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Colleg of Engineering

BACHELOR OF SCIENCE IN MECHATRONICS ENGINEERING

COURSE INFORMATION SYLLABUS (CIS)

Vision	A premier national university that develops leaders in the global knowledge economy.			
Mission	A university committed to producing leaders by providing a 21st century learning environment through innovations in education, multidisciplinary research, and community and industry partnerships in order to nurture the spirit of nationhood, propel the national economy and engage the world for sustainable development.			
Course Title	Robotics I		**Course Code**	MexE 406
Course Category	Professional Course		**Pre-requisite(s)**	ENGG 410 Engineering Mechanics and MEXE
Semester/Year	1st Semester AY 2024-2025		**Credit Hours**	3
Course Instructors	Engr. Mikko A. De Torres	17308	**Reference CMO**	
	Mechatronics Engineer		**Date Prepared**	August 17, 2024
	mikko.detorres@g.batstate-u.edu.ph/09568517289		**Revision No.:**	3
			Revision Date:	August 17, 2024
Period of Study	August 19 - December 8, 2024			
Course Rationale and Description	*Exposure to different technologies and automations used in the industry is essential in upgrading the competency of one's company. One great product of such technology is the creation of robots. It is important for Mechatronics Engineers to know the basic knowledge about robots and how they are created and programmed. It is important for them to have basic idea about robots which will be of great help for them in their future endeavor in the industry.* *The study of robotics concerns itself with the desire to synthesize some aspects of human function by the use of mechanisms, sensors, actuators, and computers. Obviously, this is a huge undertaking, which seems certain to require a multitude of ideas from various "classical" fields. In this Robotics 1 subject, Mechatronics Engineering students will be introduced to the brief history, advantages and disadvantages and mechatronics design of robots.*			
Contact Hours	*3 hours lecture*			
Criteria for Assessment	*25% Midterm Exam* *25% Final Practical Exam* *10% Long Quiz* *20% Coding Activities* *20% Individual Recitation*			
Teaching, Learning, and Assessment Strategies	*Lecture* *The course will be carried out using blended (face-to-face and on-line) learning. Face-to-face and online learning will be done through traditional classroom set-up with the support of Learning Managaemant Systems for the purpose of adopting to new normal.* *Online learning will still be approached through a Learning Management System using https://classroom.google.com/ where each class is given a webpage for their specific course and section to manage all their assessments (assignments, major exams, and course project). Students may use their mobile or personal laptops/computer in accessing the said Learning Management System.* *Major Exams* *There will be two major examinations (midterms and finals). The scope of each exam will include but not limited to those topics given in online classes. Exams will commence and end on the scheduled time through face-to-face scheduled exam of the course per section.* *Students who will not be able to take the exam as scheduled but with valid reasons, are obliged to present medical certificate, letter, etc. signed by authorized person in a week time. Special examinations will be given in an arranged schedule.*			

Intended Learning Outcomes (ILO)	**ILO**	**Upon completion of this course, the students should be able to:**
	ILO1	Calculate and determine the kinematic parameters (position, orientation, and velocity) of a robotic manipulator using mathematical models and geometric representations. (SO1 and SO5)
	ILO2	Develop and implement Python code to simulate and control the motion of a robotic manipulator based on given kinematic and dynamic parameters. (SO2)
	ILO3	Analyze the relationship between the mechanical design of a robotic manipulator and its kinematic performance, evaluating the impact of different parameters on manipulator capabilities. (SO1 and SO5)
	ILO4	
	ILO5	
	ILO6	
	ILO7	

Assessment Method and Distribution Map

Assessment Tasks (AT) Distribution				Intended Learning Outcomes							Domains		
Code	**Assessment Tasks**	**I/R/D**	**(%)**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**C**	**P**	**A**
ME	Midterm Exam	R	25	54		16						70	
FE	Final Practical Exam	R	25			50						50	
LQ	Long Quiz	R	10			50						50	
CP	Coding Project	R	20		90								90
IR	Individual Recitation	R	20	70								70	
Total			**100**										

Note: All internal assessments with feedback will be made available within 2 week after each assessment submission except Final Examination.

