotá: Mc Graw - Hill. (658.5P/CH526A)* - *Kotler, Philip (2006). Dirección de marketing. México D.F.: Pearson Educación (658.8/K11).* - *Porter, Michael E. (1997) Estrategia competitiva. Técnicas para el análisis de los sectores industriales y de la competencia. México D.F.: Continental. (658.1G/P78)* - *Ross, Stephen (2006) Fundamentos de finanzas corporativas. México D.F.: McGraw-Hill (658.15/R84)* - *Schermerhorn, John R. (2006) Administración. México D.F.: Limusa (658.3A/S29).*

Human Resources and Labor Market Module

<table>
<tr><td>Degree Program</td><td colspan="5">Plant Machinery Maintenance</td></tr>
<tr><td>Module designation</td><td colspan="5">Human Resources and Labor Market</td></tr>
<tr><td>Module level, if applicable</td><td colspan="5"></td></tr>
<tr><td>Code, if applicable</td><td colspan="5">MM-10</td></tr>
<tr><td>Courses and Semester(s) in which the module is taught</td><td colspan="3">Courses</td><td>ID</td><td>Semester</td></tr>
<tr><td></td><td colspan="3">- Decisions Making</td><td>GG4020</td><td>4</td></tr>
<tr><td></td><td colspan="3">- Human Resources</td><td>GG5040</td><td>5</td></tr>
<tr><td></td><td colspan="3">- Induction to Labor Market</td><td>GG6030</td><td>6</td></tr>
<tr><td>Person responsible for the Module</td><td colspan="3">Lima
- Henry Anchante</td><td colspan="2">Arequipa
- Tania Rojas</td></tr>
<tr><td>Lecturers</td><td colspan="3">Lima
- Henry Anchante
- Luis León
- Diana Castillo</td><td colspan="2">Arequipa
- Tania Rojas
- Karina Salas
- Eduardo Paredes</td></tr>
<tr><td>Language</td><td colspan="5">Spanish</td></tr>
<tr><td>Relation to curriculum</td><td colspan="5">Compulsory</td></tr>
<tr><td>Type of teaching, contact hours</td><td colspan="5">Contact hours and class size separately for each teaching method: lecture, lesson, practical, project, seminar, etc.
<table>
<tr><th>Nr</th><th>Courses ID</th><th>Contact hours per week</th><th>Teaching Method</th><th>Class Size</th></tr>
<tr><td>1</td><td>GG4020</td><td>2.0</td><td>Lecture</td><td>40 students</td></tr>
<tr><td>2</td><td>GG5040</td><td>3.0</td><td>Lecture</td><td>40 students</td></tr>
<tr><td>3</td><td>GG6030</td><td>2.0</td><td>Lecture</td><td>40 students</td></tr>
</table></td></tr>
<tr><td>Workload</td><td colspan="5">(Estimated) workload, divided into contact hours (lecture, exercise, laboratory session, etc.) and private study, including examination preparation, specified in hours.
<table>
<tr><th>Nr</th><th>Courses</th><th>Contact Hours per week</th><th>Private Study per week</th><th>Semester Workload</th><th>ECTS Credits</th></tr>
<tr><td>1</td><td>GG4020</td><td>2.0</td><td>2.2</td><td>76</td><td>2</td></tr>
<tr><td>2</td><td>GG5040</td><td>3.0</td><td>2.1</td><td>92</td><td>3</td></tr>
<tr><td>3</td><td>GG6030</td><td>2.0</td><td>1.5</td><td>63</td><td>2</td></tr>
</table></td></tr>
<tr><td>Requirements according to the examination regulations</td><td colspan="5">In order to pass each course of the module, student must obtain a minimal final grade of 11 (eleven). To compute the final grade, the fraction 0.5 or more is considered as a unit in favor the student. (Exam. Reg. 2013 Art. 21)</td></tr>
<tr><td>Recommended prerequisites</td><td colspan="5">Formal: None
Content: Communication and computing skills</td></tr>
<tr><td>Module objectives/intended learning outcomes</td><td colspan="5">After having finished the module, students are able to:
Knowledge:
- Formulate strategies considering decision analysis techniques and solution, personal barriers, ethical criteria and tools for creativity and innovation as the most important problem or opportunity facing
- Design and implement processes aimed at developing the human capital of a business
- Develop strategies to help you locate and develop opportunities for employability effectively and efficiently
Skills:
- Apply techniques for problem solving and ethical decision criteria
- Use modern theories and methodologies for managing human resources.
- Use methods to tailor your personal and professional profile to job opportunities that are presented
Competences:
- Apply and develop skills in planning, analysis, troubleshooting, or taking advantage of opportunities to make effective and ethical decisions.</td></tr>
</table>

	- *Apply concepts and methodologies in the management of human resources.* - *Harmonize their personal and professional profile to implement formal and relational strategies to help you locate and develop opportunities for employability effectively and efficiently.*
Content	***Decision Making**: The classic approach. The decision-making process. Identification and description of the problem in decision-making. Practical cases. Problem resolution techniques in decision-making. Team decision-making. Interpersonal barriers to decision-making. Practical cases. Social and labor ethics. Decision-Making based on an ethical perspective. Creativity and innovation in the generation of decision alternatives. Application of Creativity and Innovation in Decision-Making. Criteria to assess solution alternatives.* ***Human Resources**: Management: Fundamental skills. Management and personal supervision. Team Work. Communication in the workplace. Employee motivation. Leadership in the workplace. Workplace conflict management. Management of organizational changes. Supervision plan. Recruitment and staff selection. Individual Differences, Personality and Values in the Workplace. Training and Job Analysis. Performance and skills evaluation. Labour regulations and laws. Essay writing.* ***Induction to Labor Market**: Personal competitiveness. The résumé. Job interview, characteristics and types. Personal marketing. Employability. Employability. Types of evaluations. Staff recruitment. Understanding gestures and body language. Personal image. Professional ethics.*
Study and examination requirements and forms of examination	- *Practical: simulated job interviews.* - *Lecture: partial quizzes and final written examination.*
Media employed	*Blackboard, slides, beamer presentations, demonstration of lab examples and experiments, lab development tools and equipment.*
Reading list	- *Espíndola, José Luis (2005) Análisis de problemas y toma de decisiones. México D.F.: Addison Wesley. (153.43/E84)* - *García, Salvador (2003) La dirección por valores. Madrid: Mc Graw-Hill (179.9/G23)* - *Jennings, David (2000) Toma de decisiones: Un enfoque integrado. México D.F.: Continental 658.1G/J39)* - *Montes, Felipe (2000). Resolución de problemas y toma de decisiones. México D.F.: Trillas (153/M84)* - *Rey Sancristán, Francisco (2003). Técnicas de resolución de problemas. Madrid: s.n. (658.2/R47T)* - *Robbins, Stephen (2004) Comportamiento organizacional. México D.F.: Pearson Educación (658.3A/R71)* - *Shermerhorn, John (2006) Administración. México D.F.: Limusa (658.3A/S29)* - *Alles, Martha. (2006) Dirección estratégica de recursos humanos. Gestión por competencias. Buenos Aires: s.n. (658.3A/A43D)* - *Chiavenato, Idalberto (2006) Introducción a la teoría general de la administración. México D.F.: Mc Graw- Hill. (658.3A/CH548/2006)* - *Covey, Stephen (2000) Los 7 hábitos de la gente altamente efectiva. Barcelona: Paidos. (658.3A/C8L)* - *Goleman, Daniel (1999) Inteligencia emocional en la empresa. Buenos Aires: Industrial Gráfica. (658.1G/G71)* - *Grados, Jaime (2001) Capacitación y desarrollo de personal. México D.F.: Trillas. (658.3A/G8C)* - *Mosley, Donald (2005) Supervisión. México D.F.: Thompson (658.302/M87)* - *Robbins, Stephen (2004) Comportamiento organizacional. México D.F.: Pearson Educación. (658.3A/R71)* - *Whetten, David (2005) Desarrollo de habilidades directivas. México D.F.: Pearson Educación. (658.409/W53)* - *Bejarano, Alberto (2011). Gestión de Carrera en la Sociedad Red. Lima: ESAN (658.4093/B37)* - *Fournies, Ferdinand (1997) Técnicas de dirección de personal. Cómo instruir para aumentar el rendimiento. México D. F.: Mc Graw-Hill (658.3A/F78).*

	- *Harrison, Tony (2002) Estrategia de comunicación. Técnicas de publicidad. Lima: El comercio (658.1G/P/5)* - *Mora G., Guillermo (1995) Valores humanos y actitudes positivas. Bogotá: Mc Graw-Hill (658.3A/M79)* - *Loret de Mola, Edgardo (2009). Administración de Carrera. Lima: CENTRUM* - *Temple, Inés (2010). Usted S.A. Lima: Norma*

