INC 491 Mechanics and Control of Modern Robotics

Semester: 2/2019
Schedule: Wed 13.30–16.20 **Classroom:** CB40609
Exams: Self arrangement
Instructors:

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Required pre-requisites:
Calculus, Linear Algebra, Feedback control

Course Objective: Currently robots are extensively used in many industrial applications. Further the robotics has extended the horizons to bio medical, entertainment and elderly care applications in the recent past. Main objective of this course it to impart knowledge and experiences of robot design and analysis, to students. This course integrates the knowledge on control systems, kinematics and dynamics which students have studied in their undergraduate level to be applied for robot design, control and analysis.

Learning Outcomes: After completion the course, the students could be able to:

- Select an appropriate robot for a given application based on the specifications.
- Analyze a given robot design in terms of kinematics and dynamics.
- Design and develop a robot to accomplish a specified task.
- Apply the classical control theory for controlling and programming a robot.

Course Description:
Introduction to Robotics and Mechanics; History and evolution of Robots, Specifications of Robots, Configurations of Robot. Robot Kinematics; Rotation Kinematics, Orientation Kinematics, Forward and Inverse Kinematics. Robot Dynamics; Force and Moment, Acceleration Kinematics, Lagrangian Dynamics. Robot Control ; Path Planning and Trajectory Control , PID Control, Force and Position Control

Learning Resources: Website https://staff.kmutt.ac.th/~sudchai.boo/Teaching/inc491/inc491.html, and facebook group. This can include lecture material, supplementary course notes, problem sheets and solutions, and useful references.

Course text: None

Reference: Most books from Springer you can download from the University's Library. Book number 7 has a free version on the author's website.

1. R. N. Jazar, *Theory of applied robotics: kinematics, dynamics, and control,* 2nd, Springer , 2010
2. W.W. Spong, S. Hutchinson, and M. Vidyasagar, *Robot dynamics and control*, 2nd, John Wiley & Sons, 2008
3. B. Siciliano, O.Khatib, *Springer Handbook of Robotics,* Springer, 2008
4. P. Corke, *Robotics, Vision and control: Fundamental Algorithms in MATLAB,* 2nd, Springer, 2011
5. S. B. Niku, *Introduction to Robotics: Analysis, Control, Applications,* 2nd, John Wiley & Sons, 2011
6. A. J. Kurdila, and P. Ben-Tzvi, *Dynamics and Control of Robotic Systems,* Wiley, 2020
7. K. M. Lynch, and F. C. Park, *Modern Robotics: Mechanics, Planning, and Control,* Cambridge U. Press, 2017
8. V. Toochinda, *Industrial Robot Analysis and Control,* Chulalongkorn University Press, 2559 (in Thai)

Project:
We have no assignment for undergraduate students, but we have in-class worksheets.

Grading scheme:
In class activities: 30% Midterm Exam: 35% Final Exam: 35%

- I reserve the right to modify the grading scheme.

Course Schedule (Tentative) The course schedule has no fixed date due to the ability of the student. However, we will cover the whole topics below:

1. Introduction to robotics and mechanisms
   (a) History and evolution of robots
   (b) Specifications of robots
   (c) Configurations of robots
2. Robot Kinematics
   (a) Rotation kinematics
   (b) Orientation kinematics

(c) Rigid body kinematics

(d) Rotation, translation and homogenous transformation

(e) Forward and inverse kinematics – Denavit-Hartenberg (DH) Method

(f) Velocity kinematics and Jacobian

3. Robot Dynamics

   (a) Importance of dynamics

   (b) Force and moment

   (c) Acceleration kinematics

   (d) Lagrangian dynamics

4. Robot Control

   (a) Path planning and trajectory control

   (b) Sensors and actuator integration

   (c) PID control

   (d) Industrial robot control and programming

   (e) Force control and position control

Note: All topics and timetable may be changed!