Textbook	1	Spong, M. W., Hutchinson, S., & Vidyasagar, M., Robot Modeling and Control (1st ed.),Wiley, 2011
	2	Peter Corke, Robotics, Vision and Control_ Fundamental Algorithms In MATLAB, 2nd Ed. Springer, 2011
Other Books and Articles	3	Craig, J., Introduction to Robotics – Mechanics and Control , 3rd Ed. Pearson Education, 2005
	4	Pratihar D.K., Fundamentals of Robotics, New-Delhi, Narosa Publishing,2017
	5	Angela Sodeman (2017), YouTube Playlist, Robotics 1 U1 (Kinematics) S1 (Preliminaries),
	6	InQuisitive (2020), YouTube Video, Video Lecture on Robot Anatomy, Links and joints,
	7	AlNaimi, Ibrahim. (2018), Robotics and Automation, Chapter 2: Introduction to Robot Manipulators,
	8	

Institutional Graduate Attributes (IGA)	**IGA**	**Institutional Graduate Attributes (IGA) Statements**
	IGA1	**Knowledge Competence** Demonstrate a mastery of the fundamental knowledge and skills required for functioning effectively as a professional in the discipline, and an ability to integrate and apply them effectively to practice in the workplace.
	IGA2	**Creativity and Innovation** Experiment with new approaches, challenge existing knowledge boundaries and design novel solutions to solve problems.
	IGA3	**Critical and Systems** Identify, define, and deal with complex problems pertinent to the future professional practice or daily life through logical, analytical and critical thinking.
	IGA4	**Communication** Communicate effectively (both orally and in writing) with a wide range of audiences, across a range of professional and personal contexts, in English and Pilipino.
	IGA5	**Lifelong Learning** Identify own learning needs for professional or personal development; demonstrate an eagerness to take up opportunities for learning new things as well as the ability to learn effectively on their own.
	IGA6	**Leadership, teamwork, and Interpersonal Skills** Function effectively both as a leader and as a member of a team; motivate and lead a team to work towards goal; work collaboratively with other team members; as well as connect and interact socially and effectively with diverse culture.
	IGA7	**Global Outlook** Demonstrate an awareness and understanding of global issues and willingness to work, interact effectively and show sensitivity to cultural diversity.
	IGA8	**Social and National Responsibility** Demonstrate an awareness of their social and national responsibility; engage in activities that contribute to the betterment of the society; and behave ethically and responsibly in social, professional and work environments.

Student Outcomes (SO)	**SO**	**Student Outcomes (SO) Statements**
	SO1	**Discipline Knowledge** Ability to apply mathematics, sciences and principles of engineering to solve complex engineering problems;
	SO2	**Investigation** Ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions;
	SO3	**Design/Development of Solutions** Design solution, system, components, processes, exhibiting improvements/innovations, that meet specified needs with appropriate consideration for public health and safety, cultural, societal, economical, ethical, environmental and sustainability issues.
	SO4	**Leadership and Teamwork** Function effectively as a member of a leader on a diverse team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
	SO5	**Problem Analysis** Identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics;
	SO6	**Ethics and Professionalism** Apply ethical principles and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, environmental, and societal contexts.
	SO7	**Communication** Communicate effectively on complex engineering activities with the community, and the society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions;
	SO8	**Environment and Sustainability** Recognize the impact of professional engineering solutions in societal, global, and environmental contexts and demonstrate knowledge of and need for sustainable development;
	SO9	**Lifelong Learning** Recognize the need for, and ability to engage in independent and life-long learning in the broadest context of technological change.
	SO10	**The Engineer and Scociety** Apply reasoning based on contextual knowledge to assess societal, health, safety, legal, cultural, contemporary issues, and the consequent responsibilities relevant to professional engineering practices.
	SO11	**Modern Tool Usage** Apply appropriate techniques, skills, and modern engineering and IT tools to complex marine engineering activities;
	SO12	**Project Management and Finance** Demonstrate knowledge and understanding of engineering management and financial principles as member or a leader of a team to manage projects in multidisciplinary settings, and identify opportunities of entrepreneurship.
	SO13	**Social and National Responsibility** Apply acquired engineering knowlegde and skills in addressing community problems that contributes to national development.
CDIO Framework Skills	**CDIO**	**CDIO Skills**
	CDIO1	**Disciplinary Knowledge & Reasoning** Knowledge of underlying mathematics and sciences, core engineering fundamental knowledge, advanced engineering fundamental knowledge, methods and tools
	CDIO2	**Personal and Professional Skills & Attributes** Analytical reasoning and problem solving; experimentation , investigation and knowledge discovery; system thinking; attitudes, thoughts and learning; ethics, equity and other responsibilities
	CDIO3	**Interpersonal Skills: Teamwork & Communication** Teamwork, communications, communication in a foreign language
	CDIO4	**Conceiving, Designing, Implementing & Operating Systems** External, societal and environmental context, enterprise and business context, conceiving, systems engineering and management, designing, implementing, operating