Computer Aided Design Module

<table>
<tr><td>Degree Program</td><td colspan="5">Plant Machinery Maintenance</td></tr>
<tr><td>Module designation</td><td colspan="5">Computer Aided Design</td></tr>
<tr><td>Module level, if applicable</td><td colspan="5">First level</td></tr>
<tr><td>Code, if applicable</td><td colspan="5">MM-11</td></tr>
<tr><td rowspan="3">Courses and Semester(s) in which the module is taught</td><td colspan="2">Courses</td><td>ID</td><td colspan="2">Semester</td></tr>
<tr><td colspan="2">- Technical Drawing</td><td>MG2030</td><td colspan="2">2</td></tr>
<tr><td colspan="2">- Industrial Design and Drawing</td><td>MM3100</td><td colspan="2">3</td></tr>
<tr><td>Person responsible for the Module</td><td colspan="2">Lima:
- Héctor Zevallos</td><td colspan="3">Arequipa:
- Miguel León</td></tr>
<tr><td>Lecturers</td><td colspan="2">Lima:
- Luis Rojas
- Anwar Yarín</td><td colspan="3">Arequipa:
- Miguel León
- César Vera
- Carlos Tacusi</td></tr>
<tr><td>Language</td><td colspan="5">Spanish</td></tr>
<tr><td>Relation to curriculum</td><td colspan="5">Compulsory</td></tr>
<tr><td>Type of teaching, contact hours</td><td colspan="5">Contact hours and class size separately for each teaching method: lecture, lesson, practical, project, seminar, etc.
<table>
<tr><th>Nr</th><th>Courses ID</th><th>Contact hours per week</th><th>Teaching Method</th><th>Class Size</th></tr>
<tr><td>1</td><td>MG2030</td><td>2.0</td><td>Lecture</td><td>40 students</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">MM3100</td><td>2.0</td><td>Lecture</td><td>40 students</td></tr>
<tr><td>1.5</td><td>Laboratory</td><td>20 students</td></tr>
</table></td></tr>
<tr><td>Workload</td><td colspan="5">(Estimated) workload, divided into contact hours (lecture, exercise, laboratory session, etc.) and private study, including examination preparation, specified in hours.
<table>
<tr><th>Nr</th><th>Courses</th><th>Contact Hours per week</th><th>Private Study per week</th><th>Semester Workload</th><th>ECTS Credits</th></tr>
<tr><td>1</td><td>MG2030</td><td>2.0</td><td>2.1</td><td>72</td><td>3</td></tr>
<tr><td>2</td><td>MM3100</td><td>4.0</td><td>2.9</td><td>109</td><td>4</td></tr>
</table></td></tr>
<tr><td>Requirements according to the examination regulations</td><td colspan="5">In order to pass each course of the module, student must obtain a minimal final grade of 11 (eleven). To compute the final grade, the fraction 0.5 or more is considered as a unit in favor the student. (Exam. Reg. 2013 Art. 21)</td></tr>
<tr><td>Recommended prerequisites</td><td colspan="5">Formal: None
Content: Materials and Mathematics knowledge, and computing skill</td></tr>
<tr><td>Module objectives/intended learning outcomes</td><td colspan="5">After having finished the module, students are able to:
Knowledge:
- Interpret drawings and mechanical, electrical, electronic and fluid installations and network diagrams.
- Analyze the operation of components and mechanical systems, by using design drawings.
- Design mechanical no complex systems and components using standardized norms.
Skills:
- Produce drawings and mechanical, electrical, electronic and fluid installations and network diagrams
- Represent mechanical drawings using conventional drawing tools.
- Represent mechanical drawings using design software.
Competences:
- Design Mechanical components using computer design software following a design methodology.</td></tr>
<tr><td>Content</td><td colspan="5">Technical Drawing: Basic principles. Standardized dimensioning. Projection Systems. Sections. Full section. Types of sections. Cutting and sections. Basic electric and electronic schematics. Flow diagram. Systems of pipelines.

Industrial Drawing and Design: Fundamentals of mechanical drawing. Software. Dimensioning based on manufacturing processes. Representation and dimensioning of machine elements according to standards. Representation of</td></tr>
</table>

	machine elements through auxiliary, partial, local and displaced views. Representation of sections and cuttings according to standards (ISO 128-44:2001). Representation and dimensioning of mechanical parts. Standardized representation of dimensional adjustments and tolerances and shape. Representation of surface roughness. Introduction to Design methodology. Representation and interpretation of assembly blueprints. Representation of welded joints. Presentation and explanation of a group design of a mechanical component.
Study and examination requirements and forms of examination	- *Practical / laboratory: preparations with review, functional projects, lab reports* - *Lecture: partial quizzes and final written examination.*
Media employed	*Blackboard, slides, beamer presentations, demonstration of lab examples and experiments, lab development tools and equipment.*
Reading list	- *Bachmann, Albert (1979) Dibujo técnico. Barcelona: Labor. (604.2/B13).* - *Giesecke, Frederick (1979) Dibujo técnico. México D.F.: Limusa (604.2/G4).* - *GTZ (1981) Dibujo técnico metal 1. Curso básico con pruebas. Eschborn: GTZ (604.2/M/1).* - *GTZ (1981) Dibujo técnico metal 2. Curso superior con pruebas. Eschborn: GTZ (604.2/M/2)* - *Jensen, Cecil (2004). Dibujo y diseño en ingeniería. México D.F.: McGraw-Hill (604.2/J39/2004)* - *Sánchez Quispe, Ismael (1991) Dibujo técnico. Lima: Vultecsa (604.2/S21).* - *Spencer, Henry Cecil (2003). Dibujo Técnico. México D.F.: Alfaomega (604.2/S74/2003)* - *Hyman, Barry (2003). Fundamentals of engineering design. New Jersey: Prentice Hall. (620.004/H99)*

Mechanical Design Module

<table>
<tr><td>Degree Program</td><td colspan="4">Plant Machinery Maintenance</td></tr>
<tr><td>Module designation</td><td colspan="4">Mechanical Design</td></tr>
<tr><td>Module level, if applicable</td><td colspan="4">First level</td></tr>
<tr><td>Code, if applicable</td><td colspan="4">MM-12</td></tr>
<tr><td rowspan="3">Courses and Semester(s) in which the module is taught</td><td colspan="2">Courses</td><td>ID</td><td>Semester</td></tr>
<tr><td colspan="2">- Design of machine Elements</td><td>MM4010</td><td>4</td></tr>
<tr><td colspan="2">- Aided Design and Manufacturing</td><td>MM5060</td><td>5</td></tr>
<tr><td>Person responsible for the Module</td><td colspan="2">Lima:
- David Maita</td><td colspan="2">Arequipa:
- Nilton Anchayhua Arestegui</td></tr>
<tr><td>Lecturers</td><td colspan="2">Lima:
- David Maita
- Alejandro Rodríguez
- Héctor Zevallos</td><td colspan="2">Arequipa:
- Nilton Anchayhua Arestegui
- Juan Manuel Gómez</td></tr>
<tr><td>Language</td><td colspan="4">Spanish</td></tr>
<tr><td>Relation to curriculum</td><td colspan="4">Compulsory</td></tr>
<tr><td>Type of teaching, contact hours</td><td colspan="4">Contact hours and class size separately for each teaching method: lecture, lesson, practical, project, seminar, etc.
<table>
<tr><th>Nr</th><th>Courses ID</th><th>Contact hours per week</th><th>Teaching Method</th><th>Class Size</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">MM4010</td><td>4.0</td><td>Lecture</td><td>40 students</td></tr>
<tr><td>3.0</td><td>Laboratory</td><td>20 students</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">MM5060</td><td>2.0</td><td>Lecture</td><td>40 students</td></tr>
<tr><td>3.0</td><td>Laboratory</td><td>20 students</td></tr>
</table></td></tr>
<tr><td>Workload</td><td colspan="4">(Estimated) workload, divided into contact hours (lecture, exercise, laboratory session, etc.) and private study, including examination preparation, specified in hours.
<table>
<tr><th>Nr</th><th>Courses</th><th>Contact Hours per week</th><th>Private Study per week</th><th>Semester Workload</th><th>ECTS Credits</th></tr>
<tr><td>1</td><td>MM4010</td><td>7.0</td><td>4.27</td><td>192</td><td>6</td></tr>
<tr><td>2</td><td>MM5060</td><td>5.0</td><td>3.62</td><td>138</td><td>5</td></tr>
</table></td></tr>
<tr><td>Requirements according to the examination regulations</td><td colspan="4">In order to pass each course of the module, student must obtain a minimal final grade of 11 (eleven). To compute the final grade, the fraction 0.5 or more is considered as a unit in favor the student. (Exam. Reg. 2013 Art. 21)</td></tr>
<tr><td>Recommended prerequisites</td><td colspan="4">Formal: None
Content: Mathematics skill</td></tr>
<tr><td>Module objectives/intended learning outcomes</td><td colspan="4">After having finished the module, students are able to:
Knowledge:
- Evaluate design and select machine elements that integrated into a mechanical systems and machines.
- Design and evaluate the strengths of mechanical components and mechanisms using software.
- Prepare machining programs of mechanical components for CNC machines.
Skills:
- Manufacture mechanical components using computer numerical control machines.
- Perform 3D printing of mechanical components using 3D printers.
Competences:
- Designs and manufacture systems and mechanical components using software and CNC machines, following design standards.</td></tr>
<tr><td>Content</td><td colspan="4">Design of Machine Elements: Applications of the design methodology. Power transmission. Introduction to software-based modelling of components- CAD 3D. Asymmetric components modeling. Pin, cotter pin, tongued, grooved shaft joints. Screw joints. Modelling and determination of parameters of complex components. Slider Bearings. Analysis of resistance and component deformation using CAE software. Rolling bearing. Assembly of components according to their function. Fatigue. Cyclical load stress. Fatigue: Machine element calculation. Fatigue: calculation of machine elements. Assembly of components - level two. Axles, shafts and couplings (4 hours). Modelling and assembly of a simple mechanism. Analysis</td></tr>
</table>

