Universidad Nacional José Faustino Sánchez Carrión

FACULTAD DE INGENIERÍA INDUSTRIAL, SISTEMAS E INFORMÁTICA

ESCUELA PROFESIONAL DE INGENIERÍA ELECTRÓNICA

SÍLABO POR COMPETENCIAS

ROBOTICS & CONTROL SYSTEM

2019 - II

DOCENTE:

ING. ERNESTO DÍAZ RONCEROS

SYLLABUS: ROBOTICS & CONTROL SYSTEM
2019 - II

I. GENERAL INFORMATION

LÍNEA DE CARRERA	AUTOMATIZACIÓN INDUSTRIAL
CURSO	ROBOTICS & CONTROL SYSTEM
CÓDIGO	553
HORAS	HT: 2 HL: 4 TH=6
CICLO	X
CRÉDITOS	04
CONDICIÓN	OBLIGATORIO
PRE – REQUISITO	INDUSTRIAL AUTOMATION CONTROL SYSTEM (503)
SEMESTRE ACADÉMICO	2019 – II
DOCENTE	Ing. Ernesto Díaz Ronceros
COLEGIATURA	CIP 197965
CORREO ELECTRÓNICO	ediazronceros@gmail.com

II. SUMMARY AND COURSE DESCRIPTION

The course is of theoretical-practical nature and provides knowledge about the general fundamentals of Robotics. Spatial Description and Transformation.

Introduction To Industrial Robotics. Robot Kinematic Modeling, Calculation Of Speeds And Singularities. Dynamic Robot Modeling. Control of robots in the joint space.

COMPETENCES OF THE SPECIALTY

The student understands the fundamental concepts of robotics of manipulators. It formulates the interpretation of concepts related to robotics and expert systems. Analyzes, designs, models, programs and implements robotic systems applying concepts of kinematics, dynamics, manipulative robots, trajectories, interpolations, parameters of Denavit Hartenberg, etc. Program a sequence of routines of the Motoman robot.

COMPETITIONS OF THE COURSE

1. Describes the evolution of robotics and industrial manipulators.

2. Understands the types of direct and reverse kinematics by which the movement of robots is modeled and originated

3. Design and simulate control and position trajectories

4. Develops programming and assembly routines for the Motoman robot using the Teach Pendant

III. CAPACITIES AT THE END OF THE COURSE

	CAPACITY OF THE TEACHING UNIT	NAME OF THE TEACHING UNIT	WEEKS
UNIT I	Know the basic structure and operation of industrial manipulator robots.	Introduction to Robotics and Control System	4
UNIT II	Know the main applications of industrial robots. Know the technology of the different elements that make up a robot.	Kinematics of Manipulators	4
UNIT III	Know and know how to apply the physical principles necessary for the design and control of robots.	Robot trajectory and control	4
UNIT IV	Know how to program basic tasks in a commercial industrial robot.	Programming language of industrial robots	4

IV. CAPACITY INDICATORS AT THE END OF THE COURSE

NUMBER	CAPACITY INDICATORS AT THE END OF THE COURSE
1	*Argues* the importance of the use of robots in industry.
2	*Classifies* robots according to their different characteristics.
3	*Identifies* the fundamental parts of a robot.
4	*Describes* a manipulative robot.
5	*Program* moves for manipulative robots.
6	*Difference* between direct kinematics and reverse kinematics.
7	*Identifies* the parameters of Denavit Hartenberg.
8	*Designs* the homogeneous transformation matrix.
9	*Models* robotic systems, develops a simulation for a robotic system.
10	*Develops* a simulation for a robotic system.
11	*Plan* trajectories and sequences.
12	*Understands* interpolation techniques.
13	*Designs diffuse* control strategies.
14	*Develops* fuzzification and defuzzification techniques
15	*Analyze* the FS100 controller of the Motoman robot.
16	*Control* the Teach Pendant to program the Motoman robot.
17	*Understand* the movement types to assign to the robot.
18	*Design* trajectories by programming.
19	*Selected* actuators to complement the development of the project.

