Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Mathematical Modeling with emphasis on Robotics (DSE)	**4**	**3**	**1**	**0**		**Calculus, Linear Algebra, Ordinary Differential Equations**

Learning Objectives

This interactive learning module intends to provide capabilities and basic theoretical understanding of kinematics and dynamics with special emphasis on learning how these concepts are applied in designing robotic systems. It will also provide an insight of the technology that deals with the design, construction, and operation and its application in manufacturing and automation processes.

Learning outcomes

After completing this course, student should be able to;

- understand the mathematical model of different types of robot
- describe the architecture of robots
- explain kinematics and dynamics modeling of robots
- understand the motion analysis and control of robot
- understand the application of robot in different fields

SYLLABUS

Unit I:

Introduction to Robotics and its Applications, Links, Joints, Degrees of Freedom, Position and Force/Torque, Workspace, Robot Transformations, Robot Parameters, D-H Algorithm. (9 hours)

Unit II:

Forward and Inverse Kinematics, Cartesian and Joints Space, Velocity Mapping, Forward Kinematics of n Degrees of Freedom Robotic Arm, Inverse Kinematics of 3 Degrees of Freedom Robotic Arm. (12 hours)

Unit III:

Redundant Robot Manipulators, Mobile Robots, Dynamic Analysis of Robots, Trajectory Generators, Motion analysis, Error Dynamics Model. (12 hours)

Unit IV:

Trajectory Tracking Control, Robust Control, Sliding Mode Control, Model-Based Control, Feedback Control, Lyapunov Stability Analysis and Performance Evaluations. (10 hours)

Essential/recommended readings

1. *Introduction to Robotics*, J. J. Craig, Prentice Hall, 2003.
2. *Introduction to Robotics, Analysis, Systems, Applications*, S. B. Niku, Prentice Hall, 2001.

3. *Fundamentals of Robotics Analysis and Control*, R. J. Schilling, PHI Learning, 2009.
4. *Robot Modeling and Control*, M. W. Spong, S. Hutchinson, M. Vidyasagar, John Wiley and Sons, Inc., 2005.
5. *Handbook of Robotics*, B. Siciliano, O. Khatib, Springer 2008.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DISCIPLINE SPECIFIC ELECTIVE COURSE (DSE):

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical / Practice		
Biological Networks and Data Analysis (DSE)	**4**	**2**	**0**	**2**	**12th Pass**	**Programming languages**

Learning Objectives

This module is designed to:

- Introduce students to the complexity of biochemical pathways in living systems
- Introduce students to building and analyzing networks involving complex biological data.

Learning outcomes

After studying this course, the students will be able to:

- Comprehend the complexity of biochemical pathways and will be able to build and analyze biological networks
- Handle biological network-building databases such as STRING, Cytoscape and many more.
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SYLLABUS

Unit I: Complex biochemical pathways (6 hours)