	of resistance and deformation of an assembly. Flexible transmission elements: Chains. Modelling and import of standard components. Analysis of a design using CAD-CAE software. Straight and helicoidal gears. Analysis of the reduction system of a speed reducer. Calculations of gears and verification of their resistance using the software. Design of a mechanism, development of manufacturing blueprints for the components using CAD 3D software. Lifting mechanisms and elements in a hoisting system (Evidence). ***Aided Design and Manufacturing**: Introduction to CAD/CAM areas of application. Types of metallic plates. Types of reinforcements. Calculations to establish lengths. Types of joints. Use of technical tables. Preset profiles. Complementary operations. Types of metallic plates. Types of reinforcements. Calculations to establish lengths. Types of joints. Use of technical tables. Installations using pipelines, blending, reduction, expansion and cutting. Introduction to metallic structures. Shapes of profiles. Application of removable joints with bolts and screws. Use of technical tables. Introduction to metallic structures. Shapes of profiles. Use of cutting tools with the CNC lathe of the laboratory. Mounting and configuration. Interpreting plans of installations having pipelines. Types of pipelines. Types of accessories. Types of joints. Pipelines installation. Use of technical tables. Interpreting plans of installations having pipelines. Types of pipelines. Types of accessories. Types of joints. Pipelines installation. Use of cutting tools in MH-CNC. Types of mounting. Use of cutting tools in the computerized numeric controlled machines. Types of mounting. General information for using computerized numeric controlled machines (MH-CNC). Location of coordinates. Programming G and M codes. Fixed cycles of work. Programming G and M codes. Fixed cycles of work. Manufacture for the project. Workshop 1004. Programming G and M codes. Fixed cycles of work. Programming G and M codes. Fixed cycles of work. Defense of the Project.*
Study and examination requirements and forms of examination	- *Practical / laboratory: preparations with review, functional projects, lab reports* - *Lecture: partial quizzes and final written examination*
Media employed	*Blackboard, slides, beamer presentations, demonstration of lab examples and experiments, lab development tools and equipment.*
Reading list	- *Hall Strickland, Allen (1990) Diseño de máquinas. México D.F.: Mc Graw-Hill (621.815/H18)* - *Hicks, Tyler (2006) Handbook of mechanical engineering calculations. New York: Mc Graw-Hill (621/H3)* - *Kimball, Dexter (1947) Construcción de elementos de máquinas. México D.F.: Hispanoamericana (620.1/K55)* - *Mott, Robert L. (1992) Diseño de elementos de máquinas. México D.F.: Prentice Hall (621.815/M82)* - *Norton, Robert (2005). Diseño de maquinaria. Síntesis y análisis de máquinas y mecanismos. México D.F.: McGraw-Hill (621.815/N82)* - *Shigley, Joseph E. (1991) Teoría de máquinas y mecanismos. Madrid: Mc Graw-Hill (620.1/S47T)* - *Shigley, Joseph Edward (1994) Fundamentos de diseño mecánico. Tomo 1. México D.F.: Mc Graw-Hill (620.1/S47F/t.1)* - *Shigley, Joseph Edward (1994) Fundamentos de diseño mecánico. Tomo 2. México D.F.: Mc Graw-Hill (620.1/S47F/t.2)* - *Shigley, Joseph Edward (1994) Fundamentos de diseño mecánico. Tomo 3. México D.F.: Mc Graw-Hill (620.1/S47F/t.3)* - *Alecop (1992) CNC 8025 Fresadora. Mondragón: Alecop. (620.1/CN/A-F)* - *Alecop (1992) Manejo y programación del torno. Mondragón, Alecop. (620.1/CN/47)* - *Aviles, Rafael (2005) Análisis de fatiga en máquinas. Madrid: (620.112/A92)*

Fluid Power Module

<table>
<tr><td>Degree Program</td><td colspan="4">Plant Machinery Maintenance</td></tr>
<tr><td>Module designation</td><td colspan="4">Fluid power</td></tr>
<tr><td>Module level, if applicable</td><td colspan="4">First level</td></tr>
<tr><td>Code, if applicable</td><td colspan="4">MM-13</td></tr>
<tr><td rowspan="3">Courses and Semester(s) in which the module is taught</td><td colspan="2">Courses</td><td>ID</td><td>Semester</td></tr>
<tr><td colspan="2">- Pneumatic Systems</td><td>MM4120</td><td>4</td></tr>
<tr><td colspan="2">- Hydraulic Systems</td><td>MM5100</td><td>5</td></tr>
<tr><td>Person responsible for the Module</td><td colspan="2">Lima:
- Manuel Soto</td><td colspan="2">Arequipa:
- Miguel León</td></tr>
<tr><td>Lecturers</td><td colspan="2">Lima:
- César Lecaros
- Manuel Soto</td><td colspan="2">Arequipa:
- Miguel León
- Nilton Anchayhua
- Juan Manuel Gómez</td></tr>
<tr><td>Language</td><td colspan="4">Spanish</td></tr>
<tr><td>Relation to curriculum</td><td colspan="4">Compulsory</td></tr>
<tr><td>Type of teaching, contact hours</td><td colspan="4">Contact hours and class size separately for each teaching method: lecture, lesson, practical, project, seminar, etc.
<table>
<tr><th>Nr</th><th>Courses ID</th><th>Contact hours per week</th><th>Teaching Method</th><th>Class Size</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">MM4120</td><td>2</td><td>Lecture</td><td>40 students</td></tr>
<tr><td>3</td><td>Laboratory</td><td>20 students</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">MM5100</td><td>2</td><td>Lecture</td><td>40 students</td></tr>
<tr><td>2</td><td>Laboratory</td><td>20 students</td></tr>
</table></td></tr>
<tr><td>Workload</td><td colspan="4">(Estimated) workload, divided into contact hours (lecture, exercise, laboratory session, etc.) and private study, including examination preparation, specified in hours.
<table>
<tr><th>Nr</th><th>Courses</th><th>Contact Hours per week</th><th>Private Study per week</th><th>Semester Workload</th><th>ECTS Credits</th></tr>
<tr><td>1</td><td>MM4120</td><td>5</td><td>3.26</td><td>132</td><td>4</td></tr>
<tr><td>2</td><td>MM5100</td><td>4</td><td>2.87</td><td>108</td><td>4</td></tr>
</table></td></tr>
<tr><td>Requirements according to the examination regulations</td><td colspan="4">In order to pass each course of the module, student must obtain a minimal final grade of 11 (eleven). To compute the final grade, the fraction 0.5 or more is considered as a unit in favor the student. (Exam. Reg. 2013 Art. 21)</td></tr>
<tr><td>Recommended prerequisites</td><td colspan="4">Formal: None
Content: Basic Electronic</td></tr>
<tr><td>Module objectives/intended learning outcomes</td><td colspan="4">After having finished the module, students are able to:
Knowledge:
- Select equipment of generation, preparation and distribution or air compressed.
- Select components for pneumatic and hydraulic systems.
- Design pneumatic and hydraulic systems.
Skills:
- Perform functioning tests to Pneumatic and Hydraulic systems.
- Install and operate Pneumatic and Hydraulic systems.
- Install and perform functioning tests to Programmable Control Logical for electrohydraulic and electro Pneumatic systems.
Competences:
- Design, detect and solve problems in Pneumatic and Hydraulic systems using diagnoses tools and software.</td></tr>
<tr><td>Content</td><td colspan="4">Pneumatic Systems: Compressed air generation, preparation and distribution. Selection of a compressor for a given pneumatic system. Compressed air distribution. Direct and indirect control of a pneumatic cylinder with speed control device. Pneumatic components making up an industrial pneumatic system. Distributor and shutoff and off-set valves. Direct and indirect control of a pneumatic cylinder. Actuators. Diagram of phase displacement. Circuits, selection of pneumatic components, real application analysis. Actuator and pipeline selection. Circuits of sequence. Sequential electro-pneumatic system with control</td></tr>
</table>

	based on displacement. Sequential electro-pneumatic system with control based on time and pressure. Selection of off-set valves. Electro-pneumatic and control components: Counters, timers and vacuum switches. Implementation of solutions in electro-pneumatic systems using PLC. Sequential electro-pneumatic system based on sensorial and vacuum technique. Implementation of sequential controls and tests for electro-pneumatic systems operation. Circuits, analysis of real applications. PLC-based Control. PLC-based electro-pneumatic control. Programming of sequential control with PLC. Application of PLC and PL-controlled pneumatic systems. PLC programming and FUP language. Circuits, selection of components and analysis of applications. Diagnosis and troubleshooting. ***Hydraulic Systems**: Diagnosis and evaluation of the operation of hydraulic systems Pressure. Flow. Direct controlled pressure limiting valve. Pressure limiting valve. Manifold valve. Manifold valve 2/2 - 3/2- 4/2 - 4/3. Check valve and hydraulically deblocked check valve. Diagnose and control (oversight) the hydraulic system operation. Throttle valve. Check valve, hydraulic pilot-operated check valve. Flow-control valve. Pressure control valve. Reading of blueprints: Applications. Circuits regenerated. Differential circuits. Accumulator. Hydraulic motor. Basic electrohydraulic controls. Analysis of the operation and control of the electrohydraulic systems. Sequence valve, overpressure valve and anti-vacuum valve. Control of electrohydraulic systems using PLC. Proportional pressure control Analysis and control of electrohydraulic control systems with PLC. Control of electrohydraulic systems using PLC. Proportional flow control. Maintenance of hydraulic system. Maintenance of hydraulic components. Predictive and preventive maintenance of hydraulic systems.*
Study and examination requirements and forms of examination	- *Practical / laboratory: preparations with review, functional projects, lab reports* - *Lecture: partial quizzes and final written examination.*
Media employed	*Blackboard, slides, beamer presentations, demonstration of lab examples and experiments, lab development tools and equipment.*
Reading list	- *Festo Didactic (1976). Iniciación al personal de montaje y mantenimiento. Esslingen: Festo. (621.5/F/I-P)* - *Festo Didactic (1980). Introducción a la neumática. Esslingen: Festo. (621.5/F/I* - *Ewald, Roland (1990) Técnica de válvulas proporcionales y de servoválvulas: libro de información. New York: Mannesmann Rexroth (621.2/T/2)* - *Festo Didactic (1990) Curso de hidráulica para la formación profesional. Berlín: Festo. (621.2/F-E).* - *Schmitt, Grad (1992) Training hidráulico. New York: Mannesmann Rexroth. (621.2/T/I-I).* - *Vickers (1984) Manual de oleohidráulica industrial: 935100-S. Barcelona: Blume S.A. (621.2/V)*