V. DEVELOPMENT OF TEACHING UNITS

<table>
<tr><td rowspan="7">DIDACTIC UNIT I: I Introduction to Robotics and Control System</td><td colspan="5">CAPACITY OF THE DIDACTIC UNIT I: Know the basic structure and operation of industrial manipulator robots.</td></tr>
<tr><td rowspan="2">Week</td><td colspan="3">Contents</td><td rowspan="2">Didactic strategy</td><td rowspan="2">Indicators of capacity achievement</td></tr>
<tr><td>Concepts</td><td>Procedures</td><td>Attitudes</td></tr>
<tr><td>1</td><td>➢ Introduction. Motivation.
➢ History of Robotics Historia de la Robótica.</td><td rowspan="4">Investigate the origin of robotics.

Develop knowledge on the classification of robots.

Differentiate the robots according to their autonomy.

Differentiating robots according to their morphology</td><td rowspan="4">Collaborates with his classmates.

Admires the importance of industrial robots.

Share in class knowledge on the proposed topic.</td><td rowspan="4">Academic presentation.

Solves proposed cases.

Use simulators for robot programming.</td><td rowspan="4">Argues the importance of the use of robots in industry.

Classifies robots according to their different characteristics.

Identifies the fundamental parts of a robot.

Describes a manipulative robot.

Program moves for manipulative robots.</td></tr>
<tr><td>2</td><td>➢ Robotics Industrial.
➢ Robotic manipulators.</td></tr>
<tr><td>3</td><td>➢ Autonomous Robots.
➢ Telerobotics.</td></tr>
<tr><td>4</td><td>➢ Morphology of manipulators.
➢ Types of joints.</td></tr>
<tr><td rowspan="2"></td><td colspan="5">EVALUATION OF THE TEACHING UNIT</td></tr>
<tr><td colspan="2">EVIDENCE OF KNOWLEDGE</td><td colspan="2">EVIDENCE OF PRODUCT</td><td>EVIDENCE OF PERFORMANCE</td></tr>
<tr><td colspan="2">Written assessment to students at the end of the teaching unit.</td><td colspan="2">Presentation and writing of an academic paper.</td><td>Programming and simulation of sequences of a robot manipulator.</td></tr>
</table>

<table>
<tr><td rowspan="6">DIDACTIC UNIT II: Kinematics of Manipulators</td><td colspan="5">CAPACITY OF THE DIDACTIC UNIT II: Know the main applications of industrial robots. Know the technology of the different elements that make up a robot.</td></tr>
<tr><td rowspan="2">Week</td><td colspan="3">Contents</td><td rowspan="2">Didactic strategy</td><td rowspan="2">Indicators of capacity achievement</td></tr>
<tr><td>Concepts</td><td>Procedures</td><td>Attitudes</td></tr>
<tr><td>5</td><td>➢ Representation of Position and Orientation.
➢ Plane and Space.</td><td rowspan="4">Differentiate the position and orientation of the final effector

Create rotation matrices for each joint.

Investigate the parameters of Denavit Hartenberg.

Solve the homogeneous transformation matrix.</td><td rowspan="4">Collaborates with his colleagues.

Admires the importance of mathematical modeling.

Shares in class knowledge on the proposed topic.</td><td rowspan="4">Academic presentation.

Solves proposed cases.

Use simulators for robot programming.</td><td rowspan="4">Difference between direct kinematics and reverse kinematics.

Identifies the parameters of Denavit Hartenberg.

Designs the homogeneous transformation matrix.

Models robotic systems, develops a simulation for a robotic system.