	SDG	SDG Skills
Sustainable Development Goals Skills	**SDG1**	**Envisioning** Establish a link between long-term goals and and immediate actions, and motivate people to take action by harnessing their deep aspirations.
	SDG2	**Critical Thinking and Reflection** Examine economic, environmental, social and cultural structures in the context of sustainable development, and challenges people to examine and question the underlying assumptions that influence their world views by having them reflect on unsustainable practices.
	SDG3	**Systemic Thinking** Recognise that the whole is more than the sum of its parts, and it is a better way to understand and manage complex situations.
	SDG4	**Building Partnerships** Promote dialogue and negotiation, learning to work together, so as to strengthen ownership of and commitment to sustainable action through education and learning.
	SDG5	**Participation in Decision Making** Empower oneself and others through involvement in joint analysis, planning and control of local decisions.

COURSE POLICIES

A.

GRADING SYSTEM

The grading system adopted by this course is as follows:

Excellent	1.00	98 - 100
Superior	1.25	94 - 97
Very Good	1.5	90 - 93
Good	1.75	88 - 89
Meritorious	2.00	85 - 87
Very Satisfactory	2.25	83 - 84
Satisfactory	2.50	80 - 82
Fairly Satisfactory	2.75	78 - 79
Passing	3.00	75 - 77
Failure	5.00	Below 70
Incomplete	INC	

*Students who got a computed grade of 70-74 will be given an appropriate remedial activity in which the final grade should be either passing (3.0) or failure (5.0).

B.

CLASS POLICY

Prompt and regular attendance of students is required. Total unexcused absences shall not exceed ten (10) percent of the maximum number of hours required per course per semester (or per summer term). A semester has 18 weeks.

MISSED EXAMINATIONS

Students who failed to take the exam during the schedule date can be given a special exam provided he/she has valid reason. If it is health reason, he/she should provide the faculty with the medical certificate signed by the attending Physician. Other reasons shall be assessed first by the faculty to determine its validity.

ACADEMIC DISHONESTY

Academic dishonesty includes acts such as cheating during examinations or plagiarism in connection with any academic work. Such acts are considered major offenses and will be dealt with according to the University's Student Norms of Conduct.

DROPPING

Dropping must be made official by accomplishing a dropping form and submitting it at the Registrar's Office before the midterm examination. Students who officially drop out of class shall be marked "Dropped" whether he took the preliminary examination or not and irrespective of their preliminary grades.

A student who unofficially drops out of class shall be given a mark of "5.0" by the instructor.

C.	**OTHER COURSE POLICIES AND REQUIREMENTS**
	Every student is expected to participate in every class activity. Students may do the ungraded activities on their own time. However, students are encourage to at least do this synchronously with the class. They are also encouraged to work on the activities with groups of their classmates. The purpose of the activities is to practice with the material and to improve stduents' understanding. It is encouraged that students engage learning from each other, and may ask the instructor when there are questions. However, the solutions submitted for grading must be done *individually* . This ensures that that sudents understand the reasoning of each problem, even if they initially solved the problem with the help of their classmates.
	There will be two major examinations and two quizzes to be done in person. Other requirements may be submitted online via google forms or other e-learning platforms. Problem sets, assignments and other exercises will be given to fully understand the concepts being presented in class. It will be due at the beginning of the following lecture period unless otherwise specified. Late requirement/s will not be accepted and will be given a score of zero.

