

IT-776 : Petri nets: Theory and modeling for Systems (DPTMS)

Credit: 3

Course offered to: M.Sc./Ph.D. (Common Optional course for CS-Track & CB-Track),

Course description: The course will introduce the basic concepts of digraphs and discrete dynamical systems for modelling of complex/biological/bioinformatics networks. The concept of digraph theory and Petri nets theory can be used to develop new algorithms and model a wide variety of systems such as data science, biological networks, computer hardware and software, chemical sciences, social sciences, life sciences, etc.

Pre-requisites: Must complete the semester one and atleast credited the course on '**Computational Biology & Bioinformatics**'. A part will be classroom teaching and other part will be working exercise(assignments/practicals) with project assigned to the students.

Course Outcome(s) (CO): Upon finishing the course, the student is expected to be able to:

1. Knowledge of basic concepts of digraphs and Petri nets,
2. Knowledge of analysis techniques and algorithms for biological networks.
3. Visualization of dynamics of discrete event driven systems
4. Understanding of Petri net modeling for many complex networks.

Tentative plan:

Week	Lecture topic	CO met
15	Digraphs and Basic Concepts: Elementary concepts, digraphs and structures, Joining and reaching, connectedness, point base, limited reachability, Acyclic digraphs, balance in structures properties, orientation of graphs and digraphs; and classifications of trees, decision tree, some algorithms for solving complex networks in diverse fields,	CO 1
6-8	Distances in Digraphs: different types of distances in digraph and matrices, Introduction to flows in networks and applications,	CO 2
9-II	Petri Net Theory and Modeling: Finite state machine, Idea behind Petri nets, some formal basic definitions of Petri net, examples (theoretical and real life modeling), structural & behavioral properties and analysis methods.	CO 3
12-14	Classification of Petri nets: Boolean Petri nets and crisp Boolean Petri nets, Boolean Petri nets applications in computational and Integrative Sciences.	CO 4

Note: To encourage and motivate the students, topic related to further studies can be included/changed in the syllabus to improvement the quality of research.

Some Text books and References:

- 1.S. Lipschutz, *Set Theory and Related Topics*, Schaum's Outlines, Second Edition, McGraw-Hill, 1998.
- 2.Frank Harary, *Graph Theory*, Addison-Wesley, Massachusetts, Reading, 1969.
- 3, Narsingh Deo, *Graph Theory with Applications to Engineering and Computer Science*, PHI Learning Private Limited, New Delhi-110001, 2012, ISBN-978-81-203-01115-0.
- 4.Frank Harary, R.Z. Norman, & D. Cartwright, *Structure Models: An introduction to the Theory of Directed Graphs*, John Wiley & C Solis Inc., 1965,
- 5.Petri, C.A., *Kommunikation Mit Automaten*, Sclriften des Institutes fur Instrumentelle Mathematik, Bonn, 1962.
- 6.Peterson, *Petri net Theory and the Modeling of Systems*, Englewood Cliffs, NJ: Prentice-Hall, Inc., 1981.
- 7.Reisig, W., *Petri Nets*, Springer-Verleg, New York, 1985.
- 8.*Petri Nets-Manufacturing and Computer* (Edited by Powel Powlcwski), ISBN: 978-958-51-0700-2.
- 9.G.P. Singh, *Some Advanced in the theory of Petri Nets*, a Ph.D. thesis, Faculty of Technology, University of Delhi, Delhi, India, 2013.
10. Related articles from journals.
11. Related topics from authentic sources