MECHANISM AND ROBOT KINEMATICS

PROF. ANIRVANDAS GUPTA
Department of Mechanical Engineering
IIT Kharagpur

TYPE OF COURSE: Rerun | Elective | UG
COURSE DURATION: 8 weeks (20 Jul’ 20 - 11 Sep’ 20)
EXAM DATE: 27 Sep 2020

PRE-REQUISITES: Engineering Mechanics, Undergraduate Mathematics
INTENDED AUDIENCE: Mechanical, Electrical, Aerospace and Bio-Medical Engineering
INDUSTRIES APPLICABLE TO: Automobile and Aerospace industries, Automation and robotic device manufacturers, Bio-Medical device manufacturers

COURSE OUTLINE:
This course will be a foundation course in analysis of mechanisms and robots. After a brief introduction to the subject matter and terms, the audience will be taken from kinematic analysis of planar closed-loop chains to open loop chains. Under spatial kinematic chains, the analysis will cover closed-loop mechanisms, serial manipulators, and parallel manipulators. The course will dwell upon coordinate frames, Denavit-Hartenberg parametrization, coordinate transformations, direct and inverse kinematics, velocity and acceleration analysis, kinematic motion planning, singularities in kinematic chains, principle of virtual work and force analysis. The course will demonstrate various concepts by working out problems and exercises relevant to real life applications involving innovative mechanisms and robotic chains. The course is expected to help students and researchers in their basic understanding and use of kinematic analysis. This course will also pave way for more advanced courses on mechanism and robot dynamics and design.

ABOUT INSTRUCTOR:
Dr. Anirvan DasGupta is a faculty in Mechanical Engineering at IIT Kharagpur since 1999. His interests are in the mechanics of discrete and continuous systems. Specifically, his current areas of research includes mechanics of inflatable structures, vibration induced transport, railway vehicle dynamics, and wave propagation in linear and non-linear media. He has extensively taught courses at undergraduate and postgraduate levels like Mechanics, Kinematics of Machines, Dynamics, Dynamics of Machines, Vibration Analysis, Wave Propagation in Continuous Media, and Railway Vehicle Dynamics.

COURSE PLAN:
Week 1: Introduction to Mechanisms and Robotics (1 hr), Mobility Analysis (1.5 hr)
Week 2: Displacement Analysis (2 hr), Velocity Analysis (0.5 hr)
Week 3: Velocity Analysis (1.5 hr), Acceleration Analysis (1 hr)
Week 4: Acceleration Analysis (1 hr), Force Analysis (1.5 hr)
Week 5: Force Analysis (0.5 hr), Coordinate Transformation (2 hr)
Week 6: Coordinate Transformation (1 hr), Spatial Mechanisms (1.5 hr)
Week 7: Spatial Mechanisms (0.5 hr), Kinematics of Serial Manipulators (2 hr)
Week 8: Kinematics of Serial Manipulators (0.5 hr), Kinematics of Parallel Manipulators (2 hr)