Thermal Machines Module

<table>
<tr><td>Degree Program</td><td colspan="4">Plant Machinery Maintenance</td></tr>
<tr><td>Module designation</td><td colspan="4">Thermal Machines</td></tr>
<tr><td>Module level, if applicable</td><td colspan="4">First level</td></tr>
<tr><td>Code, if applicable</td><td colspan="4">MM-14</td></tr>
<tr><td rowspan="3">Courses and Semester(s) in which the module is taught</td><td colspan="2">Courses</td><td>ID</td><td>Semester</td></tr>
<tr><td colspan="2">- Thermal Machines</td><td>MM5120</td><td>5</td></tr>
<tr><td colspan="2">- Refrigeration and Air Conditioning</td><td>MM6100</td><td>6</td></tr>
<tr><td>Person responsible for the Module</td><td colspan="2">Lima:
- Alejandro Rodríguez</td><td colspan="2">Arequipa:
- César Vera</td></tr>
<tr><td>Lecturers</td><td colspan="2">Lima:
- Alejandro Rodríguez
- Héctor Zevallos</td><td colspan="2">Arequipa:
- César Vera
- Julio Monjarás</td></tr>
<tr><td>Language</td><td colspan="4">Spanish</td></tr>
<tr><td>Relation to curriculum</td><td colspan="4">Compulsory</td></tr>
<tr><td>Type of teaching, contact hours</td><td colspan="4">Contact hours and class size separately for each teaching method: lecture, lesson, practical, project, seminar, etc.
<table>
<tr><th>Nr</th><th>Courses ID</th><th>Contact hours per week</th><th>Teaching Method</th><th>Class Size</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">MM5120</td><td>2</td><td>Lecture</td><td>40 students</td></tr>
<tr><td>2</td><td>Laboratory</td><td>20 students</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">MM6100</td><td>3</td><td>Lecture</td><td>40 students</td></tr>
<tr><td>1.5</td><td>Laboratory</td><td>20 students</td></tr>
</table></td></tr>
<tr><td>Workload</td><td colspan="4">(Estimated) workload, divided into contact hours (lecture, exercise, laboratory session, etc.) and private study, including examination preparation, specified in hours.
<table>
<tr><th>Nr</th><th>Courses</th><th>Contact Hours per week</th><th>Private Study per week</th><th>Semester Workload</th><th>ECTS Credits</th></tr>
<tr><td>1</td><td>MM5120</td><td>4</td><td>4.62</td><td>138</td><td>5</td></tr>
<tr><td>2</td><td>MM6100</td><td>4.5</td><td>3.78</td><td>141</td><td>5</td></tr>
</table></td></tr>
<tr><td>Requirements according to the examination regulations</td><td colspan="4">In order to pass each course of the module, student must obtain a minimal final grade of 11 (eleven). To compute the final grade, the fraction 0.5 or more is considered as a unit in favor the student. (Exam. Reg. 2013 Art. 21)</td></tr>
<tr><td>Recommended prerequisites</td><td colspan="4">Formal: None
Content: Basic Electronic</td></tr>
<tr><td>Module objectives/intended learning outcomes</td><td colspan="4">After having finished the module, students are able to:
Knowledge:
- Perform the energetic balance of thermal machines.
- Recommend different types of renewable energies, for industrial systems.
- Select components for Air conditioning and refrigeration systems and firetube Boilers.
- Diagnose failures in Thermal machines and Air conditioning and Refrigeration systems.
Skills:
- Perform functioning tests to firetube Boilers and Air conditioning and refrigeration systems.
- Install Air Conditioning and Refrigeration systems and operate firetube Boilers.
- Perform functioning tests to Heat Exchangers.
Competences:
- Design, detect and solve problems in Thermal systems and Air conditioning and Refrigeration systems using diagnoses tools and software.</td></tr>
<tr><td>Content</td><td colspan="4">Thermal Machines: Thermodynamic systems. Steam properties. Steam cycles for the production of work. Steam cycles for the production of work. Regenerative power cycle Regenerative power cycle. Energy analysis of power plants. Cogeneration. Steam generators. Thermal balance. Steam Distribution. Boiler maintenance. Renewable and non-renewable energy sources.

Refrigeration and Air Conditioning: Refrigeration cycles. Components in a refrigeration system: compressors, evaporators, condensers. Components of refrigeration system:</td></tr>
</table>

	Expansion devices. Calculus of thermal loads. Refrigerants and refrigeration oil. Refrigeration system maintenance. Principles and fundamentals of air conditioning: Psychrometry. Air mixtures. Conditioning units. Hydronic systems for air conditioning. Environmental protection. Failure detection in refrigeration and air conditioning systems.
Study and examination requirements and forms of examination	- *Practical / laboratory: preparations with review, functional projects, lab reports* - *Lecture: partial quizzes and final written examination.*
Media employed	*Blackboard, slides, beamer presentations, demonstration of lab examples and experiments, lab development tools and equipment.*
Reading list	- *Castillo Neira, Percy (2002) Operación y mantenimiento de calderos industriales. Lima: Educación. (536.7/C34).* - *Haywood, R.W. (1999). Ciclos termodinámicos de potencia y refrigeración. México D.F.: Limusa (536.7/H28).* - *Woodruff, Everett (1992) Steam - plant operation. New York: Mc Graw-Hill. (621.1/W79).* - *Carnicer Royo, Enrique (1991) Aire comprimido. Madrid: Paraninfo S.A. (621.56/C23).* - *Dossat, Roy (1980) Principios de refrigeración. México D.F.: Continental S.A. (621.56/D93).* - *Withman, William (2003) Tecnología de la refrigeración I. Madrid: Paraninfo (621.56/W5).* - *Withman, William (2004) Tecnología de la refrigeración y aire acondicionado II. Madrid: Paraninfo. (621.56/W5/3).*

Fluid Mechanics and Thermodynamics Module

<table>
<tr><td>Degree Program</td><td colspan="5">Plant Machinery Maintenance</td></tr>
<tr><td>Module designation</td><td colspan="5">Fluid Mechanics and Thermodynamics</td></tr>
<tr><td>Module level, if applicable</td><td colspan="5">First level</td></tr>
<tr><td>Code, if applicable</td><td colspan="5">MM-15</td></tr>
<tr><td>Courses and Semester(s) in which the module is taught</td><td colspan="2">Courses</td><td>ID</td><td colspan="2">Semester</td></tr>
<tr><td></td><td colspan="2">- Fluid Mechanics and Thermodynamics</td><td>MM3120</td><td colspan="2">3</td></tr>
<tr><td>Person responsible for the Module</td><td colspan="3">Lima:
- Héctor Zevallos</td><td colspan="2">Arequipa:
- César Vera</td></tr>
<tr><td>Lecturers</td><td colspan="3">Lima:
- Luis Sampén
- Alejandro Rodríguez
- Héctor Zevallos</td><td colspan="2">Arequipa:
- César Vera
- Julio Monjarás</td></tr>
<tr><td>Language</td><td colspan="5">Spanish</td></tr>
<tr><td>Relation to curriculum</td><td colspan="5">Compulsory</td></tr>
<tr><td>Type of teaching, contact hours</td><td colspan="5">Contact hours and class size separately for each teaching method: lecture, lesson, practical, project, seminar, etc.
<table>
<tr><th>Nr</th><th>Courses ID</th><th>Contact hours per week</th><th>Teaching Method</th><th>Class Size</th></tr>
<tr><td>1</td><td>MM3120</td><td>4</td><td>Lecture</td><td>40 students</td></tr>
</table></td></tr>
<tr><td>Workload</td><td colspan="5">(Estimated) workload, divided into contact hours (lecture, exercise, laboratory session, etc.) and private study, including examination preparation, specified in hours.
<table>
<tr><th>Nr</th><th>Courses</th><th>Contact Hours per week</th><th>Private Study per week</th><th>Semester Workload</th><th>ECTS Credits</th></tr>
<tr><td>1</td><td>MM3120</td><td>4</td><td>2.96</td><td>118</td><td>4</td></tr>
</table></td></tr>
<tr><td>Requirements according to the examination regulations</td><td colspan="5">In order to pass each course of the module, student must obtain a minimal final grade of 11 (eleven). To compute the final grade, the fraction 0.5 or more is considered as a unit in favor the student. (Exam. Reg. 2013 Art. 21)</td></tr>
<tr><td>Recommended prerequisites</td><td colspan="5">Formal: None
Content: Basic Electronic</td></tr>
<tr><td>Module objectives/intended learning outcomes</td><td colspan="5">After having finished the module, students are able to:
Knowledge:
- Analyze industrial processes that transport fluids.
- Analyze thermal processes using thermodynamic principles.
Skills:
- Perform functioning tests to processes transport systems and thermal processes.
- Use software for calculation of transport phenomena.
Competences:
- Select components for pumping systems, heat exchangers, using software.</td></tr>
<tr><td>Content</td><td colspan="5">Fluid mechanics. Properties of fluids. Fluid statics. Pascal's Law. Fluid statics: Law of immerse bodies. Fluid dynamics: Continuity Law. Fluid dynamics: Bernoulli's Law. Heat transfer. Heat Exchangers. Selection of components for heat transfer systems using the laws of fluid mechanics and thermodynamics. Analysis of heat exchangers. Thermodynamics. Fundamental concepts. Thermodynamic properties. Ideal gas processes. First Law of Thermodynamics: Concept of energy – I. Calculation based on advanced mathematics for analyzing mechanic and fluid systems. First Law of Thermodynamics: Concept of energy – II. First Law of Thermodynamics: Energy balance. Second Law of Thermodynamics. Cyclic processes: Otto cycle. Diesel cycle. Power cycles with gases: Dual and Brayton. Internal combustion engines.</td></tr>
<tr><td>Study and examination requirements and forms of examination</td><td colspan="5">- Practical / laboratory: preparations with review, functional projects, lab reports
- Lecture: partial quizzes and final written examination.</td></tr>
<tr><td>Media employed</td><td colspan="5">Blackboard, slides, beamer presentations, demonstration of lab examples and experiments, lab development tools and equipment.</td></tr>
<tr><td>Reading list</td><td colspan="5">- Faires, Virgil Moring (2008) Termodinámica. México D.F.: Unión tipográfica.</td></tr>
</table>

	(536.7/F14) - *Mott, Robert L. (2006) Mecánica de fluídos. México D.F.: Pearson Educación. (620.106/M88)* - *Rolle, Kurt (1984) Termodinámica. México D.F.: Interamericana S.A. (536.7/R7)* - *Roselló Coria, Francisco (1983) Energía y máquinas térmicas. México D.F.: Limusa (536/R84)* - *Van Wylen, Gordon (2007) Fundamentos de termodinámica. México D.F.: Limusa (536.7/V28S)*

