Course Code	BIO571
Course Name	Network Science
Credits	4
Course Offered to	UG/PG
Course Description	The objective of this course is to provide introduction to network science, an emerging interdisciplinary discipline with applications to variou

Pre-requisites

Pre-requisite (Mandatory)	**Pre-requisite (Desirable)**
None	Graph theory fundamentals, algorithms and programming (Desirable)

*Please insert more rows if required

Post Conditions

CO1	**CO2**	**CO3**	**CO4**
Students are able to explain basic concepts of network science (random networks, scale free networks, network evolution, robustness and community structure).	Students are able to model and implement computation of network properties from empirical data.	Students are able to analyze and visualize networks.	Students are able to tweak and design algorithms to answer specific questions.

Weekly Lecture Plan

Week Number	**Lecture Topic**	**COs Met**	**Assignment/Labs/Tutorial**
1	Complex systems and network models, Characteristics of network science, Societal impact, Examples of applications	CO1	3 hours (Homework)
2	Graph Theory: Graph theory and origin of networks, Adjacency matrix, Weighted Networks, Bipartite networks, Network Metrics	CO1, CO3	3+2 hours (Homework)
3	Graph Theory: Paths and distances, Connectedness, Clustering Coefficient	CO1, CO2, CO3	3+2 hours (Homework + Assignment-1)
4	Random networks: Random network model, Degree distribution, Small worlds	CO1, CO2, CO3	3+2 hours (Homework)
5	The Scale-Free Property-I: Power laws and scale-free networks, Hubs, The meaning of scale free, Universality, Ultra-small property	CO1, CO2	3+2 hours (Homework)
6	The Scale-Free Property-II: Role of degree exponent, Generating networks with arbitrary degree exponents	CO1, CO2, CO4	3+2 hours (Homework + Assignment-2)
7	The Barabasi-Albert Model-I: Growth and preferrential attachment, The Barabasi-Albert model, Measuring preferrential attachment.	CO1, CO2, CO3	3+2 hours (Homework)
8	The Barabasi-Albert Model-II: Non-linear preferrential attachment, The origins of preferrential attachment,	CO1, CO2, CO3, CO4	3+2 hours (Homework + Mini Project)
9	Evolving Networks: The Bianconi-Barabasi model, Measuring fitness, Bose-Einstein condensation, Evolving networks	CO1, CO2, CO3	3+2 hours (Homework)
10	Degree Correlations: Assortativity and disassortativity, Measuring degree correlations, Generating correlated networks, The impact of degree correlations	CO1, CO2, CO3, CO4	3+2 hours (Homework)
11	Network Robustness: Percolation theory, Robustness of scale-free networks, Attack tolerence, Cascading failures, Modeling cascading failures, Building robustness	CO1, CO2	3+2 hours (Homework)
12	Communities: Basics of communities, Hierarchical clustering, Modularity, Overlapping communities, Testing communities, Characterizing communities	CO1, CO2	3+2 hours (Homework)
13	Spreading phenamena: Epidemic Modeling, Network epidemics, Contact networks, Beyond degree distribution, Immunization, Epidemic prediction	CO1	3+2 hours (Mini-Project Presentations)

*Please insert more rows if required

Weekly Lab Plan

Week Number	**Laboratory Exercise**	**COs Met**	**Platform (Hardware/Software)**

*Please insert more rows if required

Assessment Plan

Type of Evaluation	**% Contribution in Grade**
Mid-Sem	20
Assignments	30
Mini-Project	20
End-Sem	30

*Please insert more row for other type of Evaluation

Resource Material

Type	**Title**
Textbook	Network Science, Albert-Laszlo Barabasi (Cambridge University Press)