Develops a simulation for a robotic system.</td></tr>
<tr><td>6</td><td>➢ Rotation Matrices.
➢ Direct kinematics.
➢ Denavit-Hartenberg Parameters.</td></tr>
<tr><td>7</td><td>➢ Homogenous Transformation Matrix.
➢ Composite homogeneous Transformation Matrix.</td></tr>
<tr><td>8</td><td>➢ Inverse kinematics.
➢ Algebraic methods.</td></tr>
<tr><td></td><td colspan="5">EVALUATION OF THE TEACHING UNIT</td></tr>
<tr><td></td><td colspan="2">EVIDENCE OF KNOWLEDGE</td><td colspan="2">EVIDENCE OF PRODUCT</td><td>EVIDENCE OF PERFORMANCE</td></tr>
<tr><td></td><td colspan="2">Written assessment to students at the end of the teaching unit.</td><td colspan="2">Presentation and writing of an academic paper.</td><td>Programming and simulation of sequences of a robot manipulator.</td></tr>
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<table>
<tr><td rowspan="6">DIDACTIC UNIT III: Robot trajectory and control</td><td colspan="5">CAPACITY OF THE DIDACTIC UNIT III: Know and know how to apply the physical principles necessary for the design and control of robots.</td></tr>
<tr><td rowspan="2">Week</td><td colspan="3">Contents</td><td rowspan="2">Didactic strategy</td><td rowspan="2">Indicators of capacity achievement</td></tr>
<tr><td>Concepts</td><td>Procedures</td><td>Attitudes</td></tr>
<tr><td>9
10
11
12</td><td>➢ Trajectory Planning.
➢ Interpolation Techniques.
➢ Method of the homogeneous Transformation Matrix.
➢ Control Strategies. Diffuse control for Mobile robots.
➢ Fuzzification and defuzzification techniques.</td><td>Create trajectories for a robot.
Apply interpolation techniques.
Design control strategies.
Implement fuzzification and defuzzification techniques.</td><td>Collaborates with his colleagues.
Admires the importance of the diffuse control method.
Shares in class knowledge on the proposed topic.</td><td>Academic presentation.
Solves proposed cases.
Use simulators for robot programming.</td><td>Plan trajectories and sequences.
Understands interpolation techniques.
Designs diffuse control strategies.
Develops fuzzification and defuzzification techniques.</td></tr>
<tr><td colspan="5">EVALUATION OF THE TEACHING UNIT</td></tr>
<tr><td colspan="5"><table>
<tr><td>EVIDENCE OF KNOWLEDGE</td><td>EVIDENCE OF PRODUCT</td><td>EVIDENCE OF PERFORMANCE</td></tr>
<tr><td>Written assessment to students at the end of the teaching unit.</td><td>Presentation and writing of an academic paper.</td><td>Programming and simulation of sequences of a robot manipulator.</td></tr>
</table></td></tr>
</table>

DIDACTIC UNIT IV: Programming language of industrial robots						
	CAPACITY OF THE DIDACTIC UNIT IV: Know how to program basic tasks in a commercial industrial robot.					
	Week	Contents			Didactic strategy	Indicators of capacity achievement
		Concepts	Procedures	Attitudes		
	13	➢ Programming language of industrial robots.	**Apply** programming knowledge. **Create** programming routines for a Yaskawa robot. **Operate** the Teach Pendant. **Develop** a project with the Yaskawa robot.	**Collaborates** with his colleagues. **Admires** the importance of the diffuse control method. **Shares** in class knowledge on the proposed topic.	**Academic** presentation. **Solves** proposed cases. **Use** the Teach Pendant to program the Motoman robot.	**Analyze** the FS100 controller of the Motoman robot. **Control** the Teach Pendant to program the Motoman robot. **Understand** the movement types to assign to the robot. **Design** trajectories by programming. **Selected** actuators to complement the development of the project.
	14	➢ Programming Functions and Structures. ➢ Teach Pendant.				
	15	➢ KSS programming language (KUKA SYSTEM SOFTWARE).				
	16	➢ Development of an assembly with the KUKA Robot and Yaskawa Robot.				
		EVALUATION OF THE TEACHING UNIT				
		EVIDENCE OF KNOWLEDGE	**EVIDENCE OF PRODUCT**	**EVIDENCE OF PERFORMANCE**		
		Written assessment to students at the end of the teaching unit.	Presentation and writing of an academic paper.	Programming and simulation of sequences of a robot manipulator.		