Maintenance Management Module

<table>
<tr><td>Degree Program</td><td colspan="5">Plant Machinery Maintenance</td></tr>
<tr><td>Module designation</td><td colspan="5">Maintenance Management</td></tr>
<tr><td>Module level, if applicable</td><td colspan="5">First level</td></tr>
<tr><td>Code, if applicable</td><td colspan="5">MM-16</td></tr>
<tr><td rowspan="3">Courses and Semester(s) in which the module is taught</td><td colspan="2">Courses</td><td>ID</td><td colspan="2">Semester</td></tr>
<tr><td colspan="2">- Maintenance Management</td><td>MG4010</td><td colspan="2">4</td></tr>
<tr><td colspan="2">- Strategic Maintenance Management</td><td>MM6140</td><td colspan="2">6</td></tr>
<tr><td>Person responsible for the Module</td><td colspan="2">Lima:
- David Maita</td><td colspan="3">Arequipa:
- Manuel Vizcarra</td></tr>
<tr><td>Lecturers</td><td colspan="2">Lima:
- Luis Sampén
- Anwar Yarin
- David Maita</td><td colspan="3">Arequipa:
- Manuel Vizcarra
- Juan Roldán</td></tr>
<tr><td>Language</td><td colspan="5">Spanish</td></tr>
<tr><td>Relation to curriculum</td><td colspan="5">Compulsory</td></tr>
<tr><td>Type of teaching, contact hours</td><td colspan="5">Contact hours and class size separately for each teaching method: lecture, lesson, practical, project, seminar, etc.
<table>
<tr><th>Nr</th><th>Courses ID</th><th>Contact hours per week</th><th>Teaching Method</th><th>Class Size</th></tr>
<tr><td>1</td><td>MG4010</td><td>3</td><td>Lecture</td><td>40 students</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">MM6140</td><td>4</td><td>Lecture</td><td>40 students</td></tr>
<tr><td>1.5</td><td>Laboratory</td><td>20 students</td></tr>
</table></td></tr>
<tr><td>Workload</td><td colspan="5">(Estimated) workload, divided into contact hours (lecture, exercise, laboratory session, etc.) and private study, including examination preparation, specified in hours.
<table>
<tr><th>Nr</th><th>Courses</th><th>Contact Hours per week</th><th>Private Study per week</th><th>Semester Workload</th><th>ECTS Credits</th></tr>
<tr><td>1</td><td>MG4010</td><td>4</td><td>1.96</td><td>84</td><td>3</td></tr>
<tr><td>2</td><td>MM6140</td><td>5.5</td><td>4.37</td><td>168</td><td>6</td></tr>
</table></td></tr>
<tr><td>Requirements according to the examination regulations</td><td colspan="5">In order to pass each course of the module, student must obtain a minimal final grade of 11 (eleven). To compute the final grade, the fraction 0.5 or more is considered as a unit in favor the student. (Exam. Reg. 2013 Art. 21)</td></tr>
<tr><td>Recommended prerequisites</td><td colspan="5">Formal: None
Content: Basic Electronic</td></tr>
<tr><td>Module objectives/intended learning outcomes</td><td colspan="5">After having finished the module, students are able to:
Knowledge:
- Prepare a plan and a maintenance program for industrial equipment.
- Calculate performance indicators of industrial maintenance.
- Estimate the reliability, maintainability and availability of components and equipment.
- Use RCFA, TPM, RCM methodology for prepare maintenance program.
- Calculate life cycle cost of equipment and defines industrial equipment replacement.
Skills:
- Organize work areas and procedures for industrial maintenance.
Competences:
- Design plan and maintenance programs for an industrial equipment, using a reliability methodology.
- Optimize frequencies of preventive maintenance, work maintenance areas, standard jobs, using a methodology.</td></tr>
<tr><td>Content</td><td colspan="5">Maintenance Management: Relationship among maintenance, production and the equipment manufacturer. Stages in the management cycle. Equipment useful life. Maintenance planning and scheduling. Implementation of a maintenance system. Useful life cost. Technical and economic selection of fans and compressors. Specific costs in the useful life. Organization of maintenance and assignation of resources required for the activities. Main maintenance management indicators. Group presentation on management indicators. Financial and labour indicators. Design of a</td></tr>
</table>

	laboratory or workshop maintenance plan according to the manufacturer's information and the operational conditions. CMMS - Computerized management system. Processes, operations and components at industrial plants. Eliminating wasting. Poka- Yoke, Smed. ***Strategic Maintenance Management**: Root-Cause Analysis (RCA). Failure Mode Analysis and effects (FMEA). RCM methodology. Functions. Functional failure. Failure record. Modes, effects and consequences of the failure. Selection of a suitable maintenance task. Introduction to the reliability engineering. Basic statistics. Statistical distributions. Data and type of data. Parameters estimation. Calculation of reliability. Reliability intervals. Measures of performance. Decision-making based on indicators. Results analysis. Importance of maintenance management audits. Components and implementation of an audit process. Students analyze the equipment replacement and plan actions to be executed. TPM philosophy. Fundamentals of TPM. Team effectiveness. Presentation of group assignments – all the groups. Autonomous maintenance. Preventive and predictive maintenance. Implementation of the TPM. Training for the TPM. Students design maintenance plans based on the TPM and the RCM. Lean Maintenance. Concept of Lean Manufacturing. Maintenance Excellence Model. Implementation strategy. Decision-making. Equipment replacement. Stock control.*
Study and examination requirements and forms of examination	- *Practical / laboratory: preparations with review, functional projects, lab reports* - *Lecture: partial quizzes and final written examination.*
Media employed	*Blackboard, slides, beamer presentations, demonstration of lab examples and experiments, lab development tools and equipment.*
Reading list	- *Cotler, Mel A. (1994) Maintenance programming. New Jersey: Prentice Hall. (658.2/C85).* - *Goettsche, L.D. (1998) Maintenance of instruments and Systems. New York: s.n. (621.381I/G57)* - *González Fernández, Francisco Javier (2009). Teoría y práctica del mantenimiento industrial avanzado. Madrid: Fundación Confemetal (658.202/G71/2009)* - *Hartmann, Eward H. (1998) Cómo instalar con éxito el TPM en su empresa. A través del original proceso TPM. Lima: s.n. (658.2/H2T)* - *Levitt, Joel (2009). The handbook of maintenance management. New York: Industrial Press (658.202/L54)* - *Palmer, Doc (2006) Maintenance planning and scheduling handbook. New York: McGraw-Hill (658.202/P19)* - *Wireman, Terry (2005). Developing perfomance indicators for managing maintenance. New York: Industrial Press (658.2/W72D)* - *González Fernández, Francisco (2009) Teoría y práctica del mantenimiento industrial avanzado. Madrid: Fundación Confemetal (658.202/G71).* - *Hartmann, Edward (1992) Successfully installing TPM in a new japanese plant. Pettsburgh: TPM Press (658.2/H2).* - *Merli, Giorgio (1991) Total manufacturing management. La estrategia industrial en los años 90. Madrid: Tecnologías de Gerencia. (658.562/M43).* - *Nakajima, Seiichi (1992) Programa de desarrollo del TPM. Implantación del mantenimiento productivo total. Cambridge: Productivity Press. (658.562/N18).* - *Smith, Ricky (2004) Lean maintenance. Boston: Elsevier. (658.202/S61).* - *Wireman, Terry (2005) Developing perfomance indicators for managing maintenance. New York: Industrial Press. (658.2/W72D).*

Industrial Maintenance Module

<table>
<tr><td>Degree Program</td><td colspan="4">Plant Machinery Maintenance</td></tr>
<tr><td>Module designation</td><td colspan="4">Industrial Maintenance</td></tr>
<tr><td>Module level, if applicable</td><td colspan="4">First level</td></tr>
<tr><td>Code, if applicable</td><td colspan="4">MM-17</td></tr>
<tr><td rowspan="4">Courses and Semester(s) in which the module is taught</td><td colspan="2">Courses</td><td>ID</td><td>Semester</td></tr>
<tr><td colspan="2">- Industrial Equipment and Components</td><td>MM4110</td><td>4</td></tr>
<tr><td colspan="2">- Industrial Maintenance</td><td>MM5080</td><td>5</td></tr>
<tr><td colspan="2">- Predictive Maintenance Management</td><td>MM6120</td><td>6</td></tr>
<tr><td>Person responsible for the Module</td><td colspan="2">Lima:
- Sixto Sarmiento</td><td colspan="2">Arequipa:
- Manuel Vizcarra</td></tr>
<tr><td>Lecturers</td><td colspan="2">Lima:
- Anwar Yarín
- Luis Sampén
- César Nunura
- Luis Rojas
- Sixto Sarmiento</td><td colspan="2">Arequipa:
- Manuel Vizcarra
- Juan Roldán</td></tr>
<tr><td>Language</td><td colspan="4">Spanish</td></tr>
<tr><td>Relation to curriculum</td><td colspan="4">Compulsory</td></tr>
<tr><td>Type of teaching, contact hours</td><td colspan="4">Contact hours and class size separately for each teaching method: lecture, lesson, practical, project, seminar, etc.
<table>
<tr><th>Nr</th><th>Courses ID</th><th>Contact hours per week</th><th>Teaching Method</th><th>Class Size</th></tr>
<tr><td>1</td><td>MM4110</td><td>3</td><td>Lecture</td><td>40 students</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">MM5080</td><td>2</td><td>Lecture</td><td>40 students</td></tr>
<tr><td>5</td><td>Laboratory</td><td>20 students</td></tr>
<tr><td rowspan="2">3</td><td rowspan="2">MM6120</td><td>1</td><td>Lecture</td><td>40 students</td></tr>
<tr><td>2.5</td><td>Laboratory</td><td>20 students</td></tr>
</table></td></tr>
<tr><td>Workload</td><td colspan="4">(Estimated) workload, divided into contact hours (lecture, exercise, laboratory session, etc.) and private study, including examination preparation, specified in hours.
<table>
<tr><th>Nr</th><th>Courses</th><th>Contact Hours per week</th><th>Private Study per week</th><th>Semester Workload</th><th>ECTS Credits</th></tr>
<tr><td>1</td><td>MM4110</td><td>3</td><td>2.70</td><td>97</td><td>2</td></tr>
<tr><td>2</td><td>MM5080</td><td>7</td><td>3.65</td><td>172</td><td>6</td></tr>
<tr><td>3</td><td>MM6120</td><td>3.5</td><td>3.92</td><td>126</td><td>4</td></tr>
</table></td></tr>
<tr><td>Requirements according to the examination regulations</td><td colspan="4">In order to pass each course of the module, student must obtain a minimal final grade of 11 (eleven). To compute the final grade, the fraction 0.5 or more is considered as a unit in favor the student. (Exam. Reg. 2013 Art. 21)</td></tr>
<tr><td>Recommended prerequisites</td><td colspan="4">Formal: None
Content: Basic Electronic</td></tr>
<tr><td>Module objectives/intended learning outcomes</td><td colspan="4">After having finished the module, students are able to:
Knowledge:
- Recognize how to work and function of the major components of industrial systems
- Identify and select pump systems, industrial fans, and mineral processing equipment.
- Perform assembly and disassembly of components, mechanisms and systems of industrial machinery.
- Analyze failures and diagnose problems in industrial machinery using vibration analysis, infrared thermography and ultrasound.
Skills:
- Organize work areas and procedures for industrial maintenance.
- Calibrate, install, replace, repair and adapt components and systems of industrial machinery.
Competences:
- Develop predictive maintenance plans for critical equipment using norms.</td></tr>
</table>

