Subject Description Form

Subject Code	EIE4124
Subject Title	Modern Robotics
Credit Value	3
Level	4
Pre-requisite/ Co-requisite/ Exclusion	Pre-requisite: AMA1120 Basic Mathematics II –Calculus and Linear algebra (A waiver will be given to Senior Students, subject to their academic backgrounds.)
Objectives	Robots have been in our daily lives, integrating seamlessly into many fields. They play significant roles in the new technological revolution. This subject objective is to introduce in a systematic manner the advanced technologies used for modern robotic applications.
Intended Subject Learning Outcomes	**Upon completion of the subject, students will be able to:** Category A: Professional/academic knowledge and skills 1. Appreciate modern control techniques for robots. 2. Appreciate visual servoing techniques for autonomous robots. 3. Understand some technologies for human-robot interaction. Category B: Attributes for all-roundedness 4. Communicate effectively with others on the acquired knowledge. 5. Appreciate the importance of staying abreast of the state-of-the-art technologies.
Subject Synopsis/ Indicative Syllabus	1. Introduction of Robot Platforms and Relevant Tools • Examples of robot platforms, sensor devices, and software toolkits. • Robot Operating System (ROS). 2. Robot Kinematics and Dynamics Modeling • End-effector's position, orientation, and motion of all the joints. • Analysis and synthesis of the dynamic behaviour of robots. 3. Intelligent Control of Robot Manipulator • Methods for impedance and force control, and for tracking of desired robot trajectories. 4. Object Detection and Tracking • Object recognition and tracking with visual sensors: single or multiple moving objects. 5. Visual Servoing Control of Robot Manipulator • Visual servoing applications for human-robot cooperation. • Stereo camera-based tracking control 6. Robot Teleoperation Technologies • Body motion tracking with a Kinect sensor. • Haptic interaction with a 3D joystick. 7. Obstacle Avoidance for Robot Manipulator • Obstacle avoidance strategy and collision prediction algorithm. 8. Human-Robot Interaction Interface • Technologies of human–robot interaction, e.g., visual sensors, electroencephalography (EEG) signals, etc. • Hand gesture-based robot control system.

Teaching/Learning Methodology

Lectures and Tutorials: The subject matters will be delivered through lectures. Students will be engaged in the tutorials through Q&A, discussions, and other activities.

Laboratory Activities: Students will do experiments using software tools. Students will appreciate the technologies in modern robotics that they have learned from lectures and put them into practice in simulation environments.

Assignment: Students will finish class exercises by doing self-studies.

Assessment Methods in Alignment with Intended Subject Learning Outcomes

Specific Assessment Methods/Tasks	% Weighting	Intended Subject Learning Outcomes to be Assessed (Please tick as appropriate)				
		1	2	3	4	5
1. Continuous Assessment						
• Laboratory activities	15%	✓	✓	✓	✓	✓
• Exercises	16%	✓	✓	✓		✓
• Tests	19%	✓	✓	✓		
2. Examination	50%	✓	✓	✓		
Total	100%					

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

Laboratory activities will require students to apply what they have learned to solve problems. There will be open-ended questions that allow students to exercise their creativity in solution design, improve the design through discussions and practicing, and appreciate the need for knowing the newest technologies.

Exercises, Tests, and Examination assess students' achievement of the learning outcomes in a more formal manner.

100% of the assessment is individual assessment.

Student Study Effort Expected

Class contact (time-tabled):	
• Lectures	22 Hours
• Tutorial/Laboratory/Practice Classes	17 Hours
Other student study effort:	
• Lecture: preview/review of notes; homework/assignment; preparation for test/quizzes	36 Hours
• Tutorial/Laboratory/Practice Classes: preview of materials, revision and/or reports writing	30 Hours
Total student study effort:	**105 Hours**

Reading List and References	**Reference Materials:** 1. C. Yang, H. Ma, and M. Fu, *Advanced Technologies in Modern Robotic Applications*. Singapore: Springer Singapore Pte. Limited, 2016. 2. R. Murphy, *Introduction to AI Robotics (2nd Ed.)*. Cambridge, Massachusetts: The MIT Press, 2019. 3. A. Koubaa (editor), *Robot Operating System (ROS): The Complete Reference (Volume 5)*. Cham: Springer International Publishing: Imprint: Springer, 2021.
Last Updated	June 2022
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