VI. EDUCATIONAL MATERIALS AND OTHER TEACHING RESOURCES

All materials and resources required will be used according to the nature of the programmed topics, basically will be:

1. **WRITTEN MEDIA:**
   - Separates with thematic contents.
   - Academic guides.
   - Books selected by bibliography.
2. **VISUAL AND ELECTRONIC MEDIA:**
   - Interactive board.
   - Blackboard.
   - Multimedia projector.
   - Laboratory of robotics.
3. **TECHNOLOGY OF THE INFORMATION AND COMMUNICATION:**
   - Computer.
   - Wi-Fi
   - Internet.

VII. EVALUATION

1. EVIDENCE OF KNOWLEDGE

They are the answers to questions related to knowledge necessary for performance. This includes knowledge of facts and processes, understanding of principles and theories, and how to use and apply knowledge in everyday or new situations.

2. EVIDENCE OF PERFORMANCE

Relative to knowing how to do (how to execute) the Apprentice, puts into play their knowledge, their skills and their attitudes. This type of evidence allows to obtain direct and more reliable information, on how the Apprentice develops the technical or technological process, in order to be able to identify the apprenticeships that it possesses and those that it has yet to reach. The attitudes, values and behaviours of the Apprentice are par excellence, subject of this type of evidence.

3. EVIDENCES OF PRODUCT

Evidence by product refers to the result that the student is asked to produce something; to evaluate this type of evidence it is not indispensable to observe the student in the development of the activities, rather requires a review and/or situations already established.

The evaluation and control of attendance will be taking into account the norms in the Academic Regulation of the University, approved with Resolution of the University Council N°0105-2016-CU-UNJFSC, dated 01 March 2016.

Attendance at theoretical and practical classes is compulsory; the accumulation of more than 30% of unjustified absences will result in the disapproval of the subject by the limit of inasistencias with zero note (Art. 121°).

The system of evaluation is integral, permanent, qualitative and quantitative (vigesimal) and conforms to the characteristics of the subjects, within the general guidelines established by the Statute and the current Academic Regulations.

The vigesimal quantitative character is that the valuation scale is from zero (00) to twenty (20), for any evaluation process, with eleven (11) being the minimum approval note, for cases where students have not completed any or more partial evaluations, the zero note (00) shall be considered for the purpose of performing the average (Art. 130°and 131°).

The subject evaluation, according to Art. 127°b) of the Academic Regulation shall be carried out in four modules and each module shall take into account: knowledge assessment (EC), product evaluation (PE) and performance evaluation (ED), taking into account weighting (P1), the average of each module, with a decimal and without rounding will be given by

$$PM = (0.30)(EC) + (0.35)(EP) + (0.35)(ED)$$

The final grade of the subject will be the simple average of the averages of the four modules, only in this case the fraction 0.5 plus will be rounded to the immediate upper integer, plus there is no substitute exam and will be given by the formula.

$$NF = \frac{PM1 + PM2 + PM3 + PM4}{4}$$

VIII. BIBILIOGRAPHY

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- MATLAB R2007a The MathWorks Inc. Toolbox Image Processing. Toolbox Fuzzy Logic. Toolbox Neural Network. Toolbox Hemero Marzo 2007.
- MARTIN del Brio, Bonifacio y SANZ, Alfredo. "Redes Neuronales y Sistemas Borrosos". 3ra Edición. México. Alfa y Omega. 2003.

Huacho, Setiembre de 2019

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