	- *Perform industrial maintenance to systems and equipment, following industrial safety regulations and manufacturers manuals.*
Content	***Industrial Equipment and Components**: Types of pumps used in mobile and stationary machinery. Principles involved in pump functioning. Frequent failures in pumps. Types of fans. Principles involved in fan functioning. Selection and maintenance. Principles involved in compressor functioning. Selection of a rotary dynamic compressor. Types of equipment for material transport. Conveyor belt components. Crushers. Mills. Furnaces. Speed reducers. Speed variators. Check valve maintenance. Turbines. Classification. Design parameters. Selection of fans and compressor based on economic and technical parameters. Hydraulic turbines. Pelton Hydraulic turbines: Francis and Kaplan. Maintenance guidelines. Steam and gas turbines. Turbine maintenance. Tribology. Fuels. Normalization. Industrial applications. Safety in fuel handling.* *I**ndustrial Maintenance**: Workshop: Organization of the industrial maintenance workshop warehouse. Industrial maintenance equipment. Mechanisms: Mounting and dismounting. Workshop: Mounting and dismounting of radial bearings. Bearing mounting. Arrangement and adjustment of bearings. Workshop: Mounting and dismounting of radial bearings in housings. Workshop: Adjustment of paired angular-contact bearings. Mounting and dismounting of bearings with oil injection. Industrial lubricants. Workshop: Mounting and dismounting of bearings using oil injection. Radial seals. Workshop: Mounting and dismounting bearings using hydraulic nuts and specialized software. Students find and use data and information required for mounting and dismounting mechanisms. Workshop: Sliding bearings. O-rings. Workshop: Lubrication of bearings. Seals for hydraulic systems. Workshop-ring maintenance. Joints in pipelines and hoses for hydraulic systems. Maintenance of sliding bearings. Workshop: Hydraulic seals. Transmission with V-belts. Workshop: Maintenance of connectors and adaptors in hydraulic installations. Maintenance of transmission with timing belts and chains. Workshop: Mounting of sleeve bearings. Maintenance of transmissions with timing belts. Workshop: Failure detection in transmission with V- belts. Application of the root cause method. Transmission maintenance with pulling force elements. The students solve failures in in transmissions with V- belts using the root cause method. Maintenance of speed reducers. Workshop: Maintenance and installation of mechanic transmissions. Centrifugal pumps maintenance. Students design the installation and maintenance plan and start a pumping system. Workshop: Maintenance of centrifugal pumps Maintenance of seal units using mechanic seals. Alignment with comparator dial gauge. Workshop: Assembling and starting up of a pump.* ***Predictive Maintenance Management**: Safe use of monitoring equipment and precision maintenance equipment. Predictive maintenance. Field inspection of machinery. Field inspection of machinery. Failures in rotating equipment. Failure detection using infrared thermography. Predictive tasks. Techniques used in condition-based tasks. Failure detection using infrared thermography. Failure detection using Ultrasound 1 (linear and E-R). Techniques of condition monitoring* *P-F interval versus deviation from normal condition. Categories of condition monitoring techniques. Failure detection using angular ultrasound inspection. Some techniques of the condition monitoring. Some techniques of the condition monitoring. Vibration analysis. Data transfer for condition monitoring. Data transfer for condition monitoring. Ultrasound. Analysis of vibrations. Performing condition monitoring (condition monitoring vibration) at an industrial plant. Analysis of vibrations. Implementing predictive maintenance. Precision alignment. Precision balancing.*
Study and examination requirements and forms of examination	- *Practical / laboratory: preparations with review, functional projects, lab reports* - *Lecture: partial quizzes and final written examination.*
Media employed	*Blackboard, slides, beamer presentations, demonstration of lab examples and experiments, lab development tools and equipment.*
Reading list	• *Hucks, Tyler (1986) Bombas: Su selección y aplicación. México D.F.: Continental S.A (621.6/H4)* • *Mobley, R. Keith (2004). Maintenance Fundamentals. Boston: Elsevier.*

(658.202/M67)

- *Viejo Zupicaray, Manuel (1994) Bombas.Teoría, diseño y aplicaciones. México D.F.: Limusa. (621.6/V62/1994)*

- *Bloch, Heinz (2009) Machinery component maintenance and repair. New York: Elsevier. (621.816/B64/v.3)*
- *Burgmann, F. (1992) The ABC of mechanical seals. Burgmann: Feodor Burgmann.*
- *Fischer, Ulrich (2006) Mechanical and metal Trades Handbook. 1st. Edition. Germany: Europa Lehrmittel. (620.1/F54).*
- *Mobley, R. (2004) Maintenance fundamentals. New York: Elsevier (658.202/M67).*
- *Piotrowski, John (2007) Shaft alignment handbok. New York: CRC Press (621.8/P56).*
- *Smith, Ricky (2003) Industrial machinery repair: best maintenance practices pocket guide. USA: Elsevier Sciencie.*
- *TIMKEN (1994) Manual de rodamientos. Paris: Timken Co. (621.8/T/M).*

- *González Fernández, Francisco Javier (2009). Teoría y práctica del mantenimiento industrial avanzado. Madrid: Fundación Confemetal (658.202/G71).*
- *Jaramillo Suárez, Héctor Enrique (2008) Introducción a la mecánica de la fractura y análisis de fallas. Cali: Universidad Autónoma de Occidente. (620.1/J24).*
- *Levitt, Joel (2009) The handbook of maintenance management. New York: Industrial Press. (658.202/L54).*
- *Mobley,Keith (2004) Maintenance fundamentals. Boston: Elsevier.(658.202/M67).*
- *Mobley, Roldan (2005) Maintenance fundamentals . New York: Elsevier. (658.202/M67).*
- *Palmer, Doc (2006) Maintenance planning and scheduling handbook. New York: McGraw-Hill. (658.202/P19).*
- *Wireman, Terry (2005) Developing perfomance indicators for managing maintenance. New York: Industrial Press (658.2/W72D)*
- *Wulpi, Donald (2000) Understanding how components fail. Ohio: ASM International. (620.1/W96)*

Materials Engineering Module

<table>
<tr><td>Degree Program</td><td colspan="5">Plant Machinery Maintenance</td></tr>
<tr><td>Module designation</td><td colspan="5">Materials Engineering</td></tr>
<tr><td>Module level, if applicable</td><td colspan="5">First level</td></tr>
<tr><td>Code, if applicable</td><td colspan="5">MM-18</td></tr>
<tr><td>Courses and Semester(s) in which the module is taught</td><td colspan="3">Courses</td><td>ID</td><td>Semester</td></tr>
<tr><td></td><td colspan="3">- Materials Technology</td><td>MG2040</td><td>2</td></tr>
<tr><td></td><td colspan="3">- Strength of Materials</td><td>MM3060</td><td>3</td></tr>
<tr><td></td><td colspan="3">- Advanced Materials Technology</td><td>MM3020</td><td>3</td></tr>
<tr><td>Person responsible for the Module</td><td colspan="3">Lima:
- César Lecaros</td><td colspan="2">Arequipa:
- Ignacio Mamani</td></tr>
<tr><td>Lecturers</td><td colspan="3">Lima:
- Margarita Chevarría
- César Lecaros
- César Nunura
- Luis Sampén</td><td colspan="2">Arequipa:
- Rodrigo Perea
- Ignacio Mamani
- Juan Manuel Gómez</td></tr>
<tr><td>Language</td><td colspan="5">Spanish</td></tr>
<tr><td>Relation to curriculum</td><td colspan="5">Compulsory</td></tr>
<tr><td>Type of teaching, contact hours</td><td colspan="5">Contact hours and class size separately for each teaching method: lecture, lesson, practical, project, seminar, etc.
<table>
<tr><th>Nr</th><th>Courses ID</th><th>Contact hours per week</th><th>Teaching Method</th><th>Class Size</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">MG2040</td><td>2</td><td>Lecture</td><td>40 students</td></tr>
<tr><td>2</td><td>Laboratory</td><td>20 students</td></tr>
<tr><td>2</td><td>MM3060</td><td>3</td><td>Lecture</td><td>40 students</td></tr>
<tr><td rowspan="2">3</td><td rowspan="2">MM3020</td><td>3</td><td>Lecture</td><td>40 students</td></tr>
<tr><td>2</td><td>Laboratory</td><td>20 students</td></tr>
</table></td></tr>
<tr><td>Workload</td><td colspan="5">(Estimated) workload, divided into contact hours (lecture, exercise, laboratory session, etc.) and private study, including examination preparation, specified in hours.
<table>
<tr><th>Nr</th><th>Courses</th><th>Contact Hours per week</th><th>Private Study per week</th><th>Semester Workload</th><th>ECTS Credits</th></tr>
<tr><td>1</td><td>MG2040</td><td>4</td><td>2.92</td><td>109</td><td>3</td></tr>
<tr><td>2</td><td>MM3060</td><td>3</td><td>5.93</td><td>152</td><td>5</td></tr>
<tr><td>3</td><td>MM3020</td><td>5</td><td>4.36</td><td>131</td><td>4</td></tr>
</table></td></tr>
<tr><td>Requirements according to the examination regulations</td><td colspan="5">In order to pass each course of the module, student must obtain a minimal final grade of 11 (eleven). To compute the final grade, the fraction 0.5 or more is considered as a unit in favor the student. (Exam. Reg. 2013 Art. 21)</td></tr>
<tr><td>Recommended prerequisites</td><td colspan="5">Formal: None
Content: Basic Electronic</td></tr>
<tr><td>Module objectives/intended learning outcomes</td><td colspan="5">After having finished the module, students are able to:
Knowledge:
- Differentiate the different properties, non-ferrous, natural, synthetic and ferrous compounds commonly used in industry and analyze its applications.
- Identify, quantify and analyze the impact of different types of efforts that are under mechanical components.
- Identify materials and process used to join materials and analyze the performance of its variables.
Skills:
- Perform destructive and non-destructive testing to metals and synthetic materials.
- Perform heat treatment to metals, with the objective to varying the properties.
Competences:
- Select and dimensioning materials used in components and mechanical systems using norms.
- Evaluate the characteristics of metals and synthetic materials through destructive and non-destructive testing and modify the properties using Heat treatments using standard procedures and safety norms.</td></tr>
</table>

