**IT-776 : Petri nets: Theory and modeling forSystems (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 workingexercise(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:

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| Week | Lecture topic | CO met |
| 1-5 | **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- I I | **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& behavioural 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 encourse 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, Massacliusettes, 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.

1. Frank Haray, R.Z. Norman, *&* D. Cartwright, *Structure Models: An introduction to* the Theory *of* Directed *Gmphs,* John Wiley &C Solis Inc.,

1965,

1. Petri, C.A., Kommunikation *Mit* Automoten, Scliriften des Institutes fur Instrumentelle Mathematik, Bonn, 1962.
2. Peterson, Petri net *Theory and the Modeling of**Systems,* Englewood Cliffs, NJ: Prentice-Hall, Inc., 1981.
3. Reisig, W., Petri *Nets,* Springer-Verleg, New York, 1985.
4. *Petri* Nets-Manufacturing and Computer (Edited by Powel Powlcwskl), ISBN: 978-958-51-0700-2.
5. G.P. Singh, *Some Advanced in the theory of Petri Nets,* a Ph.D. thesis, Faculty of Technology, University of Delhi, Delhi, India, 2013.
6. Related articles from journals.
7. Related topics from authentic sources