

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)

Importance of pathways and networks in biological systems, Examples of networks from biological systems, Inter and intra-cellular networks

Unit II: Types and Examples of Biological Networks (8 hours)

Ecological network, Circulatory network, Neurological network, Metabolic network, Cellular networks and Gene regulation networks, Protein interaction networks

Unit III: Building and analysis of networks (8 hours)

Building gene and protein networks using STRING and Cytoscape and other databases and determination of master regulator genes

Unit IV: Applications of Biological Networks (8 hours)

Tree of life and macroevolution

Practical components (30 hours)

- o Practical exposure to STRING and Cytoscape for building and analysis of protein and gene networks
- o Microarray Analysis
- o Building Ecological Models
- o Neural Networks
- o Energy calculations in complex ecological food webs
- o Analysis of models related to gene regulation, epigenetic and other networks
- o Networks as filters and integrators of biological information
- o network diffusion methodology
- o Network prediction of gene function
- o Network distance between two samples
- o Inference of disease and patient networks

Essential/recommended readings

1. Molecular Biology of the Cell, Alberts et al., Garland Science, 5 edition 2007.
2. Molecular Cell Biology, Lodish et al., W. H. Freeman & Company, 7 edition, 2012.
3. Cline, M.S. et al. Integration of Biological Networks and Gene Expression Data Using Cytoscape. Nature protocols 2, 2366 (2007).
4. Hagberg, A., Swart, P. & S Chult, D. Exploring Network Structure, Dynamics, and Function Using Networkx. (Los Alamos National Lab.(LANL), Los Alamos, NM (United States), 2008).
5. Maere, S., Heymans, K. & Kuiper, M. Bingo: A Cytoscape Plugin to Assess Overrepresentation of Gene Ontology Categories in Biological Networks. Bioinformatics 21, 3448-3449 (2005).
6. Saito, R. et al. A Travel Guide to Cytoscape Plugins. Nature methods 9, 1069 (2012).
7. Shannon, P. et al. Cytoscape: A Software Environment for Integrated Models of Biomolecular Interaction Networks. Genome research 13, 2498-2504 (2003).
8. Subramanian, A. et al. Gene Set Enrichment Analysis: A Knowledge-Based Approach for Interpreting Genome-Wide Expression Profiles. Proceedings of the National Academy of Sciences 102, 15545-15550 (2005).