Content	***Materials Technology**: Introduction to the engineering materials. Ferrous materials Ferrous Materials. Obtaining, Classification, Designation and Applications Non-Ferrous Materials. Polymeric materials. Polymeric materials. Compound materials. Measuring properties of materials. Material conformation. (Recognizing machine tools, measurement and verification). Machining processes. Plating Plating. Glued joints. Welded joints. Screw joints.* ***Strength of Materials**: Calculations of forces and reactions. Equilibrium conditions in two dimensions. Geometric and analytic solutions. Equilibrium in tridimensional systems. Forces in elements of machine: axial, radial and tangencial forces. Cutting forces and flector moments. Calculations of DFC and DMF efforts in machine components using physical laws to check their design. Internal efforts in a component. Hooke's law. Compression effort. Effort of traction and cutting. Selection of material subject to combined efforts. Effort of flexion and twisting. Mohr's circle. Dimensioning of components and selection of materials for mechanisms and machines. Element s under sagging.* ***Advanced Materials Technology**: Properties of materials. Testing of materials. Mechanical testing. Traction and impact testing and evaluation of breaking resistance in engineering materials. Mechanical testing II. Non-destructive testing. Non-destructive testing ULTRASOUND. Rubric. Ferrous alloys. Physical metallurgy. Thermal treatments. Alloys with non-ferrous materials. Non-ferrous material. Polymers. Compound materials. Selection of ferrous materials and their thermal treatment for components used in machines. Corrosion I, II.*
Study and examination requirements and forms of examination	- *Practical / laboratory: preparations with review, functional projects, lab reports* - *Lecture: partial quizzes and final written examination.*
Media employed	*Blackboard, slides, beamer presentations, demonstration of lab examples and experiments, lab development tools and equipment.*
Reading list	- *Appold, Hans (1984). Tecnología de los metales. Barcelona: Reverté. (669.9/A64)* - *Ashby, Michael F. (2008). Materiales para ingeniería 1. Introducción a las propiedades, las aplicaciones y el diseño. Madrid: Reverté (620.1/A81/1)* - *De Garmo, E. Paul (1988). Materiales y procesos de fabricación. Barcelona: Reverté (620.1/D36)* - *Higgins, Raymond A. (2006). Materials for engineers and technicians.Massachussetts: s.n. (620.1/H52)* - *Shackelford, James F. (2005). Introducción a la ciencia de materiales para ingenieros. Madrid: Prentice Hall (620.1/SH47/2005)* - *Gere, James M. (2005) Resistencia de materiales. Madrid: Paraninfo. (620.112/G37)* - *Mott, Robert (1996) Resistencia de materiales. México D.F.: Prentice Hall. (620.178/M88)* - *Nash, William A. (1986) Resistencia de materiales. México D.F.: Mc Graw-Hill. (620.112/N26)* - *Ashby, Michael F. (2009). Materiales para ingeniería 2. Introducción a la microestructura, el procesamiento y el diseño. Barcelona: Reverté. (620.1/A81/2)* - *Avner, Sydney (1990) Introducción a la metalurgia física. México D.F.: Mc Graw-Hill. (669/A92)* - *Ellis, W.J. (1998) Ingenería de materiales. México D.F.: Repr. y Serv. de Ingeniería (620.1/E46)* - *Jaramillo Suárez, Héctor Enrique (2008). Introducción a la mecánica de la fractura y análisis de fallas. Cali: Universidad Autónoma de Occidente. (620.1/J24)* - *Lasheras y Esteban, José María (1981) Materiales Industriales. Barcelona: CEDEL. (669/L27)* - *Leyensetter, A. (1987) Tecnología de los oficios metalúrgico. Barcelona: Reverte. (669.02/L55)* - • *Wulpi, Donald J. (2000). Understanding how components fail. Ohio: ASM International. (620.1/W96)*

Manufacturing Process Module

<table>
<tr><td>Degree Program</td><td colspan="4">Plant Machinery Maintenance</td></tr>
<tr><td>Module designation</td><td colspan="4">Manufacturing process</td></tr>
<tr><td>Module level, if applicable</td><td colspan="4">First level</td></tr>
<tr><td>Code, if applicable</td><td colspan="4">MM-19</td></tr>
<tr><td>Courses and Semester(s) in which the module is taught</td><td colspan="2">Courses</td><td>ID</td><td>Semester</td></tr>
<tr><td></td><td colspan="2">- Mechanical workshop</td><td>MG1030</td><td>2</td></tr>
<tr><td></td><td colspan="2">- Manufacturing Process</td><td>MM3130</td><td>3</td></tr>
<tr><td></td><td colspan="2">- Welding for Maintenance</td><td>MM4090</td><td>4</td></tr>
<tr><td>Person responsible for the Module</td><td colspan="2">Lima:
- Mariano Condori
- Luis Rojas</td><td colspan="2">Arequipa:
- Karl Abt
-</td></tr>
<tr><td>Lecturers</td><td colspan="2">Lima:
- Margarita Chevarría
- Mariano Condori
- César Ortiz
- Luis Rojas
- Sixto Sarmiento</td><td colspan="2">Arequipa:
- Karl Abt
- Ignacio Mamani
- Danitza Ordiales</td></tr>
<tr><td>Language</td><td colspan="4">Spanish</td></tr>
<tr><td>Relation to curriculum</td><td colspan="4">Compulsory</td></tr>
<tr><td>Type of teaching, contact hours</td><td colspan="4">Contact hours and class size separately for each teaching method: lecture, lesson, practical, project, seminar, etc.
<table>
<tr><th>Nr</th><th>Courses ID</th><th>Contact hours per week</th><th>Teaching Method</th><th>Class Size</th></tr>
<tr><td>1</td><td>MG1030</td><td>4</td><td>Laboratory</td><td>20 students</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">MM3130</td><td>2</td><td>Lecture</td><td>40 students</td></tr>
<tr><td>6</td><td>Laboratory</td><td>20 students</td></tr>
<tr><td rowspan="2">3</td><td rowspan="2">MM4090</td><td>1</td><td>Lecture</td><td>40 students</td></tr>
<tr><td>3</td><td>Laboratory</td><td>20 students</td></tr>
</table></td></tr>
<tr><td>Workload</td><td colspan="4">(Estimated) workload, divided into contact hours (lecture, exercise, laboratory session, etc.) and private study, including examination preparation, specified in hours.
<table>
<tr><th>Nr</th><th>Courses</th><th>Contact Hours per week</th><th>Private Study per week</th><th>Semester Workload</th><th>ECTS Credits</th></tr>
<tr><td>1</td><td>MG1030</td><td>4</td><td>1.96</td><td>93</td><td>3</td></tr>
<tr><td>2</td><td>MM3130</td><td>8</td><td>1.46</td><td>161</td><td>5</td></tr>
<tr><td>3</td><td>MM4090</td><td>4</td><td>3.07</td><td>120</td><td>4</td></tr>
</table></td></tr>
<tr><td>Requirements according to the examination regulations</td><td colspan="4">In order to pass each course of the module, student must obtain a minimal final grade of 11 (eleven). To compute the final grade, the fraction 0.5 or more is considered as a unit in favor the student. (Exam. Reg. 2013 Art. 21)</td></tr>
<tr><td>Recommended prerequisites</td><td colspan="4">Formal: None
Content: Basic Electronic</td></tr>
<tr><td>Module objectives/intended learning outcomes</td><td colspan="4">After having finished the module, students are able to:
Knowledge:
- Determine operations parameters for machines-tools and welding machines.
- Identify the weldability of ferrous and non-ferrous materials to rebuild and/ or coating by welding and metallic process.
- Develop programs for machines tools with numerical control for mechanical components.
Skills:
- Built mechanical elements and components and assembly basic mechanical system, using tools and manual equipment.
- Rebuild parts of machine elements by Electrical arc welding, TIG, MIG/MAG and oxyfuel.
- Use machine-tools for machining components according to technical parameters.
- Operate machines tools with numerical control for simple mechanical components.
Competences:</td></tr>
</table>