Teaching, Learning, and Assessment (TLA) Activities

Ch	Topics / Reading List	Wks	Topic Outcomes	ILO	SO	Delivery Method
	Orientation & Introduction	1	Presentation of Syllabus, Class Rules			Lecture / discussion
1	History and Introduction of Robotics *1. History of robots* *2. Introduction to type of robots* *3. Introduction to engineering and mathematic tools for Robotics* Reading List: Nanyang Polytechnic (2004), Power Point Presentations, Industrial Robot and it's Integrated Technologies	1	Topic outcome 1 1. Define Robotics and Mechatronics Engineering 2. Differentiate robot arms and mechanical manipulators 3. Benefits of studying and building robots.	1	5	Discussion Forum Problem based Learning Google Classroom
	Mechanical Manipulator *Types of Mechanical Manipulator* Reading List: InQuisitive (2020), YouTube Video, Video Lecture on Robot Anatomy, Links and joints, https://www.youtube.com/watch?v=kLZP0kym2-s&t=141s Types of Mechanical Manipulator AlNaimi, Ibrahim. (2018), Robotics and Automation, Chapter 2: Introduction to Robot Manipulators, https://www.philadelphia.edu.jo/academics/inaimi/uploads/Introduction%20to%20Robot%20manipulator.pdf Angela Sodeman (2017), YouTube Playlist, Robotics 2 U1 (Kinematics) S6 (Parallel Manipulators), https://www.youtube.com/watch?v=wybp1_htA7k&list=PLT_0lwItn0sAfi3o4xwx-fNfcnbfMrXa7&index=10	2,3	Topic outcome 2 1. Mechanical Manipulator anatomy 2. Different classification of joints 1. Types of Mechanical Manipulator based on Motion Characteristics 2. Types of Mechanical Manipulator based on Power Source 3. Types of Mechanical Manipulator based on Control Methods 4. Types of Mechanical Manipulator based on Joints Orientation 5. Types of Mechanical Manipulator based on the number of Degrees of Freedom	1	5	Discussion Forum Problem based Learning Google Classroom
	Degrees of Freedom of Mechanical Manipulator Reading List:AlNaimi, Ibrahim. (2018), Robotics and Automation, Chapter 2: Introduction to Robot Manipulators, https://www.philadelphia.edu.jo/academics/inaimi/uploads/Introduction%20to%20Robot%20manipulator.pdf	4,5	Topic outcome 3 1. Continuation of Types of Mechanical Manipulator based on the number of Degrees of Freedom 2. Solving the degrees of freedom of mechanical manipulator	3	1,5	Discussion Forum Problem based Learning Google Classroom
2	Kinematic Diagrams *Denavit -Hartenberg Notation Frame Assignment rules* Reading List: Angela Sodeman (2017), YouTube Playlist, Robotics 1 U1 (Kinematics) S1 (Preliminaries), https://www.youtube.com/watch?v=pLXoDRctwRg&list=PLT_0lwItn0sDBE98BsbaZezflB96ws12b	6,7	Topic outcome 4 1. Practice drawing and labeling kinematic diagrams for frame asignments 2. Introduction to Denavit - Hartenberg Notation Frame Assignment rules			Discussion Forum Problem based Learning Google Classroom
	Long Quiz	8	*Conduct assessment of learning through examination*			Face to Face
	Midterm Examination	9	Assess the students learning and understanding of the topics discussed during a specified period			Face-toFace exam.

