ROBOTICS: BASICS AND SELECTED ADVANCED CONCEPTS

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TYPE OF COURSE : New | Elective | UG/PG
COURSE DURATION : 12 Weeks (18 Jan' 21 - 09 Apr' 21)
EXAM DATE : 24 Apr 2021

PRE-REQUISITES : UG level mathematics and programming knowledge.

INTENDED AUDIENCE : Primarily Masters and Ph D students in mechanical, electrical and computer science disciplines. UG students taking Robotics as an elective.

INDUSTRIES APPLICABLE TO : Ashok Leyland, Chennai, GE and GM, TAL and Tata Motors, Government organizations such as ISAC-ISRO (Bangalore), BARC (Mumbai) and CAIR-DRDO (Bangalore)

COURSE OUTLINE :

This course starts with an introduction to robotics, the key elements and constituents of a robot and science and technology in robots. It provides a unified treatment for the modelling and analysis of serial, parallel, and hybrid manipulators using the key concept of Denavit-Hartenberg parameters, solution of the direct and inverse kinematics of serial and parallel robots and the associated concepts of workspace and mobility are presented. The concept of velocity of the links of the robots and the Jacobian matrix is developed and the associated concepts of singularities in robots are discussed in depth. The equations of motion are derived using the Lagrangian formulation and their solutions using numerical methods are presented.

ABOUT INSTRUCTOR :

Ashitava Ghosal is a Professor in the Mechanical Engineering Department and the Centre for Product Design and Manufacturing at IISc, Bangalore since 1988. He completed his PhD from Stanford University, California, M.S from University of Florida, Gainesville, Florida and B.Tech from Indian Institute of Technology, Kanpur. His broad research area is in robotics and other computer controlled mechanical systems, nonlinear dynamics and product design. He is the author of Robotics: Fundamental Concepts and Analysis by Oxford University Press (2006) which is used as a textbook in many UG and PG programs in India and abroad.

COURSE PLAN :

Week 1**:** Introduction, Elements of a robot

Week 2**:** Mathematical preliminaries, D-H convention, Examples

Week 3**:** Direct and Inverse kinematics of serial robots, Workspace, Analytical and numerical solutions

Week 4**:** Parallel robots - direct and inverse kinematics, Mobility, Stewart-Gough platform

Week 5**:** Applications of parallel robots in sun tracking, vibration isolation

Week 6**:** Velocity analysis, Singularities in serial and parallel robots, Statics

Week 7**:** Redundancy and resolution of redundancy in robots

Week 8**:** Dynamic equations of motion, derivation & simulation using Matlab

Week 9**:** Motion planning, Introduction to linear control, simulations & experiments

Week 10**:** Nonlinear position and force control of robots, Simulations

Week 11**:** Wheeled mobile robots, modeling and simulations

Week 12**:** Over-constrained and deployable structures, Cable driven & pneumatically actuated flexible robots