	- *Assess and plan machining process and reconstruction of mechanical components considering safety norms and standard technical procedures.*
Content	***Mechanical workshop**: Safety at work. Material storing at the mechanical workshop Measurement of linear magnitudes. Plate cutting, folding and riveting. Hacksawing Liming. Measurement of linear magnitudes. Drilling, countersinking and reaming Identification of screws. Hand threading. Assembly and disassembly of mechanisms. Installation of accessories and pipelines.* ***Manufacturing Process**: Machining planning. Organization of the course. Safety regulations and procedures for machine tools. Use of machine tools. Angles of tools for machining. Tools for marking out, liming and sawing. Sintered tools for machining. External turning. Assignment: Group programming of CNC machine tools. Cartesian Coordinate System Milling. Operations and accessories of a lathe Operating a CNC lathe. Cartesian Coordinate System Milling. CNC lathe. Assembling a mechanical assembly. Dividing head. Manufacturing plan. Oxyacetylene welding: OAW. Welding terminology, standard processes and related processes. Oxyacetylene welding: OAW. Joints and symbols in welding. Welding processes and related processes. Manual automatic and semi-automatic oxy-fuel cutting. Automatic, semiautomatic and manual cutting. Shielded metal arc welding: SMAW. Follow the safety standards and analyze the risks of working with welding equipment. Filler materials for welding. Discontinuity in welded joints.* ***Welding for Maintenance**: Quality control of welded joints through visual inspection Quality control of welding – Defectology. Gas Metal Arc Welding. Quality control of joints through liquid penetrant examinations and blending. Wear in mechanisms. Performance of liquid penetrant examinations to evaluate welding. Effect of heat on welded joints. Gas tungsten arc welding (GTAW or TIG). Design of welded joints. Gas metal arc welding (GMAW). Weldability of carbon steel, microalloys and low alloys. Hard dissimilar coatings. Recuperation, reconstruction and coverings. Hard coatings. Brazing and soldering. Micropulverization process. Welding of aluminum and its alloys. Welding for maintenance – Real cases. CNC automatic sectionalizing. Automatic sectionalizing using a CNC machine*
Study and examination requirements and forms of examination	- *Practical / laboratory: preparations with review, functional projects, lab reports* - *Lecture: partial quizzes and final written examination.*
Media employed	*Blackboard, slides, beamer presentations, demonstration of lab examples and experiments, lab development tools and equipment.*
Reading list	- *Appold, Hans (1984). Tecnología de los metales. Barcelona: Reverté (669.9/A64)* - *Coca Rebollero, Pedro (2005). Tecnología mecánica y metrotecnia. Madrid: Pirámide (620.1/C72T)* - *Gerling, Heinrich (1989). Alrededor de las máquinas herramientas. Barcelona: Reverté (621.9/G37A)* - *Lobjois, Ch. (1984). Trazado, corte, curvado y plegado. Tecnología de la caldera. Barcelona: CEAC (697.07/L82T)* - *Gerling, Heinrich (1984). Alrededor de las máquinas herramientas. Barcelona: Reverté (621.9/G37A)* - *Horwitz, Henry (1990) Soldadura: aplicaciones y práctica. México D.F.: Alfaomega. (671.52/H76)* - *Leyensetter, A. (1987). Tecnología de los oficios metalúrgicos. Barcelona: Reverté (669.02/L55)* - *Lobjois, Ch. (1984) Uniones provisonales y permanentes. Tecnología de la caldelería. Barcelona: C.E.A.C (697.07/L82U)* - *Solar, Z.C. (1982). Problemas de tecnología de la fresadora. Madrid: Everest. (621.9/S66P)* - *AGA S.A. (1993) Manual de soldadura. (671.52/A/M)* - *American Welding Society (1995) Brazing Handbook. Miami: American Technical Publication. (671.52/A/B)* - *American Welding Society (2005) Specification for welded joints in Machinery and Equipment. Miami: AWS. (671.52/A/S-M)*

	- *Budinskik, Kenne (1983) Engineering materials, properties and selection. Virginia: Res. (620.1/B87)* - *Fernández F. (1988) Soldadura y metalurgia.(671.52/F38S)* - *Graham, Edgar (1985) Maintenance Welding. New Jersey: Prentice Hall. (671.52/G79)* - *Howitz, Henry (1990). Soldadura, aplicaciones y práctica. México D.F.: Alfaomega. (671.52/H76)* - *Oerlikon (1992) Manual de soldadura. Lima: Friba S.A. (671.52/O5)* - *Tecsup (1998) Procesos de soldadura MIG-MAG Lima: Tecsup (671.52/T/M)* - *Tecsup (1998) Procesos de Soldadura TIG. Lima: Tecsup (671.52/T/T)* - *Tecsup (2004) Recuperación de piezas por Soldadura Lima: Tecsup. (671.52/T/R-S)* - *Wulpi, Donald J. (2000) Understanding how components fail. Ohio: ASM International. (620.1/W96)*

Mechatronics Module

<table>
<tr><td>Degree Program</td><td colspan="5">Plant Machinery Maintenance</td></tr>
<tr><td>Module designation</td><td colspan="5">Mechatronics</td></tr>
<tr><td>Module level, if applicable</td><td colspan="5">First level</td></tr>
<tr><td>Code, if applicable</td><td colspan="5">MM-20</td></tr>
<tr><td rowspan="3">Courses and Semester(s) in which the module is taught</td><td colspan="2">Courses</td><td>ID</td><td colspan="2">Semester</td></tr>
<tr><td colspan="2">- Industrial Electrotechnics</td><td>EM4010</td><td colspan="2">4</td></tr>
<tr><td colspan="2">- Industrial Mechatronics Systems</td><td>MM6160</td><td colspan="2">6</td></tr>
<tr><td>Person responsible for the Module</td><td colspan="2">Lima:
- Miguel Chávez</td><td colspan="3">Arequipa:
- Nilton Anchayhua</td></tr>
<tr><td>Lecturers</td><td colspan="2">Lima:
- Francisco Camacho
- Miguel Chávez</td><td colspan="3">Arequipa:
- Nilton Anchayhua
- Jesús Medina</td></tr>
<tr><td>Language</td><td colspan="5">Spanish</td></tr>
<tr><td>Relation to curriculum</td><td colspan="5">Compulsory</td></tr>
<tr><td>Type of teaching, contact hours</td><td colspan="5">Contact hours and class size separately for each teaching method: lecture, lesson, practical, project, seminar, etc.
<table>
<tr><th>Nr</th><th>Courses ID</th><th>Contact hours per week</th><th>Teaching Method</th><th>Class Size</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">EM4010</td><td>2</td><td>Lecture</td><td>40 students</td></tr>
<tr><td>3</td><td>Laboratory</td><td>20 students</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">MM6160</td><td>3</td><td>Lecture</td><td>40 students</td></tr>
<tr><td>3.5</td><td>Laboratory</td><td>20 students</td></tr>
</table></td></tr>
<tr><td>Workload</td><td colspan="5">(Estimated) workload, divided into contact hours (lecture, exercise, laboratory session, etc.) and private study, including examination preparation, specified in hours.
<table>
<tr><th>Nr</th><th>Courses</th><th>Contact Hours per week</th><th>Private Study per week</th><th>Semester Workload</th><th>ECTS Credits</th></tr>
<tr><td>1</td><td>EM4010</td><td>5</td><td>3.46</td><td>135</td><td>5</td></tr>
<tr><td>2</td><td>MM6160</td><td>6.5</td><td>3.34</td><td>167</td><td>6</td></tr>
</table></td></tr>
<tr><td>Requirements according to the examination regulations</td><td colspan="5">In order to pass each course of the module, student must obtain a minimal final grade of 11 (eleven). To compute the final grade, the fraction 0.5 or more is considered as a unit in favor the student. (Exam. Reg. 2013 Art. 21)</td></tr>
<tr><td>Recommended prerequisites</td><td colspan="5">Formal: None
Content: Basic Electronic</td></tr>
<tr><td>Module objectives/intended learning outcomes</td><td colspan="5">After having finished the module, students are able to:
Knowledge:
- Analyzing the responses of sensors and actuators of a mechatronics.
- Designs, assembles, installs and electrical control panels.
- Configure and program a Programmable Logic Controller to control a manufacturing system.
- Check the operation of a mechatronic system.
Skills:
- Operate mechatronics systems for manufacturing process.
- Measure electrical parameters using appropriate instruments.
Competences:
- Diagnose failures and propose solutions in an industrial mechatronic system.</td></tr>
<tr><td>Content</td><td colspan="5">Industrial Electrotechnics : Safety in electrical installations. Three-phase circuits. Components of an electrical system. Symbols and electrical schematics. Single-phase transformer. Three-phase transformer. Respect of safety parameters and evaluation of the risk of electrical equipment at work. Distribution switchboards. DC electrical motors. Failure detection in components and electrical control systems using the electricity rules. Types of DC motors. Asynchronous squirrel cage motor. Selection of a squirrel cage motor. Direct starting of a motor. Star-delta starting of a motor Programmable logic controller. Basic PLC programming. Automation system using PLC. Speed variators in solid state</td></tr>
</table>

	***Industrial Mechatronics Systems**: Introduction to mechatronics. Measurement devices. Students use the concepts of electricity, electronics and computing to monitor and diagnose an industrial mechatronic system. Actuators. Fundamentals of automatic control. Programmable logic controllers. PLC programming. Students develop creative solutions using technology in mechatronic systems. Computer Integrated Manufacture (CIM) and Flexible Manufacturing System (FMS). Industrial robotics. Industrial networks. Applications of mechatronic systems*
Study and examination requirements and forms of examination	- *Practical / laboratory: preparations with review, functional projects, lab reports* - *Lecture: partial quizzes and final written examination.*
Media employed	*Blackboard, slides, beamer presentations, demonstration of lab examples and experiments, lab development tools and equipment.*
Reading list	- *Castejón, Agustín (1998) Tecnología eléctrica. Madrid: Mc Graw-Hill. (621.3/C32)* - *Ponce Cruz, Pedro (2008) Máquinas eléctricas y técnicas modernas de control. México D.F.: Alfaomega (621.3MO/P77)* - *Siemens, AG. (2000) Manual de baja tensión. Berlín: Siemens. (621.3/S/2000)* - *Ubieto Artur, Pedro (1998) Diseño básico de automatismos eléctricos. Madrid: Paraninfo. (621.3A/U14)* - *Alciatore, David (2008) Introducción a la mecatrónica y los sistemas de medición. México D.F.: McGraw-Hill (629.8/A37).* - *Bishop, Robert (2002) The Mechatronics Handbook. New York: ISA. (621.381/B59)* - *Bolton, William (2001) Mecatrónica. México D.F.: Alfaomega. (621.381/B72).* - *Ferreira Romano, Vitor (2002) Robótica industrial. Sao Paulo: s.n. (629.8/F43).* - *Pallas Areny, Ramón (2003) Sensores y acondicionadores de señal. Barcelona: Marcombo. (621.381I/P19S/2003)* - *Wait, John (1986) Introducción al amplificador operacional. Barcelona: Gili. (621.381AO/W17).*