3	Orientation Matrix Reading List: Craig, J. (2005), Introduction to Robotics – Mechanics and Control , 3rd Ed. Pearson Education Angela Sodeman (2017), YouTube Playlist, Robotics 1 U1 (Kinematics) S1 (Preliminaries), https://www.youtube.com/watch?v=pLXoDRctwRg&list=PLT_0lwItn0sDBE98BsbaZezflB96ws12b	10	Topic outcome 5 1. Orientation Matrix properties	3	1,5	Discussion Forum Problem based Learning Google Classroom
	Position Vector and Homogenious Transformation Matrix Reading List: Craig, J. (2005), Introduction to Robotics – Mechanics and Control , 3rd Ed. Pearson Education Angela Sodeman (2017), YouTube Playlist, Robotics 1 U1 (Kinematics) S1 (Preliminaries), https://www.youtube.com/watch?v=pLXoDRctwRg&list=PLT_0lwItn0sDBE98BsbaZezflB96ws12b	11	Topic outcome 6 1. Position Vector properties 2. How to build a Homogenious Transformation Matrix			Discussion Forum Problem based Learning Google Classroom
4	Python Programming Craig, J. (2005), Introduction to Robotics – Mechanics and Control , 3rd Ed. Pearson Education	12	1. Homogenious Transformation Matrix properties	2	2	Discussion Forum Problem based Learning Google Classroom
5	Denavit - Hartenberg Parameters Craig, J. (2005), Introduction to Robotics – Mechanics and Control , 3rd Ed. Pearson Education	13	1. Introduction to D-H Parameters II. D-H Parameters derivation and Parametric Table construction III. Construction of Homogeneous Transformation Matrix using D-H Parametric Table	1,3	1,5	Inperson Lecture Problem based Learning Google Classroom
	Individual Recitation Week 1-2	14, 15	*Week 1-2 D-H Frame Rules*			Face to face
	Final Practical Exam Week 2 3	16	Week 2 - 3 D-H Parametric Table			Face to face
	Examination Week	17	*This course have no final written exam.*			Face to Face

Assessment Schedule		Week No.															
Assessment Method	**Distribution**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**
	Midterm Exam							x									
	Final Practical Exam														x		
	Long Quiz						x										
	Coding Project										x						
	Individual Recitation													x			

ILO-SO and ILO-CPA Mapping	**ILOs**	**STUDENT OUTCOMES (SO): Mapping of Assessment Tasks (AT)**								
		SO1	**SO2**	**SO5**				**C**	**P**	**A**
	ILO1	ME,IR		ME,IR				ME		IR
	ILO2		CP						CP	
	ILO3	ME,FE,LQ		ME,FE,LQ				ME,LQ		FE
	ILO4									
	ILO5									
	ILO6									
	ILO7									

ILO-IGA Mapping	**ILOs**	**INSTITUTIONAL GRADUATE ATTRIBUTES (IGA): Mapping of Assessment Tasks (AT)**								
		IGA1	**IGA2**	**IGA3**	**IGA4**	**IGA5**	**IGA6**	**IGA7**	**IGA8**	
	ILO1	ME,IR			IR	IR				
	ILO2	CP		CP		CP				
	ILO3	ME,LQ		FE	FE					
	ILO4									
	ILO5									
	ILO6									
	ILO7									

ILO-CDIO and ILO-SDG Mapping	**ILOs**	**CDIO SKILLS**				**SDG Skills**				
		CDIO1	**CDIO2**	**CDIO4**		**SDG3**				
	ILO1	ME,IR				ME,IR				
	ILO2	CP	CP	CP		CP				
	ILO3	ME,FE,LQ	FE			ME,FE,LQ				
	ILO4									
	ILO5									
	ILO6									
	ILO7									

Prepared by:	Reviewed by:	Approved by:
Engr. Mikko A. De Torres Faculty Date:	**Engr. Anela L. Salvador** Head, Department of Electronics Engineering Date:	**Dr. Cristina Amor M. Rosales** College Dean Date:

Remarks:

1 The syllabus is to be distributed to the students in the first week of the semester.

2 Any changes to the syllabus shall be communicated (in writing) to the Program Chair and the approved revised version must be communicated to the students.

3 The course instructor may set a more stringent similarity percentage (minimum 20%) for their respective courses pertaining to student's submissions. However, it must be communicated in writing to the respective Program Chair and the approved revised version must be communicated to the students.